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Economics of the Salt Industry in Louisiana.

John Wright Chisholm

Louisiana State University and Agricultural & Mechanical College

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ECONOMICS OF THE SALT INDUSTRY IN LOUISIANA

A Dissertation

Submitted to the Graduate Faculty of the
Louisiana State University and
Agricultural and Mechanical College
in partial fulfillment of the
requirements for the degree of
Doctor of Philosophy

in

The Department of Economics

by

John Wright Chisholm
A. B., Baylor University, 1936
M. A., Louisiana State University, 1938
June, 1952
MANUSCRIPT THESIS

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ABSTRACT

The study, *Economics of the Salt Industry in Louisiana*, was undertaken to determine the present economic position of the salt industry in Louisiana, and to point out some possibilities for further development of this industry.

The introduction portrays the place and importance of salt to the economy of modern nations. The industrial consumption of salt is emphasized in order to show the growing importance of it.

Chapter II presents the nature and development of resources; the popular misconception of the nature of resources is shown to be a result of the objective approach. The subjective analysis is then presented as a practical approach to the development of any natural resource. The economic prerequisites for the development of resources are considered, as are the influences of certain institutions upon development of industry in general.

A study of the types of salt found throughout the world, the various methods of securing or producing it, as well as the major industrial uses for salt is the subject of Chapter III. The natural salines, artificially produced brines, rock, and plant salt are considered. The relative importance of these methods of production are given as a base for the comparison of types of salt production in Louisiana.

To provide a background, as well as a means for comparison of production in the United States, Chapter IV develops the history and production of salt in the major foreign countries. The reasons for man's
need for salt are considered, as are the sources of the salt used by
early man. Each of the important potential producers of salt is dis-
cussed because a development of salt production in such countries will
affect the further resource development pattern of the United States.

An historical approach is made in Chapter V to salt production
in the United States. Each important salt producing state is discussed,
showing when salt production first started, its development, present
importance, and position among the producers of salt in this country.
Attention is also given to the uses in each of these states. Where
possible, production figures are presented, and the economic value of
the salt to the state concerned indicated.

Early salt production in Louisiana is considered in Chapter VI.
A survey of the location of salt domes in the state, as well as some of
the theories regarding their formation is presented. The early production
locations and methods utilized to secure the salt are presented historically.
Production is shown at such outstanding salt works as; King's, Drake's,
Price's, Rayburn's, Potter's Pond, and production on Lake Bistineau.
Early development of the coastal domes follows with a consideration of
the Five Islands (Avery Island, Jefferson Island, Weeks Island, Cote
Blanche, and Belle Isle), and their start as salt producers. The influence
of the Civil War upon salt production in Louisiana is considered.

Chapter VII presents the modern development, approximately 1900
to the present, of the salt industry in the state. The coastal producers,
principally the Five Islands, are discussed. The North Louisiana producers
are considered as a separate area of production. The method of securing
salt in brine by the several chemical companies using such a raw material
is developed. Possible areas of future development are considered.

The economic importance of the salt industry to Louisiana is developed and some future possibilities for expansion pointed out.
FAMOUS "SALT" QUOTATIONS

Ye are the salt of the earth
Matthew, V, 13

Spilt salt is never all gathered
Spanish proverb

Trust no one until you have eaten much salt with him
Latin proverb

... with a grain of salt
Don Quixote

He is not worth his salt
Latin quotation
THE ECONOMICS OF THE SALT INDUSTRY IN LOUISIANA
CHAPTER I

INTRODUCTION

Out of the depths of the earth hundreds of materials have been extracted to aid man in his search for a more abundant life. One such gift of nature, salt, occurs in practically every country of the globe. "The total amount of salt in the world is estimated at astronomical figures; that in the ocean alone is estimated to have a volume of 4,500,000 cubic miles."¹ Salt may be derived or obtained from a number of sources: solid, brines, sea water, and marshes. The solid deposits of salt are generally found in a sedimentary formation beneath the earth's surface. Recovery of this type of salt may be either by conventional mining methods, i.e., shaft and tunnel, or wells may be utilized. The well type of recovery requires that water be introduced into the salt bed to dissolve the salt which is then pumped to the surface. Salt found in the form of natural subterranean brines is, in some instances, raised to the surface of the earth under hydraulic pressure and in the absence of hydraulic pressure pumping must be used to secure the salt. That contained in the ocean and certain inland lakes, as well as that in marshes, can be recovered by means of evaporation, which may take place by direct utilization of solar energy or by use of artificially produced heat.

The "gifts" of nature do not usually come to man without some effort which is economically expressed by the term "cost." The cost involved may be simply that of expending the effort to pick, gather, or

appropriate the material for immediate use. Usually, however, more than human effort is involved in securing economic goods; time and capital are required. The relative value of time alone adds to the total cost of securing material goods. The capital cost varies with time, place, and state of the industrial arts. Early salt producers in Louisiana needed only an evaporating pan, a salt lick, and wood. Such production was limited, not only because technology was crude and limited, but also because the market area was held down by the available means of transportation.

As time moved, the techniques of manufacturing and distribution improved. Man desired more and more in the way of material goods to satisfy an ever increasing list of economic wants. Technological improvements in production made possible the satisfaction of many of the new wants. Developments in techniques are often slow and so evolutionary in their appearance that the effect of the change is lost on contemporary man. Slight changes often disturb normal patterns so little that man accepts such change as normal or natural. Thus contemporary man is often unaware of fundamental changes taking place in production techniques because he is too close to the effect and unable to discover the cause. Thinking then becomes a matter of acceptance of actuality rather than a probing for cause of existence.

Salt resources have been accepted, and taken for granted, in most areas for many years. In this study a picture of the development of the utilization of salt is presented. The relationships between availability and utilization will be shown as factors affecting the economic use of salt. It will be pointed out, with examples, that existence of a raw
material does not necessarily pave the way for the manufacturing of that raw material. In the historical treatment of salt, attention will be directed to the locations of salt reserves and the type of utilization made of such reserves.

It will be shown that only within modern times has salt been produced in sufficient quantities to supply the world markets at a price within reach of most consumers. Even today certain sections of the world suffer from a lack of salt. The suffering arises because of a lack of local deposits and a lack of sufficient funds to purchase salt. To illustrate, low incomes in Central Africa make it difficult for many to purchase salt. With increased income a market for foreign salt would be developed in that section of the world. Sufficient salt to take care of all the economic needs is available, but the demand is not effective because of a lack of purchasing power.

High incomes on the part of individuals do not necessarily mean a higher consumption of salt. The human body requires only a certain amount of salt; hence the demand for salt for human consumption is very inelastic. A subsistence income would allow a sufficient amount to be purchased to satisfy the human system. The higher income, however, brings greater demand for convenience and luxury goods, the manufacturing of which often requires large quantities of salt. In this paper an attempt is made to show the growth of the utilization of salt in the manufacture of many of the common, every-day items utilized by man.

The United States has both large deposits of salt and a relatively high demand for it. Salt is produced here in numerous locations, in varying quantities and by various methods. It is found throughout the
United States in all of its three major forms: rock, brine, and sea water. All three sources are utilized in varying degrees in the production of marketable salt and are used in the brine form in the various chemical industries using salt as a basic raw material. There is no single section of the United States which can claim a monopoly of salt production; though there are several states which have reserves capable of supplying the entire salt demands of the American economy.

Among these states with vast resources of salt is the state of Louisiana. Over one hundred known salt domes occur within the boundaries of the state, and there are possibilities that others may be found before the exploration of the subsurface features of the state is completed. As yet only a very few of the salt domes are being used for the production of salt, either in brine form for the chemical industries or in the form of rock or evaporated salt for commercial and home consumption.

It would be impossible to discuss all the myriad uses being made of salt. With the human body requiring only a rather definite amount of salt, any large increase in the human consumption can only come with an increase in population. The greatest increase in consumption of salt has been in the chemical industries.

The early production of salt in various sections of the world will be considered in order to present a unified picture of the development of this basic industry. Such a discussion will center attention upon the developments in other countries of the world for they naturally developed salt production long before the existence of America was known. Short histories of the major foreign producers will be presented.
Salt production in the United States will be examined by first making a general survey of the early history of salt production in this country. The modern development will then be presented for the most important salt producers in the United States. This survey will be followed by a summary of production in Louisiana.

Finally attention will be given to salt production in the state of Louisiana. Discovery and early production will be discussed along with the economic importance of the early production. Considerable attention will be given to modern production with a summary of some of the possibilities of the future.

The importance of the interrelations existing between institutions and development has often been overlooked in the rush to gather facts and figures. All too often statistics are presented with little thought given as to the why of the figures. The economic development of any region, section or area comes about from the changing relationship between institutions and resources. Frequently governmental activity will force economic activity into certain lines and along paths dogmatically set up. The economic development of any area depends upon changes among the factors making up the economic and political order. Other factors being equal, the greatest economic gain is realized when the economic forces are free to move in response to economic motivations. In the development of resources this free play of factors helps bring about economic progress within the area. The discussion in Chapter II on resources in general is presented as a kind of bed or background into which the Louisiana salt industry will be set.
CHAPTER II

THE NATURE AND DEVELOPMENT OF RESOURCES

The word "resource" seems automatically to bring to the mind's eye a panoramic scene of vast arrays of raw materials found in the earth. At the same instant the mind considers these raw materials as having been placed in the earth for man's exclusive use. Etymologically tied to source and with the prefix "re" signifying "again," man has even in the word taken for granted the dependability as well as availability of resources. The idea of dependability of resources was generally accepted in the United States and little questioned until approximately the beginning of the twentieth century. The threatened exhaustion of certain raw materials, the passing of the frontier, and the policy of certain interests seeking to secure a monopoly control of some materials, brought forth a rising wave of interest in and demand for the development of a conservation policy in this country. The contemplated policy of conservation and control by government stimulated a growth of interest in the nature of resources and their place in the economic world. This awakened interest in the concept of resources was strong in the social sciences. Raw materials had been considered the province of the natural scientist and the development of industry was assumed to belong to those in charge of physical production. The social scientist, delving into the pattern of development of industry added to the existing knowledge of raw material development as well as gathering additional information concerning the true nature of resources. Though the social scientists have added much to the knowledge of resources, the findings of the
scientists have not in all cases been made available to the general public. There still exist a number of misconceptions regarding the nature of resources and their place in the economic order. One such misconception frequently encountered is in the economic meaning of the word "resource" itself.

The term "resource" as used by many individuals signifies the total quantity of raw materials provided by nature. In other words, the term is used objectively to indicate that a certain physical quantity of a material is available in a certain form. Such use of the term "resource" is not correct unless it is understood that the mere presence of a raw material does not necessarily mean use of that material. Actually a resource does not come into existence until its presence is known and the economy has the means, physical and mental, to use that material. When the raw material is actually usable, then, and only then, is it correct to speak of the material as a resource. This tendency to think of resources as "single tangible phenomena in nature creates the false impression of resources as something static, fixed, whereas actually they are as dynamic as civilization itself." ¹

In its broader sense the term, resource, includes far more than the physical material upon which effort is expended by man. The accumulated knowledge from the past, and the additions made by the planner are all a part of the total resource picture. Production of an economic good can only result when all these forces are welded together in the proper relationship. However, production will not result from the existence of

these forces alone for they represent only one side of the picture, production. In order for production to take place there must be present a demand as evidenced by the desires of consumers to purchase the good. Production is not complete until the good is in the right form at the right time and in the right place -- a process requiring the coordinated activities of a number of often widely separated groups.

As stated above, resources are not static, unchanging from one time to another; they are dynamic, ever changing to meet new needs and new conditions. As the wants and demands of society change, so does the concept of resources vary. The existence of such changes in the resource pattern may escape the attention of those not directly concerned with the industry or industries affected. Such a lack of awareness of change in an industry may be the result of failure to understand the complexity of resource utilization. Sometimes individuals use a segment of a resource pattern to illustrate some point without suggesting that such use may tend to give a false impression of the complete pattern. For example, some authors of textbooks on economics refer to salt as a good example of a resource with an inelastic demand, though such is actually far from the truth. These authors are making the error of referring to salt in its objective sense and are looking only at the direct human consumption of salt as a fixed figure, which it usually is. However, they are not taking into consideration the fact that salt is being used in ever increasing quantities in modern society by manufacturers, especially by the rapidly developing chemical industries. Salt today, as will be shown, has a changing demand -- one that is increasing as new processes and techniques are developed so that industry can supply the new demands.
Resources should not only be considered from the objective side, or simply as a physical mass of material, but more important, they should be considered from the subjective side. The function of resources is to provide the base and point the way for potential development. A subjective analysis of resources provides not only the tools with which an economic structure may be built upon the resource base, but also the creation of the desire for the goods to be derived from the materials. The type of structure depends upon the nature of the subjective factors being considered. Such factors vary with time, place and the state of the industrial arts for "resources are living phenomena, expanding and contracting in response to human effort and behavior. . . . To a large extent they are man's own creation. Man's own wisdom is his premier resource -- the key resource that unlocks the universe."2 Thus resources provide the foundation upon which man may build whatever superstructure he desires within the limits set by nature and the industrial arts. The structure built by man is conditioned by a host of factors which, when combined, make up a resource. The conclusion is therefore reached that "the word 'resource' does not refer to a thing or a substance but to a function which a thing or a substance may perform or to an operation in which it may take part, namely the function or operation of attaining a given end such as satisfying a want. In other words, the word 'resource' is an abstraction reflecting human appraisal and relating to a function or operation."3 Thus it is that the "bulk of man's resources are the

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2Zimmermann, op. cit., p. 7.
3Ibid. cit.
result of human ingenuity aided by slowly, patiently, painfully acquired knowledge and experience. . . . All the elements are found in nature; but this is of no value to man, who is not even aware of their existence and even less capable of isolating and utilizing them."

The natural scientist working in his laboratory or plant is constantly seeking new products, ways to improve old products, or is engaged in research activities designed to enable industry to move ahead. The knowledge gained in such activities is necessary if progress is to be made by the industrial world. It is possible however, that such knowledge will not be utilized because of the lack of movement or change among other subjective factors, such as the economic, social or governmental institutions. These forces must be considered and the necessary changes in their functioning made before industrial progress is accomplished. The subjective forces may exert a positive, negative, or even assume a neutral position in the development of resources. In any event, the position taken by such forces affects the resource pattern by determining the direction such patterns must take. An analysis of all the forces operating in these three major fields (economic, social, and governmental) lies beyond the scope of this paper. However, the influence of each group upon industry is so important that they must receive special attention.

The economic forces exerting powerful influences upon the development of the resource pattern may be resolved into land, labor, and capital. The interaction of these three, plus the other subjective factors, results in the production of economic goods. Production will continue so long as

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4 Zimmermann, op. cit., p. 9.
it is backed by a continuing demand which is sufficient to consume the product at a price high enough to make it profitable. Land, in the economic sense, is considered as including not only the surface but also the materials existing under and above the earth. In its broader aspect land may be looked upon as the natural materials upon which the other forces expend their efforts to satisfy an economic want. These natural materials (land) may be used by man for the direct satisfaction of wants. Such use suggests the existence of a subsistence or more exactly, a survival economy. Under such an economy man's existence is determined by his own physical ability to appropriate a sufficient supply of naturally available goods to keep alive. When man stops relying upon his own direct physical efforts and begins to use inanimate objects to aid him in satisfying a greater list of desires, he begins progressing and raises himself above the level of animals. Man, in the direct satisfaction of his wants, is required to expend energy in the form of labor. With the utilisation of inanimate objects man does not free himself from the necessity of labor although he does increase his ability to perform work. As progress continues, an increasing proportion of man's labor becomes mental in that he spends a portion of his time thinking about possible improvements -- ways to relieve the long hours of toil or make the same number of hours yield a greater supply of want-satisfying goods.

The "inanimate objects" developed by man to increase his productive powers are known to economists as capital. It is possible to consider capital in the light of cultural improvements in that a large share of man's present day capital consists of accumulated knowledge, classed as mental capital. Without a store of mental capital (technological knowledge)
progress cannot be made, for progress results when man builds upon what he has or begins a new phase of development. Man in his development of the present standard of living has used ever-increasing amounts of capital in the form of productive goods. Such utilization of capital produced the roundabout method of production out of the direct method used by earlier man. The roundabout method of production is more efficient as to both quality and quantity of goods produced. Without capital, mental and physical, the modern industrial organization would be impossible. Even with capital available, industrialization may not take place because the other subjective factors may operate against development. In some instances production may not develop, for example, because of the lack of an efficient transportation system.

The direct method of production calls for a minimum (ordinarily none) of combining of various materials to produce the finished product. The roundabout, or capitalistic, mode of production frequently requires the assembling of materials from the four corners of the globe. Even where this assembly is not involved it is seldom that all the materials required for the finished good are located in one area. Before industrialization begins in any area the cost of assembling the necessary raw materials must be balanced against the cost of distributing the finished product for the producing area. The relation of these costs to the selling price will determine the place or site of production. Where an efficient transportation system does not exist, development of resources is hindered, if not rendered impossible. The economical transportation of raw materials is especially important when vast quantities of a material must be transported for pro-
Grading. Where a material loses a large percentage of its original weight in manufacture, economical transportation of such a material becomes important as an industry-locating factor. Transportation does not necessarily bring an industry to an area but it helps make industrialization possible. In addition to aiding in the industrialization of an area, transportation widens the market area of the finished product. Roundabout production is often most economical when large-scale units are in operation. Large-scale operations require a large market for the distribution of the finished commodity. Once again, transportation does not make the market; it merely provides the means to reach the market. The higher the standard of living, the greater becomes the dependence upon transportation as a force in resource development for increased demands push profitable development of resources into new areas.

The economic forces mentioned above, when combined in the right proportion, result in the production of commodities at the lowest cost. The right combination of costs for any industry is referred to as the "least cost combination." This factor is one of the most important aspects of industrial location. The combination takes into consideration all costs of assembling raw materials, as well as the processing and the distribution of the finished product. At any one moment there is one combination of factors which will yield the lowest cost. The lowest combination today may not be the lowest tomorrow, for the development of a new technique, a substitute product, or a shift between any of the factors of production will change the existing cost relationship. Industrialists are constantly working on new combinations in a never ending attempt to improve the cost position of their firms. This search for lower costs
pushes forward the horizon of industry and gives to the consumer more and better goods. In the search for greater economy, new methods of production, new or cheaper raw materials, economy in the use of raw materials, or changes in the industrial organism all operate to improve the cost position of industry. The search for an improved cost position may dictate a change in location of a plant or a shift in production techniques involving a changed capital or labor structure. In some instances such changes have been held back or prohibited by influences operating outside the industrial order. Such influences might be exerted by society or government or both working together.

Thus it is that the government, together with the legal organization, and the method or trend of legal decisions become basic factors in industrial development and resource utilization. Only recently have some nations allowed outside industrialists with the capital and "know how" relatively free reign in the development of resources within such nations. At the same time other nations are taking legal steps to change the pattern of resource development by appropriating the productive facilities established by outside agencies. Such appropriation has, on occasion, worked out to the benefit of the country taking over the resources, but in other cases the lack of technological knowledge has led to difficulties in keeping up the pattern of development. The positive and negative influence of governments on resource utilization may be seen in the following illustration. In the lower Rio Grande Valley highly developed agriculture, commerce, and to some extent industry is found on the United States side of the river. On the Mexican side nature's gifts are the same, but the resources are poor. The difference is a result of governmental protection
of private property on the one side and a lack of adequate protection on the other.

Another powerful determinant of the direction of resource utilization in any age or area is found in the habits, customs and techniques of that age. These habits and customs are institutions and they shape or determine to a large degree the resource pattern. Customs may, for example, hold back new developments because such development would destroy or change the existing method of production or bring about institutional changes not desired by those in control. An excellent example of the influence of custom upon technological improvement is found in many places in the interior of China. In many places in China there are located family grave yards. The graves are mounded up and the yards are located in the fields. Modern farming methods are impossible for tractors, plows, etc. cannot be used to cultivate the small areas between and around the graves. In spite of the great need for improvements in agricultural yields little improvement can be made because the existing institution is too strong to give way to an economic need. In other sections of the world, especially since the beginning of the period of the industrial revolution, it is possible to find example after example of workers attempting to hold back technological improvements in industry by destroying a machine or refusing to use the new technique. Resistance to such changes is still found in some fields, but in most instances workers recognize the value of improvements and accept them for what the improvement is supposed to accomplish — increased production and greater benefit for all concerned.

If, instead of aiding in technological advancement, a nation, through custom, habit or law merely continues to use the techniques of
the past and adds nothing to them, then that nation has made no actual progress. Such a nation would have a static civilization and each generation would merely use what the past provided without adding anything new. Many would say that such a static condition could not exist in this modern world of today. One has only to look at the interior regions of China to find one of several examples. There, in the salt industry, is located a mine which has been in operation over 2,000 years, using the same techniques for securing the salt. There the coolies mine the salt in the same manner as their father's father secured his supply of salt. Why? The answer is, of course, impossible to find because no single explanation will do. Rather the answer is to be found in the fact that the institutions and techniques of that section have not changed. The resource pattern today is the same as yesterday because no improvements have been made in the productive process nor has the mental capital been increased.

This stationary resource pattern, resulting in a relatively stable population, has given some strength to those groups who, ever since Malthus in 1795 first put forth his ideas on population growth, have been predicting a stationary population for the world. The dates by which the world would reach the estimated figure have been pushed further and further back until at the present time the figure is somewhere around 1970 or 1980. Upon what base have such predictions been made and what has proven them all to be wrong? Basically such predictions have been disproved because of technological advance. If technological advances in resource utilization would stand still, it is possible that a stable population would be reached.

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5 Zimmermann, op. cit., p. 240.
Current techniques of production can only produce a certain total quantity of goods with the currently available resources. Given a steadily mounting demand for economic goods and only one result can be expected -- gains in technological knowledge. Such gains are made in order to supply the demanders with the goods desired. Since one demand leads to a second, technological advancement has proceeded at an accelerated rate. So long as demand spurs industry to seek additional sources of supply and a more efficient utilisation of resources, just so long can the world continue to support an increasing population. An expanding resource base enables the world to travel with an expanding population. This continued expansion in population is made possible by the development of new industries based upon changes in or development of new resources. The development of a new industry or improvement in an already existing industry takes place only when an existing set of institutions is changed or modified to include a new technique. The new institution plus the new technique equals a new industrial factor. These new patterns bring with them new developments in living habits; standards of living normally rise following changes in patterns of resource utilisation.

These new patterns of industrial development are not without their limitations as to the increase in economic goods which may be achieved. There is, of course, an actual physical limit to the goods which can be produced with any given set of the factors of production. Under normal conditions a plant will not produce up to the physical limit of its capacity. The only time such a situation might exist is when the demand for the product is so great that an unusual profit can be made from operating at peak capacity. Normally however, a firm will attempt to locate its point
of lowest cost in relation to the highest profit that can be made from the sale of the finished product. In economic language the individual firm is attempting to equate marginal revenue with marginal cost in order to maximize profit. The inability of a firm to continue expansion and reap additional profits is the result of an economic law known as the law of diminishing returns. This law sets forth the principle that for any given set of manufacturing or production conditions there is a point where the maximum profit will result. To continue production beyond that point is to reduce the profit per unit. The total profit will continue to rise for some time after passing this point of diminishing returns, but the important point to a firm is the per unit profit. Firms operating in the segment of industry classified as extractive or increasing cost, such as salt mining, are likely to reach the point of diminishing returns much quicker than firms operating in the decreasing cost area. This condition prevails because of the nature of production. Only through technological improvements can firms in the increasing cost area increase, or in some instances maintain production and keep costs from rising. If price rises as production costs rise the producer is not as much concerned with the cost pattern. When price does not rise as costs increase then the producer becomes very much aware of the point of diminishing returns. An increasing cost firm may be able to raise price to cover the increased costs if the firm is operating as a monopoly. Under such a condition the firm is not as concerned with diminishing returns as under competitive conditions where the price is not under the control of the producer.

Thus it is that an extractive industry, such as the salt industry, operating under increasing cost conditions is vitally interested in the
cost conditions prevailing in the industry. With such an interest in the cost conditions, the firms operating in the industry are seeking to locate that point which will yield them the greatest per unit profit. When that point is found the firm will attempt to maintain operations at that point so long as the technology remains the same. It will also be to the best interest of the firm to be constantly seeking out new improvements in order to improve cost conditions and increase the profitability of the firm. Where such conditions exist progress is often greatest, particularly where competitive conditions exist in the industry. Under competitive conditions a firm which first utilizes a new technique secures an advantage over other firms in the industry. As long as such an advantage can be maintained, the firm will enjoy additional profits.

Such changes in technology may be aided or hindered by the government under which the firm or industry is operating. A nation may either actively support, passively allow, or prohibit technological improvements through governmental action or the force of existing institutions. Even in the case of nations in which no restrictions are placed upon resource development or utilization, some resistance to change is found. It is not that individuals are necessarily opposed to change but rather that they hesitate to move into new fields until they are certain of the results. Alexander Pope summed it up nicely in the following: "Be not the first by whom the new is tried, nor yet the last to lay the old aside."6 Taken literally there would be no progress for someone has to be the first; yet most individuals seem to desire to let someone else lead the way. This

tendency to remain with the established institutions has been called "an institutional lag." In its economic application to the developing resource pattern it is seen that the economic changes often run ahead of the institutional changes. In other words, "the economic changes commonly precede the political consequences by a wide interval of time." In addition to the political consequences lagging behind the economic there might be added the social, for social institutions sometimes lag behind both the economic and political. The development of new processes or industries normally affects only a small portion of the population. As the industry enlarges its scope of activity, more and more people are affected. The production may reach a level requiring that markets be developed in other political or social areas, raw materials may be gathered from other nations, or workers may be required to migrate to new environments. All such conditions aid in economic development but also may make necessary some political changes. This force is constantly pulling toward imperialism's development among nations.

The start of protective tariffs, immigration laws, restrictions on import or export of capital, export restrictions on raw or finished goods all follow some economic change. This political lag is normal in that as the economic changes are being made there is no realization of nor necessity for political changes. When the need for change is first seen additional time must lapse before the necessary legislation is secured because a majority of the people responsible for legislation must be convinced of the need. England's need for free trade during the nineteenth and early

twentieth centuries was recognised by industrialists and some government leaders long before the necessary legislation was developed to turn England from a follower of the Mercantilistic philosophy. The English Corn Laws, developed in an attempt to build up English production of grains in spite of high costs, is an example of this institutional lag. The growing industrial population of England required more grain. The necessary grains could have been imported from low cost producing areas, but the idea of producing as much grain as possible at home, even though higher costs would be incurred, filled the minds of political thinkers of England. The Irish potato famine near the middle of the nineteenth century focused attention upon the economic impossibility of feeding the English population with domestically produced grains. It was realized that England must make a choice. Either become industrialised using agricultural lands for that purpose or reverse the existing industrial trend and return to an economy consistent with the ability of the land to produce agricultural products. To take the latter course would have meant less industrialization, smaller population and less foreign trade. England, with her developed resource pattern of industrialization, limited land area, and large population, chose to turn from protection to free trade and so modified her laws in that direction.

England achieved free trade much easier during this period because of the existence of the British colonial system. This system allowed England to enjoy a source of raw materials, as well as a market for surplus manufactured goods. Thus tariff walls of other nations did not disturb the economic development of England because of the protected imperialistic colonial markets. The first quarter of the twentieth century found other nations, as well as the British colonies, developing their own manufacturing
facilities, often with newer techniques and more advanced knowledge. The advantages of an early start enjoyed by England were lost in the competitive struggle for world markets. To preserve her home markets England turned from free trade back in the direction of protection. Behind tariff walls, existing techniques could be kept alive, but often some of the desire to seek out new improvements is lost in the security of a protected home market. Long supreme in the industrial world, England found that a nation cannot rest on an existing resource pattern and expect to remain in the vanguard of industrial nations. Today, as never before, England is seeking to improve her industrial position by institutional changes designed to wipe out the institutional lag which has resulted in a loss of industrial markets.

Institutions are necessary in any type of organisation to provide or act as a fundamental guide for all aspects of development. Institutions establish modes or lay out paths pointing out the direction established by past action as correct. Such guides are essential to the well-being and development of any organisation. Certain institutions are considered so fundamental or so well-established that change is neither necessary nor desirable. Industrial institutions are not of that type. Any nation desiring to progress or simply to keep up with other nations, must be willing and able to make such changes in industrial institutions as may prove necessary. The ability to assimilate or make these changes sets the progressive nation apart from the so-called backward nation. Frequently the institutional pattern of a nation can be changed for the better provided the necessary technological "know how" can be secured.

During recent years a number of leading nations have undertaken
programs designed to carry the "know how" to underdeveloped areas of the world. Never before among nations has attention been focused so strongly upon resource development in non-contiguous areas. Thinking about resources or a consciousness of the power of resources is growing throughout the world. This awareness of the importance of resources may be traced to a number of causes. War or the possibility of war focuses attention upon an available supply of those resources vital to the conduct of armed conflict. Fast developments in economic, political and social spheres have enabled nations to increase so in size and complexity as to make necessary an ever expanding resource base. The decline of free competition and the growth of economic power has made excess capital available either for foreign investment or additional domestic expansion based on raw materials obtained from undeveloped foreign nations. In addition there seems to be developing in some nations a feeling of social responsibility for those areas which have not developed their resources or are using inefficient modes of production. The United States is one such nation with an established program designed to provide technical information of the sort required for the development of resources in various areas. This program has sent technicians into many foreign nations. These trained groups, armed with tools and knowledge, have been instructing people in these foreign nations along modern technological lines. By such methods institutions of long standing are changing, standards of living are rising, and peoples of all lands benefiting from the increased production. In other words, an attempt is being made to substitute unselfish aggression for selfish aggression.

The benefits of such plans as that just mentioned do not necessarily
come from the discovery of new resources or processes. The benefits arise because the aiding countries have made the necessary contribution to place the raw materials of other nations on the available list. The raw materials have been located in the same place for centuries; to make them available required outside aid in the form of technological knowledge, capital, markets, or other essentials required for the development of resources. The existence of iron ore in Brazil has been known for many years yet no development of any consequence took place until the United States capital and engineering skill joined hands to make possible development of Brazilian iron ore. The lack of coal relatively near the iron ore and the transportation difficulties encountered have rendered it difficult to build an integrated steel industry in Brazil; consequently most of the ore still leaves that country for the United States for refining. Brazil, however, reaps the benefits from the development of a raw material long unavailable for industrial use, and a steel industry is also being established in that nation. Existence does not connote availability, which must include knowledge of techniques, markets, and capital.

While it may be possible to reach a market for finished goods from the source of the raw materials, it may not be economically profitable to manufacture and ship the finished produce to such markets because of the competitive pattern existing within the particular industry. The existence of competing areas of production may prevent the development of a potential resource even though the institutions and techniques are available for the development of such an industry in the new area. The advantage of an early start has, in many cases, worked to the disadvantage of new areas interested in industrialization. Once the patterns of resource flow,
production and distribution have been set up, it is often difficult to change them unless some new techniques can be devised to offset the advantage of the older area. An example might be made of the growing chemical industries of the South and Southwest. The first of such industries to develop in the area were those dependent upon the petroleum industry for raw materials. These new industries also depended upon the petroleum industry for a market for a portion of the finished products. Shipment of the finished product to other areas for sale at a profit was often difficult, if not impossible, because of the transportation charges, plus the existence of already established plants in other areas. Following the establishment of some chemical plants in the South and Southwest other industries were attracted to the area. These concerns were set up to supply the first chemical group with necessary materials. Among this second group were the chemical industries using salt as a raw material. The existence of the large salt deposits along the Gulf coastal area had been known for many years, yet no industrialization along chemical lines took place until the subjective pattern of resource utilization changed and made it feasible to utilize the salt of the area.

As a market develops in a new territory it frequently becomes profitable to develop the necessary facilities for the manufacture of the commodities in that area. At first, however, it is to the advantage of the producer to send the finished products into such new areas until the market is well established; then, with an established market, move into the area and begin the manufacture of the desired commodity. Thus, existence of a raw material is no guarantee of industrial development. Unless there is a market available either in the territory in which the production is to
take place or it is possible to reach a distant market economically, no production facilities will be established.

Future developments of the South and of Louisiana in particular, will depend upon the subjective analysis of the institutional pattern together with the techniques available for the development of new types of productive enterprises based upon the potential resources available in this area. Unless all the subjective factors are brought into focus and a new resource pattern developed, little additional industrialisation can be expected. The existence of special grants may attract some industries, but true permanent development comes only when the subjective evaluation of potential resources, including the necessary technological pattern, provides industry with the fundamental knowledge necessary for resource development. The entire program must be built around a knowledge of the possible goals and availability of the means necessary to achieve the desired ends.

With the subjective valuation of all factors ever in mind, it is proper to turn to a consideration of the development of the utilization of salt in many of the important industrial processes of today.
CHAPTER III

TYPES, PRODUCTION, AND USES OF SALT

Three methods of production are utilized in the commercial pro-
duction of salt. This statement does not mean that any one concern uses
all three at the same place or time, though sometimes two of the three
methods are used at the same time and place. Utilization of dual produc-
tion methods is necessary when the concern desires to produce salt in several
different commercial forms. Normally, however, manufacturers concentrate on
production in a few related fields and use only one type of production.

Today, salt production in the United States is generally concen-
trated in the utilization of salt in brine form obtained from wells.\(^1\)
There are some locations where natural brine wells supply producers with
a natural brine but such locations are rare and production is limited to
the quantities required for local needs.\(^2\) Natural brine wells usually
occur in areas where rock salt exists. The natural brine is the result
of water flowing through or over the salt deposit and forced to the sur-
face under pressure. Most of the salt produced from wells takes the form
of artificial brine. This type of brine is secured by pumping fresh water
into the salt stock. When the water has dissolved the salt and reached
a saturated solution, the solution of water and salt is forced to the
surface by pumping, air pressure, or other means. Salt in brine consti-

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\(^1\) The Mineral Industry During 1948. Edited by G. A. Roush (New

\(^2\) A discussion of natural brine wells will be presented in Chapter
V in connection with the early history of salt production in the United
States.
In 1948, 57% of the total salt output of the United States consisted of salt produced by eight chemical companies operating twelve plants in seven states. In addition to these producers, there were a number of smaller concerns in various sections producing salt in brine for use in the chemical industries.

The early salt wells were simple ones through which brine was pumped from shallow beds of salt. It was not until 1885 that the first well was drilled in New York; fresh water was introduced and salt brine pumped up. Today the natural brine system of production is considered one of the minor sources of salt. The early wells were shallow since the drilling and pumping equipment was unable to reach deeper sources of salt. The existence of deeper beds of salt was considered a certainty by geologists as they were positive that the natural brine could only come from a large bed of salt. As changing techniques brought improvements in pumping and drilling equipment, the depths from which salt could be economically secured increased. Today, certain wells are supplying artificial brine from wells as deep as 7,000 feet.

The first method of obtaining artificial brine from wells was to drill a well into the salt stock and utilize two concentric pipes to secure the brine solution. Fresh water, hot or cold, was forced down into the salt stock through the center pipe. The water dissolved a portion of the salt in the brine solution:

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4Loc. cit.


6Loc. cit.
the salt and the saturated solution was then pumped back to the surface through the outside pipe. A fully saturated solution of brine contains some 26.5 per cent of sodium chloride, or common salt. This method of securing brine dissolved and pumped to the surface only the salt in the immediate vicinity of the well. The amount that could be obtained was limited by the power of the pumps used to pump the brine. As the salt was exhausted near the mouth of the pipe it was necessary either to drill another well or force the casings of the old well deeper into the salt stock.

Many attempts were made to improve upon the methods used to secure the brine. It was not, however, until the decade of the 1930's that any great improvements were made in the production of salt in the form of brine. Prior to this date one improvement was made. This was the development of the Trump method of getting out brine; it was the method resulting from experiments carried out by Mr. Edward N. Trump, and was adaptable to any thickness of salt stock. Its use makes unnecessary the pulling of the center pipe when the level of the water is changed. In the Trump method, instead of stopping the casing near the top of the salt stock, as had been the practice in earlier drilling, the drill was carried through the salt stock. When the casing was set a horizontal undercut was first dissolved at the base of the salt bed. Solution then continued from the top of the undercut. By this method impurities in the form of rock or mud settled out of the solution and to the bottom of the under-

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out. Thus a purer solution of brine was obtained and less time was lost in securing the salt. Under the older method of obtaining the brine from the top of the salt stock, the rock and mud settled on top of the salt making it harder to secure brine. The shale falling from the roof of the cut also damaged the casing, causing increased costs of production from stoppage to repair the casings.

The second major improvement made in the securing of salt in the form of brine was patented in May, 1934, by the Selvay Process Company. Instead of a single shaft being used to pump down the water and remove the brine, the Selvay plan utilised two or more shafts. These shafts are all drilled into the salt stock but the shafts are located some distance apart. These shafts are connected by a suitable tunnel cut by drilling either through or under the salt bed. The water is forced down one well shaft, dissolves the salt and is forced by means of pumping, air lift, or other means up one or more of the other shafts. The brine obtained by this method approaches closer to the saturation point than the brine obtained by the single well method. The reason for this stronger solution is found in the fact that the solution increases in density as it moves through the salt stock to the outlet shaft. By the time the solution reaches the outlet shaft it has absorbed about all the salt it can. It is said that by the use of this method a salt bed can not only be mined more completely

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than is possible by the use of any other method, but that subsidence is
negligible and that very little cleaning of the well is required. 11

Both the natural and artificial brine must, of course, be evapo-
rated in order to separate the salt from the water. In early times the
evaporation was done by putting the mixture in a pond or open basin and
utilising the heat of the sun to remove the water. At the present time,
however, this method stands in third place behind the use of grainers
or vacuum pans as a means of evaporating the water from the salt. 12 The
open pit or pond method of evaporation is used mainly in California and
Utah. The majority of the evaporated salt produced is manufactured by
other methods. One of the best known and most utilized of the evaporated
salt producing methods is the use of "grainers," which are large open
pans, usually some 100 feet long by 15-20 feet wide and some two feet
deep. When this method of production was first introduced in the early
nineteenth century the heat was provided by steam coils or fires located
underneath the open pans or grainers. Today, however, according to Mr. W.
G. Wilcox, managing director, Salt Producers Association, Detroit, Michigan,
such pans are no longer used in the United States. 13 Grainers are in use
today with the steam coils located at or near the bottom of the pan and
not underneath or outside. 14

To secure the salt by the use of grainers, the mixture or salt and

11 Seventy-five Years of Progress in the Mineral Industry, op. cit.,
p. 342.

12 To be discussed later.


14 Hamerton, op. cit., p. 10.
water is first introduced into a large settling tank where any insoluble impurities can be filtered out. The mixture is then fed into the grainers and at around 180 degrees the salt crystallizes on top of the water. As the crystals increase in size and weight they sink to the bottom of the pan and are raked out automatically. The size of the grains of salt is controlled by the temperature, the higher temperatures resulting in finer crystals. 15

Another type of open pan is a part of the Alberger process which was patented in 1889. 16 This system embodies a combination of tubular heaters and a circular open pan termed a "grainer." This method produces the salt by heating the brine under high pressure in a pair of connected circular evaporator pans. After heating the brine it is passed through flashers which reduce the pressure and temperature. No heat is applied either in or under the open pan. The size of the salt grain is controlled more easily by this method than in the previously discussed open pan method and the salt grain is flakier than other types of salt. 17

Still another process for securing salt from brine is by the vacuum evaporator. A triple-effect evaporator was invented about 1840 in this country by John Reynolds, but as far as is known no use was made of this method until 1885 when Duncan Bros. used it at Silver Springs, New York. 18 In most of the vacuum evaporators, the brine is introduced into large

15 Hamerton, op. cit., p. 10.
cone-shaped tanks where it is heated while circulating in a partial vacuum. The hot solution is fed into evaporating pans which are operated in groups of three or four. These pans are arranged in series so that the waste heat from the first is used to help heat the second and so on through the series. The heat and temperature of each pan is regulated in such a manner as to provide for the production of the desired grades of salt.

The salt from the first pan (named for its position in relation to the cone-shaped heating vacuum tanks) is frequently utilized locally as table salt, and because of its fineness and purity is particularly well suited for this purpose. This type of salt is known in the trade as granulated. In order to make certain grades of this salt moisture proof, and to make it run as freely as possible, a small amount of some non-hygroscopic substance such as magnesium or calcium carbonate is used to coat the grains. Usually not more than one per cent of this material is added. The final product is the familiar "shaker" or free-running salt.

The salt from the second pan goes, as a rule, into chemical industries, and that from the third pan is used for pickling fish, refrigerating, and as a bath salt. The typical compositions of the salt thus produced are given in Table I.

The second most important source of salt is from mines. The mining of salt is done by utilizing the same type of shaft and tunnel or room

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21 See. cit.
and pillar mining utilized by producers of other types of mined materials. In some sections of Louisiana, to be taken up later, considerable difficulty has been experienced in sealing off water encountered in sinking shafts. There has been some trouble in sinking shafts because of the nature of the overlying rock structure. In some instances it has been necessary to incur large expenditures for the lining of shafts to prevent cave-ins. Mining salt requires a heavy outlay of capital for the sinking of the shaft, digging of lateral tunnels, hoisting and ventilation equipment, and for crushing or refining machinery. The older the mine and the further away from the shaft the mining operations must be carried on, the more expensive become the operations. Where the salt is not pure enough to be used without further refining the operations become more expensive. Because of reasons such as these, mining of salt has not kept pace with the production of salt in brine. It might also be pointed out that the uses of salt in evaporated form have not increased as much as the uses of salt in brine form. It would not be correct to judge the future of salt mining by the past for new technological improvements could give rise to a great increase in this type of salt production. The increased mechanization which has taken place in some mines, such as the use of small trucks, conveyor belts, electricity and improved hoisting equipment,

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<th></th>
<th>Grade I</th>
<th>Grade II</th>
<th>Grade III</th>
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<tbody>
<tr>
<td>Sodium chloride</td>
<td>96.0%</td>
<td>95.0%</td>
<td>91.0%</td>
</tr>
<tr>
<td>Calcium sulphate</td>
<td>1.0</td>
<td>.9</td>
<td>.4</td>
</tr>
<tr>
<td>Magnesium chloride</td>
<td>.0</td>
<td>.6</td>
<td>1.0</td>
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<tr>
<td>Insoluble matter</td>
<td>--</td>
<td>trace</td>
<td>.2</td>
</tr>
<tr>
<td>Water (moisture)</td>
<td>2.6</td>
<td>3.1</td>
<td>6.2</td>
</tr>
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has lowered the cost of production. Continued improvements will allow mines to continue to supply a portion of the salt needs of the world.

Where the mined salt is in pure form it is only necessary to hoist it to the surface of the earth, crush and screen it before packing the salt for sale. Where rock salt is mined, it is necessary to remove the salt powder after the crystals have been ground to the required size. This salt dust covers everything in the mill, and its deliquescent nature makes it exceedingly difficult to preserve nearby metals from corrosion. Machinery must be continuously slushed with oil, and motors and delicate mechanisms must operate in sealed boxings. 22

Production by means of solar heat today ranks third as a method of producing salt. However, it was the first method known to be used by the early settlers on this continent. It is thought that the possibility of making solar salt in this climate was first suggested to the colonists by finding salt crystals in empty mussel shells on the beaches along the Atlantic coast. 23 As far as is known the first evaporating shed was erected at Cape Charles, Virginia, in 1720. 24 This plant was unable to supply the needs of the colonists and most of the salt used was imported from England. Importation continued until the price of English salt rose so high that many colonists began to make their own salt. The high price led to the discovery of a number of inland salt springs where a better


24 Loc. cit.
grade of salt was made.

Today most of the solar salt manufactured or produced in the United States is made in California. Brine springs and salt marshes are found in a large number of localities throughout the state though most of the solar salt is made from sea water by evaporation. Sea salt has been manufactured at the south end of San Diego Bay and at Ocean Side, in San Diego County. The principal works are on the south and east ends of San Francisco Bay, Alameda County. In these areas sea water is led into enclosed flats during high tides. The water is impounded in the flats and allowed to evaporate. This system is profitable only where there is a maximum of sunlight. Therefore, the production of salt by this method is limited to those months during the year when rainfall is limited and sunlight at its maximum. For these climatic reasons solar salt is harvested from ponds chiefly during the last three months of the year. The salt is harvested by scraping the bottom of the pond and stacking the salt in huge piles. The steep sides of these piles become crusted and impervious to rain. Thus the salt can be stored in this manner very economically until such time as it is desired to move it to the evaporators where it is purified and made ready for sale. The salt in these piles may, at certain times of the year, be equal to about ten or eleven months supply for the producing company.

In Utah, some salt is made from the water of the Great Salt Lake. The method used is essentially the same as that followed in California. Salt obtained by this method is not as pure as salt obtained by other

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26 Loc. cit.
methods unless the salt is further refined by the use of artificially heated evaporators or similar production methods. Solar evaporation is, of course, slow and requires a considerable amount of area as the beds in which the water is evaporated must be large in order to secure enough salt to make the project economically worthwhile.

Though salt is easily obtainable in most sections of the world, and usually at reasonable prices, there are extensive regions where it is not easily accessible. One of these areas is located in central Africa, in the southern Sudan region. This thickly populated region has no source of domestically produced salt, and the low incomes of the inhabitants prevent the importation of any large quantity of foreign salt. In order to take care of the lack of needed salt, the natives have resorted to the making of a substitute salt from the ashes of certain plants. The plants are usually either tall grasses such as Sorghum vulgare or plants of a different genera, such as Salvador persica, Borassus flabelliformis, Gracis mollis and Pistia stratiotes.\(^{27}\)

The method by which this substitute salt is obtained is somewhat as fellows: the natives take the plants and reduce them to ashes by burning. The ashes are placed in perforated earthen vessels and water poured over them. The resulting solution is then evaporated by heating. The residue is again placed in solution and evaporated. This process is repeated until a weak potassium salt is obtained. An analysis has been made of some of this plant salt manufactured by the negroes in Ubangi

\(^{27}\)Harris, *op. cit.*, p. 187.
with the following results:  

<table>
<thead>
<tr>
<th>Compound</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium chloride</td>
<td>67.97%</td>
</tr>
<tr>
<td>Sulphate</td>
<td>28.73%</td>
</tr>
<tr>
<td>Carbonate</td>
<td>1.17%</td>
</tr>
<tr>
<td>Insoluble matter</td>
<td>1.65%</td>
</tr>
</tbody>
</table>

It might be pointed out that there is no trace of common salt (sodium chloride) in this combination. The natives have learned to select plants with a very small per cent of potassium carbonate, otherwise the substitute salt would be too caustic to use.

The purposes of this study do not permit further discussion of substitutes. Some special production methods and problems will come up, however, in the later discussions on production in specific locations. At this point attention is focused on actual salt resources of the world. Attention is being given to salt utilization in the United States and especially in Louisiana. Many of these uses will be found to be recent in their origin and some of these not being utilized currently in the state of Louisiana could be developed in the state.

Salt contributes more to the health and welfare of both man and beast than any other mineral. It is essential to the health of man and beast and to the preparation and preservation of food products. To point out the importance of salt to the human race the following is quoted:

The human body tends to maintain an even balance of about 0.88 percent salt. Normally about twelve pounds of salt a year obtained from food and drink suffices to furnish that vitally necessary amount. Incidentally, if the earth's population is figured at 2,250,000,000 persons, at 12 pounds per capita the annual direct

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28 Harris, op. cit., p. 247.
29 Payne, op. cit., p. 181.
consumption by human beings would amount to 27 billion pounds or 13.5 million tons. Since world production is estimated at 50 million tons, apparently about 16.5 million tons are used for purposes other than human consumption, especially industrial uses.

The approximately seventeen million tons used for industrial purposes supplies a multitude of industrial needs for which replacement by substitute materials is impractical or impossible. With substitution at least "impractical" the market for this portion of the salt production seems assured as long as present techniques continue. Of course a new technologi-cal improvement could change this resource utilization pattern. The present expansion programs of certain chemical companies indicate that they expect to continue using salt and are increasing the quantities consumed.

Until the year 1897, table, animal, and similar uses were the principal outlets for salt produced by the methods then in use. The increase in salt utilization depended upon the growth of population and animals and meats packed; hence salt production increased slowly. Since 1897, however, the enlarged demands, made possible by a changed resource pattern built upon a changed transportation system and new techniques of manufacture, for meat packing and particularly for chemical use, promoted a more rapid growth. As higher standards of living pushed the refinements of civilisation higher and higher, the consumption of salt per capita likewise increased. This new demand does not mean that each individual actually consumed more salt in its original form because the average consumption per capita has long been established at about twelve pounds per year. The increase has

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31 Seventy-five Years of Progress in the Mineral Industry, op. cit., p. 341.

32 Harris, op. cit., p. 305.
been due to the utilization of salt in the various chemical industries as well as in related industrial pursuits. Including all uses, the increase in per capita utilization has been quite marked in recent years. By "per capita utilization" is meant the total amount used directly for human consumption plus the amounts used by all other processes. Figures on a per capita basis are given for it is easier to compare consumption at one time with consumption of an earlier period when the amounts are in small units. In 1890 the per capita consumption was about 39 pounds; in 1910 about 92 pounds; in 1920 about 124 pounds; in 1930 about 134 pounds; and about 140 pounds in 1940.\footnote{Seventy-five Years of Progress in the Mineral Industry, op. cit., p. 341.} In 1945 the United States produced some 15,400,000 tons of salt, which was double the 1935 figure.\footnote{Zimmermann, op. cit., p. 784.} This increase suggests a large increase in the chemical-using industries for the population did not increase sufficiently to require anything like that much direct consumption of salt.

To illustrate the importance of salt in the life of the average citizen of the United States, the following quotation is presented:\footnote{C. D. Leiker, "Some Recent Developments in the Use of Sodium Chloride," Transactions of the American Institute of Mining and Metallurgical Engineers, Vol. 129, 1938, p. 424.}

Salt in some way or another, either directly or indirectly, enters into the manufacture or preparation of a majority of the common commodities we encounter in life's daily routine.

Salt was the source of the chlorine that bleached the cotton in the bed covers and the pulp in the morning paper. The electrolytic companion of chlorine is caustic soda or lye, which helped salt itself to make the soap for the morning bath, the lather for shaving, and the detergent for the laundry. The clothes we
had dry-cleaned with a chlorinated solvent were dyed in all probability with the aid of salt to exhaust the dye bath.

The water we drank this morning may have been softened by zeolite regenerated with salt brine and made germ-free by the addition of chlorine, or it might have been softened by soda ash made from salt.

The lacquer on the bodies of our automobiles, the glass in the windows and windshield, and the rolled iron in body and frame had salt or compounds made from it used in their fabrication. The grease and oil in the bearings and crankcase, in all probability were extracted with chlorinated hydrocarbon solvents. The bearings themselves may have been casehardened in molten salt, salt mixtures, or preparations consisting of sodium compounds. In ethyl gasoline, the bromine for ethyl bromide was probably liberated from sea water by the use of chlorine. Leather is preserved and tanned by the use of salt.

The nineteenth century saw the real beginnings of the chemical industries throughout the world. During the latter part of that century it was found that salt contained chemicals that could be used in the manufacture of many new and entirely different products. The utilization of salt in the chemical industry made unnecessary the evaporation of the brine solution, for the chemical plants were able to utilize the brine as it came from the well. The utilization of the brine naturally cut down the cost of the raw material and actually speeded up the productive process in that no time was lost in changing the raw material into a brine form. The growth of the chemical industry has resulted in a growth of salt production in brine form in the United States. Today the chemical industry ranks first as a user of salt. In 1948, the last year for which figures are currently available, the chemical-using industries consumed some 11,075,018 short tons of salt. This figure approaches three-fourths of the total production of salt in the United States.

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36 Hamerton, op. cit., p. 11.
37 See Table II.
States for 1948, as production of salt, in all forms, reached 16,408,293 short tons. As to the sources of the salt used by the chemical industries in 1948, 9,189,232 short tons were produced as brine; 1,343,854 tons of rock salt were consumed, principally in the production of chlorine and "other" chemical products; and 539,932 short tons of evaporated salt were used by the chemical industries. 38

At the present time the production of soda ash consumes more salt than any other industry or user of salt. In 1948, for example, the soda ash producers used 7,392,248 short tons of salt. Practically all of the salt used by this branch of the chemical industry was in the form of salt in brine. A small amount of evaporated salt was used but not enough to cause its inclusion as a separate figure. The growth of the soda ash industry since 1940 is shown by the fact that the industry has increased its consumption of salt from 4,910,540 short tons to the present figure, or an increase of 2,481,908 short tons in the eight year span.

In the development of the chemical industry it was the soda ash industry which started the world on the road to the modern chemical industry. This industry, soda ash, was developed in the eighteenth century by Le Blanc, who developed a process for making soda ash (sodium carbonate) from such common raw materials as salt, limestone, and sulfuric acid. 39 This industrial development was taken over in England and in that country led to the development of the modern alkali industry. This industry in turn aided the development of the soap and textile industries, both

38 See Table II.

39 Zimmermann, op. cit., p. 784.
of which use salt either directly or indirectly in various productive processes. Soda ash can be converted into caustic soda or lye by chemically reacting the soda ash with lime. The main product of Le Blanc's process, soda ash, found an increasing use in the manufacture of glass and soap, while the chlorine, a by-product of the soda ash productive process, found a market in the form of bleaching powder. 40

In 1863, the Solvay process of making soda ash was perfected. In this process ammonia is used over and over again in the production of soda ash from salt and the cost of production is considerably lower than in the Le Blanc process; the Solvay process therefore rapidly replaced the Le Blanc process. Near the end of the nineteenth century the development of the use of electrolysis in the chemical industry started a new phase of the alkali industry. This new phase began with the electrolytic production of chlorine and caustic soda (sodium hydroxide) from the brine. 41

These two products are produced in about equal amounts by this method of production. In 1948 the production of chlorine, bleaches, chlorates, etc. consumed some 2,638,028 short tons of salt as compared to 1,289,242 short tons in 1940. In 1940 salt in brine accounted for only 366,218 short tons of the total, while rock salt accounted for 539,471 short tons, and evaporated salt made up 381,553 short tons. In 1948 the utilization of salt for this type of production showed little change for the amounts being used in the form of evaporated salt. In that year only 336,180 tons of evaporated salt was used, while 706,315 tons of rock salt was

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40 Zimmerman, loc. cit.

41 Loc. cit.
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</thead>
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<tr>
<td>Wholesaling, Retailing, etc.</td>
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<td>300,000</td>
<td>300,000</td>
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<td>45,000</td>
<td>40,000</td>
<td>35,000</td>
<td>30,000</td>
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<td>10,000</td>
<td>5,000</td>
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<td>Furniture and equipment</td>
<td>78,751</td>
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<td>50,000</td>
<td>45,000</td>
<td>40,000</td>
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<td>Other merchandise</td>
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<td>Food handling</td>
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<td>Heating, cooling, etc.</td>
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<td>80,000</td>
<td>80,000</td>
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<tr>
<td>Fuel and lubricants</td>
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<td>90,000</td>
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<tr>
<td>Miscellaneous</td>
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<td>150,000</td>
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<tr>
<td>Total Operating Expenses</td>
<td>233,607</td>
<td>427,007</td>
<td>68,399</td>
<td>728,997</td>
<td>127,982</td>
<td>147,945</td>
<td>128,899</td>
<td>148,899</td>
<td>171,899</td>
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<td>231,899</td>
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<td>Interest expense</td>
<td>550,975</td>
<td>213,999</td>
<td>165,024</td>
<td>104,427</td>
<td>39,451</td>
<td>174,460</td>
<td>290,910</td>
<td>37,717</td>
<td>15,974</td>
<td>30,993</td>
<td>22,243</td>
<td>30,993</td>
<td>22,243</td>
<td>30,993</td>
<td>22,243</td>
</tr>
<tr>
<td>Total Income</td>
<td>835,408</td>
<td>426,976</td>
<td>323,930</td>
<td>665,525</td>
<td>260,020</td>
<td>224,744</td>
<td>296,033</td>
<td>13,415</td>
<td>197,751</td>
<td>211,165</td>
<td>167,126</td>
<td>704,970</td>
<td>427,751</td>
<td>368,215</td>
<td>1,289,222</td>
</tr>
</tbody>
</table>

*Note: Figures may not add up due to rounding.**
used, and salt in brine had increased to a total of 1,736,533 tons.

The necessity for such an increase in the manufacture of chlorine, bleaches, chlorates, etc., was brought about by the growth of demand pursuant to the increased production of the pulp, paper, and textile mills. These industries started producing their own chlorine for bleaching purposes by making use of the electrolytic process. All of these types of enterprises are heavy users of chlorine for bleaching purposes. These demands gave rise to the production of a great quantity of caustic soda as a by-product. The placing of this material on the market forced the Solvay plants to change their methods of production to meet this new competition. Solvay plants built their own electrolytic plants and began the production of cheap by-product chlorine and caustic soda with "soda ash subsidized power." This "soda ash subsidized power" receives its name from the fact that the manufacture of soda ash by the Solvay or ammonia-soda ash process requires large amounts of low pressure steam. The companies have, in some instances, built high pressure steam plants, used the steam to turn turbines for the generation of electricity (for electrolysis utilization) and in turn used the low pressure exhaust steam in the production of soda ash. Under this system "the soda ash might be said to be 'subsidizing' or sharing the cost of the electricity." The term "subsidy" is not being used in this quotation with the idea in mind of soda ash paying something extra or giving more than value received in payment for the steam. Rather the term is used to point out the fact

42 Zimmermann, op. cit., p. 785.
43 loc. cit.
that the production of soda ash which requires both steam and electricity, has made possible a lower cost to the producers. In other words, these enterprises might be said to be complementary industries in that they are aiding each other in the production of economic goods. It would be possible, as in some cases, to purchase the electricity while producing the low pressure steam in plant boilers. However, the additional cost incurred in producing high pressure steam and generating electricity is less than the cost of purchasing electricity and producing the steam separately. By generating electricity with the high pressure steam and using the exhaust low pressure steam directly in the productive process, such steam may be said to be sharing or in effect subsidising the cost of production of electricity used in the production of soda ash. The combining of these two operations in the one firm places such a firm in a decreasing cost position as far as power is concerned.

In Louisiana the Solvay Process Company utilised a different variation of this "soda ash subsidised power" in selecting the location of the company's plant in Baton Rouge. The present site was chosen after several years of study, and the principal deciding factor was the availability of low pressure steam. The Solvay Process Company arranged with the Louisiana Steam Products Company (now the Louisiana Steam Generating Corporation which is a part of Gulf States Utilities) for the latter concern to pass its surplus low pressure steam to the Solvay Company. The Steam Products Company in turn secured a portion of its fuel from the waste gases and sludge of its neighbor, the Standard Oil Company of Louisiana. The Standard Oil Company was paid for this gas and sludge in process steam and electricity. The Standard Oil Company is also a large
Besides needing cheap salt and limestone all of the alkali plants require cheap fuel. Therefore, most of the alkali plants in the United States are either located in the northeastern section of the United States over the brine fields which are near the coal fields of West Virginia, Pennsylvania, and Ohio, or located in the southwestern part of the United States over the salt domes of Louisiana and Texas where natural gas can be easily obtained. The natural gas or coal is not desired directly but rather the energy contained in these materials is used indirectly in the form of electricity generated from these original sources of power. Recent years have witnessed a shift of the alkali industry in the direction of the southwestern part of the United States. This growth has been aided by the development of industries using the end or finished products of the alkali plants. Among such industries might be mentioned the petroleum refineries, Kraft pulp and paper mills, viscose rayon mills, and alumina plants.

Soda ash ranks high in the list of chemicals needed by other chemical industries in the manufacture of consumer goods. Soda ash is being used in the manufacture of various types of detergents. The growth in the manufacture of detergents has caused a shift in the users of salt for soap making purposes. Salt is used as a precipitant in soap making and is also the basic raw material for soda needed for soap. Thus as one type of use begins to change another rises using the same basic raw material for a new purpose in a new way.45

44Thirteenth Biennial Report, Department of Conservation, State of Louisiana, 1936-37, p. 104.
Standing in second place as a user of salt is the chlorine manufacturing industry. As has been mentioned, the production of chlorine requires a very large amount of salt. This branch of the chemical industry used some 2,838,029 tons of salt in 1948 as compared to 1,289,242 tons in 1940. In the United States all of the chlorine produced is manufactured from sodium chloride. This industrial raw material finds many chemical uses among which are the making of bleaches and the chemical purification of water. The chlorine may be compressed and shipped in cylinders or may be absorbed in lime to form chloroide of lime used as a bleaching powder and as a disinfectant.

The number three consumer of salt in this country is livestock. Farmers and ranchers have turned more and more to feeding salt on a free basis, usually in the form of blocks for licking. The use of salt in block form came into being about 1910 or 1912. These blocks of salt have about replaced the large lumps of salt formerly placed in the fields or stables for the cattle to lick. The blocks of salt are made in hydraulic presses from the refined salt spoiled around the machines in the evaporating and packing departments. Often these blocks contain a small amount of sulphur, which is supposed to give the blocks a medicinal value.

In 1948 farmers and ranchers used some 792,498 tons of evaporated and rock salt for livestock. The amount being used for this purpose seems

45C. D. Looker, op. cit., p. 424.
to have been about stabilized for in 1940 this use accounted for 747,443 tons. The only way any large increase could occur would be for the livestock to increase in numbers for it has been determined that animals over one year of age need about two pounds of salt per month. 49

One of the latest developments in cattle feeding is the utilization of salt as a sort of control in the self-feeding of such cattle foods as cottonseed meal. In a recent experiment held at the United States Department of Agriculture Station in Woodward, Oklahoma, it was found that, "through the use of a self-feeding device yearlings could be rationed in winter at two pounds of cottonseed meal a day by mixing salt with it in the ratio of seven parts salt to sixteen parts of cottonseed meal." 50

The results of this experiment seem to show that the growth of the yearlings was only slightly less than the growth of those fed daily by the usual hand method of feeding. Information on the exact difference in weight is not available. However, there was a great saving in labor by the use of the self-feeding device and the saving more than balanced the slight weight loss.

Most of the salt used for feeding or controlling the feeding of livestock was produced from mines or by evaporation. Of the total production in 1948, 792,498 tons, only 238,966 tons came from mined rock salt, while 553,966 tons came from evaporated salt production. More than half of the "dry salt" used for livestock purposes was supplied by Kansas, Texas, and Ohio; the other came from New York, Michigan, Louisiana,

50 Hamerton, op. cit., p. 11.
Among the other important uses of salt, according to the United States Bureau of Mines, are as a refrigerant (principally in car icing) and in railroad and highway ice control. At one time a mixture of salt and ice was about the only practical means of obtaining the necessary low-temperature refrigeration required for many purposes. Such a method is still the major one used for cooling railroad refrigerator cars. However, a new method has been developed to use salt and ice to produce a uniformly low temperature efficiently and economically by freezing eutectic brine on a FlakIce Machine in the form of thin ribbons. The eutectic brine is made by diluting a saturated brine solution to eutectic composition containing 25.3 per cent salt and 76.7 per cent water. The ribbons of ice which are made by this method may be used as ribbons or compressed into the form of blocks and used in the same manner as ordinary ice or dry ice. This "salt ice" can be handled much easier and costs less than conventional mixtures of salt and ice. It has been pointed out that "three pounds or slightly less of Salt Ice have as much heat-absorbing capacity as one pound of dry ice when used for low-temperature refrigeration. The cost of producing three pounds of Salt Ice is about three-fourths of a cent as against two to four cents per pound of dry ice delivered. Salt Ice is being produced on a commercial basis by the Salt Ice Corporation of Brooklyn, New York."

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52 Hamerton, op. cit., p. 11.
53 Lockert, op. cit., p. 427.
54 Loc. cit.
Several recent developments in different fields may open up vast new areas for the utilisation of salt. Such a possible use is the one just discussed. Another such development being tested and having already shown some possibilities for economic utilization is found in the rubber industry. The synthetic rubber industry is already a large user of salt in the form of chlorine, but this new development is entirely different in the sense that salt is used as salt and not in a chemical form. One of the rubber companies (name not available) has found that "salt added to the material developed for recapping automobile tires was highly successful. Rock crystals are mixed into the stock. As the tread wears down, the salt is released, and surface pores are formed which grip the road." The formation of these surface pores is said to provide a much better gripping surface and to prevent skidding to a much greater degree than found possible under other recapping methods.

Another recent utilization of salt is in the controlling of ice formation on highways and city streets. So successful has this sort of treatment become that it stands high in the list of users of salt. One manufacturer of salt for ice cream production now packages his salt with a label describing the use of the salt for ice and snow removal. Just exactly how much salt is used for ice control is not available, but ice and dust control on highways and railroads in 1948 required some 488,934 tons of salt. These two uses combined take over seventh place in the utilization of salt in the United States.  

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55 Leeker, op. cit., p. 427.
57 See Table II.
The exact method by which the ice is removed from the roads and streets varies somewhat, but in general the following pattern will explain. Crushed rock salt is sprinkled on the streets and roads covered with ice. The salt causes the ice to melt and run off in the form of water. There is not as much danger of refreezing since the salt is in solution and lowers the freezing point of the mixture. During the past winter, 1950, a new idea for getting the salt on the roads was tried in Ohio. A crop dusting plane was successfully utilized to spray crystallized salt on a snow covered highway.\textsuperscript{58}

The City of Detroit has used salt for snow and ice removal for a number of years and reports success. The source of the salt used by this city is a salt mine located under the city proper. Some criticism has come from some motorists who have complained of the corrosive effects of salt used for de-icing of city streets. To inhibit these effects, a company that has been experimenting and testing mixtures for some time has found that a mixture of sodium chromate or sodium dichromate with the de-icing salt is successful.\textsuperscript{59}

One of the most recent new uses for salt is in the construction of stabilized roads of the farm to market type. There is nothing new about stabilized roads for they have been in use in the United States since about 1906, but they have been built using clay or top soil to stabilize sand and gravel roads.\textsuperscript{60} The Federal Bureau of Public Roads has, in


\textsuperscript{59} Chemical and Engineering News, Vol. 26, No. 1, January 5, 1948, p. 56.

\textsuperscript{60} Loeker, op. cit., p. 429.
cooperation with several state departments of highways, been developing this new type of stabilized road. Because of the possibilities for such construction, a summary of the method of construction is presented as follows:

The materials of construction most commonly used to secure stability are gravel, crushed stone, slag, sand or stone dust and natural soil binder, which includes fine sand, silt and clay. . . Alternate expanding and shrinking cause the binding material to break away from the coarse aggregate and make a loose, floating surface. . . .Solutions of electrolytes, such as common salt aid in removing air films and wetting oil grains, thus assisting in compaction, and soil treated with sodium chloride solution has a greater retentive power for moisture than soil moistened with plain water. . . .The value of the greater retentive power of moisture and of the electrolytic effects seem to be most useful during the construction period, when the separate ingredients are reaching equilibrium in the interlocked structure of which the compacted mass is composed. . . .Properly constructed salt-soil stabilized roads may serve for an indefinite time as wearing courses or they may serve as base courses for a higher type of surfacing.

In Cuba a variation of the above method has been utilized in the construction of runways for airfields. In 1942 several runways were constructed by adding salt to the layer of clay and gravel under the top dressing of asphalt to make it more elastic and thus to obviate cracking.

During recent years the importance of salt has been increased as a fertilizer. "The claim has been made that every grower of sugar beets on muck soil should apply 600 to 1000 pounds of salt per acre in addition to regular fertilizer. Experiments in Michigan, Indiana, and Belgium indicated that such additions increased the yield substantially." In one case it is said to have increased the yield of sugar beets from

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61 Lecker, op. cit., p. 429-430.
thirteen to twenty-one tons per acre when 1,000 pounds of salt per acre was added to the regular fertilizer. It has also been found that such additions of salt to the regular fertilizer plan will increase the yield of such other crops as celery and beets. The use of salt not only seems to increase the yield per acre but it also raises the quality and resistance to leaf spot and blight. In other cases salt has been utilized instead of potash on mangold and sugar beets and cabbage at the rate of 500 pounds per acre. Moreover, when employed in conjunction with a good dressing of sulphate of ammonia, salt is said to act as well as muriate of potash.

In South America a new technique has been developed for the curing of heavy hides. The disposing of the surplus hides has long been a problem to some South American slaughterers for the sparse population cannot use all of the heavy leather produced in that section of the world. The United States is a heavy purchaser of these tanned hides for there are not enough heavy hides produced in this country to supply the demand for heavy leather. Under the new method being used in South America the cattle are forced to pass through a spray of water before they are slaughtered. As soon as the hide is removed from the animal it is scrubbed and soaked in salt brine before being "cured in salt packs completely surrounded by salt held in place by a wooden frame." The hides tanned by this method are able to compete on a price basis in world markets with hides tanned by the older

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64 Chemical and Engineering News (American Chemical Society, Vol. 20, No. 20, October 25, 1943), p. 1308.
65 Mining and Metallurgy, op. cit., p. 17.
66 Chemical and Engineering News, op. cit., p. 1308.
67 Loeker, op. cit., p. 425.
methods. Though this new method does produce leather of a superior quality, the method has not been universally adopted in the United States because of economic reasons. Some of the United States packers do soak hides in a brine solution when they are going to tan them immediately. In this country the slaughtering and tanning industries are still largely separated in ownership, as well as in geographic location, though there has been a tendency for large meat packing houses to enter the tanning field in an effort to increase the profit from the sale of a by-product. This separation means that usually some thirty days separate the skinning and start of the tanning process. The lapse of time between skinning and start of the tanning process makes impossible the use of this new method of processing hides. The use of the new technique would require a relocation of the tanning industry in order to receive the hides as soon as they are separated from the animal. It is a common practice to salt down the hides, not so much to aid in the curing or tanning but to aid in the preserving of the hide until it reaches the tanner.

In Louisiana, which leads the southern states in the production of salt, crushed rock salt has found a number of industrial uses in its crushed state. Crushed salt, grades number 1, 2, and 3, are used for refrigerating, curing hides, curing fish, making salt pickles, glazing in enameling and pipe works, and No. 3 is especially adapted to capping all sorts of meats put up in pickle in barrels. The "C" (coarse) and the "F" (fine) are used for dry-salting meats, clearing oleomargarine and in

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68 Payne, op. cit., p. 183.
all sorts of chemical works, while the "A" grade is a special one made to suit the customer who regards the No. 1 as too large and the "C" as too small for his purpose, such as ice cream and pickle processing. The "D" grade is also a special one, consisting of powdered salt, which results from the grinding of any of the crushed grades in the mills and is used for any purpose where rapid solution of the salt is desired. 69

In its normal preparation for sale, salt is usually graded and sold in the two most common sizes, known as common fine (C. F.) and common coarse (C. C.). Undried salt, whether made in vacuum pans or in grainers, is usually termed common fine and salt produced by these two methods, when dried and sifted, is classed as dairy salt. 70 The most important features entering into the sales possibilities are the color and the moisture content. Most salt may contain from four to five per cent moisture. The four most common grades in the eastern markets of the United States are No. 1 common fine, medium coarse, coarse, and rock. 71

The increasing importance of the chemical producing and chemical using industries points to an increasing demand for salt. Judging from the past record of the chemical industry and the tremendous strides the industry has made during the past century, it appears that the rate of technological change is increasing. With salt standing as the basic raw material for so many of the chemicals used by many industries in the United States, there appears to be an excellent opportunity for the further development of the salt industry in Louisiana. The alkali industry

69 Harris, op. cit., p. 14.
70 The Mineral Industry During 1922, op. cit., p. 636.
71 Ibid. cit.
alone produces millions of tons of various types of alkalies annually.\textsuperscript{72}

This industry is typical of the heavy chemical branch of the chemical industry. With this industry producing a variety of new products and each new product offering opportunities for still further investigation into the utilisation of that material, the chemical using industries will likely continue to increase their utilisation of salt.

Such large-scale utilisation of salt has not always been the case. In early historical times salt was expensive and hard to obtain. Kingdoms developed salt works as the chief means of securing revenues for rulers, and in various ways the rulers showed a high regard for salt. It is to a description of the position of salt in early stages of the historical development of the world that attention will now be directed.

\textsuperscript{72}Zimmermann, \textit{op. cit.}, p. 785.
CHAPTER IV

HISTORY AND PRODUCTION OF SALT IN FOREIGN COUNTRIES

Common salt "was a human necessity literally thousands of years before it was known that oil could be put to any use, and its value to mankind has vastly exceeded that of all the so-called precious metals put together."¹ It is fairly certain that salt was used by both man and beast long before the dawn of civilization.² Salt is considered to be an essential element in the diet of animals, and the need for extra amounts of salt in the human diet arose mainly "(1) to satisfy an acquired taste, (2) to preserve food and (3) to maintain the salt equilibrium in the tissues and blood stream."³ Neither carnivorous animals nor the hunter who lives mainly on the meat he kills require additional salt, but the herbivorous animals do.⁴ So long as man lived on raw or roasted meats or fish there was little necessity for any additional salt, but as man began to move away from the sea coast and as vegetables began to supply a larger and larger part of man's daily feed needs, the demand for


²Even "kissing" is said to have started over a craving for salt. Douglas Walkington, chemist for Canadian Industries, Ltd., told of this history of the kiss; "The cave man discovered that salt helped cool them in the hot summer. So just as cows get salt by licking each other's chaps, the cave man found he could get salt by licking his neighbor's cheek. Then he discovered the process was much more interesting if the neighbor was of the opposite sex. And then, everybody forgot about salt." State-Times, Baton Rouge, Louisiana, October 21, 1950.


⁴Loc. cit.
additional salt developed, because vegetables rank far lower than meats in their salt content; the cereals rank lowest of all. It is, therefore, apparent that the growth in the need and use for salt for human consumption is bound up with the shift from nomadic to agricultural and urban civilization. The mere man began to depend on agriculture for his food, the more he began to demand salt as an integral part of his daily diet.

It has been claimed that there are few experiences more annoying than "salt hunger." The early Chinese had, among their other types of tortures, a torture which they called "hunger torture." This torture consisted of giving prisoners an ample amount of rice to eat but the salt had been left out of the liquid in which the rice was cooked. In recent years it has been found that in certain industries an extra amount of salt, usually in the form of salt tablets, must be given the workers. It was known that heat cramps often occurred among foundry workers and others exposed to high temperatures but the remedy was not found until exhaustive tests had been conducted by medical experts. The tests disclosed that these heat cramps were caused by disturbing the salt balance in the blood which bathes the brain. This type of cramp occurred when the salt lost in perspiration greatly exceeded the reserve supply in the human system. The addition of salt to the drinking water or the taking of salt tablets replaced the lost salt in the body and the heat cramps disappeared.

During the early part of the twentieth century it was noticed that

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5Looker, op. cit., p. 425.
6Ibid., p. 426.
some people were suffering from a deficiency of iodine. This condition was found frequently among those living inland in places where they could not secure fresh fish or other products having a supply of iodine which could be used by the body. It was discovered that this lack of iodine could be remedied by adding a small amount of iodine to salt. This "iodized salt" was first introduced in 1924 in Michigan, and since that time about fifty per cent of the salt produced as table salt is iodized.\(^7\)

The importance attached to salt is not a modern concept for common salt is mentioned in the most ancient writings as an important article of diet. Pliny relates that "Aucus Martius, the fourth of the early kings of Rome who reigned from 640 to 616 B.C., was the first who had sea water led into closed basins to evaporate so that salt could be made.\(^8\)" From such beginnings, Italy became known as the cradle of the saltern industry. Following the beginnings under Aucus Martius so many salterns were established that the production of salt from sea water became an important industry of early civilizations.\(^9\) In some instances colonies were founded because of the presence of salt springs; wars were fought for the possession of salt deposits; and trade routes were established expressly for the purpose of traffic in salt.\(^10\)

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\(^9\) Ibid., p. 225.

\(^10\) Looker, op. cit., p. 425.
earliest and most important of the Roman roads was built in order to facilitate the movement of salt from the sea coast near the mouth of the Tiber River. This road, known as Via Salaria, "the salt road", is the road which still passes through Rome on the way from Ostia, on the sea coast to the Inland Sabine Country.  

For most, if not all of the modern period, salt production in Italy, except on the Island of Sicily, has been under government control. The salt works or salt farms are either leased to private companies or administered by the State through the minister of Finance. 

On the Island of Sicily sea salt has been made near Trapani since 1807. Today this sea salt is produced in evaporating pans about ninety feet square and some fifteen inches deep. The sea water is brought in to the pans by means of windmills or pumps. The salt is harvested some three to five times a year though the season must close with the start of the fall rains. Much of the salt is used locally but it is also shipped to Scandinavia, Finland, and North America where it is used principally for salting fish. The production of salt in Sicily has usually been a profitable occupation in spite of a government tax on the profits made from the production of salt and an export tax on each ton. Production of salt near Trapani suffered considerably during World War II for early in 1942 bombing of the salt works was carried out by the allied nations.

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12 Ibid., p. 227.

13 Ibid., p. 228.
in order to stop production of this important commodity.¹⁴

Separate figures for recent production in Italy and Sicily are not available, but combined figures are obtainable. Recent production in these two salt producing sections is given in Table III.¹⁵ It will be noted that from 1932 to 1941 the production in Italy and her colonies (principally East Africa and Libya), including Sicily, ranged from about one million to one and a half million metric tons a year.¹⁶ More than half of this production was sea salt. The rest of the production consisted of rock salt and a small amount of salt from brine springs. The total production in Italy in recent years does not come up to that in pre-war years, and a large part of the loss is the result of the loss of the African colonies. In 1940, when the total production in Italy, including colonies, reached a total of 1,421,159 metric tons, the exports from Italy and her colonies were large enough to put the Italian Empire third among the World exporters.¹⁷ Italy proper exported some 156,000 tons but the colonies exceeded that amount.

One reason why Italian salt is able to enter world markets in price competition with salt produced under more modern conditions is that much of the salt shipped from Italy leaves as ballast. Salt being carried by


¹⁵NOTE: All production figures for European countries are given in metric tons while figures for the United States are in short tons. It might be pointed out that a metric ton is equal to 2,204.6 pounds. A long ton, used mainly in England, has 2,240 pounds, while a short ton, used in America and Canada, has 2,000 pounds. Metric tons and long tons are roughly equivalent.


¹⁷Loc. cit.
ships to provide stability for what would otherwise be an empty vessel
moves for a very low rate. Salt imported to the eastern seaboard, es-
particularly before World War II, is able to compete with American produced
salt because of the high cost of transportation borne by American salt
shipped by rail. (New England does not contain any salt deposits and
must import salt from other sections of the United States or abroad.)

TABLE III
SALT PRODUCTION IN ITALY AND SICILY18
(in metric tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>Rock Salt</th>
<th>Other Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1943</td>
<td>559,000 a</td>
<td></td>
</tr>
<tr>
<td>1947</td>
<td>584,794</td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>708,586</td>
<td></td>
</tr>
<tr>
<td>1945</td>
<td>153,256</td>
<td>995,103</td>
</tr>
<tr>
<td>1944</td>
<td>32,511</td>
<td>450,367</td>
</tr>
<tr>
<td>1943</td>
<td>468,027</td>
<td>401,859</td>
</tr>
<tr>
<td>1942</td>
<td>not available</td>
<td></td>
</tr>
<tr>
<td>1941</td>
<td>720,510</td>
<td>756,134</td>
</tr>
<tr>
<td>1940</td>
<td>685,295</td>
<td>735,884</td>
</tr>
<tr>
<td>1939</td>
<td>682,589</td>
<td>682,519</td>
</tr>
<tr>
<td>1938</td>
<td>613,870</td>
<td>836,205</td>
</tr>
<tr>
<td>1928</td>
<td>67,870</td>
<td>836,801</td>
</tr>
<tr>
<td>a. estimated</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The history of salt production in England, the leader among western
European countries in the production of salt, dates back to the time of
the Roman occupation. The Romans made salt in several different locations
in England, among which the most important were Worcestershire, Cheshire,
Woolwich, Norwich, and Sandwich. The last three locations received the
suffix "wich" because the towns were located at or near salt springs, or

18 Compiled from The Minerals Yearbook, United States Department of the Interior.
"licks" as they are known in the United States. The scarcity of salt during the Roman period of rule over England so enhanced the value of salt that the Romans paid their soldiers partly in salt and partly in specie. This method of payment is said to account for the origin of the modern word "salary" which came from the Latin *salaria* (salt).

The records regarding actual production of salt in England date back as early as 816 A.D. when the existence of a salt furnace at Worcester is recorded. It is likely that the furnace had been in existence for some time prior to the above date for salt springs had been known to exist in that area for some time. In the Doomsday Book, which was compiled in 1086, in the reign of William the Conqueror, there is a record of salt works at Nantwich, Middlewich, and Northwich.

In more modern times the salt obtained in England has been secured from natural brines and from rock salt deposits. The natural brines are apparently the direct product of the leaching of the rock salt beds. Natural brine is used for making salt in Chester and Worcester and brine artificially made from rock salt is used in the Tees Field in South Durham and Yorkshire and Antrim County, Ireland.

In the Cheshire salt territory two beds of salt are utilized, though the upper bed is not very satisfactory and has been about aban-

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20 Harris, *op. cit.*, p. 226.
21 Ibid., p. 193.
22 Ibid., p. 218.
23 Ibid., p. 189.
domed. The upper bed of salt was discovered in 1670 and is about 120 to 210 feet below the surface of the ground. The second salt bed lies below the first and is from 240 to 300 feet below the surface of the earth. These two beds of salt lie in the area around Winsford and Northwich and in these two cities is concentrated the salt industry for that section of England. The lower bed is some 105 feet thick at Northwich and somewhat thicker near Winsford. 24

The salt in this area is primarily made by the evaporation of brine, though some of the salt is mined in the form of rock salt. The salt secured in the form of brine is naturally produced by the leaching of water which seeps through faults and fissures in the marl covering the upper bed of salt. When the use of the brine first started, shafts were sunk to the level of the salt stock and the pressure of the brine solution was great enough to cause the solution to rise as much as 150 feet above the surface of the salt stock. Today, of course, it does not rise above the salt stock but rather stands below the level of the bed. 25

The Tees Field in South Durham was discovered in 1662 when the drillers of a well bored to supply water for an iron works at Middleberrough located a bed of rock salt 100 feet thick. This bed was some 1,205 feet below the surface of the earth, and the depth prevented the mining of this bed of salt. 26 Sometime after 1874 two wells were sunk into the salt stock, and concentric pipes were sent down into

24 Harris, op. cit., p. 190.
25 Ibid., p. 191.
26 Ibid., p. 195.
the salt stock. Since that time this bed has been worked by the use of the artificial brine method. It was at this location that the artificial brine method of securing salt from the earth was introduced into England from Nancy, France, where such a production method had been in use for some time.27

For at least the entire first half of the twentieth century England has stood in second place, behind the United States, in the production of salt in all forms. In this century the development of the English alkali industry has aided in keeping England in second place in the production of salt. Though the salt deposits of England do not compare in size, number, or area with those of the United States, they have been large enough to supply the needs of the various salt using industries in the British Isles. There is no danger that England will ever increase her salt producing industry to the point where it will compete in any fashion with the salt industry of the United States, for England does not have enough salt reserves to make such a possibility a reality. Even though England does stand in second place, it is a relatively poor second place in so far as the total amount of production is concerned. Whereas the production in the United States is running above 15,000,000 tons, the production in England is below 4,000,000 tons. The total salt production for England and Northern Ireland for recent years is given in Table IV.

France is one of the important sea salt producing nations of Europe though she has some deposits of natural rock salt. The major sea salt works are found along the shores of the Bay of Biscay. There are several

27 Harris, op. cit., p. 195.
regions within France where varying amounts of rock salt are found. In Lorraine, for example, the rock salt mines date back to the Roman occupation. Near Marsal, which is a little east of Dieuze, there are ruins which show that mining was carried on there by the Romans on quite a large scale. 28 In the eastern section of France are located the salt mines found in the Jura mountains, which mines produce a very pure and white salt. Still another region of salt production is found in the southwestern section in the Pyrenees mountains. The salt from this region is grayish or reddish in color and has a very decided fragrance of violets. 29 In spite of this fragrance the salt has a finer flavor than the salt from the eastern region.

TABLE IV

<table>
<thead>
<tr>
<th>Year</th>
<th>England</th>
<th>Ireland</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rock Salt</td>
<td>Other Salt</td>
</tr>
<tr>
<td>1948</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>1947</td>
<td>40,359</td>
<td>5,148,639</td>
</tr>
<tr>
<td>1946</td>
<td>20,619</td>
<td>5,386,540</td>
</tr>
<tr>
<td>1945</td>
<td>17,062</td>
<td>5,268,083</td>
</tr>
<tr>
<td>1944</td>
<td>17,771</td>
<td>5,407,791</td>
</tr>
<tr>
<td>1943</td>
<td>21,514</td>
<td>5,406,017</td>
</tr>
<tr>
<td>1942</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>1941</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>1940</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>1939</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td>1938</td>
<td>19,974</td>
<td>2,651,989</td>
</tr>
<tr>
<td>1928</td>
<td>24,254</td>
<td>1,928,576</td>
</tr>
</tbody>
</table>

28Harris, op. cit., p. 226.

29Ibid., p. 158.

30Compiled from The Minerals Yearbook, United States Department of the Interior.
The relatively few locations of salt in France made the industry one that could be easily subjected to regulation by the government. The need for revenue by the general government focused attention on the possibility of obtaining revenue from a tax on salt. The fact that salt had become a necessity of life and it was thought that the burden of such a tax would be borne by the consumers without too much complaining led the government of France to impose on it a consumption tax. One of the most famous of these early taxes was the one levied by the French in the 14th century, called the gabelle.\(^{31}\) This tax was first introduced by Philippe VI, in 1340, when he placed the production and sale of salt under the control of the royal treasury. When the revenue did not reach the expected sum because of economy in the use of salt by the peasants, the government issued an order directing the people of France to purchase a certain quantity per capita, not only for themselves but for each of their children. For some five centuries this tax was one of the most hated revenue measures used in France and when under Henri II it was illegally increased, the people finally refused to buy the salt at the government warehouses. Rioting resulted and a number of massacres occurred at various points throughout France. Louis XVI, in an attempt to gain some popular favor, repealed the tax, but the First Empire restored it and increased the tax to $3.50 per one hundred pounds. This rate was reduced to $1.00 per hundred pounds, a figure which prevailed down into the twentieth century.\(^{32}\)

\(^{31}\)Harris, op. cit., p. 218.

\(^{32}\)Ibid., p. 193.
While the production in France does not match that of England, France does produce sufficient salt to satisfy the domestic market and provide the necessary raw material for the chemical industries using salt in the production of consumer or producers goods. Production of rock salt and salt from springs has run slightly over a million metric tens for each of the past several years. The most recent available figures on production in France are found in Table V.

<table>
<thead>
<tr>
<th>Year</th>
<th>Rock Salt and Salt From Springs</th>
<th>Other Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948</td>
<td>N. A.</td>
<td>N. A.</td>
</tr>
<tr>
<td>1947</td>
<td>1,095,112</td>
<td>N. A.</td>
</tr>
<tr>
<td>1946</td>
<td>1,514,470</td>
<td>476,750</td>
</tr>
<tr>
<td>1945</td>
<td>642,378</td>
<td>514,038</td>
</tr>
<tr>
<td>1944</td>
<td>546,323</td>
<td>410,506</td>
</tr>
<tr>
<td>1943</td>
<td>1,145,000</td>
<td>561,010</td>
</tr>
<tr>
<td>1942</td>
<td>N. A.</td>
<td>N. A.</td>
</tr>
<tr>
<td>1941</td>
<td>N. A.</td>
<td>N. A.</td>
</tr>
<tr>
<td>1940</td>
<td>N. A.</td>
<td>N. A.</td>
</tr>
<tr>
<td>1939</td>
<td>N. A.</td>
<td>N. A.</td>
</tr>
<tr>
<td>1938</td>
<td>1,560,000</td>
<td>548,000</td>
</tr>
<tr>
<td>1928</td>
<td>1,707,506</td>
<td>407,768</td>
</tr>
</tbody>
</table>

France, unlike some other European countries, would not be a source of a sufficient amount of salt production to give salt producers in other parts of the world any cause for alarm. The production in France will likely continue to supply local needs but there seems to be little likelihood that any supply of salt will be found or produced that would enable

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France to compete with the United States for any market.

To the east of France are found the mines of the former Austria-Hungarian Empire. In that section of the world is found one of the oldest salt mines still producing and, from all reports, the most beautiful mine in the world. This salt mine is located in Galicia, in the northwestern part of the Province, and is known as the Wielioska mine. The first historical mention of the mine is in the salt concessions granted in 1044 to the Benedictine Monastery at Tyniec by Kasimer. Salt from this mine has been quarried out so long that, according to the last available information regarding the workings, the mine now consists of eight levels, one above the other. The depth of the mine is some 984 feet and the lowest chamber is some 500 feet below the level of the sea.

On the working levels is found the grand ballroom complete with pillars, porticoes, galleries, and stupendous chandeliers which have been carved with patient care out of glistening salt. This ballroom was constructed early in the eighteenth century for state functions attended by the Austrian emperor. On the third level of the mine there are a complete railroad station and a restaurant carved out of salt. The some twenty-five miles of railroad line in the mine terminate at the station which acts as any normal station would in dispatching the cars to the various sections of the mine.

Occasionally some very pure crystal salt is found in the mine. In

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34 Harris, op. cit., p. 232.
36 Ibid., p. 235.
eldan days these pure crystals were always sent to the king of Poland, who gave the crystals as presents to the nobility or had them cut into ornaments for his palace. Other blocks of salt are so transparent that attempts have been made to have the salt cut into mirrors. 37

Though the areas of Austria and Hungary have been producing salt for a very long period of time, present day production is not outstanding in so far as the total amounts are concerned. This section of Europe produces enough salt to take care of domestic needs but not enough to support a large salt using industry. One possible reason for this lack of a large salt production is found in the fact that most of the salt production is not only a government monopoly but this industry has, in addition, been subjected to a rather heavy tax. The revenue needs of the government have forced it to seek out every means of raising money and the essential nature of the salt industry has cost it heavily in the form of taxation.

Recent production figures for Austria reveal a very low amount of production of rock salt and an increasing amount of dependence upon other types of salt. Most of the salt, other than rock, is actually mined in a special manner. This type of production is found in the Austrian Tyrol and dates back to very early times. In this method the miners detach heavy pieces of salt from the roof of the mines and when the floor of the chamber is covered, fresh water is introduced and the resulting brine is pumped to the surface where it is manufactured into the various types of salt. 38

37 Harris, op. cit., p. 234.
38 Ibid., p. 250.
Recent production figures for Austria will be found in Table VI. It will be noted that production in that section varies considerably from year to year. No reason has been found to account for the relatively large changes in total production. Of course some of the changes can be blamed on the recent war and its effects upon production of all types. Figures on salt production in Hungary are not available except for 1943, when a total production of 341,690 metric tons of salt in all forms was reported.  

<table>
<thead>
<tr>
<th>Year</th>
<th>Rock Salt</th>
<th>Other Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948</td>
<td>1,752</td>
<td>197,615</td>
</tr>
<tr>
<td>1947</td>
<td>4,348</td>
<td>183,764</td>
</tr>
<tr>
<td>1946</td>
<td>554</td>
<td>168,160</td>
</tr>
<tr>
<td>1945</td>
<td>N. A.</td>
<td>82,648</td>
</tr>
<tr>
<td>1944</td>
<td>3,600</td>
<td>247,414</td>
</tr>
<tr>
<td>1943</td>
<td>381</td>
<td>240,656</td>
</tr>
<tr>
<td>1942</td>
<td>421</td>
<td>104,280</td>
</tr>
<tr>
<td>1941</td>
<td>536</td>
<td>106,815</td>
</tr>
<tr>
<td>1940</td>
<td>1,017</td>
<td>106,815</td>
</tr>
<tr>
<td>1939</td>
<td>1,476</td>
<td>107,809</td>
</tr>
<tr>
<td>1938</td>
<td>788</td>
<td>95,576</td>
</tr>
<tr>
<td>1928</td>
<td>1,607</td>
<td>162,212</td>
</tr>
</tbody>
</table>

Rumania has not attracted the attention as a salt producer that some other countries in Europe have gained. However, Rumania, as is said, "ranks next to the Soviet Union in salt deposits in Europe." In 1948 it was reported that Rumania was planning to establish a number

40. Compiled from The Minerals Yearbook, United States Department of the Interior.
of chemical industries based on the available salt and the other types of chemical raw materials to be found in that country. In recent years the salt production in Rumania has placed that country high among the salt producers of Europe. For example, in 1938 the government monopoly consisting of nine mines (mostly mechanised) produced a total of 370,000 tons of salt, of which 290,000 tons were edible and 80,000 tons were classed as commercial. In that same year Rumania exported some 79,000 tons of salt. Bulgaria and Yugoslavia received some 58,000 tons of block salt, while Hungary received 21,000 tons of block, ground, and industrial salt.

In the Rumanian building at the World's Fair held in New York in 1939, the ceiling, as a novelty, was built out of blocks of rock salt mined in Rumania. These blocks were rough hewn and were placed in the ceiling just as they came from the mine. It is said that from the floor these blocks resembled polished marble. In order to prevent the salt from picking up moisture from the air and turning to brine, it was necessary to keep fans playing on the ceiling.

Recent salt production in Rumania, while not outstanding by United States standards, compares more than favorably with many European countries. Such recent production figures as are available are presented in Table VII.

Early salt production in Germany consisted entirely of salt pro-

43 The Minerals Yearbook for 1943, op. cit., p. 1523.
44 The Minerals Yearbook for 1940, op. cit., p. 1427.
duced from brine springs. The exact period of history when production of salt from these brine springs began is not known, though production was reported in very early times. Wars were fought between some of the early Germanic tribes for possession of these springs which the tribes considered sacred. Among the most productive of these brine springs were those of Stassfurt, east of the Harz mountains. These springs were very productive in the seventeenth and eighteenth centuries. They were closed down as a source of salt production with the discovery of rock salt deposits around the middle of the nineteenth century.

TABLE VII

SALT PRODUCTION IN RUMANIA

(in metric tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>Rock Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948</td>
<td>N. A.</td>
</tr>
<tr>
<td>1947</td>
<td>141,435</td>
</tr>
<tr>
<td>1946</td>
<td>745,000</td>
</tr>
<tr>
<td>1945</td>
<td>277,183</td>
</tr>
<tr>
<td>1944</td>
<td>154,090</td>
</tr>
<tr>
<td>1943</td>
<td>380,240</td>
</tr>
<tr>
<td>1942</td>
<td>N. A.</td>
</tr>
<tr>
<td>1941</td>
<td>N. A.</td>
</tr>
<tr>
<td>1940</td>
<td>N. A.</td>
</tr>
<tr>
<td>1939</td>
<td>N. A.</td>
</tr>
<tr>
<td>1938</td>
<td>370,000</td>
</tr>
<tr>
<td>1928</td>
<td>N. A.</td>
</tr>
</tbody>
</table>

In 1837 the Prussian government sponsored a series of experimental borings in Prussia in an attempt to find either a stronger brine or

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45 Harris, op. cit., p. 199.

46 Loc. cit.

47 Compiled from The Minerals Yearbook, United States Department of the Interior.
rock salt. The government was especially interested in new deposits for the twenty-two salines then being used were unable to supply the market demand for salt in Prussia. In the course of these borings a supply of rock salt was found in Thuringia, at Atern. Some two years later another series of borings were started in Stassfurt, and in 1845 the upper beds of the salt deposits were reached at a depth of 816 feet. The salt, instead of being pure sodium chloride as had been hoped, contained a high percentage of potassium and magnesium. The great value of the deposit was not realized at that time and the workings were abandoned as worthless.

A few years later a boring was made in the Duchy of Anhalt, near Stassfurt, and a bed of very pure salt was found beneath the potassium salts. The government then reopened the Stassfurt boring in 1851 and, by drilling deeper, found purer salt. Work was immediately begun on a shaft in order to mine the salt and the first shaft was completed that year. In mining the salt the really valuable potassium salts, which a little later became most valuable, were discarded and began to pile up around the mouth of the mine. These salts became known as Abraum or stripping salts, a name they still bear today. The size of the piles of discarded salts threatened to take over the territory around the mine and render it impossible to work the mine. By 1859 the mine was producing more salt than could be sold at a profit to the company. Threat-

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48 Harris, op. cit., p. 199.
49 Loc. cit.
50 Ibid., p. 200.
51 Loc. cit.
ened with an operating deficit, the mining superintendent began to in-
vestigate the possibilities of using the stripping salts, and in 1861
the first factory for the manufacturing of potassium chloride was started
at Stassfurt. The remarkable growth of the industry is shown by the
fact that just twelve years later there were thirty-two factories in opera-
tion in that section of the country. Thus the utilisation of what had
been a useless waste by-product became the main product simply because
of economic necessity; the necessity in this case being brought about by
the overproduction of the primary product, salt.

Though the potassium salt deposits of Germany are limited in area,
the rock salt deposits are not limited to any one section of the country.
The rock salt deposits extend over wide areas and are of vast thickness.
The German deposits extend north from the Harz mountains through Saxony,
Altmark, Mecklenburg, Brandenburg, and Posen, almost to the Russian
boundary at Inowraslaw; and west through Brunswick and southern Hanover
to the Weser River. In southern Germany the most important salt de-
posits are found in Wurttemberg along the Neckar and Neckar Rivers.

During recent years Germany has ranked second to Great Britain
among western European nations in the production of salt. It is not
possible to compare the production figures for the two countries for
any great number of recent years because figures are not available for
both countries for the same years. Then, too, there is some question as

52 Harris, op. cit., p. 201.
53 Loc. cit.
The production figures which are given for the years 1943 and 1944 for Germany. The figures for these two years are given by one source as "estimated production" and as "actual production" figures by another source. The two sets do not agree at all. The production figures given as "actual" for recent years are presented in Table VIII.

### Table VIII

**SALT PRODUCTION IN GERMANY**

<table>
<thead>
<tr>
<th>Year</th>
<th>Rock Salt</th>
<th>Other Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948</td>
<td>1,912,000 a</td>
<td></td>
</tr>
<tr>
<td>1947</td>
<td>1,751,000 a</td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>1,541,228</td>
<td></td>
</tr>
<tr>
<td>1945</td>
<td>N. A.</td>
<td>660,000 b</td>
</tr>
<tr>
<td>1944</td>
<td>3,620,000 b</td>
<td>500,000 b</td>
</tr>
<tr>
<td>1943</td>
<td>4,000,000 b</td>
<td>550,000 b</td>
</tr>
<tr>
<td>1942</td>
<td>4,126,584</td>
<td>569,393</td>
</tr>
<tr>
<td>1941</td>
<td>3,662,968</td>
<td>665,456</td>
</tr>
<tr>
<td>1940</td>
<td>3,397,962</td>
<td>690,715</td>
</tr>
<tr>
<td>1939</td>
<td>3,094,127</td>
<td>625,060</td>
</tr>
<tr>
<td>1938</td>
<td>2,694,984</td>
<td>585,326</td>
</tr>
<tr>
<td>1928</td>
<td>2,599,699</td>
<td>509,663</td>
</tr>
</tbody>
</table>

a. Biseman Area  
b. Estimated

The table reveals that during the period from 1939 to 1944 Germany averaged some 5,655,000 tons of rock salt and 604,000 tons of refined salt. In many years prior to 1940, Germany was the world's largest exporter of salt, but in 1940 she exported only 734,000 tons. It is worthy of note that in 1941 the German government established a compulsory national cartel composed of one rock salt and two evaporated

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54 Compiled from *The Minerals Yearbook*, United States Department of the Interior.  
associations. The formation of this cartel does not mean that there were only two evaporated salt companies operating in Germany. It means, of course, that the government forced all evaporating salt producers to join one cartel in order that the government could better control the production and sale of salt. Since salt enters into the production of so many essential war chemicals, it was only natural for a country at war to control its output. Cartels have been used in certain European countries for many years as competitive controlling agencies, especially when they deal in foreign trade.

An interesting use made of the salt mines of Germany, as well as a number of other European mines, was that made during the War as a place to store gold and art treasures. The salt prevented any moisture from getting on the paintings, etc., and preserved them perfectly.

Following the end of World War II, Germany was divided between the principal allied nations both for governmental purposes and for the operation of the various sections as economic units. After the division was accomplished, the principal salt operations in the United States Zone totaled ten; in the British Zone, twenty-eight; in the Russian Zone, twenty-three; and in the French Zone, six. The creation of the joint operation of a portion of Germany by the British, American and French governments has placed the majority of the German salt industry in one section. The Russian section does, however, have some of the larger salt mines because the eastern section of Germany contains the

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57 The Minerals Yearbook for 1946, op. cit., p. 1523.
largest single deposits of salt.

In the early history of the salt industry in Europe, Spain ranked high. However, the Spanish salt production declined so much that for a large portion of the nineteenth and early twentieth centuries little is known of the salt industry though Spain had, for many years ranked second in exports with her shipments averaging more than 500,000 tons. In Spain, however, salt is found in many places. Starting in the decade of the 1930's Spain began to try to reestablish its salt industry and regain its world markets, and in recent years an average of twenty provinces have contributed to the salt production of Spain.

The recent production of salt in Spain is easily surveyed by a presentation of a few series of averages for a number of years rather than utilizing a table. For example, from 1935 to 1942, Spain averaged 870,000 tons of salt a year. In 1943, there were twenty-nine mines in operation in Spain and they produced 266,226 tons of rock salt, while 115 plants producing evaporated salt produced 500,392 tons. In the period from 1938 to 1947, a period which overlaps the above mentioned period somewhat, Spain produced an average of about 500,000 tons of salt a year.

The salt deposits of Russia, the last European country to be discussed, are by far the largest in area, though they have not been as fully utilized as have the deposits of other European countries. The

salt secured in Russia comes from sea water, salines, salt lakes and rock salt deposits. In northern Russia and parts of Siberia the salt is obtained from sea water by a very unusual method. The sea water is subjected to a temperature some degrees below freezing. A portion of the solution freezes as pure water, and this portion is removed leaving a strong brine solution still in liquid form. This liquid is again subjected to the freezing process, which is continued until the maximum salinity is reached. It is then possible to secure salt by applying a small amount of heat to the brine liquid in order to bring about evaporation of the remaining water. Salt manufactured in this manner is always impure and often dangerous to use because of the impurities. It is also difficult to keep because of the deliquescent character of the salt produced by this method.

The great salt wealth of Russia lies in the southeastern and southern parts of the nation, in the provinces of Orenberg and Astrakhan and the Donets Valley at Bakhmut.

In Astrakhan, in Russia, there are some 1,200 salt swamps and 700 salt lakes. It is said that the salinity of this region is so great that a salt dew falls. Of these salt lakes, Elton Lake is the largest; the entire bed of this lake is covered by a salt deposit of unknown depth. In a period of 160 years more than 9,000,000 tons of salt have been taken from this lake without making any apparent impression on the supply of salt. Near the beginning of the twentieth century, Lake Baskuntschak

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61 Harris, op. cit., p. 243.
62 Ibid., p. 244.
63 Loc. cit.
has become more important as a source of salt that Elton Lake because the former lake is connected with the Volga River by a canal. The bed of Lake Baskuntschak is dry, except in spring, and the salt is mined by quarrying. There are three salt beds under this lake and they have a total depth of 177 feet. The salt from this region is used chiefly in the Volga and Caspian Sea fisheries.

In the Province of Orenberg, one of the largest salt deposits in the world is located at Iletskaia-Zachita, forty miles south of the city of Orenberg. This deposit is very near the Asiatic boundary of Russia. The area of this particular salt deposit has been estimated at one square mile, though the exact depth of the salt is not known; it became necessary to step boring at a depth of about 500 feet because of the extreme hardness of the salt. The salt to that depth was pure, though there were some layers of very thin beds of gypsum and red clay separating the salt layers. To mine this salt the Russians have simply scraped away the top layer of soil to reach the salt. The salt is then marked out like ice for cutting, cut, ground, and used. It has been estimated that this deposit contains more than 150,000,000 tons of salt.

There are also large deposits of salt to be found in the Asiatic section of Russia. A large part of the salt found in that section is derived from salt lakes and the Provinces of Omsk, and the Transcaesian district are especially rich in these salt lakes. There are rock salt deposits in central Asia and in the Province of Yakutsk which might

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64 Harris, op. cit., p. 245.
65 Loc. cit.
66 Loc. cit.
furnish a large amount of salt, but they are still too distant from the principal using centers to compete in the production of salt.

As far as can be ascertained, Russia has put out no recent figures on salt production. Figures are available for a few years during the 1930's and these are presented in Table IX. It will be noted that Russian production compared, in that period of time, very favorably with other large salt producers of western Europe. Although no production figures are available, it is believed that the Russian salt industry has made a quick recovery from the effects of the War. It is known that geologists have resumed the prospecting of the Davidevsky salt deposits begun before World War II. The mine at Artemovsk, in the Donets Basin, said to be the largest mine in the U. S. S. R., has been dewatered. The mine is being mechanised and it is believed that it will have an annual output of 1,500,000 tons.

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1935</td>
<td>4,349,500</td>
</tr>
<tr>
<td>1934</td>
<td>3,644,000</td>
</tr>
<tr>
<td>1933</td>
<td>2,734,000</td>
</tr>
<tr>
<td>1932</td>
<td>2,636,400</td>
</tr>
<tr>
<td>1931</td>
<td>N. A.</td>
</tr>
<tr>
<td>1930</td>
<td>3,432,000</td>
</tr>
<tr>
<td>1929</td>
<td>2,548,106</td>
</tr>
</tbody>
</table>

68Loc. cit.
69Compiled from The Minerals Yearbook, United States Department of the Interior.
It has not been considered necessary to discuss all of the salt producing countries of Europe for production methods are about the same in the other producing countries. The remaining salt producers in Europe do not produce sufficient salt to alter the world pattern of production or use. In 1946, the following countries in Europe reported some salt production: Austria, Bulgaria, Czechoslovakia, France, Germany, Greece, Hungary, Italy, Malta, Netherlands, Poland, Rumania, Spain, Switzerland, and Great Britain. 70

The salt producing facilities of Europe have been developed, in most instances, more completely than in other sections of the world. There are, however, other areas where salt is known to exist in large quantities. In some of these areas production is already underway. In other areas, the resource pattern must change before development can begin. Some of these present and potential producers will now be considered.

South America contains several countries with varying amounts of salt in different forms, but as yet no great developments have taken place in salt production. Brasil contains a considerable quantity of salt and is utilizing it for an expanding alkali industry as well as an increasing number of chemical industries using salt as a raw material. 71 Chile has salt reserves within the country and could, if necessary, utilize sea water as a source of salt. In Chile the salt is being used to supply the domestic needs of the country and the metallurgy industries. Chile is also trying to start a chemical industry within the country. 72

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70 The Minerals Yearbook for 1945, op. cit., p. 1522.
71 Loc. cit.
Chile has a number of chemical using industries though the markets for such products are not too well developed, and the mountains cut her off from the larger markets of eastern South America. Colombia contains salt deposits of all types, but salt has been produced primarily for local use with small amounts being exported. The pattern of local utilization, human and animal, is being rapidly changed in Colombia. In November, 1961, the first big soda ash plant in South America was put into operation near Bogota, Colombia. This plant was constructed by the H. X. Ferguson Company, of Cleveland, Ohio, at a cost of some $10,000,000. The output of the plant is expected to be 52,000 tons of soda ash, caustic soda, and sodium bicarbonate annually. Colombians are expected to profit in still another way from this industrial expansion. The plant is expected to save Colombians about $2,000,000 a year in foreign exchange. This sum will then be free for the purchase of other commodities for the further development of the country.

Ecuador contains salt and produces enough for local use as well as providing some salt for the export trade. Salt production in Ecuador is under government control. In Peru are found rock salt deposits, and in that country sea salt is also produced for local use. Venezuela has salt mines and could develop a larger export trade. A small amount is currently being exported from that country. Most of the production

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73 Loc. cit.
74 Business Week, November 10, 1961, p. 166.
75 The Minerals Yearbook for 1946, op. cit., p. 1523.
76 Loc. cit.
Southwest of South America are found two well-developed commercial and industrial nations, Australia and New Zealand. In the latter country, there is no salt except that which is contained in some of the mineral springs and, of course, the salt obtainable from the ocean. The dairy industry uses a considerable quantity of salt, and it is necessary to import salt to take care of the needs of the country. Most of the salt imported into New Zealand comes from England with smaller quantities coming from the United States. Formerly Germany supplied a portion of the needs of New Zealand, but the shipments stopped with the War. It is possible that the shipments might start again, especially from the Allied section of Germany.

In Australia geologists have looked for deposits of rock salt, but have, as yet, not been able to locate such deposits. The western interior of Australia is occupied by the Great Sandy Desert, in which there are a large number of salt lakes and marshes. In the area not far from the southern coast are found a number of similar lakes. The lakes in the interior, in most instances, contain bitter salts in addition to sodium chloride and as a rule no attempt is made to refine it. The lakes in South Australia do not contain the bitter salts, and a large salt industry has been built up in that section. Most of the salt in that section is manufactured by solar evaporation, both in South

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77 The Minerals Yearbook for 1945, op. cit., p. 1523.
78 Harris, op. cit., p. 517.
80 Harris, op. cit., p. 315.
Australia and Victoria. The salt works in South Australia are located at Port Adelaide and on York Peninsula.

The salt manufacturing plants in Australia are not able to supply all of the salt needs for that country and salt must be imported. As might be expected, most of the salt imported into Australia comes from England. Before World War II small quantities of salt were sent to Australia from Germany. With Germany able to produce more salt than she needs, it might be possible to increase present German production by the development of the markets in Australia. Of course, to do so would, or might, cut into the economic plans of England to keep Empire money at home.

Northwest of Australia is located another large salt producing nation, India. India has been producing in excess of a million tens of salt a year for a number of years. Though the percentages vary from year to year, it has been found that of the salt produced in India about six per cent is made from sea water on the coast, eleven per cent from rock salt and the rest principally from the brine in salt lakes and springs.

The salt made from sea water is manufactured in the presidencies of Bombay and Madras and to a lesser extent in Bengal and Burma. The salt produced from brine is produced in the Rajputana Agency, Bombay Presidency, in Burma and to a lesser extent in the Punjab and Kashmir.

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82. Harris, op. cit., p. 316.
83. Ibid., p. 284.
84. Ibid., p. 270.
The eastern section of India, Assam, contains rich brine springs in the interior section, but these springs have not been worked for some time.

The rock salt found in India occurs in two regions in the north-western corner of the Punjab. Some of the salt deposits are worked by quarrying, others by drift mining. The Maye Mines, located in the Salt Range, at Bura, are among the most important of the mines in India. The salt is pink in color, though the color does not seem to have any effect upon the taste or utility of the salt for domestic or commercial use. A conservative estimate of the quantity of salt available in this Salt Range places the amount at ten cubic miles. It is safe to say, therefore, that the supply for all practical purposes is inexhaustible.

With her various sources of salt and production running over a million tons per year, India is ranked as one of the large producing countries of the world. For that reason the recent production figures for India are given in Table X. The figures are for a united India. Just what effect the recent division of India will have upon the technological development of the salt industry is impossible to tell. Competition between sections could lead to rapid development or bring a form of chaos. India's position in the industrial world of the future must await the future for an answer. A portion of the answer is being sought

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85 Harris, op. cit., p. 265.
86 Ibid., p. 268.
87 Loc. cit.
at the present time by the Indian government in its announced plans for increasing the salt production of the country. The government is trying to increase the sea salt production in an attempt to contribute to the expansion of the chemical industries. However, it is said that the price of salt in India will have to decline before it will be possible to establish an alkali industry. Production of salt from the works in the Khatiawer area is also being pushed to add to the increases in other sections.

### TABLE I

**SALT PRODUCTION IN INDIA**

<table>
<thead>
<tr>
<th>Year</th>
<th>Rock Salt</th>
<th>Other Salt</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948</td>
<td>2,377,951</td>
<td></td>
</tr>
<tr>
<td>1947</td>
<td>1,560,471</td>
<td></td>
</tr>
<tr>
<td>1946</td>
<td>226,447</td>
<td>1,948,894</td>
</tr>
<tr>
<td>1945</td>
<td>256,366</td>
<td>1,974,788</td>
</tr>
<tr>
<td>1944</td>
<td>233,333</td>
<td>1,661,351</td>
</tr>
<tr>
<td>1943</td>
<td>332,843</td>
<td>1,624,976</td>
</tr>
<tr>
<td>1942</td>
<td>219,481</td>
<td>1,702,845</td>
</tr>
<tr>
<td>1941</td>
<td>195,890</td>
<td>1,611,640</td>
</tr>
<tr>
<td>1940</td>
<td>207,284</td>
<td>1,484,648</td>
</tr>
<tr>
<td>1939</td>
<td>196,503</td>
<td>1,322,544</td>
</tr>
<tr>
<td>1938</td>
<td>191,395</td>
<td>1,372,971</td>
</tr>
</tbody>
</table>

Another nation classed as a large producer of salt is China. The salt manufactured in China is produced from sea water on the coast and from brines. The brine is obtained from springs and deep wells. The sea salt is made in all of the coastal provinces of China, but especially in Fukien.

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90 Compiled from The Minerals Yearbook, United States Department of the Interior.

91 Harris, op. cit., p. 257.
Shantung, and Pechili. In the southern part of China proper the brine is obtained from deep wells in the Provinces of Ss-chuan and Yunnan. The salt obtained from the Ss-chuan wells is a hard dirty looking mass when taken from the pans, but the Chinese are proud of the product and assert that its salting power is greater than that of the white, foreign salt. 92

Though the figures are not available for recent years, it is believed that the salt situation in China was greatly disrupted by the series of wars which have swept over and around that nation. The output of China is believed to be much less than the average of 260,000 tons produced in the period from 1940 to 1942. 93

Across a narrow body of water from China lies the last nation to be discussed as a salt producer, Japan. The mainland of Japan has, as far as is known, no deposits of rock salt, and at the present time the only source of salt is from sea water. 94 There are a few brine springs located at various places in the Islands, but the amounts produced are too small to be counted in production figures.

In the production of sea salt, the same method is generally used in the salt farms. That is, the floor of the saltern is perfectly level and covered with a thick bed of coarse sand which is kept loose by frequent rakings. The sand is irrigated with sea water which is led into the saltern through narrow ditches. When the floor is covered with water the source is shut off and the impounded water is allowed to

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92 Harris, op. cit., p. 258.
evaporate. The process is repeated until the sand has become saturated with salt. The sand is then put into filters and sea water is poured through, and the resulting brine is evaporated in pans over fires. The salt made by this method is grayish in color and contains eight to twelve per cent water and only eighty to ninety per cent sodium chloride. Both the Japanese and the Chinese salt is very inferior to the sea salt produced in Europe.

In some areas of Japan the sea salt is made by the same method followed in the United States. The sea water is led into enclosed basins and allowed to evaporate, leaving salt crystals on the floor. The salt is then raked up, and it is usually evaporated before being used.

Following the end of World War II the Japanese salt industry could not supply enough salt to take care of the domestic needs of that country. In 1946 production was approximately 9,000 tons a year of common salt as compared with 55,000 tons in 1939. The need for salt was so desperate, particularly for salting fish, that the Japanese converted several ferro-alloy plants from their normal function to that of producing salt for domestic consumption and fish salting. The increase in salt production was achieved by placing sea water in wooden tanks situated in open furnaces and evaporating the water by lowering electrodes into the tanks. It was known that this method was not only crude but also very wasteful of electric power. However, it seemed to be the only

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95 Harris, op. cit., p. 255.
solution possible under the conditions then prevailing in Japan. Estimates indicate that approximately twenty per cent of all salt recovered in Japan by evaporating sea water is in the Heroult-type electric furnace.

Production of all types of salt in Japan has varied considerably during recent years though at the present time the production seems to be on the upgrade. Some importation of salt from other countries, including the United States, has been allowed by the military authorities in an attempt to aid the people in securing necessary salt supplies. It is expected that the Japanese people will soon be able to supply their own needs and perhaps return to a surplus production position similar to that occupied by the nation prior to the last War. Recent production figures for Japan are given in Table XI.

**TABLE XI**

**SALT PRODUCTION IN JAPAN**

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1946</td>
<td>318,979</td>
</tr>
<tr>
<td>1947</td>
<td>247,456</td>
</tr>
<tr>
<td>1946</td>
<td>258,946</td>
</tr>
<tr>
<td>1945</td>
<td>193,845</td>
</tr>
<tr>
<td>1944</td>
<td>355,153</td>
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<td>1943</td>
<td>415,442</td>
</tr>
<tr>
<td>1942</td>
<td>475,418</td>
</tr>
<tr>
<td>1941</td>
<td>389,441</td>
</tr>
<tr>
<td>1940</td>
<td>573,581</td>
</tr>
<tr>
<td>1939</td>
<td>636,382</td>
</tr>
</tbody>
</table>


99 Compiled from *The Minerals Yearbook, United States Department of the Interior.*
From the foregoing discussion of salt production throughout the world it is evident that some areas of the world do not have sufficient salt to take care of domestic needs. It has been shown that supplies of rock salt are limited to certain areas of the world, principally Europe, Asia and North America. There are, to be sure, rock salt deposits in some other areas, but they either have not been developed or cannot be developed under present economic conditions. Chapter II indicated that the chemical development of any country is, in many respects, tied up with certain raw materials derived from salt or salt itself. Therefore, the development of many portions of the industrial organization of certain countries will be held back by a lack of salt.

Various authors in attempting to explain the development or lack of development of nations have pointed to certain economic aspects as the force or forces aiding or hindering development. Some maintain that a successful nation must have a well-rounded agricultural base while others point to the necessity of iron and steel. Such foundations are important, yet nations have advanced without such industries. Progress is easier with all prerequisites satisfied, but progress may be achieved by technological improvements utilizing such materials as are available. Any attempt to single out one resource as the motivation of industrialization and/or progress is an indication of a failing to recognize the complexity of modern economic systems. However, for a nation to become an industrial power all essential prerequisites must be satisfied either by developments within the political boundaries or by importation of the required materials. The military necessity for a self-sustaining industrial economy has required that nations seek that industrial development
which brings national power.

Salt, accepted as naturally as rain, is an essential prerequisite to political and economic development of nations. Its basic function in the diet of man places salt in the vanguard of essential elements. A survey of the multitudinous uses made of salt in industrial circles enhances the position of this material in the list of essential industrial raw materials.

Though no special attention has been given to the military or strategic importance of salt in the previous discussion, it should be kept in mind that salt plays an important part in military development. The importance is not so much for the direct human consumption of salt as it is the indirect utilization in the industrial plants of nations. In many of the industrial plants products produced from salt are used as the basis for production of items of military necessity. Being found in sufficient quantities in most highly industrialised nations, it has not been necessary in most instances to place the salt industry under special controls. The lack of such controls does not deny the strategic importance of salt, but does tend to cause salt to be overlooked as a raw material of strategic importance.

The essential nature of salt, both human and industrial, has resulted in most of the countries of Europe keeping or placing salt under some type of government regulation. Complete information regarding the present extent of regulation is unavailable. However, with the exception of England, the major countries of Europe have placed their salt industry in some sort of special category. In all cases, salt has been the object of special taxes designed to raise revenue for the governments. In other
cases the salt industry has been made into a government monopoly with either government ownership and operation of the mines or private operation under government supervision and control. These government controls do not seem to have been introduced in order to protect the strategic importance of salt. Rather, the controls seem to have been set up to increase the revenues of the government. Governments in need of additional revenues often hunt a source which can be depended upon to yield a fairly constant amount of revenue. A commodity with an inelastic demand will yield such a revenue, as will a commodity which does not have a readily available substitute. The human consumption of salt is relatively inelastic, and the industrial users of salt, in most instances, do not have an available substitute. Therefore, a tax on salt will yield a relatively constant sum. The necessary character of the human consumption also makes it impossible for users to postpone purchases or cut down much on consumption. While there are likely to be objections to the levying of such a tax, the well-to-do are not going to do much complaining. The salt tax is similar to the poll tax in that everyone has to pay it. Such a tax as the salt tax is not based upon ability to pay but on purchases of salt. The purchases of salt by rich and poor alike amount to about the same monetary figure each year, but in proportion to income the poor pay a larger percentage than do the rich. Regardless of the cause or causes of the governmental controls placed on salt, such controls have, of course, fostered the development of the industry and thereby made the products of the salt industry available for such uses as might be directed by industry or the government acting for industry in the fostering of some type of industrial development.
In the countries presented in this discussion of world salt production it was noted that the first use made of salt was for the satisfaction of the human and animal needs. Then, if a surplus remained, industrial utilization became possible. Industrial nations possessing a local supply of salt frequently overlook its importance; nations such as Japan, seek by technology, conquest, or importation to secure this necessary raw material. Had salt not been available, it is possible that technological ingenuity would have developed some other material to perform the task done by salt. The existence of salt plus technology made progress easier and possibly faster.

In the major industrial nations of the world, salt has aided economic progress. Those nations lacking in salt have been forced to seek substitutes, difficult if not impossible in certain instances, or import the salt. A nation failing to secure the salt required by industry will find a rounded industrial system difficult to obtain or maintain. Referring once again to the nations presented in this chapter, it will be noted that the top present day industrial nations have access to adequate supplies of salt. Those industrial nations lacking such supplies of salt have been forced to import the necessary supplies. Other nations, not yet industrialized, may find the path to industrialization easier if adequate supplies of salt are found within the political boundaries of the nation.

Many of the nations currently attempting to become industrialized along chemical lines must import the salt or the products made from the salt if the chemical industries are to develop. In Japan, New Zealand, and Australia there are shortages of salt which make it necessary for those countries to import salt for domestic use. It is also true that
Japan and Australia have industries in the country which require salt or products made from salt. These countries are trying to increase their salt producing capacity but most of the increase must come from sea salt. It might well be that the position of the United States in the salt expert trade could be improved by increasing the exports of salt to these countries. The economic profitability of such an increase might be enhanced by the geographic location of this nation. The United States is closer to the nations needing salt than other present day exporters of salt.

At the present time the United States is responsible for between one-third and one-half of all the salt produced in the world. It is impossible to secure accurate figures on the world production, but estimates are available and a comparison can be made. It must be borne in mind that any comparisons are in the nature of estimates and are not exact. Table XII presents a comparison of world salt production and United States total production for recent years.

**TABLE XII**

**UNITED STATES AND WORLD SALT PRODUCTION COMPARED**

<table>
<thead>
<tr>
<th>Year</th>
<th>United States</th>
<th>World (estimate)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1948</td>
<td>16,403,293</td>
<td>42,488,000</td>
</tr>
<tr>
<td>1947</td>
<td>16,055,885</td>
<td>38,761,000</td>
</tr>
<tr>
<td>1946</td>
<td>15,132,145</td>
<td>38,355,000</td>
</tr>
<tr>
<td>1945</td>
<td>15,394,141</td>
<td>34,984,000</td>
</tr>
<tr>
<td>1944</td>
<td>15,717,171</td>
<td>37,847,000</td>
</tr>
<tr>
<td>1943</td>
<td>15,214,162</td>
<td>41,188,000</td>
</tr>
</tbody>
</table>

A study of these figures and a comparison of the production figures for the United States with the figures of production in the principal

100 Compiled from *The Minerals Yearbook*, United States Department of the Interior.
salt producing countries of the world indicates the large lead which
this nation enjoys over other salt producers. It also indicates something
of the importance of the chemical industry in the United States for, as
has been shown, the chemical industry uses the majority of the salt pro-
duced in this nation. Along such lines, it would be difficult for most
nations to approach the position of the United States. There are only
a few countries with the necessary resources of salt to permit the de-
velopment of chemical industries of the size operating here. With the
known salt reserves of the United States it would be possible to increase
production far above present rates and still have no fear of exhausting
the salt reserves of the country. The export trade could be expanded
considerably with no harm done to domestic consumption or trade in salt.
Louisiana's location on the Gulf coast might be utilized to advantage
in the development of foreign salt sales, provided the opportunity is
made or presents itself.

Increased foreign trade in salt will not develop merely because
the United States has the surplus salt. There must exist an economic
need in other countries great enough so that it will become profitable
to export the salt from the United States before such trade will develop.
Increased population and certainly increased chemical industrialization
may bring that possibility into the realm of reality. One difficulty
that must be overcome in any such development is the high relative cost
of shipping salt. One of the factors hindering the movement of salt,
not only within the country but also from this country to others, is this
high cost of transportation in relation to the value of the salt. If a
solution to that problem can be found the export-import trade in salt
might be expected to increase.

Having surveyed the world situation in regard to salt and the relation that exists between world production and United States' production, attention will now be directed to a study of the development of salt production in the United States.
CHAPTER V

SALT PRODUCTION IN THE UNITED STATES

Historically, as has been mentioned, the first salt production in the United States began in 1720, along the Atlantic Coast by sea water being evaporated in open pans or ponds by solar energy. The demand for salt by the American colonists, both for home use and salting down meat and fish, resulted in more salt being produced. Discovery of inland brine springs in New York, Pennsylvania, and West Virginia, moved the center of the salt industry from the coastal areas to these new areas where natural salt brine could be obtained. As the use of artificial heat, applied under the evaporating pans or kettles, replaced solar energy the production of salt increased. The low salt content of the brine springs, as well as the smallness of the flow, led to the drilling of brine wells. Such wells became quite numerous in several of the eastern states, particularly in New York, West Virginia, and Pennsylvania, where later salt production developed into a large-scale industry.

The majority of such brine wells were shallow, since the salt was found relatively near the surface. The average depths of such wells was usually less than seventy feet. Drillers hesitated to go much deeper because it had been found that the salt usually overlay oil for which little use had been found. Several intended salt brine wells had to be abandoned when the drill stem struck oil which destroyed the usefulness of the brine. In some cases natural gas packets were discovered below or near the bottom of the salt stock. These gas wells were usually abandoned because the gas was not valuable enough to justify the cost of making it
available for use. However, some instances have been found where such
flows of gas were put to work in the salt plants. This use was perhaps
the first industrial use of natural gas in manufacturing. Mr. William
Tompkins, in 1841, used natural gas to heat his salt furnace. The gas
was encountered while boring for salt. The gas pressure was strong enough
to force the brine mixture out of the earth into a reservoir from which
it could be distributed to the furnace. Determined to put the gas to a
useful purpose in his Kanawha Valley of West Virginia salt works, Mr.
Tompkins "extemporised a gasometer from a hogshead placed over the
reservoir" into which the gas and brine mixture had been forced by the
pressure of the gas. The gas was taken from the hogshead by means of a
pipe which led to the mouth of his furnace, "a 'salt block' 100 feet
by 6 deep by 4 wide."

Natural brine springs and wells continued to supply the majority
of the salt needs of the United States until the discovery of rock salt
which brought with it a changed resource pattern. The first bed of rock
salt used was discovered in 1862, on Avery Island, in Louisiana. The
existence of salt beds had been known or suspected by geologists for many
years but no incentive had been present to push the development of the
utilization of such deposits. Increasing demand provided an incentive and

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1 Mineral Resources of the United States, 1886 (Government Printing

2 Ibid., p. 171.

3 Loc. cit.

4 The Mineral Industry, its Statistics, Technology and Trade, 1892,
the second discovery of rock salt was made June 20, 1878, in Wyoming County, New York. A company engaged in drilling for petroleum struck salt at a depth of 1270 feet. This bed of rock salt, seventy feet thick, was mined by the use of four shafts sunk into the salt stock. Discoveries of other rock salt deposits followed rapidly in various sections of the United States so that by 1895, rock salt was being mined in the Warsaw district of New York, in the Hutchinson district of Kansas, at the Avery Island mine in Louisiana, in Utah and in California. In total there were nineteen mines reporting production of rock salt in 1895.

That the new industry was not without its troubles is shown by a statement made in 1895:

The salt industry of the United States, like all other industries, has suffered from the business depression during the past year, without giving promise of improvement in the near future. The main causes, besides the general stagnation of business, to which the decrease in our salt production is due, are the slight demand for packing salt, owing to the scarcity of pork during 1897, the cessation of silver mining in the western States and territories, and the sending of fresh provisions directly to the seaports for home consumption or export.

In spite of the cyclical and seasonal troubles experienced by the salt industry, its importance to the economy of that time was well recognized by a number of writers. The possible future position of salt to the chemical industries was forecast by one writer when he said:

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Salt is an article of such prime necessity and so widely distributed that its production is subject to fewer fluctuations than that of any other article known to the mineral industry. It is true that some development in the production has come with the growth of the chemical industry in this country, and the demand for it will further increase when the electrolytic processes for producing soda and chlorine come into use.

The author's anticipation of an upward trend in salt production was substantiated when in 1897, production figures showed that, "A large proportion of the salt production of the United States is now consumed in the manufacture of soda ash, caustic soda, and bicarbonate of soda, which is carried on in Virginia, New York, and at one works in Maine." 9

If it had not been for the increased chemical utilization of salt the industry would have been in very poor shape. Even so, the industry was not prosperous in 1897 as it was still suffering from the depression and a number of plants had to suspend operations, some temporarily and some permanently. The producers of the various alkali products utilized some 364,124 short tons of salt in 1896, and 505,674 tons in 1897. 10 All of the salt used by these concerns was in the form of brine.

Though attention has been focused upon the rock salt production in the foregoing section it is not to be concluded that other methods of salt production were not important. Sea salt production, on a small scale, continued at several locations on the east as well as the west coast. Production of salt from brine or solar evaporation was carried on in a number of locations. In 1892, for example, the Syracuse, New York, works,

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10 *Loc. cit.*
considered the largest in the United States, had an evaporating surface of over 12,000 square feet.\textsuperscript{11} Other localities producing salt by the same method were, Bay and Saginaw counties in Michigan, Van Zandt and Colorado counties in Texas, Solomon City and Salina in Saline county, in Kansas, plus some smaller works in other states.\textsuperscript{12}

By the beginning of the twentieth century the major salt producing states had established their positions as salt producers. Production in the United States was scattered rather generally throughout the several sections of the country. The principal producing states for the past several years have been Michigan, New York, Ohio, Kansas, Louisiana, Texas, and California.\textsuperscript{13} In order to present a clearer and more concise picture of salt production in the producing states, a short description of operations in each of the major producing states will be presented.

Michigan, with a total production of salt of 4,387,879 tons, valued at $16,265,743, led all states in salt production in 1948.\textsuperscript{14} On a percentage basis Michigan produced 27 per cent of the salt mined or manufactured in the United States in 1948.\textsuperscript{15} The bulk of the salt produced was in the form of rock salt, though the state did produce some 871,226 tons of evaporated salt secured from brine. Productive facilities in the state are provided by some nine companies operating a varying number of


\textsuperscript{12}Loc. cit.


\textsuperscript{14}See Table XIII, p. 122.

<table>
<thead>
<tr>
<th>Year</th>
<th>Short Term</th>
<th>Total</th>
<th>Total as of Year's End</th>
<th>Year's End</th>
<th>Year's End</th>
<th>Year's End</th>
<th>Year's End</th>
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</thead>
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<td>16,403,293</td>
<td>28,052,418</td>
<td>30,877,736</td>
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<td>34,357,056</td>
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<td>32,029,963</td>
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<td>30,877,736</td>
<td>32,029,963</td>
<td>34,357,056</td>
<td>36,895,238</td>
</tr>
</tbody>
</table>

Note: Data are as of December 31. Sources: U.S. Department of Commerce.
of plants for the production of various types of finished salt. The products include mined and crushed rock salt, pressed blocks from rock salt, evaporated salt secured by the use of open pans or grainers and/or vacuum pans. There are three companies in addition to the above, producing salt in brine for use in the chemical industries.

The salt deposits of Michigan probably underlie all of the Lower Peninsula, while north of the Peninsula the deposits seem to thin out. The southern boundary can be approximated by drawing a line from a point south of Muskegon, passing through Manistee to the east and Wyandotte still further west. Going northwest from Wyandotte the salt-bearing formations thicken, and along the St. Clair and Detroit Rivers several beds over one hundred feet thick occur within a vertical distance of some 900 feet.

The first brine well in Michigan was put down at East Saginaw in 1859, and the following year production reached a total of 4,000 barrels (200 pounds each). The industry developed rather rapidly, particularly in the Saginaw-Bay section. Part of this rapid development was due to the presence of a very cheap fuel in the form of the refuse from the lumber industry. In fact this fuel cost the user nothing (except transportation) as the lumber industry was facing a serious problem in the disposal of the refuse. Thus the cost of production of the salt was lowered as a result of the cheap fuel. In addition, production of the by-products of


17I.e.c. cit.
bromine and calcium chloride, produced from the natural brines, lowered the total cost of the salt. This sharing of the cost enabled the salt produced in this area to be sold at a price below that paid for salt from the New York area. Thus the western markets for New York salt were almost completely cut off. From a production of some 4,000 barrels the first year the output of salt from brine increased until in 1906, the total production reached 1,391,522 tons, having a value of $2,018,760.19

During 1907, the first rock salt mine was opened in Michigan in a bed of rock salt which runs from Trenton to Port Huron. The mine was dug under the city of Detroit and is today still producing a large quantity of salt. Each day this mine, owned by the International Salt Company, digs out 4,000 tons of salt (equal to the total production of the state in 1859) from under Detroit.20 This output is either packaged in bags of ten and one hundred pounds or shipped in bulk by train, boat or truck to users throughout the United States and Canada.

This thirty-five foot thick bed of salt has been cut, by mining, into corridors that are fifty feet wide and twenty-three feet high. Between parallel corridors are giant pillars of salt that the miners have left standing for roof support. At the present time this mine covers an area of 240 acres.21 The salt is blasted down by use of dynamite,

19Harris, op. cit., p. 149.
led by electric shovels into truck-trailers, transported to the primary crushers (located in the mine itself), crushed and then carried to the surface where the final crushing and finishing processes are carried on. The finishing consists of screening and grading before the salt is ready for sale. Though the mine has been in operation for forty-four years, and has some sixty miles of mine roads, there is no evidence that the salt deposit will give out. The International Salt Company indicates that the remaining salt will allow production to continue for an indefinite period of time.

The location in Michigan of large salt using industries, such as the chemical, and those using the end products of the chemical producers indicate no future drop in salt production for the state. With such rock salt deposits and with the large production of salt in brine, Michigan can continue to hold her position as the leader among salt producing states. Her position seems clear when it is noted that the nearest competitor, New York, produces ever a million tons less than Michigan. Salt production in New York is also an old industry in point of time though the first brine well was not drilled until after the first well in Michigan.

Salt occurs in New York as natural brine and also in the form of rock salt. The brine is found at Syracuse in the drift, filling a pre-glacial channel. The brine, during the period after 1789, was manufactured into salt by the solar evaporation method. The industry, centered

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22 Harris, *op. cit.*, p. 144.
in Syracuse, lest control of the brine wells in 1797, when the land containing the wells was made into an Indian Reservation. In order that salt production might continue; the brine from the wells was sold to users at a fixed charge.25

Rock salt was not discovered in New York until 1865, when, while boring for oil, a bed of rock salt was encountered. However, no attempts were made to utilise the bed of salt. A second discovery of rock salt was made in 1873, in the Catha Valley, near the town of Wyoming, where a bed of rock salt, seventy feet thick, was discovered 1,270 feet from the surface. At this location the first works for the production of salt in New York by the artificial brine method was established in 1881. The success of this first well led to the drilling of a large number of wells, and production of salt in this area increased rapidly.24

The salt produced in New York is sold for a variety of uses. The grades produced include rock, and the varieties of brine salt known as coarse, solar, common fine, table, dairy, agricultural and packers salt. There were four producing companies in 1948, operating six plants. In addition to these concerns the Selvay Process Company sold salt produced as a by-product of chemical manufacture.

A large quantity of the total production of New York salt enters the market in the form of chemical products. Syracuse is the center of the chemical industry but following the discovery of rock salt in and near the Genesee Valley, the center of the salt industry was transferred

23Harris, op. cit., p. 146.
24Ibid., pp. 145-146.
to the new location where richer brines were obtainable. Solvay Process Company extracts the salt in the form of brine and conveys the brine by pipeline to the chemical plant at Syracuse.

The total production of salt in New York in 1948 amounted to some 5,065,881 tons with a value of $13,086,542. Evaporated salt production, which in the nineteenth century accounted for a large percentage of the total salt production of the State, amounted to only 429,870 tons with a value of $5,620,727. New York produced 19 per cent of the salt produced in the United States in 1948. Though evaporated salt production has declined in New York, the state's total production places it fourth among the states producing evaporated salt. Of the state's total salt production less than ten per cent is due to the production of evaporated salt, but the value of it is a little over one-third of the total value for salt production. A possible explanation of this is found in the fact that a majority of the salt produced by this method enters the market directly in the form of salt ready for consumption. In this "finished" form it has a higher value than salt produced in brine. The salt in brine is utilized by the chemical companies. As brine it is valued by the chemical companies as a raw material and not as a finished product. If the value of the finished chemicals was added to the salt production figure, the amount would go up considerably. To secure such a figure would, of course, be impossible, but it

27 Ibid., p. 1077.
would bring to the salt industry more of the prestige which it should enjoy.

The third largest salt producing state in this country is Ohio. Salt is manufactured in Ohio from natural brines in the southeastern part of the state, and from the artificial brines derived from rock salt beds in the northeastern section.28

The first known record of salt production in Ohio is the record of salt being made from brine wells in the Scioto Licks, located in Jackson County, in 1798.29 Still another center of early salt production is found in Meigs County, southeastern Ohio, where during the 1860's there were at one time some thirteen furnaces in operation. Near the beginning of the present century only five works remained in the area and they received most of their revenue, not from the salt manufactured, but from the manufacture of bromine and calcium chloride.30

Rock salt was not discovered in Ohio until 1888 when a bed of rock salt was struck by a well being drilled for oil at Newberg, near Cleveland. Subsequent explorations have shown a profitable field of salt to extend from Wayne and Median Counties north and east through the state.31 Salt is secured by brine wells at Newberg, Cleveland, Lenmore, Wadsworth and Akron. The salt beds vary in thickness from three to seven feet and are found from 1,790 to 3,259 feet below the

28 Harris, op. cit., p. 150.
29 Loc. cit.
30 Ibid., p. 151.
31 Loc. cit.
surface. The salt production from the beds in the northern part of the state is secured by the use of the artificial brine method. Evaporation is usually by means of open pans or grainers and/or vacuum pans. In 1948 there were five companies producing salt in the form of evaporated salt. One of the companies, Colonial Salt Company (owned by General Foods Corporation) also produces pressed blocks. Two companies operate wells for production of salt for chemical use. Diamond Alkali Company uses the brine for chemical production exclusively while Columbia Chemical Division of Pittsburgh Plate Glass Company processes a portion of its brine for sale in the form of evaporated salt.

Salt production in Ohio in 1948 amounted to 2,752,696 tons, valued at $5,884,343. Of the total production in the state, 141,169 tons, valued at $4,287,147, was produced as evaporated salt. Once again it is noted that a small proportion of evaporated salt, sold as such, yields a very high percentage of the total value of the salt production. Roughly twenty per cent of the production yielded eighty per cent of the income received from salt production. This high percentage of total revenue results from the sale of a finished product rather than a raw material. The largest percentage of the salt produced in Ohio enters the market through the chemical industries. Ohio is located in the chemical producing belt of the United States with both salt resources and a plentiful supply of coal for productive utilization. The center

32 The Minerals Yearbook for the years 1940-1948 inclusive.
33 The Minerals Yearbook for 1948, op. cit., p. 1079
of the chemical-using market is also found in this region -- therefore the largest percentage of the salt enters industry as a raw material. The lower value given salt by the chemical industries is the result of the raw material's being produced by these industries and used in their own plants as a raw material.

As a national producer of salt Ohio, ranking third, supplied approximately seventeen per cent of the total salt produced in the United States during 1948. In 1947, Ohio and New York each produced eighteen per cent of the total salt production in this country. An interesting point of comparison between the two states is that Ohio ranked third in the production of evaporated salt with 441,169 tons to New York's fourth place, 429,870 tons. Actually, of course, there is not a great deal of difference in the total production, 11,299 tons, yet the total value of the salt produced by this method varied considerably between the states.

The value of the production in New York was $5,820,727 while that in Ohio was $4,287,147, or a difference of $1,533,580 for not quite twelve thousand tons of salt. On a total value of all salt produced New York with $13,056,542 over-shadow Ohio's $5,884,343 total. Here the difference in value is even more evident for there was a difference of 313,135 tons of salt produced and a difference in value of $7,172,199 with New York out in front.

Without access to the actual causes of the differences in the distribution of the salt produced in these two states, it is impossible to determine the reasons for the large difference in value. Several

possible causes of this difference may be found in the operation of
economic forces governing the distribution of goods. The evaporated
salt sold in New York finds a larger population needing a certain quan-
tity of salt for human utilization. The closeness of the New England
market to New York gives a wider distribution area to salt produced in
New York. The Ohio salt would face a considerable distance problem;
always a factor where the same commodity sells in a competitive market.
The transportation charges would limit the area in which both states
could sell salt, but Ohio does not have the concentration of population
found in the New York trade area. There is also the possibility of the
existence of a demand for different grades of salt in the two states.
Ohio, in the center of the chemical producing area of the United States,
may well find a stronger demand for salt in brine form to be used as a
raw material. Salt of this type has a lower value in production figures
than salt used directly as a finished product. New York salt finds a
market for such uses as salting fish; a market which develops a demand
for a higher type of salt. Still another possible explanation of the
difference in total value of the salt in the two states might be found in
the financial structure of the producing companies in the salt industry.
It is known that several of the companies operate in both areas, and it
is possible that the companies concentrate production along different
lines in the two areas. These possible causes of the large difference
in value between the two states, do not exhaust the field. These reasons
merely point out directions which might lead to the correct answer.

Though a detailed study of the salt production in the state of
Louisiana will be presented in following chapters, a general summary is
presented at this point in order to give a complete picture of the salt producing states in the order of their importance as judged by production figures. Louisiana, in 1948, stood in fourth place as a producer of salt. Total production in the state amounted to 2,223,249 tons, valued at $6,441,751. Production of 88,306 tons of evaporated salt having a value of $991,871 placed Louisiana in seventh place among the producers of evaporated salt. On a percentage basis Louisiana accounted for thirteen percent of the total salt production in 1948. Although no figures on production in 1949 were given, one newspaper made the statement that in 1949 Louisiana produced thirteen percent of the total. It was also pointed out in the same article that the production of the United States declined five percent during 1949, while production in Louisiana fell ten percent.

The earliest production of salt in Louisiana took place largely in the northern section around the salt licks. Most of these licks were places where the brine, formed from the underlying beds of rock salt, had risen to the surface and evaporated, leaving a saline deposit known as a lick. Often these salt licks were found surrounding a brine spring which gave the area a continuous source of brine to replace the salt as it was used. These licks usually occurred or were found in a broad, flatbottomed valley, and were usually not more than 160 feet above sea level. In Louisiana these licks occur north of Red River, mostly on Saline and

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36 Ibid., p. 1077.
Dugdemona Bayous and on Lake Bistineau in Bossier, Bienville and Winn parishes.39 The production of salt from these licks never achieved more than local importance. The transportation difficulties, coupled with the high cost of producing the small quantities of salt caused the salt to be commercially produced only in time of great need.

An entirely different situation, however, prevailed in the southwestern part of the state where the large quantities of rock salt made production relatively easy. The most famous group of producers became known as the Five Island group.

Until about 1898 nearly all the salt produced in Louisiana came from Avery Island, where the first attempt to make salt was made by John Hayes. However, the first salt manufactured from this deposit was secured from the brine springs on the Island by Mr. Avery. The demand for the salt soon overtaxed the springs and in an attempt, in 1862, to clean out the springs, the bed of rock salt was discovered.40 This was the first important bed of rock salt to be found in the United States, and this discovery changed the method of making salt from evaporation of brine to open pit mining of rock salt. The salt found on Avery Island proved to be perfectly dry, homogeneous, and very pure. The salt when quarried with dynamite, necessary on account of the hardness of the salt, came out in large blocks of ice-clear transparency.

39Loc. cit.


41Lomm, op. cit., p. 36.
Production of salt in Louisiana fluctuated considerably during the last quarter of the nineteenth century with an average production within the range of from twenty to thirty thousand tons. In 1902 the second of the Five Islands to begin production, Weeks Island, started commercial production of salt. In 1922, Jefferson Island, also one of the group, entered commercial production. Production of salt at one of the interior domes located a few miles west of Winnfield, Winn Parish, in the northern section of the state began in 1955 when the Carey Salt Company sank a shaft. The production of salt in brine for chemical utilisation in the production of soda ash, caustic soda, and related chemical products began in this same period. In December, 1954, the Mathieson Alkali Works sank wells on the Old Hackberry dome, some eighteen miles southwest of Lake Charles. In 1955 the Solvay Process Company (which, as a result of a corporate merger in November, 1947, became a part of the Allied Chemical and Dye Company) began production on the Bayou Choctaw dome four and one-half miles northwest of Plaquemine.

In 1950 there were five companies operating in the state and producing mined salt. These companies produced some 1,218,527 tons of mined salt. Three companies produced salt in brine form for the chemical industries. This production amounted to 1,316,921 tons of brine in solution. The total production for the state in 1950 amounted to 2,535,448 tons.

Texas, another important southern producer of salt, stands in fifth place nationally with a total production of 1,354,107 tons, valued at $1,712,169. Production in 1948 was accounted for by three companies producing various types of salt, and one company producing evaporated salt
and salt in brine for chemical use. In 1941 the Dow Chemical Company began the production of evaporated salt from wells located near Freeport, Texas. This salt was used electrolytically in the manufacture of magnesium metal from sea water. Production at this place ceased after the end of World War II.

The salt domes of Texas, like those of Louisiana, are divided into the interior and the coastal domes. Production on several of the interior domes has been carried on since early times. One of the best known of these domes is Grand Saline, formerly known as Jordan's Saline. This dome is located in east Texas in Van Zandt county. The town of Grand Saline is located on the northern rim of the dome. Salt was first made at this location by the Indians and later by the white settlers starting in 1845. Production during the Civil War increased greatly, and a daily production of 100 tons was reached. Production at this time was by the use of the open kettle method. It was not until 1886 that the first plant for steam operation was organized on the southwest side of the town of Grand Saline. Other companies organized plants near the first plant until shortly after 1900 there were four companies with adjoining holdings. These were united by 1906 by B. W. Carrington and Company who later transferred them to the Morton Salt Company. At the present time this company operates the Kleer mine for the production of rock and pressed blocks of salt, and the Morton Works which produce evaporated salt and pressed blocks. The Kleer mine is located on the southeastern

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part of Grand Saline dome, while the brine wells and an evaporating
plant are located on the northwestern part of the dome in the town of
Grand Saline. The plant in Grand Saline was damaged by fire in the fall
of 1948. The usable refining equipment was rebuilt and moved to the
company's salt mine outside the town. The brine wells enter the salt
stock at a depth of some 285 feet and are driven an additional 200 feet
into the salt. The mine shaft was completed in 1931, after overcoming
many difficulties encountered in sinking the shaft through the heavy
water-bearing strata overlying the top of the salt. The shaft enters
the salt at a depth of some 215 feet. The total depth to the working
level is some 700 feet.

The largest interior dome in Texas is located some six miles
south of Palestine. The force exerted by the salt in moving up toward
the surface of the earth has uplifted the surface over an area in excess
of four miles in diameter. The first known salt production on this dome
took place during the Civil War when salt was produced from brine evapo-
rated in open kettles. Modern development of the dome began in 1904
when the Palestine Salt and Coal Company began operating a brine evapora-
ting plant. Brine for the plant is obtained from shallow wells sunk into
the dome. Power for the operation of the plant is obtained from lignite
mined by the company in its own mine located approximately two miles
from the plant. This lignite mine, opened in 1925, contains a number


46Weigel, loc. cit.
of seams of lignite. The company has been securing coal from three of
the seams which average some seven and one-half feet in thickness. 48

Production of salt in brine form for the utilization of the chemical industries dates from October, 1934, when the plant of the Southern
Alkali Corporation began production at Corpus Christi. 49 This plant is
located on the harbor which location gives the company access to ocean
transportation facilities. A port location was almost essential, for
when the company began production of soda ash, caustic soda, and allied
products, there was relatively little demand in that area for such items.
Since 1934, other chemical using industries have been attracted to the
Corpus Christi area and it seems safe to assume that the existence of
the soda ash plant aided in attracting industry. This company secures
its brine from the Palagana dome located approximately sixty miles north
of Corpus Christi. The brine is transported through a cast iron pipe
fourteen inches in diameter. A cost saving feature of the pipe line is
that the topography of the area allows the line to be laid in such a
manner that the brine flows by gravity and no pumping is necessary.
The Southern Alkali Corporation, in addition to the chemical utilization
of the brine, operates an evaporation plant in which evaporated
salt for general use is produced.

Salt production in Texas for commercial purposes is limited, at
the present time, to a few companies operating on domes easily reached

47 Ibid., p. 421.
48 Powers, op. cit., p. 46.
49 Weigel, op. cit., p. 408.
by drilling. There are many locations throughout the state where salt could be produced if the demand made economic production possible. In some sections salt for local consumption has been made from the numerous lagoons and salt lakes found in the western part of Texas. One such "salt lake" found in the basin of the Trans-Pecos region in West Texas has been worked for many years. Early records show that the Mexicans harvested salt from the approximately 45 acres of the lake. The salt was sold largely to stockmen in the area, though records indicate that it was often hauled more than a hundred miles by wagons during the early years of the twentieth century. Additional sources of salt are found along the banks of many of the rivers of western Texas, especially those originating in the northwestern part of the state. The Salt Fork of the Brazos and the Red River are extremely salty during periods of low water and fairly heavy deposits of salt are found along the upper banks of the two rivers.

Along the coastal regions of Texas numerous salt domes are found. Many of these are overlying oil and gas pools, as is the case in Louisiana, and relatively little production of salt takes place on these domes. A change in the resource utilization pattern in the future could bring some of these domes into production.

California, the sixth ranking state in 1948, produced 914,055 tons of salt, valued at $4,927,722. By far the bulk of salt produced in California is in the form of evaporated salt secured by solar evaporation.

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50 Geological Survey of Louisiana, Bulletin No. 8, op. cit., p. 158.

Total production of this type of salt in 1948 amounted to 740,418 tons. This total placed the state in second place, behind Michigan, in production of evaporated salt. Operating in the state in 1948 were some eleven companies, nine of which produced salt by solar evaporation and two companies producing rock salt.

Few deposits of rock salt are found in the state. However, it is possible that other deposits may exist for brine in springs or salt marshes is found in a great many localities throughout the state. In Inyo, San Bernardino, and other counties in the Great Basin area, almost every spring and stream is salty. Salt springs are found in Santa Clara, Lake, and San Luis Obispo counties. Most of these so-called salt lakes contain water only during the rainy season. At other times they are covered by a crust of salt often several inches thick. This salt may be harvested by raking into piles, crushing, and screening the salt raked up. These inland sources of salt, however, account for only a small proportion of the salt production. By far the majority of salt is manufactured from ocean water by solar evaporation.

Salt has been manufactured by solar evaporation from sea water at the south end of San Diego Bay and at Ocean Side, south and east ends of San Francisco Bay, Alameda County. At the present time, one of the world's largest salt-from-seawater operations is being carried on along the southeast shore of San Francisco Bay near Newark, California. At this location Leslie Salt Company has an evaporating pond area covering

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52 Harris, op. cit., p. 156.

about 28,600 acres from which it produces more than 500,000 tons of salt a year by the use of solar heat. Transportation of the finished salt from the packing plants to Oakland, the nearest docksides on the Bay, was one of the biggest problems faced by Leslie in setting up their expanded production facilities. It was necessary to move the salt, primarily in bulk, some twenty-two miles by truck in order to reach ocean shipping facilities. To decrease this expense the company has constructed new docks and bulk loading facilities at Redwood City, less than fourteen miles from the large producing facilities. The opening of these docks in 1961 has speeded up loading of ships, hence decreasing loading costs. Such decreases in cost will allow Leslie Salt Company to reach other foreign markets or to increase the profitability of current markets. Most of the salt produced by this company is exported for use in those countries of the Pacific area lacking in salt production in their own boundaries.

The only record found of utilization of salt in chemical production in California was during World War II when the California Rock Salt Company, operating a unit of the Defense Plant Corporation's Death Valley project, supplied salt for the manufacture of magnesium metal. The exact current status of the magnesium production facilities, as well as salt production for such production, is unknown. The plant was closed

54 Business Week, loc. cit.
55 Loc. cit.
at the end of the War, as were the other plants of a similar nature.

Kansas, which in 1948 ranked seventh among salt producers of the United States, produced more salt than did California in all of the ten-year period prior to 1948. The increase in salt production by the Leslie Salt Company of California undoubtedly accounted for most of the jump in the production in California. Though actual production in Kansas fell behind California, the value of production in Kansas exceeded that of California by $1,033,106. The higher value of the Kansas salt is the result of a combination of causes among which the cost of transportation from other producing areas aids in keeping Kansas markets for local producers. Also, salt from Kansas is sold for domestic use in relatively small units while much of the California salt is sold in ship-lead lots. In addition, much of the salt produced in California is not subjected to any further refining other than crushing and screening of the solar-produced salt while that of Kansas is primarily produced by evaporation. In the price received for various types of salt, evaporated salt brings a much higher price per ton than does solar salt.

Total production for Kansas in 1948 amounted to 831,756 tons, a decrease from a production of 904,398 tons for 1947. The value of the salt produced in 1948 was $4,960,828. The production came from some six companies operating at least nine plants throughout the state. Production was primarily of evaporated salt with the brine being secured by injecting water into beds of rock salt. Three of the companies operating in the state had rock salt mines in operation.

Salt occurs in Kansas in the form of natural brine, rock salt, and as surface deposits in salt marshes. A large number of salt springs are
found throughout the state. Such springs formed one of the first sources of large-scale production of salt. The largest salt works of this type were found at Solomon City, where in 1898 capacity production reached a possible annual total of 4,000 barrels (280 pounds each). 58

The salt industry of Kansas may be said to date from 1887, when drillers in search of oil and gas found salt at a depth of 800 feet. 59 This discovery, near Lyons, resulted in the formation of the Lyons Rock Salt Company in 1890. A shaft 1,065 feet deep, 285 feet being in rock salt, was sunk and production started. 60 By 1892 salt deposits at Kingman had brought about the sinking of two shafts in that area, and a deposit at Kanapolis had led to the sinking of a single shaft at that location. This mine, owned by the Morton Salt Company, was abandoned in July, 1949. 61 These five shafts had a daily capacity of some 2,000 tons. 62

By 1897 most of the salt producers in Kansas had begun to change their production methods from mining to production by means of artificial brine. The early center of this section of the industry was in the vicinity of Hutchinson, where producers used either ordinary pans, grainers, or vacuum pans for the production of salt. 63 Today at least three rock salt mines are in operation, but the majority of production is still evaporated
Kansas, with its production of five per cent of the salt produced in the United States in 1948, is the last of the salt producing states to be discussed in any detail. Several additional states are currently producing salt, but production, at the present time, in these states runs below 300,000 tons of salt a year. The largest producer among these states is West Virginia which produced 246,752 tons of salt in 1948, with a value of $1,197,645. Of the five producing companies operating in 1940, only three are currently operating. Of these three companies, one produces evaporated salt, and the other two produce salt for chemical utilization.

Salt is found in West Virginia on the Gauley River, from Kanawha Falls down to Point Pleasant and up the Ohio River to Pomeroy Bend. The salt found in Kanawha County, particularly around Malden, carries bromine and certain magnesium salts which are of value in the chemical industries. The Defense Plant Corporation constructed a plant for the production of chemicals from salt at Natrium and the Pittsburgh Plate Glass Company began operation of the plant in July, 1945. At the end of the war the Pittsburgh Plate Glass Company began negotiations to take over the peace-time operation of the organization and in April, 1946, they were given permission to take over the plant. This plant is utilized for the production of soda carbonate or "soda ash" and soda sulphate or "salt cake." These two soda products are used extensively in the glass

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64Payne, op. cit., p. 182.
industry where salt cake is used in the production of window glass and soda ash in the production of bottle glass. Pittsburgh Plate Glass Company by backward integration secured at least partial control over one of the basic raw materials going into the manufacture of two of the products of the company.

Utah, with a production in 1948 of 113,779 tons, valued at $429,494, stands behind West Virginia in total production. In 1948 seven companies were in operation in Utah; three producing solar salt and four producing rock salt. The most important salt lake in the United States is the Great Salt Lake of Utah, which lake is seventy-five miles long by thirty miles wide. The waters of this lake contain some twenty per cent salt and some two per cent of other saline matters. Modern salt production from this lake began in 1848 when the Mormons started collecting salt from pools along the eastern shores of the lake. Westerly winds would drive the salt water into these natural pools or depressions. During the dry season the lake water would be evaporated by the sun, leaving crusts of salt on the bottom and sides of the pools. The first artificial ponds for the evaporation of the lake water were constructed about 1860. The salt industry in Utah was given a great boost about this time by the development of a new technological process for the reduction of silver ores. The new process, the chlorination process, was used by the Alice mine at

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68 Harris, op. cit., p. 160.
69 Ibid., p. 161.
Butte, Montana, and the salt was sent from Utah to Butte by pack mule at a cost of some $200 a ton.\textsuperscript{70}

Rock salt deposits are found at several locations throughout the state, but the outstanding deposit is found northeast of Salina. This deposit is claimed to be the most extensive rock salt deposit in the world. The outcrop of this deposit is a mile and a half long and a half mile wide.\textsuperscript{71} This outcrop, owned by the Great Western Salt Company, is mined by the open pit method, the lowest cost of production possible. The salt obtained by this type of mining is utilized primarily for the production of pressed blocks of salt for cattle feeding. As the salt was taken from various sections of the outcrop, depressions were formed. Drainage from springs and the surface runoff from rains filled these depressions, dissolved the salt and formed a natural brine solution. The company established the necessary facilities for the evaporation of this brine solution and began the production of a high grade of table salt.\textsuperscript{72}

Salt production in the rest of the United States in 1948 was found in Nevada, New Mexico, Oklahoma and Virginia. These states were the only other states with sufficient salt production to be reported to the United States Department of Commerce. The states named supplied a total production of 498,082 tons, valued at $340,473. Production in the majority of cases was by small firms utilizing solar evaporation methods to recover the salt. In Virginia, the Mathieson Alkali Works, Inc., operated a plant for the production of brine to be used in the chemical industry. In New

\textsuperscript{70}\textit{Loc. cit.}

\textsuperscript{71}\textit{The Mineral Industry During 1929, op. cit.}, p. 580.

\textsuperscript{72}\textit{Loc. cit.}
<table>
<thead>
<tr>
<th>Method of Recovery</th>
<th>1948</th>
<th>1947</th>
<th>1946</th>
<th>1945</th>
<th>1944</th>
<th>1943</th>
<th>1942</th>
<th>1941</th>
<th>1940</th>
<th>1939</th>
<th>1938</th>
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<tr>
<td>Short tons value</td>
<td>$6,868,010</td>
<td>16,908,921</td>
<td>2,749,560</td>
<td>2,933,694</td>
<td>526,041</td>
<td>1,790,346</td>
<td>581,932</td>
<td>260,399</td>
<td>3,685,190</td>
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<td>Lots</td>
<td>532,747</td>
<td>2,593,356</td>
<td>598,772</td>
<td>269,964</td>
<td>192,142</td>
<td>947,439</td>
<td>298,464</td>
<td>66,302</td>
<td>3,314,948</td>
<td>182,331</td>
<td>3,369,804</td>
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<tr>
<td>Total</td>
<td>11,403,853</td>
<td>37,078,175</td>
<td>13,724,790</td>
<td>10,512,857</td>
<td>5,970,972</td>
<td>1,611,832</td>
<td>457,710</td>
<td>152,267</td>
<td>16,510,756</td>
<td>77,912</td>
<td>10,512,857</td>
</tr>
</tbody>
</table>

*Source: Compiled from the Minerals Yearbook, United States Department of Commerce.*
Mexico, the International Minerals and Chemical Corporation (formerly Union Potash and Chemical Company) produced salt as a by-product of the production of potassium salts. Very little of this salt enters commercial markets and that which does figure in commercial trade is utilized in the state for livestock purposes. New Mexico has large reserves of salt, but has only a few scattered plants providing for local use. There are no large-scale consuming industries in the state or close enough to warrant large-scale salt production.

The Island of Puerto Rico contains deposits of salt, which are worked by the utilization of solar evaporation. The salt of that Island is allowed to enter the United States market in the same manner as does the sugar produced on the Island. In 1948 Puerto Rico produced only 15,145 tons of salt, valued at $112,072. The small production has little effect upon prices in this country, but the funds secured by the Island as a result of the sale, are valuable to them. The production from Puerto Rico is usually less than half of one per cent of the total salt produced and sold or used in the United States. During 1948 only four companies operated solar evaporation facilities in Puerto Rico.

The foregoing discussion of salt production in the United States has not included a number of states which enter the production field in some years and leave the field when production costs do not justify the production of salt. In some areas salt is produced on a local basis for

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the satisfaction of a local need. Such figures are not reported for the amounts are small. Taken in total these producers probably would add a sizeable amount to the total production of this country. As has been discussed, total production in the United States in 1948 amounted to 16,408,293 tons, valued at $54,351,782. These production figures represent the salt sold or used by the producing companies. Of the total production, 3,207,408 tons with a value of $29,460,186 was in the form of evaporated salt. This production of evaporated salt was achieved by forty-eight companies operating in twelve states and Puerto Rico. Some indication of the growing importance of salt in brine may be seen from the fact that in 1948, some fifty-seven per cent of the total salt produced was in brine form.

Most of the salt produced in the United States is consumed in this country. However, some salt is exported to other sections of the world. The quantities exported each year vary considerably as Table XV shows. The export of 368,981 short tons in 1948 brought $5,672,578 in exchange to this country. The salt which leaves American ports is sent to South America, Central America, Europe (Belgium, Luxemburg, Sweden, Yugoslavia, and other countries), Asia, Africa, and Oceania.

Imports of salt into the United States have not been very large from the quantity point of view in the years since the War. Such imports

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77 Ibid., p. 1080.
79 Ibid., p. 1086.
reached their highest point since 1942 (7,754 tons) in 1948 when 5,621 tons were brought into this country. All of the imports in 1948 came from the North American area; specifically, Canada (1,878 tons), the Bahamas (697 tons), Leeward and Windward Islands (5 tons), and Jamaica (3,041 tons). The salt from Jamaica was utilized for curing fish along the eastern coast. During 1947, additional amounts of salt came to the United States from Spain (545 tons), United Kingdom (1 ton), Asia: Indian and Dependencies (less than 1 ton), and Africa: Cape Verde Islands (113 tons). None of these areas sent any salt to this country during 1948.

### TABLE XV

<table>
<thead>
<tr>
<th>Year</th>
<th>Exports</th>
<th>Imports</th>
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<tbody>
<tr>
<td>1948</td>
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<td>5,621</td>
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<tr>
<td>1947</td>
<td>188,507</td>
<td>1,910</td>
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<td>1945</td>
<td>190,524</td>
<td>4,553</td>
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<tr>
<td>1940</td>
<td>147,044</td>
<td>30,402</td>
</tr>
</tbody>
</table>

(1) Excludes 96,479 tons shipped under U. S. Army Civilian Supply Program

Prior to World War II the eastern seaboard of the United States usually imported a portion of the salt which they consumed. Most of the imported salt was used for salting fish. Salt from Southern Europe

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81 Loc. cit.
formerly came to this nation in the holds of ships returning in ballast because of a lack of cargo for the United States. Much of the salt used in the New England section formerly came in from Canada. Imports into the New England section are necessary for this area is lacking in natural salt deposits though, of course, it is possible to secure the salt from sea water by the utilization of some form of heat evaporation.

The impact of a tariff upon the importation of any economic good is often difficult to ascertain. This fact is especially true when the commodity in question is capable of being produced in this country in quantities far above domestic needs. Indeed, under such conditions the very existence of a tariff upon such commodities becomes difficult to justify, especially when production costs in this country are normally in line with costs in other nations. Tariffs have become so much a part of the American productive pattern, and the arguments pro and con are so well known that any discussion would be purely academic.

At the outset of the twentieth century salt enjoyed a certain measure of tariff protection under the Dingley Tariff Act of 1897. Under that act salt was subject to a duty of eight cents per hundred pounds for salt in bulk and twelve cents per hundred pounds for salt in bags or barrels. This act recognized the fact that under certain conditions the sale of American products abroad might be hurt because of the increase in price made necessary by the imposition of a tariff. For that reason the act made provision for the remission of the tariff on "packers" salt if certain conditions were met.

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85 Harris, op. cit., p. 164.
By 1913 the tariff on salt had been modified slightly in that the duties had been lowered. The tariff on salt in bulk was down to seven cents per hundred pounds, while the tariff on packaged salt was down to eleven cents per hundred pounds. The Underwood Tariff Act of 1913, passed by a Democratic Congress under President Wilson, made the first real attempt to reduce the tariff since the tariff of 1867. While the Underwood Tariff was not a free trade tariff it did provide for moderate duties on many commodities while placing many items on the free list. One of the items placed on the free list was salt. From 1913 to September, 1922, salt could be imported into the United States without the payment of any duty. In 1922, however, a Republican Congress passed the Fordney-McCumber Tariff. This tariff, intended to repair the damage done by the Democratic lowering of the tariff in 1913, renewed most of the tariffs in force in 1913. Salt went back on the protected list at the same rates prevailing in 1913.

The Hawley-Smoot Tariff Act of 1930, the last general tariff revision by the United States Congress, made no changes in the duties to be charged on the importation of salt. Many of the rates specified in the Tariff Act of 1930, and many of the import-tax rates subsequently imposed, have been modified by direct Congressional amendments. The changes made by Presidential proclamations have been made either under section 336 of the Tariff Act (the so-called flexible-tariff provision),

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or in pursuance of reciprocal trade agreements entered into under the
Trade Agreements Act of June 12, 1934. 85 One such agreement became
effective January, 1937, with the United Kingdom and Canada. Under this
agreement imports of bulk salt into the United States were reduced
forty-three per cent, from eleven to seven cents per hundred pounds.
Packaged salt was reduced thirty-six per cent, from seven to four cents
per hundred pounds. 86

Under the authority of the Trade Agreements Act President Roose­
velt reduced the tariff on salt imported into the United States. The
proclamation under which this reduction was made is published in
Treasury Decision 51802. 87 This reduction, still in effect, lowered the
tariff on salt to three and one-half cents per hundred pounds in bags,
and reduced the tariff on bulk salt from seven to two cents per hundred
pounds.

The Tariff Act of 1930 also made provision for the remission of
tariffs paid upon imported salt used for the purpose of curing fish. Under
this section of the tariff the salt is imported in bond, but upon proof
of use for curing fish the tariff is remitted. 88 In the case of imported
salt used in the curing of meats, if the meat so cured is exported the
tariff is refunded. 89

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87 United States Tariff Commission, op. cit., p. 17.
Though the tariff laws make provision for the remission of tariff duties on salt imported for the purpose of curing fish, no salt was imported into this country for fish curing in 1949. How much of the 768 tons of salt imported in 1948 received the benefit of a tariff remission is not possible to determine. The conclusion is possible, however, that such a provision does not bring any great advantage to foreign salt producers trying to enter the United States market. In 1948 slightly over 55,000 tons of salt were used in this country for curing fish, of which only 768 tons were imported. The existence of an exportable surplus of salt in the United States, plus the relatively small amount used for curing fish probably kept imports low. The existence of a tariff on goods not in short supply will, in most instances, act to hold down imports of those goods.

As to the effects of the tariff on salt importation, little more than mere speculation can be found. A comparison of the amounts imported in the years before the tariff reduction in 1913 and the years during which the rates were off as far as salt was concerned, show no great change. Of course any comparison that might be made is subject to the possible error that might be introduced by World War I. From 1906 to the present, imports of salt from foreign countries do not seem to follow any definite pattern. Some years saw as much as approximately 175,000 tons imported, as was the case in 1906. Yet 1925, a year when the tariff was back on, saw only some 56,000 tons being imported, while 1916, a tariff free year brought in 122,000 tons. Most of such imported salt usually goes

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into the New England area, an area lacking in large deposits of domestic salt. The price differential between domestic and imported salt would seem to make importation uneconomic except in those areas lacking in local salt. Even in such areas importation would be economic only when the cost of transportation at least equalized the cost of the salt. Another factor that must be taken into consideration when seeking an explanation of the size of imports of salt is the fact that the United States is an exporter of salt. Under the usual discussions of tariffs and their effects is found the observation that usually imports are low or non-existent in those commodities in which a nation is self-sufficient and/or has an exportable surplus of the commodity.

In the case of salt, it appears that shipments into this country are the result of a mixture of several causes. It has been pointed out that some salt comes in as ballast. Such salt is not moving as a result of normal economic considerations but rather to enable a vessel to return to this country under more satisfactory conditions. Any price that can be secured for the salt is just that much wind-fall to the ship owner. Some imports come in small quantities from countries with a domestic surplus of salt. This salt is available for sale at any price above cost or as close to cost as possible.

As is the case with any economic good, price is the ultimate determining factor as to whether production and distribution of salt takes place. Though price is the determining factor, other considerations sometimes cause salt production to take place when the price does not cover cost of production. This condition may arise because of the nature of costs in the salt industry. This industry is essentially a mining industry and
as such has a relatively high percentage of its costs classified as fixed. In shaft and tunnel mining of salt the capital cost, once made, cannot be recovered or used for any other productive purpose. The same is true in the case of wells drilled for the recovery of salt in brine. In these cases production may continue even in the face of operating deficits because it is actually cheaper to continue operation than to close down the plant. Of course the decision to continue operation is conditioned by the expectation of a higher future market price for salt. If no possibility of an increase in the price of salt can be foreseen, the plant will probably close down as soon as the price received does not cover the variable costs. On the other hand, if it is thought that price will increase in the future, production will likely continue, especially if it is possible to more than cover variable costs. If variable costs, such as power, labor, transportation, etc., can be recovered in the selling price with a little left over to apply on fixed costs, the plant will probably continue to operate. This condition of operating at a loss can continue for an indefinite period of time depending on the physical condition of the operating plant and the nature of the fixed costs. If a high percentage of the fixed costs are in the nature of taxes and bond interest, then the selling price must cover these or the plant will be forced to close. Some companies will also continue to produce and sell at a loss, when the market will likely go back up, in order to protect an established market. Such companies would rather take a short term loss and keep their product before the public than take a chance of losing the market to a competitor. However, selling price in an extractive industry is no positive guide to rates of production or selling policies.
Another factor that must be taken into consideration in seeking to determine the influence of price upon an industry is in the number of companies, firms, or plants operating in the industry. Economic theory would hold that the larger the number of firms, the better the opportunity for competition to provide the base for a competitive price. On the other hand, the smaller the number of operating firms, the better the opportunity for some form of monopoly control to enter the picture with the resulting possibility of a monopoly for the industry.

In the salt industry the trend is apparently toward fewer and larger producing companies. For example, in 1880 there were 268 salt plants reporting production, 161 in 1897, 136 in 1911, and 97 in 1925.\(^{91}\) From that date to the present the number of operating firms has varied from 71 to 85. In 1948 there were 71 plants operating under the ownership of 43 companies.\(^{92}\) In some instances the smaller number of plants has been occasioned by the closing of older, less efficient units and the concentration of production in the more modern units. An additional factor making for fewer units has been found in the acquisition of some small firms by the chemical companies in order to supply brine for the use of the chemical companies.

It does not follow that the trend toward fewer and fewer producing units means a trend toward a monopoly price. As long as at least two producing units remain active in the same market, the possibility of


\(^{92}\) The Minerals Yearbook for 1948, op. cit., p. 1079.
strong or efficient competition remains. The smaller number of units
may actually reduce costs and bring additional benefits to the consumers
of the finished product. Especially is this true when the older, less
efficient units are closed down in favor of larger, more efficient
plants. In the salt industry the fewer producing units have resulted
in an increased production. Whether this increased production has re-
sulted in a lower price to consumers is a question that remains to be
discussed.

The price of any commodity in a market is considered to be a
price for a standardized, homogeneous product. Any discussion of price
and pricing policy automatically seems to assume that the product is
homogeneous. In the case of salt, however, such an assumption must be
very carefully surrounded by a host of qualifications. There is no such
thing as a single product being sold as "salt." Hence there is no single
price, national or otherwise, to be found. Indeed, a majority of the
salt produced and appearing in the published statistics on production
does not enter the market as salt. Eight chemical companies, in 1943,
operated a total of twelve plants for the production of salt in brine
form for use in the plants of the producing companies. The salt so pro-
duced amounted to fifty-seven per cent of the total output for 1943.93
This salt is given a valuation by the producing company as a raw material
and not as a finished product. Therefore, no market price reflecting
cost conditions can be secured. Salt produced by solar evaporation is
apparently sold under a different set of conditions from salt produced.

by mining. In mining, some of the salt is pure enough to be crushed, screened and sold. To supply different needs of consumers, some of the mined salt is placed in solution and evaporated in either vacuum pans or grainers. Salt from the same source may thus enter the market under entirely different production conditions with a different cost background.

Still another factor affecting the pricing policy in the salt industry is found in production being scattered throughout the United States. Not only is production well distributed geographically, but the methods of production are also varied, even in the same region. Production from natural brine, sea water, and rock salt are found in the same area in at least one instance. A number of examples of at least two different sources of salt being utilized in the same area can be found. These producers, with their different cost conditions and finished products, are all selling what is basically a common product, "salt." The finished products, however, do not sell in the same market. In 1948 salt in sufficient quantities to be reported to the Department of Commerce was produced in thirteen states. These states were well distributed geographically, representing all sections of the United States, except the New England section. The wide distribution of production facilities make unnecessary very long hauls of salt to reach consuming markets. This distribution has also resulted in some types of specialization in the industry. For example, salt producers in the cattle raising section produce salt blocks to take advantage of an economic demand in that area.

The pricing policy in the salt industry is subject to another type of economic force. Prices for commodities are often influenced by the ability of the producers to meet seasonal fluctuations, or the price may
be conditioned by the storage characteristics of the commodity being sold. In the matter of seasonal fluctuations, most salt producers seem inclined to believe that the second half of the year brings a slightly higher demand for their product. This inclination is perhaps because of the increased feeding of livestock in pens, plus the extra demands of the meat curing and fish salting industries. In general salt producers do not attempt to keep very large stocks of salt on hand. This small supply, of course, varies somewhat according to the types of salt being produced. The largest stocks on hand are found in those areas producing solar salt. Because of climatic reasons this type of salt is usually harvested during the last three months of the year. Therefore, during a portion of the year these companies may have an eight or nine months supply of salt on hand. Most of the evaporated salt is shipped as rapidly as it is refined and packed. The companies keep in their bins only a four to five days' supply. The only major exception to this short supply is found in Michigan where several plants produce a stock pile during the winter months. This stock pile is shipped by water transportation during the summer months when the lakes are open to shipment. The less than a week's backlog of salt is kept as a reserve against plant breakdowns which would interrupt shipments of salt. The rock salt producers have found that the best and cheapest method to store their product is to leave it in the ground. At most rock salt mines the salt is usually shipped as fast as it is mined, crushed, screened and packed. Some of the

95 Loc. cit.
mines do blast down salt in the mine and leave it on the floor of the mine until such time as it is needed in the plant. Such underground piles may contain as much as eight or nine months supply of salt. 96

Production of salt, as is the case with all economic goods, is in anticipation of consumption. The aim of the producers is to produce the salt in the proper quantities to supply the effective demand present at a price which will yield a profit to the producer. The price for any economic good will be determined by a host of varying factors. It is often possible, in certain cases, to isolate such factors and accurately determine the influence which each factor has upon the price of the commodity. Most prices in the modern industrial world do not present such a simple pattern. Rather, prices for industrial as well as consumer goods are complex. As such prices are studied, the formulation of a price policy becomes difficult and often impossible. Prices may be determined under competitive, monopolistic, or a combination of the two forces resulting in a price which has aspects of both monopoly and competition. Quoted prices may also be national, regional, or local prices. Such prices may be given as delivered prices in which the cost of distribution is included or absorbed by the shipper, or given as f.o.b. prices in which the consumer is responsible for the cost of transportation. Then again, the price of a commodity will be affected by the size and number of companies operating in the industry. It is not possible to ascertain by looking at size and number alone the price policy of any industry. It is possible that an industry with only two producing companies might achieve

a competitive price. On the other hand it is also possible that an industry with seventy or eighty producing plants or firms might exhibit all of the characteristics of a monopoly. An industry with a large number of firms may reach a monopoly price position simply by each firm's following its own best self interest by relating such interest to the interests of the group. Such a price would be a monopoly price, yet there would be no actual getting together of the firms in the industry. Thus it is that factual evidence alone is not sufficient to justify, in all instances, a conclusion regarding the price policy of an industry. Only by knowing what is in the minds of the members of the industry can a conclusion be reached regarding a particular pricing situation.

Even the members of the industry may not be aware of the theoretical implications of the pricing policy which they are following, either acting as a group or as individuals seeking to maximize profits or minimize losses. In a situation where a few large concerns seem to dominate an industry as far as production is concerned, it does not necessarily follow that their pricing policy will bind or control the industry. It is also possible that some of the larger firms may find themselves involved in monopoly practices which do not carry over to other members of the industry. Where companies are separated by geographical distance, it is sometimes difficult, if not impossible, to establish a true price policy.

In the case of the salt industry, some seventy-one plants are being operated by forty-three companies. These plants are found in thirteen states reaching from coast to coast and from Canada to Mexico. In addition to these reporting companies, there are a number of very small concerns producing varying amounts of salt for consumption in the immediate vicinity.
of the production plant. Frequently these small plants operate only when the local demand is strong enough to make it profitable for operations to take place. A number of such plants operate in New Mexico and several other Western states. As has been mentioned earlier, of these forty-three companies, only six are considered to be large. The classification is one based upon total production of the companies and not upon the size of any one producing unit. Of the six large companies, two stand out not only because of size but also because of the country-wide nature of their operations. The Morton Salt Company leads all producers in the production of evaporated salt and is second in total production of dry salt. The International Salt Company, which operates the Avery Island salt mine under a lease which expires January 1, 1966, leads all producers in rock salt production as well as in total dry salt production. The third largest company is the Leslie Salt Company which leads in the production of solar salt. This company has the largest salt producing facilities at one location. It is not intended to leave the impression that these companies do not produce other types of salt for they have varied production facilities. Morton Salt Company has some rock salt interests and the International Salt Company has some evaporated salt producing facilities.

It is noted that the largest producers do not compete too actively in the production of the same type of salt. It is true that all three have facilities which overlap, but each stands at the top in one special

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field of production. Though the type of raw material may and does vary, the finished product may be and is, in some cases, the same. Therefore, varying production techniques required by the raw material, will bring varying cost patterns and make pricing policies more difficult to ascertain.

Among the largest producers of salt must also be included some eight chemical companies producing salt in brine to use in their own plants. These companies are not interested in the sale of finished salt products and the cost of the salt to them seems to be figured at the cost of production. The existence of this type of use makes difficult, if not impossible, the setting up of any national price policy based upon total production.

Even leaving out the chemical companies does not aid much in the formulation of a price policy. When it is recalled that salt enters the market in a multitude of forms designed to take care of varying needs of consumers, then is it possible to reach the conclusion that there is no single pricing policy for the industry. Rather individual price policies, subject to many variations, are to be found for companies, types of salt produced, and utilization of the finished product.

The United States Department of Commerce in 1949, did attempt to determine an average price for the major types of salt being produced. They reported that the average price of rock salt per short ton, in bulk, was $4.64, and in block form (pressed blocks) the price was $9.64. These prices as well as those given below are all based upon point of production prices. The delivered price would include cost of transportation. Vacuum pan evaporated salt in bulk brought $9.72 per short ton. Solar salt sold for an average of $12.02. Open pan or grainer produced
salt brought $13.78 per short ton. 99

Prior to 1949, it is possible to secure a few figures showing the
delivered price of certain types of rock and vacuum pan salt to New York
City. However, the value of these figures is small because they do not
represent prices on a national basis. Also, the Supreme Court decision
in 1948, in the Cement Institute Case (the Cement Institute is a trade
association to which all major cement producers belong) has thrown the
validity of all future delivered price quotations into a turmoil.

It has been found that the majority of the salt produced in this
country is consumed relatively near the point of production. Except in
the case of a few specialized types of salt produced by a few companies,
there seem to be few long distance movements of salt. The establishment
of standardized grades for table salt, for example, has made the salt
produced by one company as moisture proof as that produced by any other
company. Difference in price can be explained by brand preference,
advertising effectiveness, or other factors not directly connected with
the cost of production or distribution.

In the final analysis, the development of salt producing facilities
is going to depend upon the expansion of the market for the products manu-
factured from salt. The movement of the salt to the production facilities
located near the salt or at some distance from the salt is dependent upon
the cost of transportation of the salt, plus the other factors entering
into the selection of a manufacturing site. If the demand is strong enough
to support the price necessary to move the salt, the salt will move. In

these cases where competing manufacturing firms are producing the same prod-
duct from salt, the effect of transportation costs would enter the profit picture. This would be especially true if one of the firms were located near the raw material and the other near the market for the finished pro-
duct. In such a case the profit of the two firms would be determined by the difference in cost of shipping a finished product in the one instance and a raw material in the other. All other production factors being equal, it is possible that the plant located near the market would enjoy the great-
er profit because such a firm would be receiving a low commodity rate on a raw material, while the other plant would be paying a higher commodity, or possibly a still higher class rate, on a finished product.

The same sort of situation would be found where different types of transportation facilities are available. It is considered that water transportation, either barge or ocean, is cheaper than land transportation. Such a difference in cost of transportation may be offset by the speed which can be offered by land over water transportation. Where time is not important water transportation is often cheaper for bulky commodities. Frequently, however, competitive water-rail rates are obtained by the railroads to offset some of the advantage of the water carrier. Offering speedier delivery, and a competitive rate, the railroads often give effective competition to water carriers. It will be noted that in the case of several of the Louisiana, as well as the California producers of salt, both barge and ocean transportation facilities are available. The existence of this form of transportation does not seem to have exercised any great influence upon the growth of producing facilities. If transportation charges were the determining factor in the location of
salt producing facilities, it would be expected that those locations having water transportation facilities would expand faster than those with no such facilities. However, such does not appear to be the case. Facilities expand as needs in the area of the raw material expand or as demands in other areas send the price up high enough to pay the cost of transportation to the consuming area. In the price of the finished good the cost of transportation must appear, except in very unusual cases, if the producer is to supply the market. Transportation costs might be absorbed by the producer to meet competition or to develop a market in a new area, but such a situation would not continue for any long period of time.

The utilization of basing points as a means of overcoming transportation differentials between different companies and sections of the United States was given a blow by the Supreme Court in 1948 in the Cement Institute Case mentioned earlier. This case, brought up by the F. T. C. (Federal Trade Commission), alleged that the cement industry in the United States was guilty of price fixing on an industry wide scale by the practice of quoting a delivered price which was substantially the same all over the country. Such a price, of course, meant that in some cases users paid too much for transportation and others did not pay enough. The Supreme Court upheld the contention of the F. T. C. and ordered the Cement Institute to stop quoting a delivered price which did not reflect true cost of distribution. The effect upon other industries was almost immediately noticed for a number of other American industries were practicing the quoting of delivered prices which were in the nature of basing point prices. This case resulted in an additional action being brought
by the F. T. C. against one of the largest producers in the salt industry, Morton Salt Company.

The action against the Morton Salt Company has been along the line of price discrimination among its customers and not along the lines of unfair competition between Morton and any of the other producers of salt. The F. T. C. alleged that Morton Salt Company began price discrimination in June, 1936. It was charged that the company had set up a standard discount system available to all customers purchasing Morton's Blue Label salt. Under this discount system the customer paid a delivered price which varied according to the quantity purchased. The prices charged customers were as follows: 100

| L. C. L. (less than carload lots) | $1.60 per case |
| C. L. (carload lots) | 1.50 per case |
| 5,000 case purchase in any consecutive twelve month period | 1.40 per case |
| 60,000 case purchase in any consecutive twelve month period | 1.35 per case |

(Note: A case consists of 24 boxes of 25 ounces each)

It would appear that these discounts would be related to possible differences in cost of distribution of the salt. The F. T. C. found that only five companies were ever able to buy sufficient salt to obtain the $1.35 per case price. These companies were large retail stores (American Stores Co., National Tea Co., Kroger Grocery Co., Safeway Stores, Inc., and Great Atlantic and Pacific Tea Co.) which, because of the low price were able to sell Blue Label salt at retail cheaper than wholesalers purchasing from Morton could reasonably sell the same brand of salt to

Independently operated retail stores. 101

In addition to these discounts the F. T. C. found that Morton Salt Company had an additional allowance or discount which they allowed to certain customers. Morton referred to this discount as "competitive adjustments" which they said were necessary to meet competition. One such instance alleged by the F. T. C. concerned the Consolidated Companies, Inc. of Plaquemine, Louisiana. 102 This concern is a wholesale grocery group operating some twenty-two units or branches throughout Louisiana. Morton allowed this company an additional seven and one-half cents per case from the discount allowed all purchasers of the proper quantity. The extra discount was not allowed other wholesalers in the area.

The quantity discounts referred to above were not deducted from the invoice price, but rather it was the practice of Morton Salt Company to make quarterly, semi-annual, or other stated period remittances or rebates to those customers qualifying for the various discounts. 103

The F. T. C., after the hearing, issued a cease and desist order on July 28, 1944. In this order Morton Salt Company was ordered to stop the practice of offering quantity discounts where such discounts could not be justified on the basis of cost saving. The F. T. C. did, in the order, allow Morton to grant up to and including a five cent per case discount where cost savings would justify such a discount.

As might be expected, the Morton Salt Company took the case to court and the Supreme Court rendered its decision on May 5, 1948. Although up-

103 Loc. cit.
holding the F. T. C. on all contentions and major points, the Supreme Court did send back to the Commission one portion of the case for reconsideration. This was the section dealing with the up to five cents per case discount. The Commission had revoked even this discount on the grounds that such a discount might "possibly" lessen, injure, or prevent competition. Morton Salt Company had contended that neither the Clayton Anti-Trust Act nor the modifications made by the Robinson-Patman Act prevented such a discount where a differential tends in no way to injure competition. Morton Salt Company maintained, "The Commission must either find and rule that a given differential injures competition, and then prohibit it, or it must leave that differential entirely alone."\(^{104}\)

The Supreme Court agreed with Morton Salt Company on that point. The other discounts were not allowed. The F. T. C. issued a modified cease and desist order on November 2, 1948, but the discount was not included in the order. The F. T. C. was given the authority by the Supreme Court to review the entire policy of discounts by the Morton Salt Company and apparently that is what the Commission is doing. After the order was issued Morton Salt Company started back through the courts in an attempt to secure the discount which they feel is justified by cost differences. At the present time the case is still in a Federal District Court in Chicago.

It would thus appear that as far as a pricing policy in the salt industry is concerned, no single price policy can be found. With even the granting of quantity discounts by companies under fire, it seems

that any attempt at industry wide price fixing or control would be
doomed. Especially is this true under the Robinson-Patman Act which
outlaws price discrimination which exists solely because of a large buyer's
ability to purchase in large quantity. Price discrimination is allowed
between buyers to the extent that a lower price can be justified by
reason of a seller's diminished cost resulting from quantity manufacture.
Under the act the burden is on the seller to prove that such quantity
discounts are justified by cost savings.

Even in one type of salt, table salt, it is possible that wide
variations may exist in the price being charged the customer. Such
differences may be the result of different methods of production, effec-
tiveness of advertising, consumer preference, and a number of other reasons.
The wide range of salt products and types renders it virtually impossible
for any single price policy to be established that would truly represent
the industry or reflect cost conditions in the various branches of the
industry. Variations in the cost pattern can be found in a single state,
especially one such as Louisiana where both rock and evaporated salt
are produced by relatively large companies. With two of the largest
companies in the United States operating plants in Louisiana some attention
must be given to their production facilities and policies in the state.
These two companies are Morton Salt Company, operating the Myles Salt
Company as a wholly owned subsidiary, and the International Salt Company,
operating the rock salt mine on Avery Island under a lease arrangement.
Following a discussion of the early historical development of the salt
industry in Louisiana, the modern development will be considered in some
detail.
CHAPTER VI

EARLY SALT PRODUCTION IN LOUISIANA

Indians living in Louisiana were the first producers of salt in the state. Evidence in the form of pieces of pottery, arrow heads and other items associated with the home life of these early Americans has been found both in North and southwestern sections of Louisiana. In both of these areas the Indians apparently used crude forms of evaporating equipment to secure salt from brine springs flowing over or through beds of rock salt. It is not definitely known whether the Indians secured salt from these springs regularly or occasionally. The reliance of the Indians upon fresh meat would enable them to live without having to use additional salt; the flesh of wild animals contains enough salt to fill the basic needs of the human body.

The early settlers coming into Louisiana from other sections of the United States found these salt springs, or "licks" as they were called, and began the production of salt. The term "lick" used to describe the area around the salt springs probably originated from the fact that animals came to these springs to "lick" the ground in order to obtain needed salt. All of the salt produced in the state came from such springs until 1862 when the rock salt deposit on Avery Island was discovered. The discovery of other deposits of rock salt soon followed and production from brine springs, never of more than local importance, soon ceased.

The discovery of additional rock salt deposits continues to add to the potential salt resources of the state although production of salt is carried on at only a few of the numerous known deposits of rock salt. At the present time some one hundred and eleven proven salt domes have
been located in Louisiana. These domes are usually considered as occurring in two separate areas; one in the northern and the other in the southwestern section of the state. In 1936, fifty-three of the domes were in the southern area and the remaining fifteen in the northern section.\(^1\)

Most of the domes found since 1936 have been in the southern section where drilling for oil and sulphur has been extensive. Since the salt domes are usually found to be associated with oil, gas or sulphur, it is only natural that discoveries would be carried on in these areas believed to contain these minerals. It is thought that additional domes will be found as the geological surveying of the state continues to add additional knowledge of the underground structure. The domes found in the southwestern section of the state are usually referred to as the coastal domes. They are located in a belt about seventy miles wide, bordering the Gulf of Mexico. The domes in the interior are separated, as far as is known, by an area lacking in salt domes. These interior domes are located within a rectangular area on the east flank of the Sabine uplift, about seventy-five miles long and some thirty-five miles wide. \(^2\) This area includes most of the parishes of Bienville and Winn.

These salt domes have actually been proven by drilling into the salt stock. In addition to these proven domes there are about as many salt dome "prospects." Most of the "prospects" occur in south Louisiana where


the presence of salt has already been indicated by data obtained with geophysical instruments.\(^3\) The data obtained regarding salt domes is generally the result of the search for oil and sulphur; there are still large areas that are incompletely explored.

The method by which these deposits of salt reached their present locations is still a subject of discussion by geologists. The age of the deposits is also a speculative subject. Mr. R. E. Taylor is of the opinion that both the interior as well as the coastal domes are probably of the same age, possibly Permian.\(^4\) He points out, however, that the final proof as to the age of the deposits must await the discovery of the "mother" bed of salt. This bed of salt, still in an undisturbed condition, is still undiscovered and its depth can only be estimated. It is thought that the bed must lie very deep in the earth, possibly 12,000 to 15,000 feet in the northern part of Louisiana, and from 15,000 to 30,000 feet in the coastal area.\(^5\)

All of the theories regarding the formation of the salt domes in Louisiana and Texas hold that the salt reached its present location from some deeper source. The theories, however, differ in some instances as to the method by which the salt moved from the "mother" bed. Most of the theories hold that the movement was made under some sort of pressure.

Historically, these theories have developed from sketchy outlines to the more modern complex theories. One of the first European geologists to become interested in the structure of American salt domes was Van de

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\(^3\)Taylor, *op. cit.*, p. 19.

\(^4\)Ibid., p. 21.

\(^5\)Loc. cit.
Gracht, who, in the middle of the nineteenth century, held to the theory of the formation of domes from the flowing of salt under pressure. He said:

I consider these saline plugs as having been pushed upwards by orogenic pressure, and not by recrystallization forces inherent in the rock salt. It is my firm belief that the intense lateral pressure has caused the rock salt to behave as a plastic mass and has squeezed it upwards not unlike a volcanic neck, wherever the overlying strata afforded a weak spot inviting passage.

In explaining the process of recrystallization which would have to take place in order for a deposit to be formed, Mr. Van de Graacht held that the recrystallization came as an effect and not a cause of the formation.

American geologist, Mr. B. deGolyer, has utilized the same theory in a slightly different form to explain the formation of the salt structure of the Texas-Louisiana area. He believes that these deposits are plugs of salt which have intruded into previously almost undisturbed Tertiary and Cretaceous formations from deeply buried salt structures.7

As to the origin of these first salt structures Mr. de Golyer believed that they were formed by "orogenic forces."8

Mr. R. Thomassay, another European who visited the Five Islands (located in southwestern Louisiana) in 1857 and again in 1859, put forth a theory of volcanic origin to explain the salt formations of that section. His theory is summed up somewhat as follows; "In the sense that it (Petite Anse, one of the Five Islands) comes from a volcano of water, mud, and gas, and that the rock salt was formed from the evaporation of sea water

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7 Loc. cit.
8 Loc. cit.
by volcanic heat." The symmetry of the mounds making up the Five Islands
and the ponds existing on the Islands impressed Mr. Thomassy very much
and he regarded them as being extinct crater types.  

Seven years later, or in 1867, Mr. C. A. Goessmann suggested the
theory that these salt domes resulted from the evaporation of brine
springs flowing up through older deposits of bed salt. This theory
was later taken over by several geologists and became the basis for much
more complicated and detailed theories.

Colonel S. H. Lockett, who visited the Islands in 1870, considered
them to be merely a continuation of the Cote Gelee, Coreneno, Grande
Coteau, and Opelousas Hills. He maintained that, "the whole at one time
forming a great natural levee along the shores of an estuary occupying
the Mississippi Valley. During a great flood a series of mighty crevasses
were made in the levee, and thus the Islands were formed."

In 1907, Mr. Gilbert D. Harris announced his theory of dome uplift
by the force exerted by growing salt crystals. His theory holds that;

The longer we study these peculiar structures the more convinced
are we that although they may be located along lines of weakness,
faults, or fractured anticlines, they are not to any great extent
due to tangential, mountain-making forces, nor to volcanic upheavals,
nor igneous plugs, as has recently been suggested, but to the slowly-
acting, little understood, correction-forming forces as well as the
power of crystallization. Hot salines or calcareous solutions coming
from earlier Mesozoic or later Paleozoic beds beneath, rising

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9 Symposium, op. cit., p. 7.
10 loc. cit.
11 ibid., p. 8.
12 loc. cit.
perhaps by hydrostatic pressure alone, may very readily, upon reaching a level where the pressure is somewhat relieved and the temperature decreased deposit some of their mineral contents.

By the end of the first quarter of the twentieth century the thinking of salt-dome geologists seems to have become stabilized along certain rather definite lines. In 1931, in the Geology of Iberia Parish it was said:  

These (thoughts) center around the sedimentary origin of the salt, the pre-Cretaceous age of the salt, and the tectonic forces which have caused its intrusion in the form of domes. The cap rock is still the subject of much controversy and the concept of the shape of these salt plugs is at present under-going somewhat of a change which may eventually have a bearing on the ideas concerning the origin of the cap rock.

The interest being maintained in the structure of the cap rock is not only because of the geologic problems associated with its occurrence but also because of the economic importance of the structure. The salt-dome cap rock has been supplying the greater part of the world's sulphur, and is a source of oil.  

As Mr. Taylor pointed out in The Origin of the Cap Rock of Louisiana Salt Domes, "Wherever cap rock is found it is definitely associated with a salt plug." Continuing he maintains that, "The anhydrite part of the cap rock rests directly upon salt that is 'mush' and cavernous, the cavities being filled with brine and anhydrite salt, or less commonly, on hard and compact salt, the contact in such cases being sharp."

15Taylor, op. cit., p. 6.
16Ibid., p. 28.
17Loc. cit.
As to the structure of the Gulf Coast salt Mr. Taylor says:

Rock salt obtained from mines and from wells in the salt plugs of the Gulf Coast is all of the same general character. Most of it is very compact, although there are zones of 'soft' salt in some of the mines. The salt from some of the well cores, and all of that in the mines, is composed of alternate bands of light and dark-gray salt. The darker bands, termed 'pencil stripes' by the miners, have an average width of as much as 18 inches, while the lighter-gray salt is in bands of somewhat greater width. The banding is a very persistent feature, and in the mine, series of bands can be traced from room to room. They run virtually parallel to each other and have a nearly vertical attitude, although in mine rooms with high ceilings many of them can be traced upward to the apices of isoclinal folds. Overfolding and faulting are also shown by the bands. The salt of the darker bands contains somewhat more anhydrite sand than that of the lighter ones, and there seems little doubt that the bands are 'year rings' formed in the original bedded salt. Their present intensely folded condition must have been brought about during intrusion of the salt from greater depths.

The salt domes of the interior regions of Louisiana were the scene of the earliest salt producing efforts. The first production in this area was limited to the scraping up of the salt deposited around the salt licks. Most of these licks were places where the brine, formed from the underlying beds of rock salt, had risen to the surface and evaporated, leaving a saline deposit known as a lick. Often these salt licks were found surrounding a brine spring which gave the area a continuous source of brine to replace the salt as it was used. These licks usually occurred, or were found, in a broad, flat-bottomed valley, and were usually not more than about 160 feet above sea level. In the state these licks occur north of Red River, mostly on Saline and Dugdemona Bayous and on Lake Bistineau in Bossier, Bienville, and Winn parishes.

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18 Taylor, op. cit., p. 28.

19Loc. cit.

20Taylor, op. cit., p. 28.


20Loc. cit.
In the interest of chronology and ease in following the development of the various early salt producing sections of Louisiana, the discussion of the development will present each important salt works in turn. In this way it will be possible to show the development and importance of the works as separate units.

One of the earliest references to the development of salt in Louisiana is found in the Journal of M. de Bienville. This Journal tells of salt production in an area west of Saline Bayou proper. Just south of a great bend in Nelligan branch of Saline Bayou is located Great Lick. This one was an open sand plain where operation of salt works began early. Close to Big Lick and separated from it by a ridge was located Little Lick. It was here that early settlers in the area reported that the Indians made most of their salt. The large amounts of potsherds substantiate such claims. M. de Bienville, writing in his Journal on March 22, 1700, says of salt production in this area:

"Four and a half leagues to the west from the Tensas we found some Ouachitas, with several pirogues partly loaded with salt." On March 29, 1700, he left the village of the Ouachitas for that of the Natchitoches and after crossing Red River he records meeting "six Natchitoches who were going to the Corocas to sell salt."

Sometime later a Danile Cox reported salt production on the Natchitock River about a hundred miles from the mouth of the river. At this location the Indians made salt for their own use as well as for sale to the neighboring Indian nations.

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22 Loc. cit.

23 Loc. cit.
The several "licks" located in this area are collectively known as Drake's saline or salt works. These licks are "level, barren patches arranged roughly in a circular form, and surrounded exteriorly by low hills or knolls."\(^{24}\)

It seems impossible to ascertain the date when white men first made salt at this location. It is likely that some salt was produced at a very early date because of the location of the post of Natchitoches near the salt licks. One of the earliest accounts of salt production by white men in this area is found in a letter written by a John Sibley to General Dearborn. This letter, written at Natchitoches, on April 10, 1806, gives the following account of the production facilities:\(^{25}\)

About twelve miles north of Natchitoches, on the northeast side of the river, there is a large lake called Lac Nois; the bayou of it communicates to the Rigula de Bandieu, opposite Natchitook, which is beatable the greater part of the year. Near the lake are the salt works, from which all the salt that is used in the district is made; and which is made with so much ease, that two old men, both of them cripples, with ten or twelve old pots and kettles, have for several years past made an abundant supply of salt for the entire district; they inform me they make six bushels per day. . . . The salt is good. . . . I am informed there are twelve saline springs now open, and by digging for them, for aught any one knows, twelve hundred might be opened. A few months ago Captain Burnet of the Mississippi territory, coming to this place by the Washita, came by the salt works, and purchased the right of one of the old men he found there, and has lately sent up a boat, with some large kettles and some negroes, under the direction of his son; and expects when they are all in order, to be able to make thirty or forty bushels a day. Captain Burnet is of the opinion that he shall be able to supply the Mississippi territory, and the settlements on the Mississippi from Point Coupee, upwards, lower than they can get it from New Orleans and bring it up.


\(^{25}\)John Sibley, as quoted in Veatch, op. cit., p. 55.
By 1812 Captain Burnet had sunk only three wells, which were furnishing brine for thirty kettles. These kettles, holding a total of 660 gallons of brine, enabled seven laborers to produce some two hundred and forty barrels of salt per month at an expense of one hundred and forty dollars. 26

The wells and springs in this area changed hands several times during the years following 1812 as different individuals attempted to manufacture salt at a cost low enough to compete with salt imported into the region. As the population in the area increased, so did the demand for salt. In the decade of the 1840's Mr. Reuben Drake, who then owned the licks, and for whom they are now named, attempted to obtain a stronger brine. Mr. Drake drilled several deep wells, eight in all, varying from one hundred to two hundred feet, though one well reportedly reached a depth of 1011 feet. In this deep well the pressure was reported to be great enough to lift the water into a tank thirty-five feet above the opening of the pipe. 27 All of the wells produced artesian brine for the evaporating pans located near the wells.

Sometime prior to 1854 Drake's Lick passed into the possession of Mr. J. C. Weeks, who used two of the wells, drilled earlier by Mr. Drake, for the production of salt. One of the wells used was on Little Lick, while the other was located in Upper Lick. During the salt season, usually during summer and early fall, Mr. Weeks produced from thirty to forty bushels of salt a day. 28


27Veatch, op. cit., p. 57.
Although salt was being produced on several of the licks located in North Louisiana they were not able to supply the needs of the State. Therefore, nearly all of the salt used in the middle Southern States was imported. The outbreak of the Civil War and the increasing efficiency of the federal blockade soon cut off most of the imports of salt. The need for salt focused attention upon the possibilities of increasing local production. The salt licks in North Louisiana drew people from all parts of the State as well as from Mississippi, Alabama, and Arkansas.

As the federal troops began to move north from New Orleans toward Alexandria, many of the sugar plantations were abandoned and the planters with their slaves and sugar kettles moved into North Louisiana to make salt. Drake's Lick then became the scene of a vastly increased production of salt. Mr. Weeks allowed many of these new arrivals to settle on his land and charged them a nominal sum as rent. This rent seems to have varied according to the individual and location on the property.

The increased production had enabled Mr. Weeks to expand his facilities, as well as allowed him to take in a partner, Mr. Slaughter. These men had "six evaporating pans, three about thirty feet long and eight feet across composed of a number of square pans bolted together, and three halves of steamboat boilers. These were mounted on rude foundations of ferruginous sandstone." The brine for these furnaces was

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28Veatch, op. cit., p. 57.
29Loc. cit.
30Loc. cit.
31Ibid., p. 58.
obtained from one of Drake's old wells located on Little Lick. The brine
was lifted some twenty-five feet to the furnace by means of a horse power
pump.

It was in 1863 that Mr. Weeks made a contract with Mr. Cobb
Manlove, representing the Confederate government, to supply all the salt
that could be produced at a price of ten dollars per bushel.\(^{32}\) Mr. Weeks
soon realized the trouble that could arise from a fixed price contract.
While he was forced to deliver his salt to the government at a fixed
price, his neighbors were selling their salt for as much as five dollars
a bushel more.

During the Civil War Drake's Lick, especially the Upper Lick
portion, was the center of salt making operations in that area. The lack
of salt from other areas enabled the producers to manufacture and sell
at a profit the salt secured by relatively primitive methods. Very soon
after the end of the Civil War operations on this Lick ceased. Salt could
not be produced at this lick, with the methods then in use, at a cost
which would enable the salt to be sold in competition with salt produced
elsewhere by improved methods. The improved transportation facilities,
both river and rail, by lowering the cost of transportation, plus a
lower production cost enabled salt from other sections to move into North
Louisiana and undersell the locally produced salt.

Located in Bienville parish about eight miles from Bienville and
approximately one mile from Saline River was another famous site of early
salt production in North Louisiana. This lick, known as Rayburn's Salt

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\(^{32}\) Veatch, *op. cit.*, p. 59.
Works was located in a flat, circular, slightly swampy area covering some forty or fifty acres. The lick was some distance from the settlements in the Red River valley and it was not until approximately 1840 that any salt was produced at this location. The Indians do not seem to have used this lick for no remains, either of pottery or means of evaporation, have been found.

In 1840, a Mr. Foust began to make salt at this lick. The salt was produced on a very modest scale and sold to the settlers living in the immediate neighborhood. Mr. Foust continued his production on a small scale until the Civil War produced an increased demand for salt. The fame of this lick spread and by 1862 men had come from several states to make salt. Mr. Foust put his son-in-law in charge of collecting the rent imposed upon the salt producers for the privilege of making salt and for the wood used in the process. The son-in-law, Mr. Sampson Rayburn, collected the rent, which was $2.75 per bushel, and the lick became known as Rayburn's Lick.

The production of salt at this lick was crude, as at all the licks in this section of the state. Shallow wells, fifteen to twenty feet deep, were dug and pumps used to force the salt solution high enough to run by gravity to the furnaces. The furnaces consisted of three or four large sugar kettles mounted on crude foundations made of ferruginous sandstone brought from the nearby hills. Where such kettles could not be secured,

34 Veatch, op. cit., p. 72.
35 Ibid., p. 73.
large boilers were split lengthwise, wooden bulkheads inserted in the open ends, and salt made in them.\textsuperscript{36} The furnaces were heated by means of wood fires. Each of these furnaces is said to have been able to average some thirty bushels of salt a day. In 1899, the remains of sixty-six such furnaces were still well defined.\textsuperscript{37} During the peak of operations at this lick it was said that Mr. Rayburn was collecting $375.00 per day for Mr. Feust. This figure would give a daily production of approximately 1,000 bushels.\textsuperscript{38}

At the end of the War most of the works were closed down because of the cheaper salt to be secured from sources using more modern production methods. Small amounts of salt continued to be made by Mr. G. C. Whitlow until about 1872 when the local market ceased to provide a sufficient profit to enable the salt works to continue in operation.

In the same area but located fourteen miles due west of Rayburn's Salt Works was found another source of salt. This lick, known as King's Salt Works, was situated on the side of Castor Bayou, a tributary of Black Lake Bayou. The entire lick occupies some two hundred acres but the main lick, where most of the salt production took place, covered about forty acres.\textsuperscript{39}

The Indians knew of the existence of salt at this lick, as was true of most of the others in the area, but do not seem to have manufac-

\begin{footnotes}
\item\textsuperscript{36} A Preliminary Report on the Geology of Louisiana, 1899, Part V, p. 122.
\item\textsuperscript{37} Ibid., p. 123.
\item\textsuperscript{38} Loc. cit.
\item\textsuperscript{39} Loc. cit.
\end{footnotes}
tured much salt at this location. From the few remains of pots and arrowheads the Indians seem to have used this area as a hunting ground. The existence of the salt lick attracted the animals and made hunting easier.40

In most respects the activity at King's Salt Works was identical to that found at Rayburn's. It was not until some time during the 1840's that Mr. King began to make salt for himself.41 A well some 150 feet deep was dug and the brine evaporated in a small furnace. Most of the salt production took place during the fall and early winter months after the crops were gathered. Then the negro labor would be taken to the salt house and the winter's supply of salt would be produced. From all reports, the neighboring planters utilized this same lick in the same way for the production of their salt. Salt production during the Civil War increased as men from other areas moved to this lick and started salt production. The lick was soon covered with shallow wells from eighteen to twenty feet deep. Crude furnaces of the same type and size found at Rayburn's Lick were constructed on the edges of the hills surrounding the lick.42 The end of the war seems to have brought these activities to a quicker stop than at either of the previously discussed licks. This shut-down was likely caused by the lack of any large local market to which the supply of salt could be sold. The planters produced their own salt rather than depending upon outside sources.

Six miles north of Drake's Salt Works still another source of salt

40Veatch, op. cit., p. 77.


42Loc. cit.
was found. This lick, known as Price's Salt Works, was located near the edge of Dugdena bottoms. Little is known of the early activity at this lick, but it does not appear that the Indians used it as no remains of Indian handiwork have been found. The early production by white men is also difficult to trace. No dates can be given for the first attempts at salt making, for when Mr. John Walker moved into the area in 1859, he found several old wells.

The period of greatest activity at this lick was during the Civil War when production reached a level which enabled it to rank fourth among the north Louisiana salines. The first to make salt during the War were Mr. George Christian and Mr. Conrad Stark, who dug wells and set up furnaces on a section of the lick known as Smith Lick. In 1861 Col. George Richard Price, Mr. J. W. McHenry, and Mr. John Sholars began producing salt at a location which became known as Price's Salt Works. Col. Price's son has given an excellent description of the salt works. The description runs as follows:

They dug a number of wells before they found water of sufficient strength and quality to begin operations. They brought old sugar kettles from the sugar farms above Alexandria, La., with a capacity of from 500 to 3,000 gallons each. They first put up a large furnace on the order of the old sugar furnaces in lower Louisiana, consisting of 10 kettles with the largest kettle at the mouth of the furnace and ranging smaller back to the chimney. The water was pumped up by home-made pumps with tubing of long pine poles bored out by hand. These pumps were erected in wells

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43 Veatch, op. cit., p. 64.
44 Ibid., p. 65.
45 Ibid., p. 64.
46 Ibid., p. 66.
47 Price, as quoted by Veatch, op. cit., p. 66.
dug in a circle and connected by levers attached to a zigzag wheel, which was attached to a main shaft in the center like the shaft wheel of an old fashioned horse-gin. This was turned by horse power. The water was conveyed to a large tank or vat at the furnace by troughs dug out of split pine saplings of about six inches in diameter. This cold water was turned into the first seven large kettles and boiled to a strong brine, then dipped up by hand and poured into a settling vat and from there emptied into the three upper or smaller kettles for graining and boiled down to salt.

When the market was dull this salt was scooped up and put into draining vats to dry, and when well drained and dry was stored in a salt house but when the demand was great it was frequently sold from the draining vat at from $3.00 to $10.00 per bushel of 60 pounds. The price varied with the demand and I have seen 50 wagons waiting their turn. . . . The furnace made from 40 to 100 bushels per day, depending on the amount of water available. The water tested about one bushel of salt to eight of water and would hardly float an egg.

For some unknown reason this lick does not seem to have attracted the large number of producers that other licks in the area attracted. Large numbers of producers did come to Price's Lick, but stayed only a short time and then moved on, even though one favorable factor which ought to have attracted salt producers to this location existed. This factor was that no rent was charged for making salt as the land was at that time government property. 48 Salt making fell off at the end of the Civil War and the last recorded attempt at salt making at this lick took place in 1869 when a man by the name of Bynum purchased fifteen of the kettles formerly used at Drake's Lick and moved them to Price's Works. 49 Mr. Bynum made salt for a short time and then closed down his furnace.

The largest of all the salt works in north Louisiana during this early period were found on a portion of the old bottom of Lake Bistineau. 50

48 Veatch, op. cit., p. 67.
49 loc. cit.
50 ibid., p. 81.
Lake Bistineau is one of a number of lakes formed along Red River valley during the period of the famous log raft, which blocked steamboat traffic above Shreveport. This log raft caused the mouths of several of the tributary streams to silt up and when the log raft was cleared the lakes were left. In the old lake bottom were a number of elevated areas which rose some ten to fifteen feet above the surrounding bottoms. When the lake covered the entire lick these elevations were surrounded by water and during the Civil War some of them received names: Stansberry Island, Coon Island, Frenchman Island, and Salt Island. 51

The salt works were located in a circular pattern about three-quarters of a mile in diameter. On the eastern side of this group of works was located the largest collection of wells, which became known as Potter's Pond. 52 This name was given to the location because of the large accumulations of pot shreds found there, probably the result of many years of Indian habitation.

This area does not seem to have attracted many salt producers prior to 1846 when two men, Mr. B. M. Thompson and Mr. W. C. Howard, took samples of the brine from Potter's Pond to test the strength of the salt. Apparently it was not strong enough for no evidence is found of any attempts to make salt. 53

One possible reason for the lack of salt production at this location is found in the fact that the people purchased their supplies from

51 Veatch, op. cit., p. 82.
52 Ibid., p. 85.
53 Loc. cit.
the Red River settlements where salt production was already being carried on. These supplies reached the Bistineau area by boats which came up Lake Bistineau and Bayou Dorcheat. The boats were able to reach the town of Minden which marked the head of navigation for the area. In 1865 boats were unable to reach these settlements because of a severe drought which lowered the level of the lake so that boats could not come up from Red River. The supplies of salt got so low that the population of the area had to make salt. Most of the salt was produced at Potter's Pond. As soon as navigation was resumed it appears that salt making about disappeared at this location.

The federal blockade during the Civil War once again cut off the salt supplies of the area, but this blockade affected a much wider area than did the drought. People came to the Lake Bistineau region from Texas, Arkansas, and Mississippi to make salt. In 1863 and 1864 it was estimated that as many as 1,000 to 1,500 people were engaged in salt making in this area.

As was the case at the other salt works during the war, sugar kettles, wash kettles, and steamboat boilers were used to evaporate the salt. At Lake Bistineau, however, high water prevented continuous operations. Salt making usually started about June and continued until about Christmas. The price of this salt, which varied from a dollar to a dollar and a half per sack before the start of the war, rose to ten

54 Veatch, op. cit., p. 83.
55 Loc. cit.
56 Ibid., p. 84.
dollars a bushel just before the fall of Vicksburg. The difference in price in these two periods may not indicate a difference in value; rather the difference may simply be in the value of the money used in the period. The close of the war brought with it the end of large scale salt production at Lake Bistineau, although families in the area continued to make salt for home use during the summer months.

The crude methods used for evaporation of the brine, inefficient management, and a cheaper source of salt, all combined to bring an end to the production of salt from the salines of north Louisiana. By 1871 little evidence remained of the productive facilities used at the various licks. In the Second Annual Report of the Geological Survey of Louisiana, published in 1871, the statement is made that:

The wells are numerous (Price's, Bayburn's, King's), and their surroundings of shanties and troughs for evaporation are decay­­­ing close by. There are accommodations at each of them for hundreds of workers, and hundreds were at work here during the war when Louisiana supplied the whole South with salt; but all is silent now. It certainly seems a pity that not even our home requirement can be met by such abundant resources as we possess here, but that we must still be tributary to New York, Turks Island and Liverpool for an article that we should supply the whole country with. The desertion of these works is fairly attributable to the rudeness of the appliances used in them, and they still offer a remunerative investment to the capitalist, especially those near the navigable Bayou Saline.

The hopes of such men as the author of the report quoted above never materialized. The salines of north Louisiana have remained forgotten as far as salt production is concerned. One factor keeping these

57 Veatch, op. cit., p. 86.
58 Loc. cit.
salines from developing in the period following the Civil War was the rise in the production of salt in another section of the state. The production of rock salt in the southwestern part of Louisiana was easier and cheaper than production by evaporation of the salines in the northern section. The most famous group of producers in the southwestern part is known as the Five Island group.

These so-called islands are in reality a series of five large symmetrical hills, or rounded eminences, rising to an elevation of 100 feet or more from the surrounding flat, marshy plain of southwestern Louisiana. These hills run along a line bearing 8. 49° E. and running from Lake Peigneur, ten miles west of New Iberia, to the mouth of the Atchafalaya River. From a visit to these islands it is readily seen that in the ordinary sense they are not islands. However, it is also easy to understand why they are termed islands. The lower four are separated from the mainland by an impassable sea marsh and cypress swamp. During periods of high tides, when the wind is from the south, the lower four are almost completely surrounded by water. All of the islands face, on one side at least, the waters of a bay or lake.

In order from the southeast these islands are called; Belle Isle, Cote Blanche, Week's Island (Grande Cote), Avery Island (Petite Anse), and Jefferson Island (Cote Carline). The largest of these islands, Grande Cote, or Week's Island as it is known today, is in the form of an irregular circle with a diameter of a little over two miles. Petite Anse, Avery Island, is the longest with an extreme length of approximately two

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and a quarter miles. Week's Island has an area of about 2,000 acres, while the smallest of the islands, Cote Carline or Jefferson Island, has an area of about 300 acres. The highest point on the Five Islands is found on Avery Island where Prospect Hill reaches a height of 180 feet above sea level.

Petite Anse Island, Thomas' Island, Marsh's Island, Salt Island, or Avery Island, as it has been called in succession, is located about ten miles south-southwest of New Iberia, in Iberia Parish. This island is some three miles from the shores of Vermillion bay. Petite Anse bayou flows along the western side of the island. During the first half of the nineteenth century this bayou was used to transport the sugar produced on the island, for Avery Island produced sugar before production of salt was started. Avery Island is completely surrounded by marsh, and transportation was a major problem during the eighteenth century. The only means available at that time was water, for it was not until early in the nineteenth century that a raised causeway was constructed through the marsh to the mainland. The use of Petite Anse bayou as a means of transportation was hindered during a great portion of the nineteenth century by a bar which developed at the mouth of the bayou. This difficulty was partially overcome in 1860 by the digging of a canal from the lower part of the bayou through the marsh to the Gulf. In 1886 a branch of the Southern Pacific railroad was completed from New Iberia to the island. 63 With the

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62 Ibid., p. 238.
63 Ibid., p. 238.
completion of this means of transportation, the island possessed three major means of getting its products to the markets of the world.

The existence of the brine springs on the island was known to the Indians long before the white man came to Louisiana. In some places the remains of potsherds and ashes are at least three feet deep and extend over an area of some five acres. 64 A piece of basket work was found lying directly on top of the deposit of rock salt; a fact which gave rise to the speculation that the Indians knew of the existence of the rock salt deposit from which the brine was derived. The use of this area for the production of salt by the Indians seems to have ceased before the white man showed any interest in the area for there are no records to be found of Indians securing salt at the time the brine springs were found by a white man.

The brine springs were discovered by Mr. John Hayes in 1791, while he was hunting on the island. 65 The slowness of transportation in that section of the country (the steamboat was not developed until 1807) made it difficult for the settlers to secure the salt necessary for daily living. Consequently attempts were soon made to evaporate salt from the brine secured from the salt springs on the island. The War of 1812, by slowing down the shipments of salt into south Louisiana, increased the demand for salt from Avery Island. This increased demand, evidenced by an increase in the price of salt, led to an expansion of the salt works under Mr. John C. Marsh, then owner of the island. 66

64 Veatch, op. cit., p. 239.
65 Ibid., p. 240.
Following the end of the war and the resumption of the imports of salt from other areas, the salt works on Marsh Island or Avery Island were closed. At various times during the next forty-odd years salt was produced on a small scale under the direction of Mr. Marsh or his son-in-law, Judge D. D. Avery.

The scarcity of salt following the beginning of the Civil War focused attention upon the old salt works established by Mr. Marsh. The salt works were rebuilt and production started by the eighteen year old son of Judge D. D. Avery, John Marsh Avery. The increased demand for salt soon overtaxed the springs and Mr. Avery directed the negroes to clean out the springs in order to improve the flow of brine. One of the negroes came upon a "hard log" which he could not dislodge. Mr. Avery went down into the well and discovered that the so-called "log" was in reality the top of a bed of rock salt. Mr. Avery, on May 6, 1862, became the first white man to discover a bed of rock salt in the United States for it was not until several years later that a bed of rock salt was found in New York. The area around the top of the rock salt deposit was cleared off and production by the open pit method began. The salt found in this open pit proved to be perfectly dry, homogeneous and very pure. When it was quarried it was necessary to blast it loose with dynamite because of the hardness of the salt. The salt then came out in large

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66Veatch, op. cit., p. 240.
67Loc. cit.
68Loc. cit.
69Loc. cit.
blocks of ice-clear transparency. In his discussion of the character of this salt Mr. Vaughn makes the following statement:

The salt is mostly white, hard, dry and crystalline, the individual crystals varying from one-eighth to one-quarter of an inch across and up to more than two inches in length. The salt stands up well, and practically all can be shipped as rock salt, differing in this respect from the salt at Weeks Island, which shatters readily. The purity of the salt even of the darker portions, is remarkable. These darker portions, so evident as streaks or bands, are not caused by any hard substance, but by the absorption of the light rays by minute particles of transparent anhydrite. This anhydrite may easily be filtered from water in which dark salt has been dissolved. The only foreign substance found within the salt core is a rather thin mass of tough red sandstone.

A chemical analysis of the salt reveals a composition almost pure. This analysis showed the following composition:

- Sodium chloride . . . . 98.8828%
- Sulphate of lime . . . . .7025
- Magnesium chloride . . . .0030
- Calcium chloride . . . . .0038
- Moisture . . . . . . . . .3286

Several additional pits were dug in order to increase the production of salt, and by April 17, 1863, it was estimated that between 10,000 and 30,000 tons of salt had been secured. Production was stopped on the above date when the mines were seized by federal troops, under General Banks. These troops had been sent from New Orleans for the express purpose of stopping the production of salt on Avery Island.

The importance of these salt operations to the Southern states is shown...
in the following quotation given by Mr. Arthur C. Veatch, in his report on the "Five Islands" submitted in 1899. In this report Mr. Veatch quotes from a news item appearing in the New York Times on April 27, 1863. The news item states:

For the past two months it (the steamer Cornie) has been constantly employed in carrying salt from the mines, several miles southwest of New Iberia, to the junction of the Tchede and Cahawba, Bayous. From this point the salt has been transported to Alexandria, and by way of Red River to Vicksburg, Port Hudson, and other places occupied by the rebels. . . . Seven miles west of New Iberia and near Vermillion Bay, in the middle of a mud lake, thick grown with flag and cane, rises a ledge of solid rock salt, the surface and depth of which have not yet been discovered. From this mine thousands of dollars' worth of the best salt has been daily sent away for the use of the rebel army. Negroes were employed to blast and break it up. Some being ground at the mine. It is reported that the rebels paid four and a half cents per pound for what they took away. When our troops reached Iberia (April 17) a regiment was sent to destroy all tools and machinery there.

The close of the Civil War did not bring a resumption of salt production. It was not until 1867 when Mr. Chouteau and Mr. Price made preparations to resume production. These men, rather than utilizing the open pit method of production, sank a shaft in order to mine the salt. This first shaft was eight by eight feet and about eighty-three feet deep. The shaft was soon sunk an additional eight feet to bring the total depth to ninety, of which fifty-eight feet was in solid salt. From the bottom of the shaft, galleries were driven east and west a distance of one hundred and fifty feet. It was from these galleries, twenty-five feet wide

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73 Veatch, op. cit., p 241.
74 Loc. cit.
75 Geological Bulletin No. 1., op. cit., p. 131.
and ten feet high, that the salt was mined. Production does not seem to have been too profitable for upon the death of Mr. Price in 1870, Mr. Chouteau abandoned the workings.

The mine remained closed until 1879 when it was leased to the Galveston Company. This company apparently did not produce much, if any, salt for they transferred the lease to the American Salt Company in 1880. This company took over the shaft sunk by Chouteau and Price, fitted up a crushing mill at the mouth of the mine and started production. The transportation problem of getting the salt out to a market was partially solved when the company had a canal cut across the marshes from near the mouth of Petite Anse bayou to the Gulf. To get the salt from the mine to the bayou, a tramway was built from the mine and a short embankment made across the marsh to the bayou. There a number of slips were dug and the salt from the mine was loaded into lighters for transportation to Vermillion bay. In the bay the salt was transferred from the lighters to schooners for shipment to various markets. This form of transportation was not too satisfactory because of the difficulty of changing the salt from the lighters to the schooners, the cost of the operation, and the accidents to both schooners and lighters because of the mudflats and bars in that section of the bay.

Following six years of operation the American Salt Company sold its interests to the New Iberia Salt Company. This new company, in an attempt to solve the transportation problem, made the necessary arrange-

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77 Veatch, op. cit., p. 241.
ments with the Southern Pacific Railroad company for the construction of a branch line from New Iberia to the mine. This line was completed in 1886 and, for the time being at least, the transportation problem was solved. Even before the transportation problem was solved the company was attempting to deal with another type of problem -- seeping water. These early producers of salt on Avery Island did not know or realize the extreme irregularity of the surface of the salt. In one place, for example, the level of the salt under the surface of the earth changes from twenty to one hundred feet in less than two hundred yards. The American Salt Company had first experienced this trouble when they extended their tunnel at the ninety foot level both east and west. The company presumed that at least forty feet of salt helped support the roof of the mine when in reality the tunnel had approached the outer limit of the salt. Water soon seeped through the crevices, dissolved the salt in the roof and soon a sink-hole appeared. As the size of these sink-holes increased, the amount of water, sand and debris increased. Mining operations were interfered with and it became necessary to abandon, first the east and then the west tunnels. In 1886 it was considered necessary to deepen the shaft if mining operations were to continue. The shaft was then sunk an additional seventy feet, making its total depth 168 feet. Lateral tunnels, eighty feet wide and forty feet high, were dug on the 160 foot level, and salt production resumed.

80 Loc. cit.
In 1893 the Myles Salt Company of New Orleans obtained a sublease on the property. The production by this company was subject to the same water seepage which bothered the American and New Iberia companies. The water, which had caused the abandonment of the upper level of the mine, finally managed to get into the lower working level, and that portion of the mine had to be abandoned in July 1895. Operations were continued on the upper level on a small scale until the following year, 1896, when the mines reverted to the Avery family by default of contract.

In 1898 a new company was formed, the Avery Rock Salt Mining Company, to carry on operations in the old shaft and to sink a new shaft. It was realized that operations in the old shaft would be more or less temporary because of the water seepage. Therefore, sinking of a new shaft located southwest of the old mine was begun. This shaft entered the salt stock at a depth of fifty-four feet, but was continued to a depth of 464 feet. This extra depth was considered necessary because of the trouble experienced in trying to keep the water from seeping between the salt and the timbers of the shaft. Within the year the depth of this shaft was increased to a total depth of 520 feet.

Production of salt on Avery Island varied considerably during the years prior to 1900. It is, of course, impossible to secure yearly produc-
tion figures for the early years, but such figures as are available are presented in Table XVI. Causes of the fluctuations are difficult to ascertain. Writers of the period under consideration point to varying causes and perhaps all ideas are valid. Certainly one of the causes of early variations in production was the transportation problem which increased the cost of the salt to distant consumers. Another cause pointed out by Veatch in 1899, was the development of the rock salt deposits of Kansas in 1889–1899. Veatch says that "although the quality of the Kansas salt is inferior to that of Petite Anse, its nearness to the great packing houses largely offsets the difference."85 Certainly it is true, as the table shows, that production on Avery Island (Petite Anse) declined as the Kansas production increased. However, it must be remembered that in the years being considered, the water seepage problem at Avery Island was causing the closing of a tunnel and making necessary the sinking of a new and deeper shaft.

### Table XVI

**Early Salt Production on Avery Island**

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
<th>Year</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1812-1861</td>
<td>?</td>
<td>1887</td>
<td>47,750</td>
</tr>
<tr>
<td>1861-1862</td>
<td>200-500</td>
<td>1888</td>
<td>25,214</td>
</tr>
<tr>
<td>1862-1865</td>
<td>10,000-30,000</td>
<td>1889</td>
<td>45,588</td>
</tr>
<tr>
<td>1868-1880</td>
<td>5,000</td>
<td>1890</td>
<td>39,978</td>
</tr>
<tr>
<td>1881</td>
<td>15,000</td>
<td>1891</td>
<td>24,320</td>
</tr>
<tr>
<td>1882</td>
<td>25,000</td>
<td>1892</td>
<td>28,000</td>
</tr>
<tr>
<td>1883</td>
<td>37,130</td>
<td>1893</td>
<td>26,800</td>
</tr>
<tr>
<td>1884</td>
<td>31,355</td>
<td>1894</td>
<td>28,047</td>
</tr>
<tr>
<td>1885</td>
<td>41,893</td>
<td>1895</td>
<td>22,569</td>
</tr>
<tr>
<td>1886</td>
<td>41,957</td>
<td>1896</td>
<td>24,256</td>
</tr>
</tbody>
</table>

*1861-1896 compiled from *Mineral Resources of the United States.*

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Production of salt at Avery Island increased following the completion of the new shaft. Yearly production figures varied considerably during the first years of operation under the Avery Rock Salt Mining Company. The further development of salt mining facilities on the island in the twentieth century will be considered in the following chapter on Modern Development of Salt Production in Louisiana.

Jefferson's Island, the second of the Five Islands on which salt was found, has had a variety of names. These names include the following: Cote Carline, Dupuy's Island, Miller's Island, and Orange Island. The present name, Jefferson's Island, comes from the actor Joseph Jefferson who, near the end of the nineteenth century, had a winter home on the island.

The Jefferson Island salt dome is located on the southeastern side of Lake Peigneur about nine miles west-southwest of New Iberia. This so-called island is not really an island for it rises out of a prairie. The resemblance of this dome to the other members of the island group caused this elevation of land to be classed as an "island." The sea marsh is some two miles away and the Gulf is nine miles to the south. Except for Lake Peigneur, which touches the island on the northwestern side, the island is surrounded by flat prairie land used for the cultivation of rice and sugar cane.

Jefferson Island has an elevated area of approximately three hundred acres. The island is very regular with a maximum diameter of about

86 Veatch, op. cit., p. 254.
87 Loc. cit.
a mile, and an elevation of seventy-five feet. The area covered by the salt dome was not established until test wells were drilled in 1928. At that time it was proven that fully seven-eighths of the salt dome lies under the bed of Lake Peigneur. Its average depth was found to be 850 feet. "The elevation of Jefferson Island was formed by a small spine of salt which is of a higher elevation than the main salt mass, and Lake Peigneur was formed by subsidence caused by the dissolving of the upper end of the salt by migratory waters." 

From a transportation point of view Jefferson Island is well located. A good road connects the island with New Iberia. A branch of the Missouri Pacific Railroad provides transportation for the movement of salt to the various markets served by the producer of salt on the island. The Intracoastal Canal is only about nine miles south of the island and could furnish water transportation if the Delcambre Canal, which connects Lake Peigneur with Petite Anse bayou, were deepened.

The existence of salt on the island was not definitely known, though geologists thought that salt would be found on the island because of the geological likeness to the other members of the Five Island group. In 1894 Mr. Joseph Jefferson let a contract for the drilling of a water well near his home. This resulted in the discovery of rock salt at a depth of 334 feet. The discovery took place in the summer of 1895. Upon this discovery Mr. A. P. Lucas was placed in charge of the drilling and,

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89 Loc. cit.
with a diamond pointed drilling bit sank the hole to a depth of 2,090 feet. The drill stem was still in rock salt when it was decided to stop the work. 91

Attempts to produce salt at this location did not take place until 1919, when a company was formed to mine the salt. The lack of an effective economic demand in the area at the time of the discovery prevented the development of this potential resource. The present day development will be discussed in the following chapter.

In point of time the third of the Five Islands on which salt was discovered was Week's Island, or Grand Cote as it is sometimes called. This island is located on the eastern shore of Week's Bay, an eastern lobe of Vermillion Bay. Until the early 1860's the only way to reach the island was by canoe through Week's bayou from Prairie Au Large below New Iberia. All of the products to and from the island were shipped by shallow draught schooners which were able to enter the bay. During the 1860's Mr. Weeks, at considerable expense to himself, built a raised dirt causeway connecting the island with the mainland at Cypremort Point. 92

On three sides the island is surrounded by a sea marsh and on the fourth by a swamp through which the raised causeway was built. Water transportation was possible to within a quarter of a mile of the island by the use of Week's Bay. The area of this island, the largest of the Five Islands, is slightly over 1900 acres.

90 Geology Bulletin No. 1, op. cit., p. 142.
92 Veatch, op. cit., p. 232.
The discovery of salt on Avery Island in 1888 and the high price being received for the salt produced, started a search on Week's Island for salt. A number of wells were dug in an attempt to locate salt but none of the wells reached salt. The revival of interest in salt production in this area was stimulated by the discovery of salt on Jefferson's Island and Belle Isle. Mr. F. F. Myles began exploration as a private enterprise on Week's Island. The first well was drilled by Mr. N. Conrad, who started the search for salt in March, 1897. Between March and June, 1897, five holes were drilled and salt was reported in only one of them, the fourth, at a depth of 276 feet. In July, 1897, Mr. A. F. Lucas, who had been in charge of the drilling on Jefferson and Belle Isle, was placed in charge of the drilling on Week's. The seventh well drilled, counting these already sunk, struck salt at a depth of 205 feet during August, 1897. In all, fourteen wells were drilled during this preliminary exploration.

Apparently satisfied as to the existence of a sufficiently large quantity of salt to warrant the establishment of production facilities, Mr. Myles formed a company for the production of salt. This company, organised in March, 1898, was known as the Myles Salt Company. Mr. George Cowie was placed in charge of drilling an additional fourteen holes in order to select the best location for the shaft to be sunk to the salt. In July, 1898, a site was selected on the location of hole No. 24, where the salt approached nearest the surface.

94Loc. cit.
The sinking of the first shaft took nearly three years because of the presence of quicksands above the salt and the difficulty encountered in sealing the shaft to keep out the water. To sink the shaft the company utilized a tubular casing ten feet in diameter. This casing was one hundred feet in length and extended some ten feet into the salt stock. The casing enabled the company to pass through the bed of quicksand without too much difficulty, but the trouble began when the casing stepped and a seal between the casing and the rectangular shaft had to be made. This seal had to be strong enough to keep out the water which seeped down beside the casing. The manner in which this seal was achieved was as follows: 95

After lowering the iron casing 10 feet into the salt mass, the cylindrical form of the shaft was continued downward for 35 feet. First comes wood lagging, 3 inches thick. Then concrete 1 foot thick. Then at fairly even intervals, 4 rings of asphalt from 3 to 5 feet in height and with bases 2 to 3 feet thick. Moreover the surface of the salt was heated by hand torches and painted with asphalt everywhere. The heating was carried on to such an extent that in some places the liquid asphalt penetrated the salt mass to a depth of 12 inches. . . . Below the tubular lagging, i. e. below 135 feet the shaft is 10 feet square.

In 1902 the shaft had reached a depth of 600 feet and working tunnels were being dug running both east and west. Production of salt at this location was begun in March, 1902, and has been practically continuous since. Further developments at this location will be considered in the following chapter.

Near the mouth of Myrtle bayou, one of the tributaries of the Atchafalaya River, and about eight miles from the mouth of the Atchafalaya

95Harris, op. cit., p. 69.
River is located Belle Isle, another of the Five Island group. Belle Isle is surrounded by a veritable network of bayous and impassible sea marsh. Myrtle bayou is about a quarter of a mile from the island and transportation by water was available to the island from Morgan City.

In November, 1896, Mr. A. F. Lucas, who seems to have been more interested in the discovery of rock salt deposits in the Five Island group than any other individual, began explorations on Belle Isle. In December, 1896, Mr. Lucas found salt on the island at a depth of 378 feet. As was the case on the other islands where he directed the search for salt, Mr. Lucas did not seem to have been interested in the development of the salt producing facilities on Belle Isle. In 1897 and 1898 the Gulf Company, a company interested in salt production and not oil, drilled thirteen additional test holes in order to determine the best location for a shaft. In August, 1898, the company started construction of a shaft at the site of test hole No. 11, where the salt stock had been found within 103 feet of the surface.

When the company began work on the shaft they also built a sawmill to provide the timbering for the shaft and for the necessary buildings. Buildings were constructed to house the workmen, a machine shop, and an evaporating plant for the production of evaporated salt. While these extensive and expensive construction projects were being carried out, the company dug a short canal from Myrtle bayou to the eastern side

96Vaughn, op. cit., p. 385.
97Veatch, op. cit., p. 222.
98Loc. cit.
of the island in order that steamboats could reach the island. To provide transportation facilities, a tug and two steamboats were purchased, and construction begun on a floating elevator to be used to load the salt on the boats. All this construction took place before the shaft was completed and before it could be determined whether or not the production of salt would be possible.

By May 19, 1899, the shaft had reached a depth of 175 feet. The salt at that depth was impure but the company reported that it was becoming "whiter." The shaft was continued to a depth of 390 feet and a lateral tunnel started from that point. This lateral tunnel was driven first in a northerly direction and then turned east for a distance of approximately 240 feet when "water rushed in and within two hours filled the shaft to sea level." The company then tried to sink a second shaft one-quarter mile to the southwest of the first shaft but quicksand and soft clay stopped work on this shaft at the 200 foot level. Attempts were made to seal off these soft materials by freezing them in order to prevent caving while timbers were placed to hold the material in place. The attempts failed. Abnormal air pressure was then tried to force the materials to stay in place until the shaft could be sealed. In spite of all these efforts, the quicksand and water forced the abandonment of this second shaft.

The Gulf Company then turned its efforts to the utilization of

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100 Harris, op. cit., p. 77.
101 Loc. cit.
salt in brine form. Pumps were installed on a hill to the north of the second shaft, and the natural brine, formed by the water flowing over the bedded salt, was pumped to the surface and crystallized.\textsuperscript{102} Because of the presence of oil in the brine solution it was difficult to crystallize and when crystallized the salt retained a rusty stain. The unconsolidated character of the overburden above the salt permitted the brine to escape and, had the process of pumping been continued long, the island would have been reduced to sea level. Therefore the mine was finally abandoned.\textsuperscript{103}

By the spring of 1906, everything was abandoned as far as salt mining was concerned. As Harris points out, "The partially constructed boats were rotting at their wharves. The first shaft... was marked only by a pond of water. Expensive machinery in evaporating plants and machine shops as well as immense boilers by the score were rapidly rusting into worthless junk."\textsuperscript{104} The Gulf Company went into bankruptcy and its affairs were put into the hands of a receiver who sold all the buildings and equipment. In 1907 the island was in the hands of the New Orleans Milling and Mining Company, which was drilling for oil.

Belle Isle as a producer of salt brought ruin to the only company which tried to bring salt from the ground and place the product in the hands of the consumer. The experience of this company was one of trying to do too much too fast. Rather than begin on a small scale, which could

\textsuperscript{102}Harris, \textit{op. cit.}, p. 78.

\textsuperscript{103}Loc. \textit{cit.}

\textsuperscript{104}Loc. \textit{cit.}
have been done in this case, they strove to spring full grown into production. The existence of the raw material was known, but the company failed to consider all aspects of the problem before investing all their capital. At the time the company first started attempts at salt production, some geologists were already pointing out the difficulties that might be encountered in attempting to secure salt at Belle Isle. Though he wrote after the company failed, the words of Mr. Harris on the prospects of Belle Isle as a salt producer are worthy of note; 106

We have always looked somewhat askance at Belle Isle as a salt producer. Not but that salt is sufficiently plentiful to supply the whole world's needs for centuries to come, but that the salt is very difficult to obtain in any practical manner. Shafts and mining have proven failures. The beds or lenses of salt nearest the surface are local and dangerous to mine. Dissolving the salt by forcing down fresh water, allowing it to become saturated with salt and then pumping it out again and evaporating the brine to salt is indeed practicable, but, as in England, where the overlying deposits are unconsolidated, the houses, fields and all are ruined by the caving in that takes place soon after any considerable amount of salt is removed. In other words, salt can be obtained in quantities at Belle Isle only by ruining the island.

The last of the Five Island group to be considered is Cote Blanche, located on Cote Blanche Bay in the western part of St. Mary's Parish. This island occupies the geographical center of the group of islands. The island may be reached by means of a raised causeway built across the marsh from the mainland at Cypremont Point. In point of size, Cote Blanche ranks third among the Five Islands, with an area of approximately 1400 acres. 106

As early as 1862 attempts were made to locate salt deposits on this island, but every attempt failed. As far as can be ascertained, no

106 Harris, op. cit., p. 85.
further serious attempts were made to locate the salt which geologists felt sure underlay the island until the spring of 1921 (a discussion to be considered in the following chapter). Mr. Gilbert Harris, writing in 1907, maintained that the reason the salt deposits on the island had not been found was that the borings were too shallow and not in the right place. He said, "It would seem to us that if a really deep boring, say 2,000 feet, were made on this island and salt were not found, that there would be some chance of finding oil in paying quantities. That the uplift or form of the island is due to salt and its attendant materials and phenomena as in the other salt islands we do not for a moment doubt."107

Production of salt in Louisiana at the turn of the twentieth century was concentrated in the southwestern part of the state on Avery Island where rock salt was being mined. The existence of salt on three of the other members of the Five Island group had been proven but no production facilities were in operation at that time. The facilities in north Louisiana were not in commercial production, although it is probable that some production for local or home use was taking place on a few of the salines of that area. The lack of transportation facilities hampered the development of some mining operations in the southwestern area. It is possible, however, that the lack of an effective demand for large quantities of salt had more to do with the slowness of development of salt production in the state during the nineteenth century. When the Civil War and its blockade of southern ports shut off the imports of salt,

107Harris, op. cit., p. 86.
the production facilities of the state increased rapidly. The resumption of imports of salt from other areas shut down Louisiana production. The shut down was not the result of a lack of high quality salt, for the Louisiana salt, including the salines of north Louisiana, compared favorably with salt from other areas. The rock salt of Avery Island ranked far above that from most other areas in purity. Rather the closing of the salt works seems to have been a result of the lack of modern, efficient, economical means of production. The older methods of production did not allow Louisiana salt to be produced and sold in competition with salt produced under more modern conditions elsewhere. Whether the inefficient methods of production in the state were the result of a lack of knowledge, lack of capital, lack of a sufficiently strong market to absorb the larger production of modern methods, or some other factor is difficult to determine. It is certain that a lack of a strong market in the state, as well as in those parts of the south which could have been reached by the water transportation available in the southwestern section, influenced the size of production facilities.

The producers in other areas might have been resorting to a policy of charging what the traffic would bear in the sale of their salt. By such a policy salt could be sold in the vicinity of the production facilities at a price high enough to yield a substantial profit to the producer. The salt which might "spoil" the local market, that is cause a drop in prices, would then be sent to other areas and sold for something over the variable costs involved in moving the salt. Of course the reverse of the above situation might also prevail. The reasoning is based on the fact that modern production facilities enable a producer to supply
more than a normal local market. To continue profitable operations, a larger market area must be developed. Instances of the above type of action by producers in other lines of economic activity have been proven. That such was the case in salt production is not known, but salt production is of the type which would lend itself to such practices.

Surplus capital for investment in new types of industrial development in Louisiana during the last half of the nineteenth century was scarce. Such capital was scarce all over the South for the area had little opportunity to build up a source of such funds. Such capital as was available for investment usually sought those lines which promised a certain, quick return. The development of salt mining facilities was slow, if large-scale operations were attempted. Also, the fixed capital cost of salt mining was high, and there was little chance of recovery of much of the investment in case of failure.

Whatever the cause or causes, the salt industry in Louisiana during the nineteenth century was primarily one of small-scale production, and a seeking for new sources of salt by many individuals and companies. The large-scale development of production facilities came in the twentieth century, and it is to a consideration of such developments that attention will now be directed.
In 1900 commercial salt production in Louisiana was limited to the activities on Avery Island. Production of salt at this location was in charge of the Avery Rock Salt Mining Company, organized in West Virginia on August 8, 1898. This company was operating a mine where rock salt was secured. Although production was being carried on at only one location, the Myles Salt Company, which had been organized in March, 1898, was engaged in sinking a shaft on Weeks Island. This project was completed in 1902 and production began in that year.

From production by two companies, engaged in the mining of rock salt, the industry has grown until in 1950 five companies were operating salt mines and three companies were engaged in the production of salt in brine. While this growth is not spectacular when compared to the development of many other industries, it does represent a changing resource pattern in Louisiana. This changing pattern was brought about by a number of factors including an increased demand for salt (especially in the chemical field) and more modern production techniques. In addition, a recognition by those interested in industrialisation in the state, of the necessity of a balanced, well-rounded economy in which industrial development plays its part along with agriculture, aided the development of salt as an industrial raw material. This changing resource pattern, bringing with it a number of changes in customary ways of doing things, has helped bring to the state a number of additional industries which have contributed to the development of the region.

As the number of producers has increased, the production of salt
has grown. Production at Avery Island in 1900 amounted to 44,358 tons. The start of production on Weeks Island in 1902 pushed total production in 1904 to 260,118 tons. Production in 1905 remained above the 200,000 ton mark, but dropped in 1906 to 157,270 tons, and remained below the 200,000 ton figure until 1920, when Avery Island and Weeks Island produced a total of 265,085 tons of rock salt. Since 1939 production has been above the 1,000,000 ton figure. In 1950 production of salt in brine amounted to 1,316,921 tons, while mined salt amounted to 1,218,527 tons; the total of all types of salt was 2,535,448 tons. The companies responsible for this increase, their location, methods of production, and use of the salt will be considered in the following section. The historical method of presentation is used as a means of gaining continuity in the discussion.

The Five Islands of the southwestern part of the state are still the major producers of rock salt. Although figures for the individual producers cannot be given, the total production for Iberia parish can be secured. Production in this parish in 1950 amounted to 840,933 tons. This includes production at the three members of the Five Island group currently engaged in salt mining. The nature of the salt resources on these three islands was summed up well by Mr. F. E. Vaughan who, writing in 1925, made the following statement:

In thickness and purity the salt masses beneath Jefferson Island, Avery Island, and Weeks Island easily outrank any other known in this country. In Europe the famous Strassfurt deposits, of Permian age, show only 685 feet of pure rock salt. The salt wells in strata

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of the same age at Sperenberg, near Berlin, pass through about
3,800 feet of rock salt. The famous Wieliszka deposits of Galicia,
Austria, have an aggregate thickness of 4,800 feet. But this does
not represent the thickness of a single mass of salt such as under-
lies each of the Five Islands. The saliferous formations of
Wieliszka consist of lenses of salt separated by beds of clay,
marl, and anhydrite. The great deposits of the Salt Range in India
are associated with beds of clay, their aggregate thickness generally
running from 300 to 700 feet and never exceeding 1,200 feet.

While these various deposits are of considerably greater areal
extent than those of the Five Island which are being mined, there
seems little doubt but that the latter rank first of the world's
deposits for thickness and purity; they may even rank first as
to the total tonnage of workable salt.

Avery Island production in 1900, under the Avery Rock Salt Mining
Company, amounted to 44,358 tons of rock salt. The International Salt
Company, incorporated in New Jersey in August, 1901, acquired at that
time, complete control of the stock of its wholly owned subsidiary, the
Avery Rock Salt Mining Company. The shaft in use at that time, and still
in use today, was 520 feet in total depth. The only additional shaft sunk
at this location was in 1922, when the company dug a second shaft in order
to provide better ventilation for mine operations. The shaft being used
for mining operations enters the salt bed a few feet above sea level. A
brief description of this shaft indicates that, "It is 21 by 10 feet,
520 feet deep, and is divided into four compartments, two for hoisting,
the other two for compressed air, for power, electric wires, and venti-
lation."

The salt is mined by first undercutting one wall of a tunnel
driven into the salt. This involves cutting out a portion of the salt

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near the floor level in order that the salt in the wall will fall when blasted. Blasting holes are next cut into the wall above the undercut, and explosives are placed in the holes. These explosives are fired during the night when the workers are safe above ground. The explosion breaks some twelve hundred tons of salt into small pieces. This salt is loaded, by an electric shovel, into cars which are hauled to the hoisting shaft by an electric locomotive. Instead of unloading the cars in the mine, they are carried up some 670 feet in forty seconds to the top of the breaker house. Here the cars are automatically dumped, and the salt moves to a series of large roll crushers. These crushers reduce the lumps of salt to the various commercial sizes of coarse rock salt. From the crushers the salt is passed over a series of screens which grade it according to size. From the screening room the salt moves to the packing section where some of it may be packed in bags or, as is the case for much of the commercial salt, loaded in bulk directly into railroad cars or barges.

In order to produce an even purer type of salt for table use, the company installed a set of vacuum pans to produce evaporated salt from the rock salt. These vacuum pans stand approximately sixty feet in height and vary from twelve to sixteen feet in diameter. In these vacuum pans, steam surrounds approximately 1700 copper tubes in which the brine solution is being carried. The heat from the steam crystallizes the salt which settles to the bottom of the pan. From there the salt is taken

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5*“Louisiana Salt Mine,” Baton Rouge Morning Advocate Magazine, April 29, 1951, p. 10.*
to filters for drying and then to a rotary cooler which lowers the
temperature of the salt. Finally the salt is sent to the packing machines
where it is automatically weighed and placed in packages ready for sale
to consumers.

In order to add to its already diversified production and to
give consumers an additional product, the company began, in 1941, to
produce pressed blocks manufactured both from rock salt and evaporated
salt.\(^6\)

The production facilities, including the mine and the evaporating
plant, of the Avery Salt Company are being operated by the International
Salt Company, with its home office at Scranton, Pennsylvania. The Avery
rock salt mine and evaporating plant are under lease to the above company.
This lease expires on January 1, 1966.\(^7\) The Avery Island mine is one of
three rock salt mines operated by the International Salt Company. From
its mines and evaporating plants this company produces a total of sixty-
nine different kinds or types of salt used by domestic and industrial
users for many varied purposes.\(^8\)

Production of salt on Avery Island rose from the 43,560 tons in
1900, to an average production in the 1930's of about 100,000 tons. Pro-
duction in 1934, for example, was 94,309 tons; in 1935, 93,898 tons; while
in 1936, it was 101,116 tons. The 1937 figure amounted to 114,470 tons.\(^9\)

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\(^6\) The Minerals Yearbook for 1941 (Washington, D. C.: United States


\(^8\) "Louisiana Salt Mine," op. cit., p. 10.
Production in 1940 was 140,110 tons, and in 1941 the island reported a production of 157,804 tons. The publishing of separate figures for the various producers in Louisiana was discontinued, and it has been impossible to secure accurate production figures for individual producers. However, it is known, by estimating production from severance tax payments, that production on Avery Island in 1950 must have exceeded 200,000 tons.

Beginning in March, 1902, the Myles Salt Company, Ltd., became the second of Louisiana's modern producers of salt. Its production on Weeks Island, the location of the company's activities, had been delayed because of the difficulty encountered in sinking a shaft. The shaft was sunk to a depth of 645 feet before operations for mining were started. The method of production of the salt is much the same as that utilized in other mines. The room and pillar method, by which giant pillars, approximately seventy-five feet square are left to help support the roof of the mine, is utilized in this mine. The rooms from which the salt is mined are ordinarily about seventy-five feet wide and from sixty to seventy-five feet high. The salt is first undercut, and then the overcut is made to force the salt to fall into the rooms. This is done in order to make it easier to break up the salt and load it into the gondola cars which carry it from the workings to the mine shaft.

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10Fifteenth Biennial Report, 1940-41, Department of Conservation, State of Louisiana, p. 216.

At this mine the roll crushers are located on the working level in the mine rather than on the surface. The gondola cars are automatically dumped into the roll crushers which grind the salt and send it to a storage bin located an additional 100 feet deeper in the mine. From this bin the salt is loaded into the skip and hoisted to the surface. As the salt has already been crushed the only processing which most of it receives is grading. This process is done by passing the crushed salt over vibrating screens with different sized meshes. The larger grades of salt are packed into bags for shipment while the finer grades are reground, to insure greater uniformity, and passed through a rotary kiln in order to drive off all possible moisture. The mill is provided with automatic machinery for filling the boxes of salt and for filling and sewing the bags. A greater percentage of the salt produced at this mine is crushed than at any of the other islands because of the incoherent nature of a large part of the salt.

The finest grades of salt sold by this company are produced by evaporation in open pans or grainers, or in vacuum pans. The salt from the mine is mixed with brine from the mill, passed through a series of filters, evaporated, dried, and cooled in revolving drums. It is then sifted, and finally packed ready for shipment. Among the types of salt produced by this plant are; iodized table salt, ice cream salt, and livestock salt. The latter, which is manufactured either with or without trace minerals or sulphur, is pressed into blocks or bricks for economical use by farmers.\(^{13}\)

In addition to producing salt for direct use by humans and animals, the Bay Chemical Company operates a chemical plant in connection with the salt plant. This company uses salt as the important raw material for a number of chemicals. Among the products manufactured are sodium sulphate (salt cake), muriate (hydrochloric) acid, and dicalcium phosphate. 14

On July 1, 1947, the Myles Salt Company, Ltd., was purchased by the Morton Salt Company and the name of the operating company changed slightly. The new name is, Myles Salt Company, Inc. 15 On October 1, 1949, the Morton Company, as an economy move, merged the Myles Salt Company with the parent company. 16 To increase the variety of products produced by this company, the Morton Salt Company is currently working on the construction of facilities costing $1,970,179, at Weeks Island for the production of a petroleum catalyst. 17

Production at the Myles Salt Company during the middle 1930's was fairly constant, averaging around 175,000 tons per year. Production in 1940 was 255,944 tons, while in 1941 it climbed to 337,907 tons. 18 In 1950 it is estimated that production was in excess of 300,000 tons.

Jefferson Island was the last of the Five Island group to start production. In an effort to determine the outlines of the salt deposit

15 Cittinger, op. cit., p. 10.
17 Baton Rouge Morning Advocate, March 27, 1962, p. 8-B.
18 Fifteenth Biennial Report, op. cit., p. 216.
under the island, Mr. Lawrence Jones and Mr. J. L. Bayless of Louisville, Kentucky, hired Mr. C. J. Weber to drill thirty-six holes on the island in July, 1919. Having determined the contour of the salt, and believing that mining of salt on the island was possible, Mr. Jones and Mr. Bayless formed a company for that purpose. This company, the Jefferson Island Salt Mining Company was organized in October, 1919. The sinking of a shaft was begun immediately. The shaft could not be sealed against the water which ran in, and it was abandoned. In March, 1920, a second shaft was begun but was not completed until February, 1922. Its completion was delayed because of the difficulty of sealing out the water. The shaft enters the salt stock almost at its highest point, which is about forty feet below sea level and one hundred and four feet below the surface of the ground. The circular shaft used for mining is twenty-five feet in diameter, lined with reinforced concrete, and is 900 feet deep. The working tunnels are cut on the 800 foot level, and the extra depth of the shaft is to allow the skips, used to carry the salt to the surface, to descend to a position below the working level. The salt can then be loaded into the skips by gravity; a procedure which saves in cost of operation. Even with the completion of the shaft, mining operations did not begin immediately because it required some time to cut out a working space sufficiently large to enable actual mining operations to start. The operations actually began in April, 1923, and have been practically continuous ever since.

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20 Ibid., p. 761.
21 Ibid., p. 758.
The mining is carried on by an adaption of what is known as the "shrinkage system." In this type of mining a large undercut is made by drilling and blasting. Then, "slice after slice is blasted down, the fallen salt serving as a working floor, until the desired height is reached." In this manner rooms forty feet wide by eighty feet high are cut. The broken salt is loaded into cars by an electric shovel, and hauled to the shaft.

At the shaft the cars are dumped directly into the hopper of a roll crusher which reduces the size of the lumps to approximately six inch cubes. From the crushe the salt moves to a storage bin located in the mine. As needed at the surface, the skips load from the underground bin and carry the salt to the final crushers, located at the surface. These crushers reduce the size of the lumps to approximately three-fourths of an inch in diameter. The salt is then carried over a series of screens which grade it into the various commercial grades.

To meet certain market demands, evaporated salt, both vacuum pan and grainer is manufactured. This evaporating section was added to the company's facilities in 1932. The brine is made from the salt which is too fine to market, or when necessary, from finely crushed rock salt. The salt is dissolved in hot water, agitated and pumped to a settling tank located on the highest point of land near the plant. The clarified brine flows to double-effect evaporators for crystallization to vacuum


23 *loc. cit.*

pan salt, or to three open-pan evaporators for grainer salt. The company
secures steam for both types of evaporators from its own boiler plant fired
with natural gas. The company also produces power for the operation of the
mill and mine.

The Jefferson Island Salt Mining Company produces evaporated salt
(both open-pan or grainer and vacuum pan), rock salt, and pressed blocks
from rock salt. The salt is shipped from the mine by a branch line of the
Missouri Pacific Railroad, built from New Iberia.

Production was temporarily suspended in August, 1940, when a fire
completely destroyed the plant on Jefferson Island. The company spent nine
months constructing a new plant, and during the last three months of 1941,
was able to mine and sell rock salt, pressed blocks from rock salt, and
evaporated salt made in vacuum pans.

Production of salt on Jefferson Island has consistently been above
the 100,000 ton mark, except, of course, when the mine was closed by fire.
Such figures as are available are presented in Table XVII. It is impossible
to estimate production during the last ten years from the severance tax
collection figures because these figures are given by parishes. Three
producers are located in Iberia parish, making it impossible to separate
the returns.

Located in St. Martin parish, approximately six miles northeast
of Lafayette, and one mile east of Bayou Vermillion is a salt dome known

\[2^{25}\] W. M. Weigel, "The Salt Industry of Louisiana and Texas,"
Transactions of the American Institute of Mining and Metallurgical

### TABLE XVII

**SALT PRODUCTION ON JEFFERSON ISLAND**

(Short tons)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
<th>Year</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1923</td>
<td>93,391</td>
<td>1932</td>
<td>191,764</td>
</tr>
<tr>
<td>1924</td>
<td>112,974</td>
<td>1933</td>
<td>204,988</td>
</tr>
<tr>
<td>1925</td>
<td>160,823</td>
<td>1934</td>
<td>218,181</td>
</tr>
<tr>
<td>1926</td>
<td>183,949</td>
<td>1935</td>
<td>194,912</td>
</tr>
<tr>
<td>1927</td>
<td>217,424</td>
<td>1936</td>
<td>213,856</td>
</tr>
<tr>
<td>1928</td>
<td>228,750</td>
<td>1937</td>
<td>197,544</td>
</tr>
<tr>
<td>1929</td>
<td>205,479</td>
<td>1940</td>
<td>181,182</td>
</tr>
<tr>
<td>1930</td>
<td>218,542</td>
<td>1941</td>
<td>40,025*</td>
</tr>
<tr>
<td>1931</td>
<td>216,787</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Operated only three months because of fire.

As Anse La Butte. The existence of salt at this location was determined during the early years of the twentieth century by drillers searching for oil. The first successful oil well was drilled in 1902, and the peak of oil production reached in 1908. The complete area covered by the salt was not determined during this early search for oil, but by 1934, more than 300 salt, oil, and sulphur exploration and exploitation wells had been drilled on this dome. These wells have enabled geologists to map the area covered by the salt dome, but the exact thickness of the deposit is not yet known. It is known however that the salt bed, in at least two locations, is over 1,000 feet thick.

Production of salt at the Anse La. Butte dome has not been as successful as that in Iberia parish on the Five Island group. The first

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28Sixth Biennial Report, 1928-1929, Department of Conservation, State of Louisiana, p. 159.

29Twelfth Biennial Report, op. cit., p. 481.
attempt to produce salt at Anse La Butte was made by the Lafayette Salt Company in 1920. The company drilled a number of test wells into the northern part of Flat Lake to determine the depth to the salt stock in that area. One of these wells encountered salt at a depth of 160 feet; the closest to the surface that salt has been found in this area. Two additional wells were drilled in 1920, for the purpose of securing brine for the production of evaporated salt. These wells entered the salt stock at approximately 200 feet, but were extended an additional 600 feet into the salt. Fresh water was pumped into the wells to dissolve the salt and produce a brine solution. This solution was pumped to the surface where it was evaporated in vacuum pans. Only a small quantity of salt was produced from these first two wells as they caved in after a small amount of salt had been dissolved. A third well was drilled, this one nearer Flat Lake, and the drilling continued until the bit had gone 1600 feet into the salt stock. The brine obtained from this well accounted for the majority of the salt produced by this company before operations ceased in 1927. During the six years in which this company operated, a total of 30,173.51 tons of salt was produced. The reasons given for abandoning the wells were: the high cost of production with the equipment and methods being used, and the competition offered by the salt mines of Iberia parish.

31Loc. cit.
32Loc. cit.
33Loc. cit.
34Loc. cit.
In the spring of 1925, the Star Salt Corporation began the operation of an evaporation plant for the production of table salt out of brine from the Anse La Butte dome. The well drilled by this company entered the salt stock at a depth of about 240 feet, but it was sunk some 1350 feet into the salt stock before drilling stopped. The plant of this company was located in Lafayette, and the brine was pumped to the plant from the well on the Anse La Butte dome. This plant was located near the Baldwin Lumber Company's saw mill in order to lower the cost of production of the salt. The steam for the vacuum pans, used to evaporate the salt, was obtained from the surplus steam produced at the saw mill. It was hoped that the cost of production of the salt would be lowered sufficiently by the use of this steam for the producing company to make a profit on operations. The Star Salt Corporation produced evaporated salt for eight years but was forced to close its plant in 1930, because of high costs and low prices. During the eight years of production, the company manufactured 89,456.26 tons of salt. Annual production figures of this dome are given in Table XVIII.

No further attempts were made to manufacture salt from this dome until 1943, when the Gordy Salt Company began operation of a brine well at Breaux Bridge. The brine from this well is used for the production of evaporated salt. Production figures for the company are not available.

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34 *Geological Bulletin No. 3*, op. cit., p. 88.
35 Ibid., p. 89.
36 Loc. cit.
but some idea of production can be gained from a study of the severance tax paid on the salt produced. From these figures it is calculated that production since 1946, has been a little over 26,000 tons a year, and that for 1950, production exceeded 30,000 tons. 39

After more than half a century in which no recorded commercial production took place, North Louisiana began preparations aimed at capturing some of the salt markets formerly supplied by the area. In 1930, the Carey Salt Company, with its home office in Hutchinson, Kansas, began sinking a shaft into the Winnfield salt dome. This dome is located approximately four miles west of the town of Winnfield, in Winn parish. The shaft was completed in December, 1931, when a depth of 836 feet was reached. The actual mining operations take place on the 811 foot level; the extra depth of the shaft being used for the hoisting equipment. This mine utilizes a circular, concrete-lined shaft, divided into two parts.

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38Geological Bulletin No. 3, op. cit., p. 89.

39Production figures estimated from Biennial Reports of the Department of Revenue, State of Louisiana.
One half contains the balanced skip and cage; the other half is used for ventilation purposes.

The salt is mined by a modified room and pillar or checkerboard system with rooms varying from twenty to eighty feet high, and averaging about fifty feet in width. Pillars, averaging sixty-five feet in diameter are left to support the roof. In mining the salt, an undercut is first made in the wall in order to enable the salt to break away more easily. High explosives are used to blast down the salt, but care must be exercised in this operation because of differences in the salt found in the mine.

Some of the salt in the mine is classed by the miners as "soft" and some as "hard." The miners set up this classification based on the ease or difficulty encountered in mining the salt. There is, however, an actual difference in the salt. The "hard" salt contains coarse grains of anhydrite and has a lower sodium chloride test than the "soft" salt which contains fine-grained pieces of anhydrite, plus a higher sodium chloride content. In addition, the salt in this mine contains carbon dioxide gas. It is this gas, which is found in greater concentration in the "soft" salt, which causes the difficulty in blasting. The gas pressure is so strong that, "occasionally when a round is fired many more tons of salt than are expected are holed out from the face or roof leaving peculiar, twisting, tunnel-like cavities. In one case a tunnel was blown out which continued above the roof of the mine more than a hundred feet. . . When this gassy

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41Ibid., p. 218.
42Loc. cit.
salt is crushed under foot in the mine, popping noises like those of small torpedoes are heard."43

The salt which is blasted down, is loaded into mine cars and hauled to the shaft. The cars are automatically unloaded into a hopper, which in turn, automatically fills the skip when it is lowered to a position near the bottom of the shaft. Taken to the top of the tipple, seventy feet above ground, the salt is fed through the roll crushers which reduce the size of the lumps to approximately three inches. At these crushers the salt is hand-picked for anhydrite and discolored salt before being sent to the mill building. After being hoisted to the top of the mill building, the salt is sent through the mills and screens for grinding. It is then ready for packing and shipping.

The salt is mined according to the grade wanted by the mill. The "soft" salt, which may be distinguished in the mine, is usually of a better quality than the "hard," although a considerable variation may be found between the two types. The following analysis is considered a fairly typical sample of the salt found in this mine; 44

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sodium chloride</td>
<td>97.23%</td>
</tr>
<tr>
<td>Calcium chloride</td>
<td>.08</td>
</tr>
<tr>
<td>Calcium sulphate</td>
<td>1.65</td>
</tr>
<tr>
<td>Iron and aluminum oxides</td>
<td>.05</td>
</tr>
<tr>
<td>Acid insoluble matter</td>
<td>1.01</td>
</tr>
</tbody>
</table>

Ten different sizes and grades of salt are marketed from this plant, besides stock bricks and blocks.45 The table salt after being

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44 Ibid., p. 291.
45 Loc. cit.
screened and milled is kiln dried and the salt dust, a large portion of which is anhydrite, is removed by a system of fans. The stock blocks are pressed from dry salt by the application of 500 pounds of hydraulic pressure. As is done in most other plants, sulphur is added to some of the blocks to give them a medicinal value.

Production at this mine averaged some 60,000 tons of salt a year during the first six years of operation. By 1941, production had climbed to a total of 120,354 tons. During the years of World War II the production varied, but by 1947, had apparently stabilized around the 100,000 ton mark. This estimate is based upon figures on production derived from the reported severance tax collections by the State Department of Revenue.

Production on the domes to be discussed in the following section is limited to the securing of salt in brine for use in the manufacture of chemicals. At the present time production is taking place on three such domes, all located in the coastal dome area. The first of these domes upon which commercial production began was the Old Hackberry Dome (also known as Hackberry Island Dome).

This dome is located on Hackberry Island on the southeastern border of Black Lake, eighteen miles southwest of Lake Charles. A report on the size of this dome reveals that, "In comparison with the average south Louisiana salt dome, which is between one and two miles in diameter, the salt stock of the Old Hackberry dome is enormous. It

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underlies a large part of seven sections; having a length of three and a half miles and a width of two miles. . . . As the source bed from which the salt comes to form the ridge must be at least five miles below the surface, the amount of salt involved in its formation really staggers the imagination.48

Even with the tremendous known commercial reserves at Old Hackberry, East Hackberry (located about a mile to the northeast of Old Hackberry), and Black Bayou, production was not begun until December, 1934, when the Mathieson Alkali Works, Inc., opened its plant at Lake Charles. The site for this plant was selected after an exhaustive study covering some five years. The site finally selected has access to the Intracoastal Canal, and ocean vessels entering the Sabine Channel reach Lake Charles through connecting waterways. Several railroads serve the area; among these roads are the Kansas City and Southern, Missouri Pacific, and the Southern Pacific. The actual plant site consists of 1,650 acres in Calcasieu parish lying south of the Southern Pacific Railroad and cut by the State's concrete highway between Lake Charles and Sulphur, Louisiana.49

The most important raw material used by the Mathieson Alkali plant at Lake Charles is salt in brine. This brine is obtained from wells drilled into the salt stock on the Old Hackberry dome. Water is pumped into the wells, the salt dissolved, and the brine pumped to the large chemical plant located approximately fifteen miles north of the salt dome. The salt contained in this brine solution is very pure. Tests run on this

49Thirteenth Biennial Report, op. cit., p. 93.
solution show the sodium chloride content to be 99.99 per cent. The company has drilled four wells on the central portion of Old Hackberry dome where the wells entered the salt stock at an average depth of 2,000 feet. Three of the wells were drilled 655 feet into the salt, and the fourth about 1,000 feet into the salt stock. From the brine obtained from these wells the company manufactures both light and dense soda ash and liquid caustic soda.

Production of salt in brine during the first year, 1935, of operation amounted to 56,091 tons. By 1937, the production had reached a total of 119,053 tons, and in 1941, a total of 253,846 tons were produced. Estimates of production at the present time can only be made from tax reports of the Department of Revenue. An estimate of production in 1950, gives a total production of something in the neighborhood of 500,000 tons of salt.

The second chemical company to begin production of salt in brine was the Solvay Process Company. Solvay Process Company, with its home office in Syracuse, New York, announced on November 1, 1947, that as a result of a corporate merger, it was succeeded by the Allied Chemical and Dye Company. This merger included the operations on Bayou Choctaw salt dome in Louisiana. The Solvay Process Company, after several years of study, selected a plant site in north Baton Rouge. The principal deciding factor was the availability of low-pressure steam which could

50Thirteenth Biennial Report, op. cit., p. 95.
51Twelfth Biennial Report, op. cit., p. 495.
52Fifteenth Biennial Report, op. cit., p. 216.
be secured from the Louisiana Steam Products Company (now the Louisiana Steam Generating Corporation) located to the south of the Solvay plant. The plant of the Solvay Company is a completely integrated alkali producing plant, erected in 1955 on an eighty acre tract adjacent to the Mississippi River on one side, and the tracks of the Illinois Central Railroad on the opposite side.

The salt for the use of the Solvay Process Company is secured from the Bayou Choctaw dome (also known as the Grosse Tete dome), located approximately four and one half miles northwest of the town of Plaquemine, in Iberville parish. This dome is an intrusive salt structure with an east-west diameter, on the 5,000 foot salt contour, of considerably less than a mile. The top of the salt stock is rather flat and varies in depth below the surface from 600 to 700 feet. The salt for the Solvay plant is obtained from three brine wells, drilled to depths in excess of 1,800 feet. The saturated brine solution is piped from the salt dome to the plant of the company located some fourteen miles northeast of the dome. The brine crosses the Mississippi River at the plant site in north Baton Rouge. The brine solution contains 99.9 per cent sodium chloride. The salt does contain a small amount of insoluble mineral matter which must be separated from the solution before the salt can be used in production. The brine is used in the production of caustic soda products and both light and dense soda ash.

56 Ibid., p. 165.
Production of salt in brine at the Bayou Chootaw dome totaled 207,951 tons the first year of production, 1936; increased to 277,677 tons the following year, and amounted to 510,137 tons in 1937. Production by 1941, had reached 408,189 tons. Production, as estimated from the Department of Revenue figures on collection of severance tax, has continued to increase, and in 1980, amounted to something over 800,000 tons.

In April, 1946, the Southern Alkali Corporation, a Delaware corporation organized in 1931, leased the major portion of a government owned plant in Lake Charles, Louisiana. The Southern Alkali Corporation, already operating a soda ash and caustic soda plant at Corpus Christi, Texas, was desirous of expanding its production facilities. The leased plant in Lake Charles was obtained by the company for the production of caustic soda and liquid chlorine. Salt in brine to be used in the production of these products was obtained from wells located in Calcasieu parish, near the site of the plant. Southern Alkali Corporation began production in late 1947, and very little salt was utilized that year. In 1949 and 1950, production of salt in brine for use in the production of chemicals was in excess of 200,000 tons a year. This estimate comes from severance tax figures of the Department of Revenue.

The Southern Alkali Corporation, at the time production in Lake Charles started, was owned 61 per cent by the Pittsburgh Plate Glass

58 Loc. cit.
Company and 49 per cent by the American Cyanamid Company. During 1950, the American Cyanamid Company sold its 49 per cent interest to the Pittsburgh Plate Glass Company for a reported approximately $19,000,000.

The producers which have been discussed in the preceding pages have been the only producers of any size or importance in the salt industry in Louisiana during the modern period. There have been various small producers who have appeared on the scene, produced small amounts of salt for a few months or perhaps a year or so, and then disappeared. These producers have, in some instances, operated on one or more of the salt domes already discussed. In other cases, production by these companies has taken place on one of the many other salt domes found in the state. A few of these salt domes which seem to offer the best opportunities for future economic development will be discussed. The domes already being utilized can increase their production considerably, and can probably supply, from the immense deposits of salt available at these locations, any future demand which might develop in the state.

One of the Five Islands, Cote Blanche, located on Cote Blanche Bay in the western part of St. Mary's parish could become a producer of salt. It has been noted that during the Civil War attempts were made to locate salt on this island. No salt deposits were located, and it was not until 1919, that any further attempts to locate salt were undertaken. In 1919, the Cecil Rhodes Company drilled six holes in the northeastern part of the island in search of salt but was forced to give up the search without locating any deposits of salt. In the spring of 1921, the Southern

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Salt Syndicate, made up largely of New York, Philadelphia, and New Orleans business men, was organized to search for salt on the island. The company began drilling in June, 1921, and soon located the salt deposits. By the following year some fifty-four holes had been drilled, and the shape of the salt bed fairly well determined.\textsuperscript{61} The uppermost part of the salt deposit lies approximately 298 feet below the surface of the ground. This deposit is also some 297 feet below the water level. The depth of the salt below sea level would involve rather serious difficulties in sealing off the water which would be encountered. In addition to the trouble with water the company had some trouble with the land owners over the leases, and as far as is known, no attempt has been made to secure the salt.\textsuperscript{62}

A second possible salt producing center of the state is the Pine Prairie Salt Dome, located about one mile west of Easton, a small lumber town in the center of Evangeline parish. This dome, the northern-most of the coastal group of domes, is easily reached by various railroad lines to Alexandria, or by the Gulf Coast Lines to Eunice. Any producer locating on the dome would have good transportation facilities available. It is known that there are massive deposits of rock salt at a depth of only 500 feet under a heavy cap of firm rock, and this type of deposit offers a favorable situation for salt mining. About 1908, the dome was prospected by the Myles Mineral Company for limestone and salt but no development was started.\textsuperscript{63}

\textsuperscript{61}Vaughan, \textit{op. cit.}, p. 376.
\textsuperscript{62}Ibid., p. 378.
Still another potential producer of salt in Louisiana is the Fausse Pointe Dome, also known as Loreauville or Eagle Point. This dome is located about eleven miles east-northeast of New Iberia. The major portion of the dome underlies the western edge of Lake Fausse Pointe. This salt dome is one of the largest domes of the Gulf Coastal area with an east-west proven diameter of almost 12,000 feet, or more than two miles. The surface of the dome is rather irregular as compared to the domes on the Five Islands. The eastern edge of the Fausse Pointe dome rises to within 823 feet of the surface, but the western half of the dome averages approximately 1,400 feet in depth. The prospecting of this dome, as has been true for most of the domes, was done by oil companies in search for oil or gas. In all, some twenty-one wells were drilled in the search for oil. Although the size of this dome would assure a salt producer of a reserve capable of supplying market demands for many years, it is not likely that any development will take place. The dome is rather difficult to reach and most of the material used in the exploration for oil on the dome was transported by boat. Many of the wells were drilled on pilings.

The remaining salt domes of the state have all been located by companies seeking oil, gas, or sulphur. Most of these salt domes are not, for one or more reasons, suitable for economic development under the present pattern of resource utilization. The current and anticipated demands for salt and the products made from salt, can be satisfied by

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64 Geological Bulletin No. 1, op. cit., p. 156.
65 Ibid., p. 141.
66 Loc. cit.
the producers currently operating in Louisiana. That the present producers can increase production to take care of rapid rises in demand has been demonstrated by the expansion which took place during World War II. The continued high production, as compared to pre-war figures, and the increase in some cases, has shown that the operating industries are expecting to maintain production levels already developed by the utilization of this industrial raw material.

The development of salt production in Louisiana can be seen from the figures on total production presented in Table XIX. It would be interesting to compare the development of the several producers, but such figures are not available for most years. The figures presented in this table are for total salt production and include rock, evaporated, and salt in brine used by the chemical industries. These production figures represent the statistical side of development, or present the results of a combination of many forces operating together. The development of the salt industry in Louisiana has been possible because certain factors have been present in the state.

However, in a discussion of the development of a specific industry it is possible to lose sight of the basic causes for the development. Likewise, in an attempt to project present patterns of development into the future, optimism or a strong desire for further industrialization may color or introduce distortion in the projection. A complete description of the past development of an industry must include a discussion of the factors responsible for the existence of the industry, if any plans for the future are to have a solid foundation. In the development of the Louisiana salt industry, a number of factors can be pointed out as con-
### TABLE XIX

**RECORDED SALT PRODUCTION IN LOUISIANA**

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
<th>Year</th>
<th>Production</th>
<th>Year</th>
<th>Production</th>
</tr>
</thead>
<tbody>
<tr>
<td>1861</td>
<td>500 (1)</td>
<td>1901</td>
<td>44,558</td>
<td>1926</td>
<td>538,460</td>
</tr>
<tr>
<td>1862</td>
<td>30,000</td>
<td>1902</td>
<td>69,458 (2)</td>
<td>1927</td>
<td>616,017</td>
</tr>
<tr>
<td>1863</td>
<td>11,000</td>
<td>1903</td>
<td>60,869</td>
<td>1928</td>
<td>642,208</td>
</tr>
<tr>
<td>1868-79</td>
<td>5,000</td>
<td>1904</td>
<td>260,113</td>
<td>1929</td>
<td>825,371</td>
</tr>
<tr>
<td>1880</td>
<td>3,320</td>
<td>1905</td>
<td>206,691</td>
<td>1930</td>
<td>540,988</td>
</tr>
<tr>
<td>1881</td>
<td>15,000</td>
<td>1906</td>
<td>167,270</td>
<td>1931</td>
<td>581,462 (5)</td>
</tr>
<tr>
<td>1882</td>
<td>25,550</td>
<td>1907</td>
<td>154,349</td>
<td>1932</td>
<td>437,126</td>
</tr>
<tr>
<td>1883</td>
<td>57,130</td>
<td>1908</td>
<td>126,284</td>
<td>1933</td>
<td>551,493</td>
</tr>
<tr>
<td>1884</td>
<td>31,555</td>
<td>1909</td>
<td>157,271</td>
<td>1934</td>
<td>666,591</td>
</tr>
<tr>
<td>1885</td>
<td>41,898</td>
<td>1910</td>
<td>155,143</td>
<td>1935</td>
<td>777,391 (6)</td>
</tr>
<tr>
<td>1886</td>
<td>41,957</td>
<td>1911</td>
<td>155,279</td>
<td>1936</td>
<td>919,613</td>
</tr>
<tr>
<td>1887</td>
<td>47,750</td>
<td>1912</td>
<td>158,604</td>
<td>1937</td>
<td>983,566</td>
</tr>
<tr>
<td>1888</td>
<td>25,214</td>
<td>1913</td>
<td>152,389</td>
<td>1938</td>
<td>997,052</td>
</tr>
<tr>
<td>1889</td>
<td>45,588</td>
<td>1914</td>
<td>154,440</td>
<td>1939</td>
<td>1,097,670</td>
</tr>
<tr>
<td>1890</td>
<td>59,978</td>
<td>1915</td>
<td>161,763</td>
<td>1940</td>
<td>1,173,506</td>
</tr>
<tr>
<td>1891</td>
<td>24,520</td>
<td>1916</td>
<td>161,194</td>
<td>1941</td>
<td>1,298,125</td>
</tr>
<tr>
<td>1892</td>
<td>25,000</td>
<td>1917</td>
<td>175,239</td>
<td>1942</td>
<td>1,456,454</td>
</tr>
<tr>
<td>1893</td>
<td>26,900</td>
<td>1918</td>
<td>173,835</td>
<td>1943</td>
<td>1,813,592</td>
</tr>
<tr>
<td>1894</td>
<td>26,047</td>
<td>1919</td>
<td>189,744</td>
<td>1944</td>
<td>2,036,921</td>
</tr>
<tr>
<td>1895</td>
<td>22,368</td>
<td>1920</td>
<td>265,085</td>
<td>1945</td>
<td>2,162,568</td>
</tr>
<tr>
<td>1896</td>
<td>24,236</td>
<td>1921</td>
<td>218,177</td>
<td>1946</td>
<td>4,411,045</td>
</tr>
<tr>
<td>1897</td>
<td>27,000</td>
<td>1922</td>
<td>359,557 (3)</td>
<td>1947</td>
<td>4,766,908 (8)</td>
</tr>
<tr>
<td>1898</td>
<td>50,000</td>
<td>1923</td>
<td>367,971 (4)</td>
<td>1948</td>
<td>2,458,190</td>
</tr>
<tr>
<td>1899</td>
<td>28,739</td>
<td>1924</td>
<td>409,940</td>
<td>1949</td>
<td>2,315,718</td>
</tr>
<tr>
<td>1900</td>
<td>43,560</td>
<td>1925</td>
<td>522,194</td>
<td>1950</td>
<td>2,535,448</td>
</tr>
</tbody>
</table>

(1) See Geological Bulletin, No. 1, Louisiana Department of Conservation, pp. 74-75, for sources of information for years 1861 to 1902, Avery Island Salt Dome.

(2) Commercial production of salt begun on the Weeks Island Salt Dome.

(3) Commercial production of salt begun on the Anse La Butte Salt Dome. The mine was abandoned in 1930. See Geological Bulletin, No. 3, Louisiana Department of Conservation, pp. 89-90.

(4) Commercial production of salt begun on the Jefferson Island Salt Dome.

(5) Commercial production of salt begun on the Winnfield Salt Dome.


(7) Commercial production of salt begun again on the Anse La Butte Salt Dome.

(8) Commercial production of salt begun in Calcasieu parish by the Southern Alkali Corporation.

67 Compiled from the Biennial Reports of the Department of Conservation of Louisiana.
ditioning the past development. Certain ones of these factors will have a definite influence upon the future development of the salt industry in Louisiana. Other factors have developed as a result of the increased industrialization of the state. Some contributing causes for development have been the result of definite action by the state government. The significance of these factors will be described and their influence, not only on the development of the salt industry, but on industry in general, will be indicated.

Any development or expansion of an industry requires varying amounts of investment capital. In the salt industry the investment is usually high. Especially is this true in regard to the fixed capital which must be invested in mines and wells. This investment is one that cannot be recovered in case of failure of the business. For that reason, a large-scale plant must have a source of investment funds which are large and a source where the investors are willing to take a greater chance than in many other lines of investment. The source of investment funds is important in the development of local industries. If such funds can be obtained locally, then the normal return on the invested funds will usually remain in the area and may be used for further improvement of the industrial structure. It might be possible, however, for outside promoters to come into the region and raise local capital for the establishment of the industry. Under such a condition the promoters may carry the profits from their efforts outside the region, leaving only the normal return on the invested capital available for further expansion of industry. If it becomes necessary to obtain the capital for industrialization from sources outside the region desiring to expand productive
facilities, then future development depends upon the willingness of the receivers of the profits either to leave or reinvest the profits in the developed area. The South has always suffered from a lack of a sufficient supply of investment capital to take care of the industrial needs of the area. Investment funds have come into the South because of the better investment opportunities and higher profits available in the region.

The better opportunities exist because the need for the capital is greater than the available supply. Under such conditions the rate of return on borrowed funds must be high enough to attract the necessary capital. Thus Southern industrial firms have sometimes been forced to pay more for capital than similar firms located in already developed areas. To secure the funds for industrialization, the South has gone outside the area for funds for almost all of the large industrial plants currently operating in the region. It is true that in most instances the plants built in the South, especially during recent years, have been expansions of firms already operating in other areas. These firms were able to expand in the South because they had the necessary capital either in their business or could secure the funds. Such expansions as these companies have made in the South have still been expansions utilizing funds derived or secured from sources outside the South. In the case of the salt producers operating in Louisiana, all but one, and it is the smallest of the producers, is owned or controlled by companies with headquarters outside Louisiana. Any decisions as to the expansion of facilities in Louisiana are made outside the state. Of course there is nothing necessarily wrong with such a situation. However, in the case of the salt industry, a decision to expand facilities and/or production
by these companies may not bring the expansion to Louisiana as all these companies have production facilities located in other areas. Thus, their production may increase, as will the profit, without any benefit being received by Louisiana. If the expansion does take place in this state, the profit may find its way out of the state and into investment in other areas. However, the demand for labor will be increased and to that extent the state will benefit.

It is possible that the present development of the salt industry would not have taken place without the aid of outside capital, but it is also true that what is done with the profits made from operations in the state affect the future development of the state. The salt industry is not the only industry in which outside sources of capital predominate. All the major southern industries are organised along the same lines. This situation cannot be changed until such time as sufficient funds are available in the South for the development of southern owned and operated industrial plants.

Some aid in the development of southern owned industrial plants might come from the organisation of local groups interested in the future of southern industry. Such local promoters might be able to build up sizeable amounts of capital funds by combining, in one organization, the small amounts which individuals have available for investment. The growth of southern financial institutions will aid in providing funds for the continued development of industry in the South. However, the time when the South will be able to supply its needs for investment funds seems to be still far off in the future.

The attitude of the state government toward industrialization is
another factor that must be considered in the development of industries in a state. In all southern states the state governments are eager for, and working toward, the industrialization of their state. In several southern states, tax exemptions have been granted to new industries and to expansions of old industries. Louisiana has had a partial tax exemption feature since December, 1946. A similar law was in force during the period from 1956 to 1941. This tax exemption law allows the state to contract for exemption on certain ad valorem taxes. One argument that has been advanced in favor of the exemption follows the line of reasoning that our unfavorable competitive situation with other states on taxes makes such an exemption necessary. The answer might well be given to this argument that, it is not tax exemption that is needed, but an analysis of the tax structure and a revamping, if necessary, of the offending laws. An industry interested in coming into the state is going to take a long-run view of the tax structure before committing large funds to a plant in Louisiana. The Louisiana tax exemption is for a maximum of ten years. Hence, an industry interested in permanent development in the state will not likely come to the state on account of the tax exemption but because the state has the other prerequisites for the successful operation of the industry. One condition under which an industry might be drawn into the state because of the exemption would be where two sites are available for the location of the industry. If both sites are equal in all other respects, which is doubtful, then tax exemption will make the difference. The type of industry likely to be attracted by tax exemptions are those interested in a quick profit at the lowest possible investment of capital. The exemption will give such a firm a competitive advantage over similar firms located in non-tax-exempt
states. This advantage will, of course, last only for the duration of the exemption.

These industries, sometimes termed "fly-by-night," are usually small. The capital investment is small and the exemption would also be small. However, such industries, by moving into a community, change the labor, wage, and other established economic patterns of the community. If the industry moves out at the end of the exemption period the community suffers. Examples of such industries would include hosiery, underwear, men's shirts, as well as some types of agricultural processing plants. The equipment used by such firms is easily moved and does not require special types of buildings nor are total power requirements high. Individually such plants are small and their closing affects only a small segment of the state; collectively, it is possible they may affect the total economy to a considerable extent. The effect would be more noticeable during a recession than in a prosperity period. The individual communities concerned might suffer a local recession from the closing of such plants. Some evidence has been found in other states where firms have moved out when the exemption period ran out. However, the majority of industrial plants developing in the South are interested in permanent locations. The salt industry is a permanent type of industry and it is doubtful if tax exemption is the attraction or even a major cause of development.

In this discussion of tax exemption it is not intended to leave the impression that tax exemption exerts no force in attracting new industries. Taxes are expenses or costs which must be paid by all business firms. Anything lowering costs of doing business will exert a pull on new industries. Other factors being equal, tax exemption will exert a strong
drawing force to aid industrialization. It is felt, however, that tax exemption is not a major drawing force.

Along the same line as tax exemption, are such plans as the BAWI (Balance Agriculture With Industry) started by Mississippi. Such plans have been set up in a number of southern states and already some signs of trouble are being recognized. Such plans have usually allowed local communities or counties to bond themselves to provide buildings for new industries. Along with the buildings, certain tax exemptions are given by the states to those industries selected to receive the exemptions. Complaints have been raised that this system gives the new firms an unfair advantage over the firms already established in the field. This may arise, for instance, because title to the building rests with the community. The industrialist is merely leasing such facilities; hence his lease payments are deductible as costs from certain taxes. The textile industry in particular has complained because the firms owning their facilities do not have this advantage. The textile firms have been able to show that the firms enjoying the benefits of BAWI have about a two per cent cost advantage in bidding on contracts for the production of goods. It has also been pointed out that firms leasing the property are not worried as much about the fixed cost investment in case of failure. Most of the firms entering such arrangements are small and have little fixed capital investment. If times get bad, they simply fold up, leaving the community with an empty building and a heavy bonded indebtedness. Whether such a plan will be used

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in Louisiana at some future time cannot be forecast. As far as the salt industry is concerned, it is questionable that the industry would receive any direct benefits from such a plan because of the nature of the salt production. It is unlikely that any community would construct salt producing facilities and lease them to some operator because of the large amount of fixed capital investment required to open large-scale salt producing facilities.

Under some conditions the granting of tax exemptions and similar inducements to industry may work to the ultimate advantage of the community in which plants are established. If the inducements are limited to partial exemption, as well as limited in duration, it is possible that the total taxes paid by the enterprise may offset the exemption. This factor, plus the increase in wages to members of the community, will increase the prosperity of the town. Such an increase will result when a new industry is a permanent one suited to the pattern of development of the area.

In a study made by the National Planning Association's Committee of the South, of the reasons why industry moves to the South, it was found that none of the major plants coming into the South since World War II listed tax exemptions or special privileges as being of major importance. These industries came for other reasons: principally, raw materials, developing markets, and in some instances, labor. Such industries moving into the South did not turn down tax exemptions when available. They did,

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However, on several occasions turn down offers of buildings and similar facilities. It is doubtful that exemptions for expansion are necessary once the industry is established. This idea is especially true where the industry concerned is of a permanent nature and has a heavy investment in capital equipment. Expansions take place not because of tax exemptions but because of expanded markets which make necessary the expansion of production facilities. An industry cannot be blamed for taking the tax exemption when it is available, but the wisdom of such exemptions is open to question.

Any discussion of tax exemption naturally leads to a discussion of the entire tax structure as it affects industry. It is outside the scope of this study to attempt to measure the relative burden of taxes on the salt producers of the various states. The salt producers in Louisiana are probably subject to, on the average, no greater burden than that met by producers in other states. This conclusion seems valid under the assumption that if the taxes in this state were more burdensome, the salt producers would not be expanding facilities but would be leaving the state as facilities were worn out. It is possible that the salt producers in the state may enjoy a tax advantage over producers in other states during the period in which tax exemption operates. However, this industry is permanent and the transitory tax exemption would have little effect upon the long-run tax burden of the industry. One tax which is levied by the state on the salt industry is different from the ordinary type of business or industrial tax. This tax is called a severance tax. The severance tax may be defined as follows:
The severance tax may be defined as a compulsory contribution exacted from individuals or firms engaged in the extraction or severance of natural resources from the soil or water, the amount of the tax being measured by the quantity of the natural resources severed or by the value of such resources when severed.

Severance taxes on the salt industry, along with other natural resources of Louisiana, are not new. The first severance tax to be placed on the salt industry was embodied in, Act No. 196 of 1910. This act placed a tax of one-fifth of one cent on each ton of salt produced.71 The act was not in effect long for it was declared unconstitutional. The legislature of 1912 enacted a new law, Act 209 to take the place of the earlier law. The only real change made from the 1910 act was in changing the base from a "quantity" to a "value" figure in computing the tax. No important change was made in the severance tax law, as it affected the salt industry until the passage of Act No. 140 of 1922, which placed a severance tax of four cents per ton on all salt produced in the state.72 It will be noted that in the 1922 act the base was returned to a quantity basis, and this basis has been used since 1922. The only other change made in the severance tax on salt took place in 1948, when the rate of taxation was increased to six cents per ton. It was also felt that salt in brine should be given a different rate, and it is taxed at a rate of 0.005 cents per ton.

The severance tax was placed on the various minerals of Louisiana with a conservation as well as a revenue idea in mind. It was desired to

71Ibid., p. 44-45.
prevent the waste of the natural resources of the states, but at the same time to allow the wise development of such resources in response to market demands. The total yield of the severance tax to the state has been good, ranking high in the list of sources of revenues during the past fifteen years. The amounts yielded by the tax on salt have not been particularly outstanding, even in recent years when salt production has been high. In 1950, the total revenue from the severance tax on salt, including rock, evaporated, and salt in brine, was only $57,790.43. In 1949, the revenue was higher with a total of $61,144.02, while in 1948, the total was $50,945.41. As to the effect of such a tax on the development of the salt industry, it is felt that as long as the tax is no higher than it is, development will continue if the market demand continues to rise.

The conclusion is based upon the continued existence of this strong market demand, and the present state of taxation, not only in Louisiana but also in the other salt producing states.

The existence of a market for the finished product is always of prime importance as a locating factor for any industry. The salt industry is no exception. The early development of the industry in Louisiana was in response to the growing demand for salt for human and animal utilization. The use of Louisiana salt for Louisiana produced chemicals did not develop until the decade of the 1950's. The development of the petroleum refining industry, a large user of the end products of the chemical companies utilizing salt, brought a need for certain chemicals made from salt. While

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73Sciennial Reports of the Department of Revenue, State of Louisiana.
the petroleum industry was new in the state, such chemicals were imported from other producing areas. The increasing importance of the petroleum industry increased the market for salt, and salt using chemical industries began development in Louisiana. Thus the development of a home market aided in the development of a new industry in the state.

The chemical industry, as well as the producers of salt in its various forms, are able to produce more salt and/or salt products than the market in the state can absorb. It is necessary therefore, to seek markets in other states and areas if large-scale production is to continue. Such markets can be and are developed where it is possible to reach the market cheaper than other producers who might supply such markets. It is in such cases that the cost of transportation becomes very important.

The Louisiana salt producers have available a number of types or means of transportation for the finished products. All of the producers of chemicals, using salt as the basic raw material, are located at points where rail, barge, ocean, and highway transportation can be utilized. In the case of producers of salt, all of them have access to rail, or truck transportation at the mine. In only one case is it necessary for a large producer to move his product any distance to reach water transportation facilities. The producers of salt in Louisiana have been known to sell their products in as many as twenty-four states as well as Cuba and Puerto Rico. Salt from at least one of the Five Islands, Avery Island, is shipped out by barge to other states and large quantities move in bulk by rail. Most of the large shipments out of the state are understood to be bulk shipments. This is understandable when it is recalled that railroad rates
on bulk shipments are lower than on package shipments. The packaging
cost of salt would be no higher at the point of distribution and the
saving on transportation cost would probably justify the establishment
of packing facilities at the market. One possible reason for large
shipments out of the state is to be found in the fact that the Louisiana
salt producers, with the exception mentioned earlier, are controlled by
large national companies. These companies can ascertain their national
needs and increase or decrease shipments from areas as the demands
change. While this does not seem to have had any adverse effects upon
the Louisiana salt production facilities, there is always the possibility
that development in the state will be controlled by outside companies to
suit their needs. If the facilities were developed by local capital the
development might forge further ahead. On the other side of the picture
is the possibility that locally developed facilities would not have the
marketing information available to a large national concern.

The existence of tax exemption, favorable governmental actions
in the form of industrial legislation, markets in the state or within
favorable transportation range, all will operate to increase industriali-
sation of a state. The operation of these forces is, of course, contingent
upon the existence of the necessary natural resources within the state.
However, all the above factors will not operate to bring about indus-
trialisation unless the total cost of production remains below the selling
price of the finished product. If the potential producer is already oper-
ating a plant in another state, a move to the new area will not be profitable
in all cases. If the plant already in operation is relatively new, a
shift in production facilities will take place only if a change in tech-
niques or the possibility of a greater profit makes a move economically feasible. An increased market demand requiring the construction of new facilities would, of course, allow the new facilities to be built in the new territory, if the profit opportunities were present. The situation regarding movement of a plant to a new area would be somewhat different in the case of a plant which had depreciated to the point where replacement had become necessary. Under such conditions a move would be made if a greater profit could be realized or if the future profit possibilities were stronger in the new area. A move to raw materials, such as salt, turns upon the balancing of relative costs of production at the various potential locations. A growth of using industries in the area of a raw material will invite new companies into the area. Also, the development of new and improved shipping methods may allow an industry to take advantage of bulk shipment of a finished product to the market instead of moving the raw material to the market for processing. The recent development of an acid resistant lining for railroad tank cars allows the shipment of many chemicals which formerly were limited to small shipments because of the cost of transporting dangerous chemicals. This meant that raw materials for the manufacture of such products had to move to the market where the manufacturing took place. Now production may take place at the raw material. Such an improvement may add to the list of chemical producers operating in Louisiana. As transportation facilities are improved, or the cost lowered, the resource pattern is changed. Such changes enable the raw material producing or supplying states to gain manufacturing facilities as such raw materials are usually weight-losing resources. Materials of that nature usually exert a strong drawing force upon industries.
As these changes in techniques take place, the pull exerted by salt as a drawing force for further industrialization in Louisiana increases. The establishment of the salt using chemical industries in Louisiana has resulted in the increased availability of chemicals for other industries. Some of the chemicals being produced from salt are used in the manufacture of glass. At least one glass factory is already in operation in the state. Still another chemical product of salt is necessary in the production of alumina. The alumina industry is currently expanding in Louisiana. The use of chemicals produced from salt by the petroleum industry is well-known and this industry is also expanding. The pulp and paper industry, textiles, synthetic rubber, and many other industries use salt or some product made from salt. The exact pull exerted by the salt resources of Louisiana upon further industrialization is difficult to measure because of the many and varied factors entering the industrial location picture. As the markets for the finished products of the salt using industries develop, so will the salt industry increase its place among the industries of the state. The salt resources have attracted a number of chemical plants and they in turn have attracted other industries. The difficulty of isolating the effect of the raw material upon these secondary industries depending indirectly upon salt, has kept the salt industry from the recognition it should receive as the supplier of a valuable industrial raw material.

It would appear that the further development of the Louisiana salt industry depends, to a large extent, upon the ideas of individuals and companies located outside the state. It is, of course, impossible to say what course the industry might have taken had it been developed by
local capital. It does appear that the development has probably gone
further because production facilities have been established with the aid
of outside investment funds. The existence of a national marketing system,
coordinated production facilities, long-range planning and development
programs, set up by national producers undoubtedly have aided the industrial
development of Louisiana.

With the present known resource pattern, including the techniques
available for the utilization of the resources, it seems that future
development of the salt industry in Louisiana must await future demands.
Unless the industrial demand increases, either because of new uses being
developed for salt or an expansion of already known uses, salt production
for industrial purposes seems to have become stabilized. The human and
animal utilization will continue to provide a small, fairly uniform rate
of increase in the consumption of salt. This demand assumes that the
present rates of population growth continue. There is always the possibil-
ity that technological changes will bring with them a new demand or an
expansion of an old demand, but such changes cannot be foreseen.

One avenue that needs to be explored further as a means of possible
expansion of the Louisiana salt industry, is the foreign market. As pointed
out earlier, there are areas of central and South America where adequate
supplies of salt are lacking or difficult to obtain. As the income level
and standard of living of those areas are raised the amount of salt used
will increase. The increase in demand will not be large for salt to be
used by humans. Rather, the increase in consumption of salt will come
indirectly from the increased demand for those items of general consump-
tion which require salt in their manufacture. The development of such a
market would not only increase the production of salt in Louisiana, but would probably require an expansion of the secondary industries using the chemicals manufactured from salt.

The salt industry of the state would also benefit from the establishment of other new industries within the state, especially those industries requiring salt or products made from salt. The establishment of such industries would not only benefit the salt industry but the state as well. An enlargement of the pulp and paper industry, for example, backed up by a strong policy of wise forestry, would aid the salt industry as well as all segments of the economy of the state.

Within the framework of a well-balanced economy in Louisiana, the salt industry would find an increasing demand for its products. A balanced economy for Louisiana, based upon a knowledge of the resources and capabilities of the state would provide additional jobs, more income, and a wealthier population. Industrialization for the sake of industrialization is to be avoided. Unless all the factors previously discussed as necessary for permanent development are present, the industries attracted to the state will be transitory in nature. Louisiana can build a sound economy with a permanent industrial base in which the salt industry will occupy an important place, provided the necessary planning is done before additional industrialization begins. Such planning could well be undertaken by the state acting in cooperation with industry.
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John Wright Chisholm was born in Jackson, Mississippi, March 18, 1914. He was graduated from the Matador High School, Matador, Texas, in 1932. He attended Weatherford Junior College, Weatherford, Texas, during 1932 and 1933. After completing his course of study he transferred to Baylor University, Waco, Texas. He received his A. B. degree from Baylor University in the spring of 1936.

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From 1939 through the spring term of 1942 he was an Instructor in the School of Commerce and Business Administration of the University of Alabama. In June, 1942, he entered the Army of the United States, in which he served forty-four months. Discharged from the Army, with the rank of 1st Lt. in February, 1946, he returned to teaching at the University of Alabama for the spring and summer term. In the fall of 1946 he returned to Louisiana State University as an Instructor in Economics.

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Title of Thesis: Economics of the Salt Industry in Louisiana

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