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THE ALUMINUM INDUSTRY OF THE UNITED STATES, 1940-1947

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

Paul Timothy Hendershot
B. A., Henderson State Teachers College, 1938
M. A., Louisiana State University, 1941
August, 1947
TO

THERESA, MARY and CLAUDE
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This dissertation constitutes an economic history of the aluminum industry of the United States during the years from 1940 to 1947. The study was undertaken to discover what important industrial changes had been made in the industry during that period, and to relate these changes to the field of economics. Purposes which were outlined for the study were as follows:

1. To continue the study of the aluminum industry of the United States from the year 1940 to the present time, in order to show what has taken place during the "defense," "war," and "postwar" periods of the past seven years;

2. To present, both in terms of economic history and economic theory, the major economic aspects of the vast aluminum industry as it developed during the years from 1940 to 1947; and

3. To show the postwar economics of the industry, as the field today is influenced by the extensive productive capacities developed during World War II and by the entry into the field of production of competitors of the Aluminum Company of America, which for many years held the outright monopoly of ingot aluminum production in the United States.

The material has been presented in five chapters. An historical background of the industry prior to 1940 has been presented in Chapter I. Various phases of the history
of the aluminum industry have been discussed, such as (a) the period of discovery and experimentation; (b) early commercial manufacture of aluminum; (c) the status of the industry near the turn of the century; (d) the role played by the Aluminum Company of America in World War I and in the interim between the two world wars; (e) court litigation concerning monopoly control in the industry; and (f) the position of the aluminum industry in 1940, when the United States embarked upon its defense program.

Changing conditions in the aluminum industry after the beginning of the defense program of the United States are described in Chapter II. The various stages in aluminum production which were affected by the program of expansion were: (a) mining of bauxite and other ores; (b) production of alumina (reduction of the ores); (c) production of pig aluminum (reduction of alumina to the virgin metal); (d) the fabrication of ingot aluminum; and (e) production of finished aluminum products. The expansion program which was inaugurated by the Aluminum Company of America in 1940 is described. A brief history of the entry of the Reynolds Metals Company into the field of primary aluminum production is given. The beginning of competition of Reynolds Metals Company with the Aluminum Company of America was financed through the Reconstruction Finance Corporation and its subsidiary, the Defense Plant Corporation. Activities of the Defense Plant Corporation
in the building of important alumina, aluminum, and fabrication plants during the emergency are an integral part of this chapter.

In Chapter III the history of the aluminum industry in World War II is presented under nine headings, as follows: (a) expansion of plant facilities to supply adequate amounts of aluminum for the war effort; (b) dispersal of the industry throughout the United States; (c) creation of potential post-war competition; (d) development of new alloys and processes in aluminum reduction; (e) integration of aluminum processes in one plant, as exemplified by the Reynolds plant at Listerhill, Alabama; (f) success of additional private companies in the aluminum industry during the war; (g) extension of the industry in the Southern and Eastern portions of the United States; (h) development of the new aluminum industry of the Pacific Northwest; and (i) a summary analysis of the total contributions of the aluminum industry to the war effort. These factors were instrumental in the breaking down of the great monopoly in primary aluminum which had existed prior to World War II.

The postwar aspects of the aluminum industry are presented in Chapter IV, which deals with such factors as the following: (a) surplus productive capacity resulting from aluminum industry expansion during the defense and war periods; (b) disposal of alumina, aluminum, and fabrication plants owned
by the Government; (c) analysis of administration policies in regard to disposal of aluminum facilities; (d) the partial settlement of the problems of disposal; and (e) the development of potential competitive enterprise for the postwar aluminum industry of the United States.

The postwar economics of the aluminum industry is the subject matter of Chapter V. Various interpretations of the events which occurred in the industry during the years from 1940 to 1947 have been made in the light of economic theory. It has been found that the postwar economics of the industry differs greatly from the prewar situation. The enormous expansion of the industry during the emergency gave rise to surplus capacity which has not been utilized to its fullest extent in the brief period which has elapsed since the end of World War II. The presence of active competitors of the Aluminum Company of America in the field of primary aluminum gives promise of a great expansion of production and consumption of the metal in the years to come. Present day conditions point to the continuance of both Reynolds Metals Company and the Kaiser interests in the various phases of production and fabrication of the metal, but the long run analysis of the situation will depend upon developments after the periods of leases of government-built facilities run their course.
Potential competition of Canadian producers of aluminum with American interests is considered as a definite possibility, particularly in the absence of postwar cartels in the industry. Consideration is given to the philosophy of cartelization of the postwar aluminum industry. The establishment of a philosophy of abundance in the aluminum industry appears as the best solution to afford a maximum amount of aluminum products in postwar markets. Scarcity production and high prices in the field have militated against extension of uses of aluminum in the past. A flexible price program, accompanying abundant production of the metal, will result in the maximization of consumer satisfaction in the use of aluminum. Producers may find it to their advantage to make their profits on the basis of volume production, with low profit per unit, rather than restricted production and high profit per unit.
INTRODUCTION--HISTORICAL BACKGROUND OF ALUMINUM INDUSTRY
DEVELOPMENT IN THE UNITED STATES

The history and economic development of aluminum show a rapid growth hardly equaled by that of any other industry. Students of the aluminum industry have had a most fertile field for study. The literature describing the industry is considerable and in a variety of forms. Technical studies describing the industrial processes involving aluminum production have been presented in various books and periodicals. Economic studies covering more than half a century have described the unique aspects of monopoly or monopolistic competition. In some treatises writers have sought to show the economic and historical development of the aluminum industry from the standpoints of both practice and theory, particularly in the light of the elements of monopolistic competition. In this study an attempt is made to trace the economic development of a great industry, and, also, to apply some of the facts in the field of economic theory to the interpretation of the aluminum industry as it exists at the present time.

Certain major purposes may be set forth in regard to the present study of the aluminum industry of the United
States during the years from 1940 to 1947. These purposes as outlined below will serve as the main guide for the present descriptive analysis and interpretations which the study of the aluminum industry encompasses. Three main purposes are presented, as follows:

(1) To continue the study of the aluminum industry of the United States from the year 1940 to the present time, in order to show what has taken place during the "defense," "war," and "postwar" periods of the past seven years;

(2) To present, both in terms of economic history and economic theory, the major economic aspects of the vast aluminum industry as it developed during the years from 1940 to 1947; and

(3) To show the postwar economics of the industry, as the field today is influenced by the extensive productive capacities developed during World War II and by the entry into the field of production of competitors of the Aluminum Company of America, which for many years held the outright monopoly of ingot aluminum production in the United States.

These purposes, as outlined here, will be carried out as a program to build upon previous work done by the writer in presentation of the development of the aluminum industry of the United States prior to 1940. That previous

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study of the history and economic implications of the aluminum industry served to enhance the writer's interest in aluminum, as well as to show the possibilities of further studies of this important industry. The present study appears to be of even greater significance, because of the rapid expansion of the aluminum industry during the past seven years.

Many facts appear in the history of the aluminum industry of the United States, but the recent wartime expansion of the industry, with the shifting of a great part of the industry from one location to another, constitutes an economic phenomenon needful of description. Some of the most important features which serve to show the greatness of the industry are presented in a publication by three University of Washington professors, whose work was published in 1944. Four reasons given by Professors Engle, Gregory, and Mosse for the

2 Nathanael H. Engle, Homer E. Gregory, and Robert Mosse, Aluminum (Chicago: Richard D. Irwin, Inc., 1944). This book was published as one of the "Industrial Series" of the Bureau of Business Research of the College of Economics and Business, University of Washington, Seattle. It is one of the most recent published surveys of the aluminum industry. Its chief interest in aluminum appears to be from the standpoint of the metal's market appeal, because the sub-title of the book reads, "An Industrial Marketing Appraisal." However, it should be noted that this book does make very significant contributions to the entire field of study of the aluminum industry. Although it was published during the war, it served an interesting purpose, inasmuch as the authors themselves stated that it was written to give a picture of the aluminum industry as it would be when the war ended, and to serve as a guide both to businessmen and the officials of the national government in their decisions on future policies in regard to the aluminum industry of the United States.
publication of their book, entitled Aluminum, are as follows:

1. the enormous expansion of aluminum producing capacity during the defense and wartime periods;
2. the depletion of the limited bauxite reserves of the United States;
3. the shifting of the center of gravity of the aluminum industry from the East and Southeast to the Pacific Northwest; and
4. the beginning of competition in the field of primary aluminum production, an area which historically has been monopolized by only one producer in the United States. Many additional specific facts connected with the aluminum industry in the years from 1940 to 1947 will be presented. Various economic interpretations of the facts will be given in the presentation of material throughout the study.

It is felt that in the first chapter of the present study a brief resume of the history of the aluminum industry will serve as an introduction to the more detailed discussions of recent wartime aluminum industrial and commercial developments. An understanding of the past is most essential in

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3 As the title of this first chapter indicates, its chief purpose is to acquaint the reader with the facts in the case in terms of the pertinent historical background necessary to the understanding of the aluminum industry of the United States after 1940. This summary can in no way substitute for a more careful analysis of the industry for those years from 1886 to 1940, but will merely serve to place the present study on a sound historical foundation. A wide variety of publications are available to the reader concerning prewar conditions in the industry. Many of the references are cited in this study.
order to understand and interpret the present. This background is perhaps more vitally applicable in the aluminum industry than in any other type of business enterprise, mainly because of the violent upheavals that have occurred in the industry in a very short period of years.

**Discovery and Experimentation in Aluminum Production:**

At one time aluminum was more precious than silver and gold. Its rarity even in the nineteenth century may be shown by the fact that at the time of Emperor Napoleon III of France a set of aluminum knives, forks and spoons was used for state occasions, while the gold and silver ones were used for everyday purposes. Less than 100 years ago (in 1852), the price of aluminum was $545 per pound, but extensive scientific research within a few years had caused increased production and a consequent decline in price. Within ten years, in 1862, the metal sold for $12 per pound, but not in large or commercial quantities. It remained for many years simply an oddity in chemical laboratories, until Charles Martin Hall, in the United States, and Paul Heroult, in France both discovered the electrolytic process of aluminum reduction.


The discoveries of these two men were made in the year 1886, while each was working independently of the other and knew nothing of the work of the other chemist. It was one of those strange coincidences in history: the invention was perfected simultaneously by two men who had not known anything of the work of the other inventor. Charles M. Hall obtained the patents in the United States for his invention, and gave the impetus to the vast American aluminum industry. In the same manner, Paul Heroult obtained the European patents, and the great aluminum industry of Europe is the fruit of his invention.

Economic historians of the aluminum industry have noted the strange coincidence that gave exactly the same type of invention to two widely separated inventors in the very same year. Such a coincidence is not a great rarity in the field of industry, but it adds interest to the study of the aluminum industry. A parallel instance in the field of study of economic theory was the discovery of marginal utility analysis. Economists will recall the fact that three men were mainly responsible for the early development of the marginal utility school of thought in economics. Jevons, Menger, and Walras were the founders of the Austrian School of thought. These three men arrived at their own basic conclusions independently of each other, and in different nations of Europe, at approximately the same time. Each of these men had expounded his own philosophy of economic theory concerning marginal utility before he knew of the work of the other two economists.

The lives of Charles M. Hall and Paul Heroult were most interesting from the standpoint of their similar biographies, and are of particular interest to the historian of the aluminum industry. For a more detailed analysis of the period of discovery and experimentation, plus intimate details on the lives of these two men, the reader is referred to the writer's previously cited work, in which Chapter II is entirely devoted to this period of discovery and experimentation in aluminum reduction.
It must not be felt by the reader, however, that Charles Martin Hall and Paul Heroult were the only important men in the history of aluminum research and experimentation. Many other men had preceded them in the field, and had made valuable and lasting contributions. A list of these men would include the names of such distinguished scientists as Lavoisier, Davy, Oersted, Wohler, Ross, Berzelius, Bunson, Deville and Castner. Particularly it must be noted that both Deville and Castner had produced aluminum on a large scale for their day, although neither had been able to set up commercial production of the new metal. Hamilton Y. Castner, an American, had succeeded in producing aluminum at the rate of about 500 pounds a day in 1889, but its cost at that time was about $4 per pound.

This list does not exhaust the complete roster of men who contributed to the scientific discovery in the field of aluminum through the ages. However, it does include those men whose contributions have been most outstanding, and to whom the great majority of credit for pioneering in the field has been given.

At least two writers have given enormous credit to Hamilton Young Castner for his great work in the aluminum field in the United States even before Charles M. Hall's revolutionizing discovery of the electrolytic reduction process for aluminum. It is impracticable at this point to recount the facts they have presented, but the reader is referred to the two following articles about Castner: V. H. Lord, "Hamilton Young Castner (1858-99); a Forgotten Pioneer in the Aluminum Industry," Journal of Chemical Education, Vol. XIX, (August, 1942), pp. 353-56; and John M Oskison, "The American Creator of the Aluminum Age," World's Work, Vol. XXVIII, (August, 1914), p. 439.
In the discovery of the electrolytic process in 1886, Charles Martin Hall actually laid the cornerstone for the great aluminum industry of the United States. He opened up a wide field for the expansion of this new metal into the railroad, automobile, airplane, and other types of industries which use aluminum in such huge quantities at the present time. Extension of the uses of the metal has been rapid since Hall's day. Aluminum is employed today in such a variety of ways that a list of its uses covers several pages. Later chapters in the present study will show the particular adaptations of aluminum to industrial usage, mainly in terms of demand and supply, the possibility of expansion of its industrial and commercial uses, and possible substitutes for aluminum.

Early Commercial Manufacture of Aluminum:

Commercial manufacture of aluminum was developed slowly, mainly because Charles M. Hall found difficulty in convincing industrialists of the importance of the new metal. The early history of his attempts to secure the interest of capitalists constitutes an important chapter in itself, but

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9See Engle and others, op. cit., "Appendix 3," pp. 425-34. A complete alphabetical list of the many uses of aluminum is given in this reference. It is difficult to imagine all the varied uses of aluminum, until confronted with such a complete list, which extends from "accessories" to "xylophones." The technical and chemical qualities of the metal have made it a versatile light metal.
his later successes tend to make the early trials of a young inventor appear less significant. After many failures to attract capital, Hall made contact with a Pittsburgh concern, the Pittsburgh Testing Laboratories, Inc. As soon as Hall had convinced Captain Alfred E. Hunt of the importance of his invention, a reorganization of the Pittsburgh Testing Laboratories, Inc., was accomplished, and the Pittsburgh Reduction Company was founded. The history of this company is relatively short, but it is most important to the history of the aluminum industry of the United States. This new company took over Hall's process and operated it, with a beginning capital of $20,000. From this rather meager beginning, the industry grew into the industrial giant which is known today as the Aluminum Company of America. The company had been reorganized with a capital of $1,000,000


11 "The Aluminum Company of America," Fortune, Vol. X, (September, 1934), p. 49. This article gives one of the most interesting accounts of the early history of the industry. The human side of the story is well presented, along with many of the important facts concerning capitalization of the Pittsburgh Reduction Company.
in 1889, and was still known as the Pittsburgh Reduction Company until it became the Aluminum Company of America in 1907.

Two prominent families contributed to the success of the early company when it needed both business acumen and real financial assistance. These two families, which remain today as synonyms of power in the aluminum industry of the United States, were the Davis and Mellon families, represented in the early years of the industry by Arthur Vining Davis and Richard Beatty Mellon. Great success attended the attempts at commercializing the aluminum production which Hall had initiated. The net result was that millionaires were made in the field of aluminum in the United States.

In this study, the Aluminum Company of America will hereafter be referred to simply as Alcoa, since that is the name which most writers have attached to it. One distinction should be made, however. In Tennessee there is a city which is known as Alcoa, but when this city is mentioned at any place in the discussions, it will be designated as Alcoa, Tennessee. Any future references to the company will simply be to Alcoa.

Arthur V. Davis, together with Charles M. Hall, officiated at the birth of the aluminum industry proper when, on Thanksgiving Day, 1886, he and Hall worked a 24-hour stretch to produce the first aluminum at the Pittsburgh plant. Davis became a millionaire in the aluminum industry, and was the president and chairman of the board of directors of Alcoa for a period of many years.

Richard B. Mellon, who succeeded to the presidency of the Pittsburgh Reduction Company in 1899, represented the famous Mellon company which later caused Alcoa to become known as a "Mellon company." Apparently this family's relationship with Alcoa was the cause of an amazing incident in
Fortunately Charles M. Hall had been shrewd and had retained a 40 per cent interest in the company. This foresight made him a millionaire along with the others. The great success story of Charles M. Hall has made him one of the unusual inventors of the United States. It gave him an opportunity to become a prominent benefactor of Oberlin College, in Ohio, where his experiments had reached a successful conclusion. Likewise, Berea College, in American history in the early 1920's. At that time both Andrew W. Mellon, the Secretary of the Treasury, and Harlan F. Stone, the Attorney General of the United States, were in President Coolidge's Cabinet. As the Attorney General, Stone was interested in bringing monopoly suits against Alcoa. But this prosecution, if continued, it had been alleged, would have been embarrassing to Secretary Mellon. It is interesting to note that at the time Harlan F. Stone was kicked upstairs to the Supreme Court of the United States. His successor, John J. Sargent, did nothing to jeopardize the position of Alcoa or Secretary Mellon. In fact, the Republican era following the First World War was one of almost complete laxity in the matter of anti-trust proceedings against monopolies after Stone assumed his position as an Associate Justice of the Supreme Court of the United States.

Holmes, op. cit., p. 176. The story of Hall's close association with Dr. Frank F. Jewett, his chemistry teacher at Oberlin, is one of the stories which is almost without parallel in the educational circles in the United States. It is truly a great example of the influence of teachers on young minds and of the power of both teacher and pupil to work out difficult problems together. It was this association which influenced Hall to leave a huge bequest of one-third of his $27,000,000 estate to Oberlin in 1914.
Kentucky, has been a significant beneficiary of Hall's generous philanthropies.

**Status of the Aluminum Industry Near the Turn of the Century:**

Near the end of the nineteenth century, aluminum had been established as one of the important new metals for use in the twentieth century. The Pittsburgh Reduction Company was one of only three companies in the world which were producing aluminum at that time. An interesting account written by Samuel Rideal in 1896 gives production figures for several years, as follows:

According to Richards, the world's production up to 1892 was only 2,586,000 pounds; but in 1893 about 1,474,000 pounds were produced, and in 1894 a total of 2,244,000 pounds. Last year (1895) the American output has been estimated at 850,000 pounds, and it is believed that the production of the present year will reach over 2,000,000 pounds, as the Pittsburgh Reduction Company will have ready by the first of June plant capable of making 10,000 pounds per day.

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15 Other bequests made by Hall include a large sum to the American Missionary Society and approximately one-sixth of his estate for the advancement of education in the Near and Far East. While not of too much significance directly to the economist or economic historian, nevertheless these facts concerned with Hall's fortune serve to extend one's appreciation of the power of a great new industry to be a boon to the world in both an educational and religious way. Thus it may be seen that aluminum has been of great value in many ways, and not only in terms of its service to the economic system in which we live.

It is remarkable that the closing years of the nineteenth century saw such an astounding development of the new industry of aluminum manufacture. It was truly the dawn of the "Age of Aluminum," as many of the writers of the period chose to call it. Patent troubles resulted in some court litigation, but in the settlement of the cases the Pittsburgh Reduction Company did not lose too much in terms of control over the new industry, although it did have to pay damages to the complaining company over a period of years.

In reality, the court litigations may be said to have benefited both the company and Hall in some ways. Fortified by adequate financial backing, the company looked to the twentieth century full of hope for the future of the aluminum industry. As time has shown, the hope was not in vain.

17A brief history of the court litigations concerning aluminum patents will show that infringement was charged against the Pittsburgh Reduction Company by the Electric Smelting and Aluminum Company, for whom Hall had worked in 1887-1888. The case arose out of the granting of patent rights to C. S. Bradley for the reduction of aluminum compounds, in 1892. Actually, it should be noted that the final court decision was rendered against Hall and the company, and that until the expiration of the Bradley patents in 1908-1909, damages and royalties had to be paid to the Cowles company, which had taken over Bradley's rights. When it is stated that the court litigation benefited Hall and the company, it is meant that, although payments had to be made, the net result was the strengthening of the company through the court's permission for the continuation of the company's activity in the production of aluminum. See H. T. Warshow (ed.), Representative Industries of the United States, (New York: Henry Holt and Company, 1928), p. 8.
Rapid expansion of the aluminum industry of the United States was made possible early in the twentieth century by a series of events which left their imprint upon its structure. These events were: (1) the changing of the name of the Pittsburgh Reduction Company to the Aluminum Company of America; (2) the program of expansion inaugurated by Alcoa; (3) the early attempt of Alcoa to fix prices and control the industry as a monopoly; and (4) the partly successful attempts of competitors to gain a foothold in the industry, particularly in the fabrication of aluminum. The recapitalization of the Pittsburgh Reduction Company took place in 1889. This move was followed in 1907 by the changing of the name of the company to the Aluminum Company of America. The new company immediately launched out upon a vast program to gain control of the essential mines (bauxite areas), most of the important reduction plants and fabricating facilities, and the greater part of the important distributing agencies for the products of aluminum. Even early in the century an early and partly successful attempt by Alcoa to fix prices and control the industry as a monopoly was made.

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18 Monopolies customarily find that price-fixing is one of their stocks in trade, and the fact is that Alcoa must have realized this from the beginning. With such extensive control over bauxite deposits, fabricating plants, and the marketing of aluminum ingots, sheet aluminum, wire, tubing, and other products, Alcoa found that it could dictate terms and prices to most of the companies with which it dealt. See Report of the Federal Trade Commission, House Furnishings Industry, Vol. III, (Washington: Government Printing Office, 1925).
Later attempts of competitors to gain some control in the industry were hindered, in large part, with the possible exception being in the fabricating business. Some companies were attracted to this phase of the industry. A virtual monopoly in the production and of the aluminum industry existed until after the entry of the Reynolds Metals Company and the Olin Corporation into the field of ingot production after the United States embarked upon its defense program just prior to World War II. The significant fact is that Reynolds and Olin did not enter the field of primary aluminum production until after 1940. Even at that late date, the entry of potential competitors to Alcoa was made possible by the United States Government, through the Reconstruction Finance Corporation and its subsidiary, the Defense Plant Corporation, which financed enormous plant expansion during defense and wartime periods.

19 These statements move us a little ahead of the historical trend of our story, but they serve to show the necessity of the historical background. Entry of the federal government into the field of aluminum production in reality was not such a surprising move, because it was a well-known fact that the plant capacity of Alcoa at the time of the beginning of the defense activities of the United States was woefully inadequate to supply all of the needs of the nation's defense program. Reynolds Metals Company and the Olin Corporation both were in a favorable position to get federal assistance in their moves into the field of ingot aluminum production. The subsequent entry of the United States into World War II enhanced the position of these two companies as it did all wartime industries. Later chapters will treat adequately the story of the Reynolds Metals Company and the Olin Corporation in their influence on the aluminum industry after 1940.
Early complaints against Alcoa were the order of the day after 1907, with some of the companies themselves charging Alcoa with price fixing and monopolistic control. Many of the criticisms against the company, however, were made by companies which previously had thought aluminum to be entirely impracticable from a commercial viewpoint. Since Alcoa had been the company to demonstrate the feasibility of aluminum, it had gone ahead of the other companies both as a producer and as a fabricator of aluminum. Some of the other companies which entered the field as fabricators soon began to complain of the monopoly of Alcoa as a producer. Nevertheless, the position of Alcoa was so secure that in 1908 and 1909, when the Bradley patents ran out, no new company arose to challenge Alcoa's supremacy in the field of primary aluminum production.

20 A case in point is the experience of Charles M. Hall with the Electric Smelting and Aluminum Company, of Lockport, N.Y. He had been unable to convince the company of the practicability of commercial production of aluminum, and his contract with them had been terminated at the end of one year. However, this was the same company that later brought suit against him for infringement of patents, and which also charged Hall's company with monopoly practices. The story of this episode is given fully by John M. Oskison, op. cit., p. 444.

21 Many factors may aid an infant industry in its opening drive for supremacy in an industrial field. In the case of Alcoa, it apparently was a combination of many factors, such as an early start, control of essential patent rights, the domination of both production and fabrication fields in the aluminum industry, and the advantage of a protective tariff. As in the case of other types of industries, however, the aluminum industry continued its rise to power even after the essential patents had run out. The reason was that even then other companies could not hope to compete favorably and on equal basis with Alcoa.
Many companies in the early decades of the century continued their antagonism toward the Alcoa monopoly by openly advocating the importation of foreign aluminum. A constantly increasing supply of scrap aluminum gave them a great measure of relief. These companies did not look upon Alcoa as the "father of the aluminum industry," but rather as the "dog in the manger," which was biting the hands of other industries that gave it the extensive markets for the sale of aluminum products. The Ford Motor Company and General Motors Corporation may be cited as examples of companies whose dependence on Alcoa placed them in a disadvantageous position in terms of bargaining for the essential aluminum parts that went into automobiles produced by them. These two companies employed two solutions to reduce their dependence on Alcoa's fabricated products. Henry Ford simply turned to other aluminum fabricators after he had been unsuccessful in his attempts to fabricate the metal for himself. General Motors Corporation used a different method, that of using smaller and smaller quantities of aluminum in its cars. General Motors products, even in the modern era, contain smaller amounts of the metal than those of other similar companies.

The Ford Motor Company, the Bohn Aluminum and Brass Corporation, and the Bausch Machine Tool Company were three examples of potential competition to Alcoa in the early years.
of the twentieth century. It must be pointed out, however, that Ford's attempt to become a fabricator was an unsuccessful effort to rid himself of dependence on Alcoa for materials for his cars. After spending about $5,000,000 in setting up shop equipment with which to make the necessary parts for his automobiles, Ford was faced with rising prices of ingot aluminum during World War I. The net result of his attempt at fabrication was the complete scrapping of the $5,000,000 worth of equipment. His decision was to turn to steel as the solution of his problems. This decision has had an important long-run effect upon the market for aluminum in the automobile industry. It accounts in great measure for the difficulties faced in later years when producers of aluminum sought re-entry into the automobile industry as a potential market for the metal.

The stories of Bohn Aluminum and Brass Corporation, in its attempt to withstand pressure from Alcoa, constitute another interesting phase in aluminum history, to which much attention has been given by many writers. The significant

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22Full particulars concerning this bold move on the part of Henry Ford may be obtained from the following source: "The Aluminum Company of America," Fortune, (September, 1934), op. cit., p. 100. The story shows the extent to which one industrialist may be moved to change his entire plans when he is subjected to pressure from another industrial group or from the economic system. In this case, particularly, it was a combination of both, because Ford had stood for two raises in aluminum prices before he abandoned his whole plan for fabrication of aluminum.
feature about this company is the fact that it still exists as a strong company in aluminum fabrication. Additional information is on record about a famous quarrel between Alcoa and the Bausch Machine Tool Company. The net result of the trouble was that Alcoa came out on top in a series of arguments over United States Navy contracts and the new water-power sites on the Saguenay River, in Quebec, Canada.

Many writers, including H. T. Warshow, have shown that the history of the aluminum industry of the United States in the twentieth century, up to the time of World War II, had been mainly a history of Alcoa and its activities. As Warshow has stated:

Monopolization of the bauxite deposits of the United States by this company and its monopoly on the domestic production of aluminum, which is fortified by high import duties, make it impossible to consider conditions in the aluminum industry separately from the position of the Aluminum Company of America.

Professor Donald H. Wallace, whose book, Market Control in the Aluminum Industry, is a classic in discussions of the aluminum industry of the United States, stated the case

23 "The Aluminum Company of America," Fortune, (September, 1934), op. cit., pp. 100-02. This article gives a full story not only about the Bohn Aluminum and Brass Corporation, but also about the troubles that the Bausch Machine Tool Company had with Alcoa through the years.

briefly when he said that "for the student of monopolistic and competitive forces the aluminum industry presents an unusually interesting specimen."

The extent to which foreign competition had been early eliminated from the American aluminum scene can be shown with reference to the attempt to establish a French company, known as L'Aluminum Francais, tried to get into the production field in this country in 1913. It was organized in the United States as the Southern Aluminum Company, but was under the control of the French concern. This potential producer and competitor to Alcoa began a plant at Badin, North Carolina in 1913, but partial completion was all that was possible before the outbreak of World War I. The French company had been forced to withdraw, and the result was that Alcoa was enabled to purchase the properties which had been owned by the Southern Aluminum Company. This move served to eliminate the threat of foreign competition on American soil, and since that time no foreign producer has had the audacity to erect plants in the United States to compete with Alcoa in ingot aluminum production.


26 This incident appears to be adequate proof of the supremacy of Alcoa in the United States in prewar years. In a way, it might have been an unfortunate thing for the consuming public in the United States when the French company
One must not infer from the foregoing statement, however, that foreign aluminum ingots have not found a market in the United States. The domestic fabricators of aluminum in this country customarily have had three sources of supply as far as aluminum ingots are concerned. These sources are to be noted as (1) Alcoa products; (2) the aluminum-scrap market; and (3) foreign producers of aluminum. Alcoa products have been available to the domestic market typically on a basis of high prices and restricted productions. A certain amount of scrap aluminum usually was available to domestic fabricators, but the supply was uncertain and in many instances lacked the uniformity of quality that was desired. Foreign aluminum was imported into the United States on a limited basis, because high tariff rates on ingot aluminum made it difficult to send the metal into this country to compete with Alcoa's product. Both the aluminum-scrap market and foreign ingot importations have varied considerably through the years. At times domestic fabricators actually were able to obtain more metal from the scrap market and from imports than was being made available by Alcoa, but they could not always depend upon these conditions.

was forced to retire from the field. It was more than 27 years later when any semblance of competition appeared in the field, at the time Reynolds and Olin Corporation began ingot aluminum production in this country.
Alcoa Aluminum in World War I and in the Interim Between World War I and World War II:

Although the chief concern of this study is the presentation of material facts and economic interpretations connected with the aluminum industry of the United States during World War II, it is of importance to recount some of the pertinent information dealing with the aluminum situation during World War I. Few extensive or thorough analyses have been made of the contributions of the aluminum industry during World War I, but enough has been written to show how Alcoa took up the new burden and responded rather well during these years. Production to satisfy the increased demands for new aluminum products made expansion of the aluminum industry a necessity. One of the outstanding and noticeable characteristics of the industry during the war years was the extension of its field of usefulness. Whereas before the war the automobile industry had become the greatest purchaser of aluminum, vast research projects on aluminum during the war years extended the areas of demand for the metal, and new markets were opened up for both aluminum and its alloys. It is safe to say that no other metal received more scientific attention during World War I than did aluminum.

This description appears to be an interesting case of the fact that history repeats itself, because the same thing happened in the aluminum industry during World War II. Scientific research was greatly expanded, particularly in aluminum reduction processes and alloys.
Of significance to an understanding of the aluminum industry during World War I is the treatment given to the subject by Bernard M. Baruch in his book, *American Industry in the War*. Briefly, this is the story of aluminum in the war as told by the report of the War Industries Board, of which Baruch was chairman:

The chief war use for aluminum was in the manufacture of ammonal, which is a mixture of aluminum dust and ammonium nitrate, used in the manufacture of munitions. Other military uses were for fuses, flayers, castings for engines, personal equipment, mess equipment, and as a deoxidizer in steel manufacturing.

Not enough aluminum could be produced to supply the war needs of ourselves and the Allies and at the same time supply normal civilian requirements. Hence the control to be exercised by the Board had to be directed chiefly to two problems: Control of distribution and control of prices. The Board also assisted the Aluminum Co. of America in securing power for increased production and encouraged the recovery of secondary metal from scrap.

The normal prewar price of aluminum is about 20 cents per pound. When this country entered the war, open-market prices were about 60 cents, while contract prices ranged around 38 cents.

The war requirements for aluminum were being studied by the commissioner of raw materials of the Council of National Defense in March, 1917, and on April 25, 1917, with the market at 60 cents, Mr. Davis, president of the Aluminum Co. of America, offered to provide the United States Government

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with whatever it wanted for its preparedness campaign at whatever price the Government should put upon it. This offer was accepted for 2,000,000 pounds of aluminum ingots at 27\frac{1}{2} cents a pound, and a few days later enlarged to 8,000,000 pounds, to be delivered before August of that year. In September, 1917, the company agreed with the War Industries Board "to accept direct and indirect orders at the prevailing contract prices" (38 cents), and to refund to the Government any difference which might exist between this contract price and any fixed price which might be decided upon at a later date.

\[ \ldots \ldots \text{32 cents per pound was recommended on February 28 (1918), and approved by the President on March 2.} \ldots \ldots \text{A compromise was (later) reached at 33 cents, and this was continued until March 1, 1919.} \]

A further history of aluminum production during World War I, and in the period immediately thereafter, shows a rapid increase in the metal from 1914 to 1918, and then a rapid slump in production from 1918 to 1921. Production had been so great during the war that a large "surplus" existed in the market during the years following. The disposal of this so-called surplus was made possible only after the company had reduced prices from a level of 32.9 cents per pound to a level of 19 cents per pound in November, 1921.

\[ ^{29}\text{Technically, economists are cautious in designating quantities of goods as "surplus" when in reality the price situation is such that consumers will not take them off the market. In this case, it is noticeable that as soon as the price was made flexible, instead of rigid, the aluminum was disposed of in normal ways to the consuming public. Most economists would agree that in strict economic theory there is no surplus "until supply exceeds demand at a price of zero." See Harlan L. McCracken, Value Theory and Business Cycles (New York: McGraw-Hill Publishing Company, 1936), p. 201.} \]
However, changing conditions in the aluminum industry meant that this price reduction was not to last long, because by 1926 the price had been raised to a level of 28 cents per pound for primary 98-99% metal. This ability of the company to meet varied circumstances in the economic system is unique. In later years Alcoa fell into line with other companies in the industrial field and used the familiar technique of reducing production rather than using flexible prices to meet the economic depression in the early 1930's.

In the years immediately following World War I, the interest shown by Alcoa in foreign buildings was very noticeable. The company began a program of expansion both in international and domestic spheres. Norway became the object of Alcoa's attention in 1921, mainly in terms of the expansion of the company's control over adequate and cheap hydroelectric power for greater operations in that country. The company soon had extended its control over some outstanding waterpower sites, and had gained control of two of the Norwegian companies, Det Norske Nitrid and Norsk Aluminum Company. Both of the Norwegian companies had been

\[30\text{H. T. Warshow, op. cit., p. 29.}\]

\[31\text{High, rigid and sticky prices have characterized many fields of industry, and aluminum is no exception. More will be said in later chapters about such prices and their effects on the economic system.}\]
engaged in aluminum reduction in Norway before Alcoa appeared on the scene.  Alcoa extended its control in the domestic sphere in 1924 by acquiring important fluorspar mines in both Kentucky and Illinois. Acquisition of these mines made the company's manufacture of artificial cryolite (for electrolytic reduction of aluminum from bauxite) easier and more certain in terms of its control over the natural resources involved in production of ingot aluminum.

The extent to which Alcoa had actually extended its control over the various fields of aluminum activity can best be illustrated by the statement that in 1926 the holdings of the company could be grouped under eleven different headings, as follows: (1) mining properties; (2) bauxite; (3) magnesium; (4) carbon electrodes; (5) alumina; (6) aluminum; (7) aluminum manufactured goods; (8) sales; (9) railroads; (10) power and public utilities holdings; and (11) miscellaneous holdings, which included brass, paper, iron, tar products, and fluorspar companies. In terms of these widespread holdings, Alcoa was one of the world's outstanding examples of integrated domination in any kind of industrial field.

32H. T. Warshow, op. cit., p. 29 ff.

33For a complete picture of the domination of the company in these respects, consult Warshow, op. cit., p. 53, or Hendershot, op. cit., p. 69.
The account given above is not a picture of the control exercised by the company in 1940, however, because several significant changes had been made in that interim between 1926 and 1940. Changing conditions in the aluminum industry had resulted in Alcoa's disposal of a great many of its foreign properties and subsidiaries prior to the latter date. The number of companies controlled and dominated by Alcoa had been reduced from a total of about 75 (as shown by Warshow in 1926) to the number of 26 companies in 1940, according to Moody's Industrials for that year.

Eighteen of these 26 companies, owned entirely by Alcoa at that time, were to be found in the United States, Canada and Dutch Guiana. The other eight companies, most of which were owned by Alcoa to an extent greater than 25%, and mostly more than 50%, likewise were scattered through the three countries named above.

Court Litigation Concerning Monopoly Control in Aluminum:

A history of the aluminum industry prior to 1940 would not be complete without some mention of the many cases that came into the courts as a result of the charges of monopoly and unfair trade practices against the Alcoa

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35Ibid.
system. Active prosecution of the Alcoa monopoly in primary aluminum began in 1912, and since that time many cases involving such charges have come before the various courts of the United States.

One of the famous consent decrees in the aluminum industry litigations was handed down by Judge James M. Young as a result of the prosecution of the company in 1912. Many important subjects were covered in Section 7 of this consent decree. The prohibition of the following types of discrimination and unfair trade practices was specifically mentioned:

1. Combining with other companies to restrict output and control prices of aluminum;
2. Delaying shipments of material or furnishing known defective material to its customers;
3. Charging higher prices for crude or semifinished aluminum to competitors than to subsidiaries;
4. Refusing to sell crude or semifinished aluminum to competitors in the field of aluminum fabrication;
5. Requiring competitors to divulge information concerning the expected usage of aluminum sold to them;

(6) Requiring the making of agreements not to compete with the Alcoa system in certain lines;

(7) Intimating that the failure to enter into such agreements would deprive competitors of metal; and

(8) Taking the position that enlargement of competitors' plants would be a signal for cutting off the supply of aluminum materials to them.

This decree in 1912, covering all of the above phases of the abuse of other companies by Alcoa, served a very good purpose, but it did not prevent other cases in the courts. There are five cases that deserve mention in the history of aluminum prior to the time of the administration of Franklin D. Roosevelt as President. These five cases dealt with the Sawyer-Austin Lumber Company, the Southern Aluminum Company, the Norsk Aluminum Company, the Aluminum Rolling Mill Company, and Aluminum Manufacturers, Inc. The prosecution of Alcoa in these cases was not successful, however, and the Government and the companies were unable to break up the monopoly held by Alcoa in primary aluminum production. Laxity on the part of the Department of Justice in vigorous and outright prosecution of Alcoa at other times in the 1920's led one writer to exclaim:

When is a monopoly not a monopoly? When it belongs to the Secretary of the Treasury, and

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37 For a complete description of these cases, the reader is referred to Hendershot, op. cit., pp. 85-121.

when an inconvenient Attorney General is promoted to the Supreme Court. If you don't believe it, ask the Federal Trade Commission, which on April 4 dismissed all monopoly complaints against the Aluminum Company of America. When Mr. Stone left the cabinet for the Supreme Court, his great successor John J. Sargent forgot all about aluminum, and William D. Mitchell has not happened to think about it.

A case involving the Bausch Machine Tool Company was brought into the courts in 1932, but after two years of fighting, Alcoa emerged victorious. The Roosevelt Administration, at least in its earlier years, appeared as a formidable opponent of Alcoa, and in April, 1937, brought suit against the company on the specific complaints of price control and antitrust violations. This case was still in the courts in 1940, at the time when the United States launched its defense program. It was one of the longest cases in the history of American jurisprudence. Settlement of the case was not made until after the United States had become involved in World War II. The wartime disposition of the case will be discussed in later chapters. Political considerations and industrial expediency have been the guiding principles in all of these long series of litigations against the aluminum monopoly, according to many observers in recent years.


Status of the Aluminum Industry in 1940:

Careful analysis of the aluminum industry of the United States reveals that this country was placed in a disadvantageous position when the defense program was begun after war broke out in Europe in September, 1939. Adequate aluminum supplies to fill the needs of the defense program of this country could not be furnished by Alcoa, although company officials at first indicated that Alcoa's productive capacity would be sufficient. One of the most caustic comments ever to be made about Alcoa and its response to the new defense program is the following statement made by New Republic as late as February, 1941:

Alcoa's response to the defense program was typical of a monopolistic industry. Alcoa went to the NDAC (National Defense Advisory Commission) and offered to cooperate—if the Commission would bring pressure on the Justice Department to call off its two-year old anti-trust prosecution. This was too much even for the NDAC.

As a further indication of its desire to cooperate in the defense program, Alcoa, as soon as the anti-trust hearings were concluded, cut the supplies of raw aluminum to the Reynolds Metals Company by 40 per cent. The Reynolds Metals Company, a potential competitor of Alcoa's, was, and is today, engaged in defense orders. Its deliveries are incomplete because it lacks aluminum.

This statement is typical of the attitudes which were expressed in many circles about Alcoa and its stranglehold on the aluminum industry of the United States by 1940. It will be possible in the next chapter to carry this analysis still further. Our discussions will revolve around the various aspects of the aluminum industry in the defense program. The gigantic expansion of the aluminum industry under the supervision of the United States Government constitutes an entirely different pattern from that followed by Alcoa in prewar years.
The foundation was laid in Chapter I for the further discussion of the aluminum industry of the United States during the years, 1940-1947. In Chapter II the first phase of this recent period of aluminum development will be presented. The whole period from 1940 to 1947 is, in reality, the most important and far-reaching period of aluminum development in this country. The importance of the period should be considered in each of the three phases of "defense," "war," and "postwar" activities. The initial period of defense activities covers about two years, 1940 and 1941. During this time the aluminum industry of the United States was girding itself to fulfill its many commitments to the national defense program, and to the actual war program after 1941.

Outbreak of war in Europe in September, 1939, had been a signal and a forewarning that the United States inevitably would become involved in World War II. Our time-honored policy of isolationism, which had held sway in the United States since World War I, was painfully being swept away by the knowledge that Hitler had begun his program of
world conquest. It was apparently natural that the United States should begin in 1940 a great program of defense, and that the sympathies of this nation should be turned toward the Allied cause.

Leaders in governmental circles and in high military positions apparently felt that protection of the United States necessitated an adequate air defense. It was evident from the beginning that aluminum would play an important role in the preparedness program. But air defense, as such, was not the only reason why aluminum was destined to play such a highly significant part in World War II. It had been well established in World War I that aluminum was valuable in many ways in the waging of war. The chief use of the metal in that war was in the manufacture of explosives, although aluminum was used in a variety of other ways. Both technical and engineering developments during the interim between the two wars resulted in a wider variety of uses for aluminum.

It is true that the great demand for aluminum in the defense program was for airplanes, which are made almost entirely of aluminum. However, the military uses for aluminum extend to other types of equipment, such as equipment used by individuals in the armed forces, pontoons, parts of the fixtures and even the basic structures of torpedo boats and large ships, parts of automobiles and trucks which are essential for the mobility of fast-moving troops, radios and
other types of communications equipment for both land and sea operations, and a variety of other types of products and military supplies which use the metal in lesser quantities. Indeed, as has been said by other writers, the modern god of war carried a shield of aluminum in World War II.

This dependence upon aluminum during the period of defense becomes more apparent when it is realized that World War II in Europe in late 1939 and early 1940 already had shown the necessity for dependence upon warplanes as a means of offensive actions as well as defensive measures. It may be pointed out that ninety per cent of the weight of the average modern plane is made up of this light metal. During the war it was noticeable that an average warplane might have as much as 7,000 pounds of the metal in it, while a modern bomber at times used as much as 16,000 pounds of aluminum. These figures by themselves may not appear to mean much, but when it is recalled that President Franklin D. Roosevelt had spoken in 1940 of as many as 50,000 planes a year as a goal of our defense program, the dependence upon aluminum becomes of great significance.

The sympathy of the United States toward the Allied cause turned into something akin to alarm early in 1940 when

\[^{1}\text{Aluminum and the Emergency,}' Fortune, Vol. XXIII, (May, 1941), p. 66.\]
the successes of Germany were making the headlines nearly every day. The United States became quite concerned, especially with respect to the shortages of aluminum and the methods for providing adequate supplies of the metal. This task became more difficult than was at first expected, mainly because Germany had not been negligent in the matter of aluminum production. In fact, a brief account of Germany's success in production of the metal will show that the Hitler program had resulted in such progress in the production of the metal that Germany as early as 1934 had actually outstripped the United States. This great German production of aluminum had made possible the building up of the great scourge of Europe, the German Luftwaffe. When war came, the air arm of the German military forces was well prepared for the works of devastation that it accomplished in France, England and the other smaller countries of Europe. The German nation had risen from a position of only negligible importance to one of the greatest of aluminum producers within a few short years.

In reality, the American public must have been most startled to read in the New Republic for January 27, 1941, that in 1939 Germany had outstripped the United States in

\[2\] See Table I for a complete study of the production of the world in regard to aluminum in 1933 and 1940.
aluminum production, leading this country by a quantity of 73 million pounds. German production for that year amounted to about 400 million pounds, and United States production was only 327 million pounds. But this fact was not the most startling, because it was further pointed out that in the year 1940, subsequent to the acquisition of French and other aluminum production properties, the German program might have been able to extend production of the metal beyond the billion-pounds-per-year mark. Germany, apparently dedicated to a program of air supremacy over Europe, was making good in her efforts to put more and more warplanes into the sky.

In almost direct contrast to the pattern of production shown for Germany, Great Britain was not in such an enviable position in regard to her own aluminum output. Despite aid which had been forthcoming from both Canada and the United States, Great Britain could not approach Germany's great productive capacity. Even before France and her aluminum facilities had fallen into the hands of Germany, the combined operations of England, Canada and the United States were not favorable in comparison with the German output of the metal. Production in the United States will be seen to have been increasing gradually prior to 1940, but the real

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aluminum situation was not much improved by that time. It was a significant fact that inventories of aluminum were declining rapidly, and this condition left the defense program in a more vulnerable position than it might otherwise have been. As a matter of fact, the dependence on day-to-day production of the metal was imminent when several events occurred to make the situation look somewhat better. These events, together with outstanding facts concerning the major features of the vast aluminum industry, will be presented in the following discussions.

The big questions in the aluminum industry late in 1939 and early in 1940 revolved around the problems of production, plus the entire industrial structure of the industry as it was then constituted. The problems of production of aluminum did not change overnight, but the realization of the greater impact of the defense program made a new appraisal of the industry imperative. Some of the problems of the industry in the initial stages of the defense program concerned: (1) the various stages and processes in the manufacture of aluminum; (2) the natural resources which were available for production of the metal; (3) the electrical energy for aluminum plants; (4) labor resources; and (5) the capital and management in the industry at the outset of the defense program. Some of these problems were of greater importance than the others. Each of the
problems had to be met, however, in order to obtain greater production of aluminum to supply both Allied needs and those of the United States in our own program of preparedness. A brief statement of each problem will suffice at this point to show the difficulties involved at the beginning of this new era of aluminum progress.

While no extended exposition of the technical processes in aluminum manufacturing is contemplated here, it is necessary to point out that throughout the history of the aluminum industry, and especially in 1939, it was impossible to speak of only one integrated aluminum industry, in the sense that all the stages and processes of production were carried out in one place. In fact, the field of aluminum consisted of a series of industries, integrated more or less into a cohesive pattern which produced the familiar automobile parts, aircraft metal, and kitchen utensils. Analysis of the industry based on this type of integration will show five various stages through which aluminum passed to reach the ultimate consumers. These five stages, each one of which posed a different problem in the matter of national defense, are as follows:

1. Mining of the raw materials or ores;
2. Production of alumina (reduction of the ores);
3. Production of pig aluminum (aluminum ingots);
4. Fabrication of aluminum ingots; and
5. Production of the finished aluminum products.

Bauxite is the chief ore of aluminum, and is to be found in the United States in the State of Arkansas in great quantities, and in high quality ores. It is found, also, in other states, but in the form of lower grade ores. In Arkansas, where the "Grade A" bauxite is obtained principally by the open-pit mining method, two counties, Saline and Pulaski, have been the chief sources of supply. The finest ores of the United States are found to contain usually more than 25% alumina and not more than about 7% silica. Even before the war, however, it had been customary for the aluminum industry of the United States to import bauxite from abroad, chiefly from Surinam (Dutch Guiana) in South America. Prior to the defense program, about one-half of the ores processed in the United States were imported, while the other half was mined in this country, with Arkansas supplying about 90% of the domestic bauxite of the nation. Other states which have produced smaller quantities of low-grade ores are Alabama, Georgia, Mississippi, Tennessee, and Virginia. The possibility of employing lower-grade ores had been considered, but it was not until the United States was actually in the war that pilot plants for using such ores were established. The Kalumite Corporation built a plant for the extraction of aluminum from alunite in Utah, near Salt Lake City, and three other companies later erected similar plants to test certain types of clays. With
the advent of the defense program in the United States, this problem of obtaining adequate supplies of bauxite meant two things: first, the extension of mining operations in Arkansas; and, second, the further importation of additional ores from South America.

Alumina is the end product which is necessary for the reduction process that results in ingot aluminum. It is obtained from the bauxite ores, or from ores of lesser quality, through the use of either the Bayer or Bedersen processes, both of which have been highly successful in alumina reduction. One of the greatest problems connected with this stage of the production of aluminum was to be confronted during the war period, when it became necessary to use ores with a higher silica content. Under normal conditions, the Bayer process works best with ores of about three per cent silica, but could process other ores with as high as seven per cent silica. However, under the press of wartime production needs, the soda-lime-sinter process was devised. This process was capable of processing ores with as high a silica content as fourteen or fifteen per cent. Such problems had not faced the aluminum industry before, and in 1939 and 1940 they were still ahead of the reducers of bauxite ores. Only one reduction plant, at East St. Louis, Illinois, had been operated before the war by Alcoa interests. Introduction of new reduction methods had been retarded, because this plant had
been using only the highest grade of ores. Later alumina reduction facilities were built to handle the low-grade ores, and the soda-lime-sinter facilities were incorporated into the new government plants which had to be built.

Production of aluminum ingots is the reduction of alumina, carried out through the process of electrolysis. The process was invented by Hall and Heroult, and was the only process employed commercially by Alcoa, although the other processes of reduction by chemical action, such as the Castner process, had been known for many years. The electrolysis process is highly technical, and one of its chief problems is sufficient electrical energy for the proper reduction of alumina. A brief glance at the ingredients necessary for the production of one pound of virgin aluminum metal will show the problems of materials involved in the productive process. The various ingredients necessary are as follows:

2 pounds of alumina;
8 to 10 kilowatt hours of electricity;
0.05 pounds of cryolite;
0.03 pounds of aluminum fluoride;
0.58 to 0.65 pounds of carbon paste; and
0.015 man-hours of labor.

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Necessarily, then, it must be considered that the great problem in the reduction of alumina are concerned chiefly with the production of enough electrical energy to reduce the alumina to virgin metal, and the provision of adequate amounts of skilled labor to work in the reduction plants. This latter item of labor was one of the chief problems in the aluminum industry in the initial stages of defense activities. It was particularly necessary in the years of 1939 and 1940 to train additional men to operate the various facilities provided by Alcoa's expansion, the entry of Reynolds Metals Company into the field of aluminum production, and the entry of the Government into the field at a later date.

Both the reduction of alumina from bauxite and the further reduction of pig aluminum from the alumina are the two necessary processes which must take place before actual fabrication of the virgin metal can be done. Ingot aluminum, as it comes from the aluminum reduction plant, is a metal of high purity, with a great portion of it being as much as 99.7% pure, or even more than that amount. By the process of alloying this light metal with such metals as copper, silicon, magnesium and manganese, or even other metals such as iron, zinc, nickel, etc., aluminum is made stronger and more adaptable to various industrial usages. Fabrication of the metal is done in huge aluminum rolling mills, such as the ones now located at Alcoa, Tennessee; Chicago, Illinois;
and Spokane, Washington. Prior to the war, however, the rolling mill facilities were adequate only for the prewar production of aluminum, so it became one of the major projects of the defense program to provide more rolling mills to take care of the increased production of the metal. One of the unique features of the aluminum rolling mill is the fact that it could be used for steel, but steel rolling mills could not be used for aluminum, due to the greater sensitivity of aluminum in the process.

In the fifth, and last, stage in the production of aluminum, the production of various shapes, forgings, castings, and extrusions is necessary from the aluminum sheet which has been produced in the rolling mills. This is the most detailed level of the entire industry, because of the various uses to which the finished products are put. Suffice it to say that particular applications of aluminum in the various fields of aluminum consumption number more than 2,500, and that these many markets constituted one of the great problems facing the industry in 1940. The fact that one market, the aircraft industry, was being built up to take over a great majority of the entire output of the aluminum industry caused grave concern to Alcoa and others. This probably was because Alcoa was looking to the post-defense era, when it again would be necessary to consider all of the various markets noted above. Civilian demand continued steady even after the
defense program began, but the aluminum to fill this demand was not forthcoming from the industry. Diminution of the supply for the civilian market was perhaps a natural result of the defense program, but it still remained a peculiar problem for Alcoa to solve. This situation will be considered in the discussion of the expansion of Alcoa to meet the growing demands being made on the aluminum industry for defense purposes.

Since all of the five stages of production mentioned above had their particular problems during the defense era, it can be seen that their impact upon Alcoa and upon the Government was of immense proportions. The discussion of the stages of production brought out some of the features of the other problems which were listed before. The problem of natural resources is one which revolves around bauxite and the other ores that may be used in the production of alumina. The problem of electrical energy posed even greater difficulties for those in charge of the expansion of facilities, because it is much more difficult to provide for the building of dams and hydroelectric facilities than it is to extend mining operations for bauxite. Labor for the working of the expanded facilities constituted a problem at first, but the training of additional personnel did not loom as too difficult for the industry to handle. Although unionism in the industry did create some special difficulties with
respect to jurisdictional disputes, production of aluminum did not lag because of an acute labor shortage. Men were recruited and trained in the technical processes of aluminum reduction and fabrication in time to take over the operation of the expanded facilities in the industry.

A resume of the problems of production in the industry would not be complete without reference to the problem of capital and management as it appeared in 1940. The extent to which this one problem influenced the entire course of the aluminum industry subsequent to the inauguration of the defense program may be summarized in the statement that prior to the second World War only one corporation in the United States produced primary aluminum. That corporation was Alcoa, a company which was integrated to include all of the phases of aluminum production mentioned in previous discussions. In the brief summary given by Professor Engle and his collaborators, the following is of significance:

This corporation was— and still is— an integrated one which, by itself or through its subsidiaries, owned and operated bauxite mines, sea and railroad transportation facilities, power sites, dams, and houses, alumina plants, reduction plants, rolling mills, metallurgical works, and finished products factories.

5Ibid., p. 118.
A further analysis of Alcoa in terms of ownership and management in the aluminum industry in 1939 is provided in these additional statements:

No picture of the Aluminum Company of America would be complete without reference to ownership and management. Recent investigation made by the Temporary National Economic Committee provides us with considerable information which thus far has been used very little... Some 8,000 shareholdings are listed, but the data show that more than three-fourths of all stock is in the hands of approximately 100 shareholdings. The "small" shareholdings of less than 1,000 shares possess less than 200,000 common shares out of a total of 1,473,000 or 13 per cent, and about 25 per cent of the preferred stock. Changes in ownership have been minor since 1939 and the situation no doubt still remains that the net worth of about $250 million belongs largely to 100 shareholdings. But the analysis may be further narrowed. The data show that the 20 largest holders had two-thirds of the common stock and more than one-half of the preferred stock.

Such data as these show that the aluminum industry at the outset of the defense program was so closely held by Alcoa that the policies of that company were concurrently the policies of the entire industrial structure of primary aluminum, almost without exception. The company's own policies apparently were the policies of the Federal Government, also, until it was found out that the real problems of defense were interwoven into the bottleneck of aluminum production.

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6Ibid., pp. 129-30.
The industrial structure of the aluminum industry in 1940, therefore, showed inadequate facilities to take care of the program of the United States, much less the extra program of foreign demands. Fabrication and finished products in the aluminum industry could not be expanded on short notice to take care of the civilian consumer demand and at the same time take care of the new defense program. Costs of production in the industry apparently were met along the pattern which had been operating in the industry for several years. In retrospect, it appears that the aluminum industry definitely was not in the proper position to meet the expansion demanded of it by defense and war, although at the time both Alcoa officials and government officials were apparently content to say to the American public that enough aluminum was available to meet every contingency. The extent to which these statements were true can be judged impartially by the history of the industry since 1940, to which we now turn for a study of the expansion program which Alcoa itself launched in that year. This program of expansion by Alcoa was only one of three important events which took place in the era of the defense program. It could not be considered by itself, because the other two events are of great importance, also. The two other events which will become a part of the discussion in this chapter are the entry of the Reynolds Metals Company into the field of ingot aluminum production, and the entry of the Government
into the field through its plans for the erection of additional production facilities to aid the whole program of defense. All three of these stories will become the subject matter for our remaining discussions in this chapter.

Expansion Program of the Aluminum Company of America:

It has been noted previously that some writers have been most critical of the way in which Alcoa met the problem of increasing demands for its aluminum products. That particular analysis of Alcoa’s moves and motives was not at all flattering to the company, and it may be said to have been a bit harsh, even though it was probably true in its entirety. The obvious attempt on the part of Alcoa to eliminate pressure of prosecution by the promise of more and more aluminum for the defense effort was deplorable. If the charges were true (and they have not been denied, as far as the writer knows), then Alcoa is to be censured for such practices, despite its later efforts to make amends.

Other writers, perhaps with a more sympathetic turn of mind toward Alcoa, have written interesting accounts of the expansion program inaugurated by the company in 1940. It is with these reports that we shall be primarily concerned here. Perhaps the most favorable review of the operations of Alcoa during the year 1940 has been put into print by I. W. Wilson, who was the company’s vice-president in charge
of operations at that time. Writing a rather lengthy article for The Commercial and Financial Chronicle in January, 1941, Mr. Wilson reviewed the aluminum situation as it had existed during the previous year. The result was that Alcoa was made to appear as the hero in the story rather than as the monopolistic industry that had been pictured in the New Republic. Some of the passages are pertinent for a variety of reasons. One of the most forceful paragraphs which he wrote is as follows:

Aluminum focused its efforts on National Defense in 1940. Highlights of the developments during the year of importance to Aluminum Co. of America were: Its decision to carry out now at a cost of more than $150,000,000, in the interest of National Defense, a program of expansion which would normally occur in the next two decades; the announcement by the National Defense Advisory Commission that the program of the Aluminum Co. of America, together with that of others in the industry, makes present and planned production adequate for all estimated defense needs; and continued price reductions by the Aluminum Company at a time when the price trends of most commodities were distinctly upward.

Obviously, this kind of writing makes Alcoa appear to be a public-spirited company, particularly at the time when the organization needed to make such an impression on the American people. If it could be made to appear that

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7I. W. Wilson, "The Aluminum Industry," The Commercial and Financial Chronicle, Vol. CLIII, (January 25, 1941), pp.530-31. While apparently written as a piece of institutional advertising for Alcoa, this article contains some basic material on the aluminum industry as it appeared at the end of 1940.
Alcoa was rendering great public service in the interest of national defense, and without regard to its own pocketbook or profit and loss statement, then the public desire for more intensive action in the antitrust suit would be lessened. The fact that the company did embark upon such a program of expansion might also have been motivated by the fact that, in spite of the reduced price of aluminum, profits were still to be made in the field. At least that is the conclusion which one might draw from a survey of the industry at the time.

An article in Fortune (May, 1941) brings the story of Alcoa's expansion into a better focus by showing the specific steps which had been taken in the matter of increasing production of ingot aluminum immediately. Excerpts from this article which have a bearing on the present discussion are as follows:

Meantime, what has Alcoa done about aluminum capacity? In 1939 the company produced 327 million pounds of raw aluminum, the then all-time high, practically all of which went into commercial products. Its actual capacity was around 335 million, and it would have produced more than 327 million had it not been for the drought and consequent waterpower shortage.... The company

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8 A further discussion of this antitrust suit will be given in a future account of the settlement of the suit and the decision handed down by Judge Caffey in the New York court. More court litigations followed Judge Caffey's decision.

increased its capacity at the end of 1939 to about 435 million pounds a year by adding facilities at Massena, New York, and Alcoa, Tennessee. Early in 1940, while the war was still pursuing a languid course, it announced $30,000,000 expenditures on improvements that included, besides the Vancouver plant, additions to sheet capacity for aircraft, an extrusion plant near Los Angeles dedicated mostly to shapes and rivets for planes, and by April a further addition not only to finished aluminum facilities at various plants, but to primary or raw aluminum capacity. All this occurred before President Roosevelt's speech about 50,000 planes.

There can be little doubt, however, that the pressure of commitments to Allied countries in Europe had much to do with the expansion program, along with the extension of defense program activities at home. Although it has been charged that there was a tendency on the part of the Democratic administration to forget about the preparedness program during the election year of 1940, there was still the fact to be considered that Roosevelt had spoken of 50,000 planes a year, plus all of the other types of armaments that would use aluminum. Hence the necessity for a reappraisal of productive capacity in the aluminum field, and the further decision on the part of Alcoa to do even better in its program of expansion. In October, according to Fortune, the company launched its whole program, urged on, perhaps, by the conditions described in the following paragraph:

Came October, 1940, with passage of the excess profits tax amortization bill, and Alcoa promptly
made the headlines with an announcement that it was going to spend $150,000,000 on expansion. Since then the figure has been upped to $160,000,000—some $65,000,000 goes for primary capacity (including $15,000,000 on a steamship line and $16,000,000 on power) and $95,000,000 for finishing capacity. Starting with a capacity of 435,000,000 pounds of the raw metal at the beginning of 1940, Alcoa hopes to have 720,000,000 pound capacity by July, 1942. If its request for Canadian power at Massena, New York, is granted, it will up the figure by as much as 60,000,000 pounds. This means that Alcoa may turn out some 575,000,000 pounds in 1941 and perhaps 700,000,000 pounds in 1942.

Such were the hopes of the company concerning the success of its expansion in terms of post-emergency profits and demand for aluminum that Alcoa did not even bother to solicit aid from the Government, through the Reconstruction Finance Corporation or any other government agency. All of this expansion was to be financed out of cash and bank loans. It apparently was one of the greatest financing ventures ever attempted by the company. This type of financing of defense expansion was in direct contrast to what the Reynolds Metals Company and the Olin Corporation did when they decided to enter the field of ingot aluminum production in the United States.

See the later discussions concerning both Reynolds Metals Company and the Olin Corporation in their relations with the Reconstruction Finance Corporation and the Defense Plant Corporation. Alcoa must be remembered as the company which operated all but one of the later government plants.
The significance of all of these new and vast preparations for greater production in the aluminum industry to Alcoa may be shown by a further statement which was made by I. W. Wilson. This statement is as follows:

Following a schedule which calls for the increase of its ingot production to something in excess of 700,000,000 pounds by July, 1942, as compared with the 1939 level of 327,000,000 pounds, Aluminum Co. of America will thus more than double in three years a production built up over more than half a century.

One may have occasion to wonder, in the light of the above statement, whether or not the company had been missing a good opportunity of expansion in the past. If in the period of fifty years the company had not expanded to its full capacity in terms of satisfying the demand for aluminum products, it may be imagined by some that Alcoa had not taken any too much trouble to examine the shape or slope of its demand curve for aluminum. Since all of the contemporary accounts of the company's expansion indicated that the hopes for the future were for an expanding demand for the metal, it may not be unfair to say that such a domestic demand for aluminum might have been built up even before the preparedness program began. This type of analysis will be pursued further in the

12I. W. Wilson, op. cit., p. 531.
chapter which deals with the economics of the present-day aluminum industry of the United States.

Following only briefly at this time the line of argument presented above, we may point out further statements which show the impact of the defense program upon the industry in 1940. Attributable to I. W. Wilson, the analysis goes into the problem of the obligation of Alcoa in the defense program and the possibilities for the future as they were seen in the early part of 1941. Excerpts of importance are as follows:

At the same time the company fully realized the obligation of all industry, insofar as possible, to keep men and plants at work, after there had disappeared the demands of a crisis forced upon American industry by the warmakers of totalitarian nations. The company is naturally concerned about the future when the defense and emergency demands come to an end. Therefore, it has started now to develop new peacetime uses and wider peacetime markets for aluminum, intensifying the peacetime research which in the short space of 50 years has raised aluminum from a brush-and-comb novelty to one of the most useful of all metals.

Continuing its frequently reiterated policy of passing along to the public the benefits of research and economies of operations, the company three times reduced its price of aluminum ingot during 1940. Its price was 20 cents a pound when

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13 This economic question of the elasticity of the demand curve for aluminum is one of the most important from the viewpoint of the entire industry. Suffice it to say now that the demand curve for aluminum has been generally regarded as elastic. More detailed discussions of this point will be forthcoming in later chapters.

14 I. W. Wilson, op. cit., p. 531.
the year started and is now 17 cents. It has been the hope of the company that these reductions would assist in meeting the country's emergency responsibilities.

In this connection it should be recalled that Aluminum Co. of America does not as a rule make consumer goods; but there are some 30 large industries which used Alcoa products in more than 2,500 applications during 1940. The company is confident that these industries appreciate that the supplying of aluminum for the National Defense constitutes a greater service to them than if they actually received the metal to the full extent of their normal industrial uses.

Defense comes first. When the emergency is past, there will be more aluminum available than ever before.

The company's new metal-producing plant at Vancouver, Wash., originally intended to produce 30,000,000 pounds of ingot yearly, went into operation in 1940 with a capacity of 60,000,000 pounds, and is now being expanded to produce more than 150,000,000 pounds annually. Although the Aluminum Company is the largest industrial power customer of both TVA and Bonneville, it has under way two great hydroelectric projects in the Southeast. New fabricating facilities are being built or planned for the company's plants at Alcoa, Tenn.; Lafayette, Ind.; Los Angeles, Calif.; New Kensington, Pa.; Detroit, Mich.; Cleveland, Ohio; Edgewater, N. J.; and Massena, N. Y. These additional fabricating facilities will increase the company's output of castings, sheet, tubes, strew machine products, rivets, extruded and rolled shapes, rods and bars, and forgings.

In addition to the features pointed out in this summary of the activities of the company during 1940, it is to be noted that several laboratory research experiments had been brought to a successful conclusion during the same year. Alcoa's research facilities, known as Aluminum Laboratories, Inc., have been noted through the years as being capable of
technical research activities of a high caliber. A description of the work accomplished in research in 1940 is as follows:

The most important single development in the research laboratories this year probably was the placing in operation of the Templin universal metal-working machine. Most powerful device of its kind in the world, this scientific giant permits the study of stresses and strains in various forms of aluminum and competing materials in their full size, rather than in the scale models to which the laboratories were formerly limited. It is expected that valuable information about the properties of aluminum will be forthcoming.

Research during 1940 was also responsible for important developments in brazing aluminum alloy products; in increasing application of anodic treatment finishing processes for aluminum; improving the merits of aluminum house paint; continuing to open up fields for the use of aluminum in marine applications, and in many further ways painting to expanding markets for the metal in the years to come.

In keeping with this general trend of analysis of the company's activities of 1940, it is also interesting to note the following portion of its annual report for that year. This statement is only a portion of the total report, but it does serve to show the general analysis which the company was making of its own expansion program of the year.

15Ibid.
Briefly quoted in Barron's for April 7, 1941, the statement reads as follows:

The employment for national defense of a large percentage of the present aluminum production necessarily reduces the amount of aluminum available for civilian uses, creating an important situation in civilian markets. Every effort, however, is being made to alleviate this situation. In order to insure markets for the greatly increased production for which outlets must be found following the present emergency, the company is maintaining its research, development, and advertising activities, and taking all other steps permitted by present conditions.

Believing that the best interests of the country, as well as those of the Aluminum Co., could be served by lowering prices as improved economies and research permit, three reductions, each of one cent per pound, were made during the year 1940 in the basic price of aluminum ingot, bringing the price to 17 cents per pound. Reductions in the prices of fabricated products also were made.

Production in 1940, the highest in the company's history, exceeded by 25% the production of 1939.

Evidently, this sort of information concerning aluminum and the progress made by the great American producer, Alcoa, was having its effect upon the Allied countries of Europe. In an effort to show just what the prospects were, as they appeared in England, one only has to check over some of the contemporary issues of the Economist, one of England's popular economic journals. This account, however, as given

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below, pointed not only to the growing American supply of aluminum, but also to the fact that the entire situation appeared all right to the English people. Remembering that this account was written in December, 1940, nearly six months after the fall of France, it appears a bit amazing that such great confidence could be expressed in the future supply of this necessary metal. Only excerpts of this report will be given at this point, but they will serve to show how the aluminum situation was viewed from the other side of the Atlantic Ocean. Some of the statements are:

"... meanwhile production of both bauxite and finished aluminum in other parts of the Empire is rapidly expanding. In Canada, where the Aluminium Company of Canada, Ltd., had started a $7,000,000 expansion programme shortly before the war which included considerable extensions in the reduction capacity of the Arvida and Shawinigan Falls works, the potential output of finished aluminum has now been raised to well over 100,000 tons. Further extensions with financial support of the British Government are in progress and should soon enable the Dominion to supply the whole of our huge war requirements...."

While the Allied territories are now virtually self-sufficient both in bauxite and finished aluminium, substantial quantities of American aluminium were acquired by the Ministry of Supply from the United States in the first year of the war. Although consumption of aluminium in the United States, which rose by 97 per cent to 167,600 short

tons last year, is still growing at a rapid rate, that country can still be regarded as an efficient source to supplement British supplies should this be necessary. Production in the United States in 1939, at 148,400 tons, was some 20,000 tons smaller than consumption, but last year the Aluminum Company of America not only completed an expansion programme at a cost of $26,000,000, but also started another estimated to absorb $30,000,000. Works now nearing completion will raise its potential output to 215,000 tons early in 1941. Another, with a capacity of 30,000 tons, is to start in production in the middle of next year. Adequate supplies for the huge United States re-armament programmes are thus more than assured. On the European continent, too, production of aluminium has advanced substantially this year, although figures are unobtainable. The present war, therefore, is proving of decisive influence on the world aluminium supply. Last year world production is estimated by the United States Bureau of Mines to have reached 647,400 metric tons, against 478,800 tons a year before and 259,600 tons five years ago. This year an output of 750,000 tons seems assured, and further increases are almost certain to follow.

Perhaps a better analysis of the entire field of world aluminum production in 1940 will serve to show the importance of production of the metal in the various countries involved in World War II. This analysis is given in the form of Table I, which shows the primary aluminum production by continents and by countries, both in 1933 and 1940. The comparison with 1933 is given simply to show the changes that defense and war programs had wrought in the world situation. It will be noted that the relative figures for total production of aluminum in the world show that between 1933 and 1940 the output of the metal had been increased about six
times. Of much more significance to Alcoa and to the entire United States is the relative decline in the position of the

TABLE I

PRIMARY ALUMINUM PRODUCTION BY CONTINENTS AND COUNTRIES,
1933 and 1940

<table>
<thead>
<tr>
<th>Continents and Countries</th>
<th>Output in Metric Tons (Thousands)</th>
<th>1933</th>
<th>1940</th>
<th>Percentage of World Output</th>
</tr>
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<tr>
<td>World Total..............</td>
<td>142 803</td>
<td>100.0</td>
<td>100.0</td>
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<tr>
<td>A. Europe</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Germany</td>
<td>19 240</td>
<td>13.3</td>
<td>29.9</td>
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</tr>
<tr>
<td>Russia</td>
<td>4 55</td>
<td>3.1</td>
<td>6.9</td>
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</tr>
<tr>
<td>France</td>
<td>14 50</td>
<td>10.1</td>
<td>6.2</td>
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<tr>
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<td>8 28</td>
<td>5.3</td>
<td>3.5</td>
<td></td>
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<tr>
<td>Norway</td>
<td>15 15</td>
<td>10.9</td>
<td>1.9</td>
<td></td>
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<tr>
<td>Other Countries</td>
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<td>0.9</td>
<td></td>
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<tr>
<td>Total Europe</td>
<td>87 471</td>
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<td>58.6</td>
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</tr>
<tr>
<td>United States</td>
<td>39 187</td>
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<td>23.3</td>
<td></td>
</tr>
<tr>
<td>Canada</td>
<td>16 110</td>
<td>11.4</td>
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</tr>
<tr>
<td>Total North America</td>
<td>55 297</td>
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<tr>
<td>C. Asia</td>
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</tr>
<tr>
<td>Japan</td>
<td>.. 35</td>
<td>... 4.4</td>
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</tr>
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</table>

Source: Minerals Yearbooks, U. S. Bureau of Mines; and Engle and others, op. cit., pp. 184-85. Figures on the production of aluminum by countries are rounded off to nearest thousands. The table is for comparative purposes only, and specific data should be consulted from the above references, if desired.
United States in aluminum production for the period indicated. Germany's output of the metal had increased from about 19,000 metric tons in 1933 to about 240,000 metric tons in 1940, and her percentage of the world's output of aluminum was boosted from only 13.3% to 29.9% in that period of seven years. On the other hand, the production of the United States rose from 39,000 metric tons in 1933 to 471,000 metric tons in 1940, but there was a relative decline in the percentage of her world output, the figures being dropped from 27.2% to 23.3% during the same seven years. Even the total relative output for the continent of North America showed a decline from 38.6% to 37.0% for the period, although the European output also showed a slight total decline in terms of percentages. The situation was changed somewhat from that of 1933 by the entry of Japan into the field of aluminum production, to the extent that the Japanese production in 1940 was 4.4% of total world output of the metal. Other figures on the table are of importance in regard to several of the countries, but the ones given above show the relative positions of the dominant Allied and Axis countries in terms of aluminum production in 1940.

These data show the apparent necessity not only for the tremendous expansion of Alcoa facilities, but also for the entry into the industry of Reynolds Metals Company during the defense period of 1940 and 1941. This story of the first
real competitor to Alcoa in the field of ingot aluminum production is significant in many respects, and will be presented in the following section of this chapter.

**Brief History of the Reynolds Metals Company and Its Entry into Ingot Aluminum Production:**

One of the interesting features of the Reynolds Metals Company is the fact that its original entry into the field of aluminum was merely in the capacity of a consumer of the metal, along with other types of metals. The company was incorporated in the state of Delaware, in the year 1923, and was for many years engaged in the production of a variety of finished products, such as thermostats, instruments for measuring temperature and pressure, foils for packaging, insulation, and the like. During the first ten years, the company followed a program of expansion through the acquisition of additional corporations which were engaged in similar business activities. Later on, just on the eve of the outbreak of World War II, the company became interested in aluminum, first in the field of fabrication and then later in all of the various activities needed to make Reynolds Metals Company, like Alcoa, a thoroughly integrated company in the aluminum industry.

Reynolds Metals Company had been a customer of Alcoa for several years, and had dealt in the production of some
aluminum foil, powder and paste. The company had even been an importer of ingot aluminum from France, and had been most successful in all of its business activities. Richard Samuel Reynolds, president of the company, conceived the idea in 1940 that the successful waging of the war would depend to a large extent upon production of aluminum, because the metal was essential in aircraft production. With this idea in mind, Mr. Reynolds contacted various officials of the Government, and even had an interesting interview with Arthur Vining Davis, president of Alcoa. These conversations amounted to almost complete failure at first, especially the one with Mr. Davis, but Mr. Reynolds was persistent in his efforts to convince the officials in the Government that more aluminum capacity was needed at that time. His contacts with Senator Lister Hill, of Alabama, bore fruit, even after Mr. Davis had refused to consider the idea of Alcoa expansion up to a billion-pound capacity.

Government financing of the Reynolds program for aluminum was forthcoming from the Reconstruction Finance Corporation, and at a later time through the Defense Plant Corporation. The original application to the E. F. C. resulted in the granting of a loan of $15,800,000 to the company to

build a plant for aluminum ingot production. Later loans made by the R. F. C. to Reynolds brought the total up to $20,000,000. Original plans for construction of facilities at Listerhill, Alabama, and at Longview, Washington, were made. Both plants were to be ingot production plants, with capacities of 40,000,000 and 60,000,000 pounds, respectively, each year. At the time, it was planned that the company could use electrical energy from Bonneville dam for the Washington plant, although interference on the part of Secretary of the Interior Ickes became necessary at one point to assure an adequate supply of power to Reynolds Metals Company. It was not expected that Reynolds could reach full production until 1942, and, as it turned out, the United States actually was engaged in World War II before the company reached the full capacity which it set out to accomplish. The rapidity with which the expansion of Reynolds Metals Company had taken place is shown in the following brief summary of their broad activities in the period from 1940 to 1942:

In 1940 Reynolds went into bauxite mining by the absorption of Bauxite Mining Company. In 1941 Reynolds Metals acquired Reynolds Alloys Company which operates large aluminum sheet and shape mills built by the Defense Plant Corporation, and also Reynolds Ore Company which operates an alumina plant at Listerhill, Alabama.

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19Ibid.

20Engle and others, op. cit., pp. 131-32.
At the same time a horizontal expansion took place. An extrusion plant was built with Defense Plant Corporation financing which has since operated with a capacity of 48 million pounds yearly, producing extruded bars, tubing, and shapes. In 1942 the production of aircraft parts was begun. On the whole, Reynolds now owns or operates some 35 plants located at such points as Louisville, Kentucky; Chicago, Illinois; Richmond, Virginia, Harrison, New Jersey; New York City; St. Louis, Missouri; Listerhill, Alabama; and Longview, Washington. Like Alcoa, Reynolds is now an integrated concern from bauxite mining to the fabrication of the most delicate precision instruments. It operates on a smaller scale than Alcoa, but because of its connections with other metals and because of its production of highly elaborated finished products, Reynolds may be said to have a wider range of activities than Alcoa.

An examination of recent balance sheets of Reynolds shows that its total assets in 1942 were about one-seventh of Alcoa's. Fixed assets, property, plant and equipment after deducting depreciation were valued at $7.8 million in 1936. By 1942 these assets, including the so-called "emergency facilities," had increased to $34 million.

In terms of the defense program, it must be admitted that the entry of Reynolds Metals Company into the field of aluminum created quite a stir in industrial circles. In retrospect, it will be further admitted that the move was one of great importance in the building up of wartime supplies of this strategic metal.

Testimony by Mr. Reynolds before the Truman Committee during the defense period showed plainly what his opinion of the Alcoa program had been. In the brief period of only six months, the Reynolds Metals Company had constructed one aluminum plant and two metal-reduction plants, and Mr. Reynolds
felt that Alcoa could have bettered that record. In his testimony, Mr. Reynolds stated further that no lack of aluminum production should be allowed to hold the defense program back. He stated that "aluminum ingots can be increased and multiplied as fast as aviation, automobiles, and other defense contractors can expand their facilities." It was this unbounded faith in the entire aluminum production program that kept the expansion program of the Reynolds Metals Company in high gear throughout the defense period and during the war itself. In one respect, it was much easier for this company to maintain a high degree of faith, since most of its financing had been done with public funds. Alcoa's expansion, as noted before, was provided for by a small group of people and by the process of "plowing back" their profits into the business.

Further expansion of Reynolds, beyond the $20,000,000 in loans previously mentioned, was made possible after the United States entered World War II, but this phase of the aluminum expansion program will be presented in the next chapter. The company had made a successful beginning in the aluminum industry by the time of the ending of the defense period, and was to emerge as a definite competitor to Alcoa in the aluminum industry of the United States. One of the

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significant features of the contract of Reynolds Metals Company with the Government was the inclusion of an "option to purchase" clause, which would permit the company to purchase the Louisville, Kentucky, extrusion plant from the Defense Plant Corporation. Reynolds had been operating this plant for the Government. Their option was a feature which was not included in the contracts with Alcoa. Such operations of the Defense Plant Corporation in the field of financing the aluminum industry in its expansion program make it necessary to review the history of this agency briefly.

Activities of the Defense Plant Corporation:

Originally, the Reconstruction Finance Corporation had been the chief agency for extension of loans in industry in the United States. Established by an act of Congress in 1932, the R. F. C. had been active throughout the period of the 1930's in aiding all types of American industry. It was only natural that in the beginning of the defense program this corporation would lend money to such companies as the Reynolds Metals Company. However, it became apparent in August, 1940, that a specialized defense agency should be set up, and at that time the Defense Plant Corporation was established as a subsidiary of the R. F. C., mainly to facilitate the building of various types of defense plants.

22Engle and others, op. cit., p. 134.
The Defense Plant Corporation entered immediately into the aluminum industry, and operated mainly as a financial holding company, controlling all facilities acquired by it, with the exception of the options to Reynolds and to the Olin Corporation. With adequate financial resources, the corporation extended its investments in the aluminum field until about $500 millions had been released. Although its activities during the defense period had not extended very far, the tremendous expansion of its interests after the United States entered World War II made the Defense Plant Corporation "by far the largest single factor in the industry." Evidently, the entire program of its expansion was due to the fact that officials in Washington finally began to realize that the bottleneck in aluminum could cost the Allied nations the victory in World War II. Many suggestions had been made by various interested officials and individuals concerning the Government's entry into the aluminum production field, with at least one writer urging that the best way to provide aluminum was "to begin construction of a chain of government aluminum plants that will give us planes now and cheaper pots later."25
In mid-year, 1941, the news from Washington, D. C., was that the Government finally had decided to erect eight new plants for the production of aluminum. It came as a distinct surprise to many Americans, because of the persistent efforts on the part of Alcoa officials and even Commissioner Edward Stettinius, of the National Defense Advisory Commission, to impress upon the country the adequacy of the aluminum supply. It seems impossible that Mr. Stettinius could have issued his famous statement of December 29, 1940, to the effect that "investigations just completed disclosed no serious shortages." The events of 1941 proved him to be incorrect in his analysis, and further established the necessity for greatly expanded production of aluminum.

The years of 1940 and 1941 had begun the great revolution in the aluminum industry of the United States, and the next three years were to see the wartime activity in this field exceed even the most hopeful dreams of expansion. With the active participation of the United States in World War II after December 7, 1941, this country embarked upon its true

wartime program, the history of which will include an account of the success of the vast aluminum industry in its continuation of the program begun as a defense measure. The next chapter will be devoted to the history of the aluminum industry from December, 1941, to September, 1945.
CHAPTER III

THE ALUMINUM INDUSTRY OF THE UNITED STATES IN WORLD WAR II

Entry of the United States into World War II in December, 1941, gave a great impetus to the aluminum industry of this country. Following the events which had taken place during the defense program era, the industry engaged in still further efforts to place the United States in a strategic position to wage a successful war. Germany had been gambling, along with Japan, upon the possibility of being able to hold the United States at arm's length with its air forces, mainly because of its vastly superior prewar position in regard to the primary supply of airplane metals. This gamble on the part of the Axis powers was quickly recognized as just a hope on their part, because the immediate response of both private industry and the Government of the United States gave rise to a phenomenal wartime production of the metal.

The vast expansion program of Alcoa, the entry of the Reynolds Metals Company, and the Government's decision to

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1Hal F. Lee, "America Turns 'Pro,'" Barron's (March 16, 1942), p. 8. This article is typical of the early wartime discussions of the problems faced in the light-metals field. Lee points to the gamble that Germany and Japan were making, and suggests that the United States might surprise the Axis in regard to wartime aluminum production.
erect aluminum producing facilities were discussed in the previous chapter. The full story of the success of these programs was to be told in terms of their wartime activities. Early in 1942, at a time when the shock of Pearl Harbor and of other events was still fresh in the minds of the American public, the vast program of expansion in the aluminum industry was continuing as rapidly as could have been expected. The United States was beginning to be looked upon as the "Aluminum arsenal of the democracies," with the result that the Government's program was of particular interest. The entire history of the aluminum industry in wartime is closely allied with the various problems as they are listed below:

1. Expansion of plant facilities;
2. Dispersal of the aluminum industry;
3. Creation of potential postwar competition;
4. Development of new alloys and processes;
5. Integration of aluminum processes in one plant;
6. Success of additional private companies in aluminum;
7. Extension of the aluminum industry of the South and East to meet expanded needs;

\(^2\text{Ibid.}, \ p. \ 8.\)
8. Development of a new aluminum industry in the Pacific Northwest to aid in wartime productions; and

9. Total contributions of the aluminum industry in World War II.

Governmental intervention, of course, was being felt not only in the field of aluminum, but also in other fields, because the situation in regard to some other metals was critical after our official entry into the war. The whole picture of the frantic search for metals was adequately presented in March, 1942, in an article in Fortune, where the facts were presented as follows:

The crisis is barely realized. Few people are aware that one month after Pearl Harbor a squad of top U. S. specialists, metallurgists, and geologists packed themselves into a plane for South America to set going an all-out metals survey of Latin America. Few more realize that for over two years a small army of U.S. experts, state geologists, and engineers has been scouring this country by pack horse and mud-spattered automobile in a similar exploration of the continental U. S. With this survey now broadening into hemispheric scope the greatest hunt for metals in the history of the Western Hemisphere is on. It is brute weight of metal that must count in the next eighteen crucial months of this war, and the speed with which the hemisphere is made to disgorge new metal supplies may well tip the balance. The Axis has indicated its realistic grasp of the issue by making a beeline for metal resources in every country it has overrun. And the latest, smashing report of the U. S. Bureau of Mines is that the Axis by

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The great extent to which this analysis and prophecy came to be actual fact can be judged by the activities which surrounded the aluminum industry itself. Adequate recourse to South American bauxite ores had aided the industry during the prewar and the defense periods, but more and more emphasis was placed during the war on the utilization of domestic ores, even to the extent of developing the lower-grade ores and the erection of pilot plants for research activities.

The situation in early 1942 in regard to bauxite ores and their importance to the aluminum picture has been further stated as follows:

Important as are all the other strategic metals, aluminum probably will go into history as the metal of World War II. It is the metal of air power. It is the metal in which the Axis stole such a long march on the Allies, building up to 48 per cent of world output, that it will take us until the end of 1942 to

\[4\text{-Ibid.}, \text{ pp. 132-35.} \]
pull ahead. It is the metal in which pressure on production is now greater than in any other. The most startling fact about aluminum to many people is that the U. S. imports over 50 percent of its needs in high-grade bauxite ore, from which aluminum is made. The bulk of U.S. supplies of this vital ore come from British Guiana and Surinam, whose huge deposits can fill our full import needs (total estimated war needs: over three million tons a year) as soon as the U. S. triples the shipping capacity now available. In the interim the U. S. is drawing deeply on its domestic bauxite reserves, which are precariously small. Known deposits of high-grade bauxites, mostly in Arkansas, total some nine million long tons; below this, at extra cost for silica removal, are usable submarginal reserves of another nine million long tons. If all outside supplies were to be cut off these reserves would make us self-sufficient—but at the price of exhausting them in something under six years.

This is a shaky backdrop for aluminum..... The broadest, most prolific, and untapped source for alumina is high-alumina clay.....Some of the world's top researchers have been attacking this problem for two decades, because in the long view bauxite is limited and clay must eventually become the world's source for aluminum.....The most dangerous notion that the U. S. may have is that it has plenty of time, that extreme measures to broaden U. S. production of strategic metals need not be taken quite yet. The initiative, it should be noted must come from government.....On their side private capital and industry cannot too far abrogate their traditional function of taking risks without destroying their reasons for being.

There could have developed a substantial argument in terms of economic theory as to whether or not the Government should have been entering the field of production of aluminum, but it will be readily seen by most economists that in this
time of emergency private enterprise simply was not in any sort of position to produce an adequate supply of the metal. It had been apparent for many years that the classic analysis of an "invisible hand" had not received much appreciation in the field of aluminum, and no competition had developed.

Expansion of Plant Facilities:

Expansion of the various companies reached its highest point in the period from 1942 to 1945. Government-built plants made the picture of the aluminum industry a more satisfying one, in terms of production and prices. The Reynolds Metals Company, which had begun its building program in 1940 and 1941, continued to expand, mainly with financial aid from the Government. It is not surprising, then, to find that in 1943 the reduction capacity of this company had been increased to approximately 170 million pounds in the Longview and Listerhill plants. The Reynolds company had little more than one-fifth of the capacity which Alcoa could boast in 1943. The extent of its capacity was about eight per cent of the total capacity of the United States. However, the Reynolds Metals Company could boast of having a unique

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5Private enterprise versus government intervention is a point which will be discussed in the chapter dealing with the economics of the aluminum industry.

6Engle and others, op. cit., p. 134.
record behind it, in terms of the pioneering in the field of modern aluminum production techniques. Mr. James A. Lee, in an article concerning this company, pointed to the many "firsts" that had been achieved by Reynolds since its entry into the field of aluminum production. He described the decision of Reynolds to go into the field of virgin metal production in the following statement:

This decision was quickly put into definite form with the construction of the first aluminum plant in the Western Hemisphere and probably in the entire world to start with the bauxite ore, process it to alumina, reduce the oxide to metal, and roll sheets, rods, and bars, all in one continuous straightline flow of materials over a mile in length. Throughout this long line are numerous evidences of pioneering spirit.

1. It is the first aluminum plant in which low grade domestic ore was used exclusively;
2. This is the first commercial plant to use closed circuit wet grinding of bauxite;
3. The bedding down of bauxite was introduced;
4. Most of the red mud is removed by settling rather than by filtration;
5. Rectangular Soderberg continuous electrodes are used in the cells; and
6. Rolling doors are provided for the furnaces.

Another contemporary report on the growth of the Reynolds Metals Company also is of great interest, mainly because of the fact that it pointed to the postwar future of the company in terms of its competition with Alcoa. From this article the following is quoted:

The growth of Reynolds during the war changes the picture of the aluminum industry. A competitor with a capacity of one-fifth that of Alcoa's is not a negligible one, especially since Reynolds' facilities are of the most modern. The Longview plant is on tidewater and has very cheap power near at hand. In the future it may have access to locally produced alumina, either from imported bauxite or from local clays. Reynolds' Listerhill plant is the only one in the United States where alumina refining, aluminum reduction, and fabrication are integrated on the same site. In the future, the success of Reynolds may depend on its ability to take over some of the government-owned plants now operated by others and thereby extend its share of total capacity and reduce Alcoa's lead. Here again the policy of the government on the disposal of its holdings may be decisive.

The analysis is not complete, however, when only the expansion of Reynolds is treated in the discussion of the wartime period. The greatest single influence throughout the entire period of the war was the Defense Plant Corporation. This government corporation carried through its original plans to build alumina plants and aluminum reduction

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*Emile and others, *op. cit.*, p. 134.*
plants. The rapid extension of its program of building aided the war effort greatly. The Defense Plant Corporation made a total investment of approximately half a billion dollars in the aluminum industry during the defense and war periods. The corporation eventually owned alumina plants to the value of nearly $100 million; nine aluminum reduction plants worth nearly $175 million; rolling mills valued at more than $100 million; and an extrusion and fabricating plant which cost more than $30 million. Additional facilities brought the sum total of investments of Defense Plant Corporation to the staggering sum of more than $633 million. Some of the actions of this governmental agency were severely criticized. Its decision to purchase 1,300,000,000 pounds of aluminum from the Aluminum Company of Canada, at a price of 15 cents per pound, was criticized by many people. It must be admitted that this action was caused by the dire necessities of war, and some of the criticism was not justified. An advance payment of $68 million was made by the Defense Plant Corporation. This money allegedly was used to construct a dam on the Saguenay River, thus giving Canadian producers an advantage in the postwar era through their low power costs. In defense of this move, the following statement is presented:

9Ibid., pp. 135-37.

10Ibid., p. 137.
the realization that they must gird themselves for war. Aluminum was needed in vast but undefinable quantities. Frantic efforts were made to increase capacity at home and in Canada. Economic considerations both immediate and long run were ignored. The important consequence is that we have insured an adequate supply of aluminum, to secure victory. Offsetting facts are that we have subsidized a potential competitor in Canada, and have built a number of poorly located, high cost plants at home. We have also established some new efficient and well located plants. Only the test of time can reveal the net benefits or losses flowing from policies forged of necessity in the fire of war preparation.

Government activity throughout the war in the aluminum program may best be shown by presentation of facts concerning the Defense Plant Corporation's interest both in aluminum and in magnesium, which is the chief competitor of aluminum among the light metals. Mr. Hans A. Klagsbrunn, of the Defense Plant Corporation, published one of the most comprehensive reviews of the aluminum and magnesium industries of this country that appeared at the close of hostilities with Germany. During the war, of course, it had been a matter of close censorship, and figures on such production could not have been published. But with the end of war with Germany, conditions were changed considerably, and various articles began to

\[\text{For a typical example of wartime writing on the aluminum industry, see F. C. Frary, "Aluminum in War," Chemical and Engineering News, Vol. XXI, (December 10, 1943), pp. 2018-19. For obvious reasons, it was much later than 1943 before it was possible to draw a complete picture of the aluminum industry.}\]
appear, even before the cessation of war with Japan.

Mr. Klagsbrunn's article appeared in the July, 1945, issue of Industrial and Engineering Chemistry. This magazine was one of the first periodicals to present an adequate summary of events during the war years. The article was accompanied by a number of significant tables concerning various phases of the aluminum and magnesium industries during the war.

Significant among the opening remarks of Mr. Klagsbrunn is the following statement:

When it became apparent that tremendous increases were necessary, Defense Plant Corporation, at the request of War Production Board, constructed two alumina plants, nine aluminum reduction plants, and thirteen magnesium metal plants. These additions gave a total designed capacity of 2286 million pounds of aluminum (about seven times the 1939 Alcoa peak) and 586 million of magnesium (about eighty-seven times the Dow high of 1939). Actual production, however, showed a larger capacity for all of the aluminum plants and for nine of the magnesium. Even without full use, supplies came so rapidly that cutbacks were ordered for aluminum by December, 1943, and for magnesium in May, 1944. During December, 1944, aluminum had been cut back to only 48.5% of capacity, magnesium to 16%. The problem of adequate supply of these metals had, within a space of four years, been completely overcome.

This description of American aluminum and magnesium production is one of the most amazing stories of industrial production ever known in the United States. From a story of

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"too little," and almost "too late," the development in the aluminum industry had progressed so well that even before the opening of the second front in Europe it was possible to begin these cutbacks which Mr. Klagsbrunn mentions. The Defense Plant Corporation had made investments in both the aluminum and the magnesium industries to the extent of about $1,059,957,000, more than half of which had gone into aluminum production. In a more detailed breakdown, it is shown that $263,648,000 was spent for alumina and aluminum plants; $365,575,000 for aluminum fabricating plants; and $41,435,000 for miscellaneous plants, including the sintering plants, power, etc. This made a total of $670,658,000 that was spent by Defense Plant Corporation on aluminum. The rapid expansion of facilities which had been made possible for the industry by this outlay of money caused the United States to be in a strategic position to turn the entire course of the war in Europe. The enormous production of warplanes and equipment for the armed forces made an Allied victory possible.

Although the preceding discussions show the extent to which the entire aluminum production program had been a huge success, particularly after governmental intervention, there is one additional feature of the wartime activities that improves the whole picture. It is the story of the Olin

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13Ibid., p. 608.
Corporation, which was mentioned earlier in this study. It is of significance to the complete discussion of aluminum in war, mainly because it is typical of the interest of the government in the development of aluminum from alunite, rather than from the traditional ore, bauxite. In reality, it is a part of expansion in the entire industry, because it opened up a wide field for research and experimentation with the lower-grade ores for use in the postwar world.

One of the earlier reports on the activities of the Olin Corporation in the field of aluminum production was given by Professors Engle, Gregory and Mosse, as follows:

Little is known about the most recent entry in the aluminum field, the Olin Corporation. Owners of Western Cartridge Company, a closely held middle west corporation, the Olin family undertook, in 1942, to build and operate for the Defense Plant Corporation an aluminum plant at Tacoma, Washington, with capacity to produce some 40 million pounds of pig aluminum annually. The company has been granted an option to purchase this plant, which is believed to be the only option to buy an aluminum reduction plant thus far issued by the D. P. C....

Recognizing the necessity for an independent supply of alumina the Olin interests purchased control of Kalunite, Incorporated, at Salt Lake City, Utah, a company which had been formed to promote a process for extracting alumina from alunite. With $4,954,088 of Defense Plant Corporation funds a plant was constructed near Salt Lake City with capacity to produce 72,000,000 pounds of alumina annually. Completed late in 1943 the plant is expected to be in production early in 1944.

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14Engle and others, op. cit., pp. 134-35.
No information is available on the intentions of the Olin Company to take up their option on the Tacoma plant and to become permanent competitors of Alcoa and Reynolds. Neither are facts to be found on the capital strength of the company. The excellent plant at Tacoma located close to tidewater is turning out aluminum of very high quality using alumina from southeastern plants. This organization may become a strong nucleus for another effective factor in the aluminum industry.

Actually, the last statement on the part of the authors mentioned above did not evolve as they had indicated it might, because the Olin Corporation did not remain in the field of aluminum production, at least at the Tacoma plant. This plant, according to Klagsbrunn, had cost a total of $6,297,000 by December 31, 1944, and had two pot lines for the reduction of alumina to the virgin metal. Designed for an annual capacity of 41.6 million pounds, the plant in actual operation bettered that mark, with an annual equivalent, based on its best month of production, of 43,392,000 pounds. This was not sustained production, however, and actual figures for production of the plant in 1942, 1943, and 1944, were approximately 5 million, 37 million, and 37 million pounds, respectively, for those three years. Initial operations had begun in September, 1942, and full scale operation was effected in March, 1943. Costs, as given by Klagsbrunn, amounted to 15.38 cents per pound of ingot aluminum produced, which made the Tacoma plant one of the highest cost facilities which were built during the wartime
emergency. Perhaps the higher costs of this plant might have contributed to the decision of Olin Industries, Inc., to close the plant in 1945.

On December 11, 1944, the Olin Corporation had merged with the Western Cartridge Company, with the result that the new company had been named Olin Industries, Inc. Its aluminum plant at Tacoma, and an ordnance plant in St. Louis, had been closed in 1945, but the company had retained Kalunite, Inc., of Salt Lake City, as a subsidiary. The Olin Company has ceased to be an important factor in the aluminum industry. Even the alumina producing facilities of Kalunite, Inc., had proved to be quite disappointing, although they had paved the way for greater research in alumina production from alunite. Initial operation of the Salt Lake City plant had begun in July, 1944, but the total production of alumina had reached only 1,069,000 pounds in the last half of 1944. By that time, the plant had not been adequately tested, owing mainly to difficulties with equipment. The production of only slightly more than one million pounds of alumina, in a plant designed

15Complete details on the Olin Corporation and its successor, Olin Industries, Inc., are still lacking, although the story as given is fairly complete, as far as it can be ascertained. These data have been assembled from Klagsbrunn, op. cit., pp. 610-11; Moody's Industrials, 1946, p. 2755; and Standard Corporation Records, June, 1946, p. 3444.
for a capacity of 72 million pounds, proved to be extremely disappointing on many grounds.

At the same time that it extended financial aid to Kalunite, Inc., for the Salt Lake City plant, the Defense Plant Corporation, in an attempt to augment aluminum facilities, built three additional small plants to develop processes using materials other than bauxite ores. These three plants, like the one built by Kalunite, Inc., (which was owned by Olin Corporation), were constructed by private operators, as follows: Columbia Metals Company, Salem, Oregon; Monolith Portland Midwest Company, Laramie, Wyoming; and the Ancor Corporation, Harleyville, South Carolina. All of these three plants were mainly in the nature of experimental actions for developing alumina from clays, which are in reality low grade aluminum ores.

**Dispersal of the Aluminum Industry:**

Wartime dispersal of the aluminum industry of the United States has been a subject for much comment by various writers who have noted the suddenness with which this scattering of all types of plants was accomplished. Most writers have merely commented on the vast dispersion which has taken place, without analyzing the entire situation to any great

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16 Klagsbrunn, op. cit., p. 612.

17 Ibid., p. 611.
extent. However, upon close examination, it will be found that the expedient things were done to assure hasty production of aluminum with which to fight the war. Prewar descriptions of the industry, even after Reynolds Metals Company entered the field of alumina and aluminum reduction, were limited to a relatively small number of plants of both types. The privately-owned companies producing alumina were Alcoa and the Reynolds Metals Company, with a total of three plants engaged in the reduction of alumina. Two of these plants for alumina reduction, one at East St. Louis, Illinois, and the other at Mobile, Alabama, were owned and operated by Alcoa. The other plant, at Listerhill, Alabama, was owned and operated by Reynolds. That company had been financed in its initial stages by the Reconstruction Finance Corporation, and later received financial assistance from the Defense Plant Corporation. These three alumina plants were the total alumina facilities early in 1942. But this picture was to be changed considerably, both in terms of dispersion and quantity of alumina production, by the entry of the Defense Plant Corporation into the building of additional alumina facilities.

The Government had embarked upon the program of alumina production as early as August, 1941. A contract with Alcoa for the construction of an alumina plant at Hurricane
Arkansas, was executed at that time. This plant, with an annual rated capacity of 1,555,000,000 pounds of alumina, was situated six miles from the Saline county bauxite mines in Arkansas. It was an attempt to locate the alumina reduction plant close to the source of the raw ores. Its initial production was planned for a lower figure than that given above, but the later agreements reached between Alcoa and the Defense Plant Corporation boosted the capacity. Still a second plant was planned and erected at Baton Rouge, Louisiana, with the expressed purpose of using Arkansas and South American ores, provided conditions permitted the importation of the latter raw materials. The entire program which surrounded the building of the two extra alumina plants had been set forth by the War Production Board and its predecessors. Alcoa was to operate the two government-owned alumina plants. Completion of these plants gave the dispersion of the alumina plants, their rated annual capacities, their ownership and operation, and the sources of their bauxite ores, as shown on the following page.

Analysis of Table II will show that the Defense Plant Corporation, through its ownership of the Hurricane Creek and Baton Rouge plants, was the largest single owner of alumina reduction capacity. Total capacity of these two plants was 2,555,000,000 pounds of alumina annually, or 52.2% of the capacity of the entire industry. Alcoa plants ranked second
in importance in alumina production, with a total capacity of 2,140,000,000 pounds annually, The Reynolds Metals Company, with the 200,000,000 pounds capacity, ranked third.

### TABLE II

**WARTIME ALUMINA FACILITIES**

<table>
<thead>
<tr>
<th>Plant</th>
<th>Ownership Operation</th>
<th>Rated Annual Capacity (Million Pounds)</th>
<th>Source of Bauxite</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hurricane Creek (Arkansas)</td>
<td>DPG—Alcoa</td>
<td>1,555</td>
<td>Arkansas</td>
</tr>
<tr>
<td>Baton Rouge (Louisiana)</td>
<td>DPG—Alcoa</td>
<td>1,000</td>
<td>Arkansas Surinam</td>
</tr>
<tr>
<td>Mobile (Alabama)</td>
<td>Alcoa</td>
<td>1,300</td>
<td>Arkansas Surinam</td>
</tr>
<tr>
<td>East St. Louis (Illinois)</td>
<td>Alcoa</td>
<td>840</td>
<td>Arkansas Surinam</td>
</tr>
<tr>
<td>Listerhill (Alabama)</td>
<td>Reynolds</td>
<td>200</td>
<td>Arkansas Surinam</td>
</tr>
<tr>
<td><strong>Total Capacity</strong></td>
<td></td>
<td><strong>4,895</strong></td>
<td></td>
</tr>
</tbody>
</table>

Source: Klagbrunn, *op. cit.*, p. 611.

Alcoa, with its plants at East St. Louis, Illinois, and Mobile, Alabama, had a total of 43.7% of the annual capacity for alumina production, while Reynolds' total was 4.1%, from its Listerhill, Alabama, plant. In the two plants owned by the Defense Plant Corporation, and in Alcoa's two plants, it was
arranged during the war to install lime-soda-sinter processing facilities. The purposes behind this move were to decrease losses of alumina in the Bayer process, to conserve the limited resources of bauxite ores, and to utilize the lower grade ores.

The dispersion among the alumina plants was more than matched by the wartime dispersal of the various aluminum ingot facilities under both private and government ownership. Dealing briefly with the privately owned facilities for the reduction of the virgin metal from alumina, Alcoa had a total of five plants, scattered over the United States as follows: Alcoa, Tennessee; Badin, North Carolina; Massena, New York; Niagara Falls, New York; and Vancouver, Washington. All five of these plants had been in aluminum reduction business in 1939, with the exception of the Vancouver plant, which had produced nearly 10 million pounds of aluminum in 1940, after which its production had steadily increased each year until the 1943 cutbacks. The same may be said for the other four plants in regard to their wartime production of ingot aluminum. Production in all of them steadily increased in the years 1940, 1941, 1942, and 1943. The Reynolds Metals Company had two aluminum reduction plants, those located at Listerhill, Alabama, and Longview, Washington.

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Ibid., pp. 611-13.
of ingot aluminum did not begin in these two plants until 1941, but it was greatly expanded throughout the next three years, and reached maximum figures in 1944. Even without the vast expansion of the government-built ingot aluminum plants, this phase of the activities of the industry was well dispersed from coast to coast. This dispersion was effected mainly on the basis of adequate power supplies, which is a necessary adjunct to ingot aluminum reduction.

The previous picture of the privately owned ingot aluminum production facilities is complicated by the addition of the nine government-built plants. The wide dispersal of the industry achieved by this move on the part of the government is one of the unique features of the history of aluminum during the war. Of these nine plants, eight were operated during the war by Alcoa, and the Olin Corporation operated the ninth. The Alcoa-operated plants were widely scattered over the entire country, as follows: Burlington, New Jersey; Jones Mills, Arkansas; Maspeth, New York; Massena, New York; Riverbank, California; Spokane, Washington; Torrance, California; and Troutdale, Oregon. The plant operated by Olin Corporation was, as we have seen, in Tacoma, Washington. Briefly, the total dispersion of the ingot aluminum plants, both privately owned and government owned, shows that a total of 16 such plants were operative in the United States during the war. Of this number, four were in
New York, four were in Washington, two were in California, and the remaining six were widely scattered, one each being in the states of Arkansas, Tennessee, North Carolina, Alabama, Oregon, and New Jersey. This dispersion has been criticized as being uneconomic in many ways, but it has been upheld because of the expediency of fighting and winning a war.

The eight aluminum ingot plants constructed by the Defense Plant Corporation and operated by Alcoa during the war added greatly to the supply of ingot aluminum, and may be credited with full share in winning the war for the Allied powers. A total of 38 pot lines for aluminum reduction had been established by the construction of these facilities, and Alcoa had control of 36 of them, the remaining two were operated by Olin Corporation at its Tacoma, Washington, plant. As in the case of the privately owned plants, the nine plants owned by the Defense Plant Corporation increased total production for all aluminum facilities. Six of the plants had been in operation in 1942, and the remaining three were placed into operation in 1943. Total ingot aluminum production for the year 1943, including both privately owned plants and government owned plants, was 1,840,075,000 pounds, which was more than sufficient to satisfy the war effort. The following table shows the wartime production of the sixteen ingot aluminum reduction plants, for the years 1942, 1943, and 1944.
It is particularly significant to note the great superiority of some of the producing plants over the others. The reason for these differences is explained on the basis of the original designed capacity of the various plants, the original costs

TABLE III

ALUMINUM INGOT PRODUCTION IN THE UNITED STATES BY GOVERNMENT OWNED PLANTS AND PRIVATELY OWNED PLANTS, 1942-1944

<table>
<thead>
<tr>
<th>Location</th>
<th>Operator</th>
<th>1942 (Thousand Pounds)</th>
<th>1943 (Thousand Pounds)</th>
<th>1944 (Thousand Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burlington, N. J.</td>
<td>Alcoa</td>
<td>48,549</td>
<td>22,454</td>
<td>194,096</td>
</tr>
<tr>
<td>Jones Mills, Ark.</td>
<td>&quot;</td>
<td>20,704</td>
<td>133,885</td>
<td>177,245</td>
</tr>
<tr>
<td>Maspeth, N. Y.</td>
<td>&quot;</td>
<td>44,133</td>
<td>105,137</td>
<td>9,059</td>
</tr>
<tr>
<td>Massena, N. Y.</td>
<td>&quot;</td>
<td>34,933</td>
<td>143,109</td>
<td>191,698</td>
</tr>
<tr>
<td>Riverbank, Calif.</td>
<td>&quot;</td>
<td>37,174</td>
<td>36,719</td>
<td>36,719</td>
</tr>
<tr>
<td>Spokane, Wash.</td>
<td>&quot;</td>
<td>25,309</td>
<td>94,852</td>
<td>104,776</td>
</tr>
<tr>
<td>Totals (government plants)</td>
<td>146,045</td>
<td>850,329</td>
<td>701,714</td>
<td></td>
</tr>
</tbody>
</table>

Privately Owned Plants

<table>
<thead>
<tr>
<th>Location</th>
<th>Operator</th>
<th>1942 (Thousand Pounds)</th>
<th>1943 (Thousand Pounds)</th>
<th>1944 (Thousand Pounds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcoa, Tenn.</td>
<td>Alcoa</td>
<td>310,778</td>
<td>272,919</td>
<td>272,919</td>
</tr>
<tr>
<td>Badin, N. C.</td>
<td>&quot;</td>
<td>98,247</td>
<td>65,049</td>
<td>65,049</td>
</tr>
<tr>
<td>Massena, N. Y.</td>
<td>&quot;</td>
<td>152,069</td>
<td>143,492</td>
<td>143,492</td>
</tr>
<tr>
<td>Niagara Falls, N.Y.</td>
<td>&quot;</td>
<td>38,670</td>
<td>40,889</td>
<td>10,584</td>
</tr>
<tr>
<td>Vancouver, Wash.</td>
<td>&quot;</td>
<td>181,369</td>
<td>164,654</td>
<td>164,654</td>
</tr>
<tr>
<td>Listerhill, Ala.</td>
<td>Reynolds</td>
<td>62,975</td>
<td>100,408</td>
<td>100,408</td>
</tr>
<tr>
<td>Longview, Wash.</td>
<td>&quot;</td>
<td>52,040</td>
<td>63,876</td>
<td>63,876</td>
</tr>
<tr>
<td>Totals (private plants)</td>
<td>896,148</td>
<td>989,746</td>
<td>850,982</td>
<td></td>
</tr>
<tr>
<td>Grand Totals</td>
<td></td>
<td>1,042,193</td>
<td>1,840,075</td>
<td>1,552,696</td>
</tr>
</tbody>
</table>

Source: Adapted from Klagsbrunn, op. cit., pp. 610-11.
involved, and the number of pot lines which each plant contained. The government built plants in 1943 produced 850,329,000 pounds of virgin metal, almost as much as the 989,746,000 pounds which were produced by the privately owned plants. This record is unusual for the government owned plants to attain, in view of the fact that the plants at Riverbank and Torrance, California, never did attain maximum capacity. One pot line at Riverbank and two at Torrance were never put into operation.

Peak production for all of the government owned plants was reached in December, 1943, with a total of 104,500,000 pounds of ingot aluminum for that month. At the end of that month, the first cutbacks were made at two of the Defense Plant Corporation plants, and in three plants operated by Alcoa. These cutbacks were definite signs that the vast program for aluminum production to meet the war emergencies had served the purpose. The whole problem of dispersal of the industry to meet the immediate wartime needs of the country in regard to adequate amounts of the metal was solved successfully. The postwar problem of the greatest economic usage of these facilities was still to be faced. Obviously, wartime dispersal of the aluminum industry had been made mainly on the basis of adequate power supplies. Postwar considerations would give attention to other problems of nearness to markets, transportation difficulties and adequate raw materials.
Creation of Potential Postwar Competition:

Much of the previous discussion has shown the lack of competition in the aluminum industry prior to 1940. Activities of both Reynolds Metals Company and the national Government in bringing about some competition in the era of preparedness was shown in Chapter II. But the all-out efforts of the United States during the actual wartime period were responsible for the real crystallization of the element of competition in the industry. The vast program of expansion which was carried out under the sponsorship and financial assistance of the Defense Plant Corporation resulted in the creation of a national aluminum industry ownership that rivalled, as we have seen, all of the efforts of Alcoa through the years of the twentieth century. Expansion of the Defense Plant Corporation into several lines of aluminum industry activity intensified the prospects for competition.

The extent to which this competition was a potential threat to Alcoa's power in the industry may be illustrated by the reiteration of the statement that the Defense Plant Corporation built two alumina plants, nine aluminum reduction plants, two rolling mills, and an extrusion and fabricating plant. These activities placed this governmental agency in the entire field of the aluminum industry, with the exception of the mining of bauxite or other ores. It was apparent that the governmental agency was interested in giving aid only in
those fields of the industry which were inadequate to meet the wartime demands for the metal. The actual intention on the part of the Government to stay in the aluminum production business was never made an important issue. It was generally understood that the plants being erected would either be turned over to private industry at the end of the war, or be abandoned or, as a safety measure, be placed in a stand-by status as a precaution against being unprepared in the event of another war. However, the idea of turning the plants over to private industry was the question which was uppermost in the minds of those connected with the aluminum industry, because it was not known during the war whether by this means the Government would seek to cripple Alcoa.

Obviously, many people had felt kindly toward the Government when aid was extended to Reynolds, Olin and others for various plants in the aluminum industry. Then, after the Defense Plant Corporation had built the two alumina plants and turned them over to Alcoa for operation, there was a wave of skepticism about the Government's intentions. This feeling of anxiety was intensified when it became known that Alcoa, in addition to operating the two alumina plants, would be given the opportunity to operate eight of the nine ingot aluminum reduction plants. However, these moves on the part of the Government may be explained by the fact that Alcoa seemed the only company prepared to operate these facilities.
Since the Government made no commitments to Alcoa, such as the "option to purchase" which had been given to Reynolds and the Olin Corporation, it could not have been felt at that time that Alcoa would take the greatest share of the postwar aluminum capacity developed by the federal Government. In fact, several later moves on the part of Alcoa and the Government showed that competition was a more likely prospect for the postwar aluminum industry than was the extension of Alcoa's monopoly with the direct aid of the Government. Subsequent leases of government-owned plants both to Reynolds Metals Company and to Henry J. Kaiser facilitated the postwar competition which had been hoped for by many people. These latter problems of leases, together with the turning of patent rights over to the Reconstruction Finance Corporation, to be made available to all producers of aluminum in the United States, will be discussed in the next chapter.

**Development of New Alloys and Processes:**

Experimentation with new alloys and new processes for handling both the ores and the virgin metal has long been an outstanding feature of the aluminum industry. The wartime period saw a great extension of these types of experimentation, with the result that many new and significant discoveries were made. While the technical end of the new developments will not be considered here, the growth of the
industry through these new alloys and processes is of great economic importance. These new alloys have made the extension of aluminum markets more feasible, and have added to the usefulness of the metal in many industrial applications which were previously impossible. Both Alcoa and Reynolds developed outstanding alloys, which have been put into industrial use. Both companies have been constantly experimenting with the metal in a variety of ways. Further refinements of the Bayer process of alumina reduction have been accomplished, particularly with the use of the soda-lime-sinter process. This process utilizes or saves much more of the alumina content of the various ores. One of the important postwar commentaries on the development of alloys and aluminum processes appeared in Chemical and Metallurgical Engineering for February, 1946, as follows:

Not all developments in aluminum have had to do with the (Bayer) process, since many concerned new alloys, finishes and applications. The past year marked the commercial introduction of new clad alloys which combine high yield strength with good resistance to corrosion. Alcoa's new high strength 753 alloy and Reynolds 8303 alloy, both newcomers, have found wide acceptance; they are the strongest aluminum alloys of their type ever used. Alloy 635, which made its debut during the war, is noted for its ability to take a bright, clean anodic coating. Significant progress was made during

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the last year in the fields of welding, brazing, and resin bonding, all of which will have their impact on the fabrication of postwar aluminum products.

Developments in the field of aluminum finishes continued at a rapid pace. Electrolytic processes have been further perfected and peacetime customers of aluminum will find the metal finished in practically every color of the rainbow.

Commercial electroplating of aluminum is now available for many types of products. Nickel, copper, silver, chromium and gold plating can be applied now to aluminum using a zinc immersion procedure.

A great deal of significance has been attached to this wartime development of aluminum alloys, mainly on the basis of their prospective uses in the postwar era. In regard to the new Alcoa alloy, 75S, the following has been said:

New high-strength alloys have been reported in the aluminum field. Alloy 75S contains zinc, copper, manganese, magnesium, and chromium. Its increased strength over older alloys is said to have saved 400 pounds in an airplane. The construction of a New York skyscraper from this and other aluminum alloys is proposed by the Aluminum Company of America.

Other industrial applications of this same new alloy, plus the Reynolds alloy, 303, have been mentioned in various articles, the following of which is typical:

Aluminum alloys are again being extensively used by the transportation industry in trains,

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20The Americana Annual, 1947, p. 441.

21Ibid., p. 24. See also "New Alloys, Techniques Expand Markets for Aluminum After War," Iron Age, Vol. CLVII,
trucks, and buses, and in the marine field. The use of aluminum in ship superstructures is a promising development. The building industry has been a large user of aluminum, and new developments are continuing this trend. The introduction of aluminum roofing sheet, particularly for use on farm buildings, sheds, and the like, has opened a very large market which should keep the rolling mills busy for some time. Other important applications in building and home construction are aluminum spandrels, coping, window frames, and sills, building hardware, and venetian blinds. Structural uses of aluminum are increasing, and a railroad bridge span with aluminum-plate girders 10 feet in depth and 100 feet long has been installed near Massena, New York.

All of these important uses of aluminum alloys will make the wartime investments in research and experimentation worthwhile in terms of additional consumer usages of the metal.

Integration of Aluminum Processes in One Plant:

Previous reference has been made to one of the greatest achievements in the aluminum industry of the war, that of integration of all of the processes of aluminum production into one plant, as achieved by the Reynolds Metals Company, at Listerhill, Alabama. While perhaps not on a par with the great expansion of the entire industry in terms of its importance, this integration of the essential processes of alumina reduction, aluminum ingot reduction, and rolling mill fabrication,
shows that it is possible, without widespread dispersal of these functions, to carry out a program of aluminum production on an economic scale. Although each of these processes was carried out at the Listerhill plant on a smaller scale than was possible at other locations where larger plants had been erected, the integration did serve to impress upon the leaders in the aluminum industry the necessity for reduced postwar costs. One of the significant features of this integration was its saving of costs of transportation, both for the alumina after it had been reduced and for the ingot aluminum after it was ready for fabrication.

Each of the steps in this integrated plant is presented in detailed fashion in the May, 1943, issue of Chemical and Metallurgical Engineering, together with a flow sheet which shows graphically how each stage is carried out in the mile-long industrial plant. The entire project was unique from the standpoint of industrial engineering, plant management, and continuous-flow operations. The nearest approach to the Reynolds technique of aluminum production in the war was the establishment of the new alumina plant at Hurricane Creek, Arkansas, and the placing of the aluminum reduction plant near by at Jones Mills, Arkansas,

The bauxite, alumina, and virgin metal all could be produced in Arkansas within a radius of a few miles, but this integration was not comparable to that of Reynolds at Listerhill. The interest in this type of integration was further manifested by Reynolds in its lease of the Hurricane Creek and Jones Mills facilities after the war.

**Success of Additional Private Companies in Aluminum:**

Although the major wartime developments in the aluminum industry were achieved by those large companies which have been mentioned quite frequently thus far, there were some smaller companies which were able to gain some degree of recognition for their contributions in the field during the war. Mainly with the aid of government funds, these small companies, like Reynolds and Alcoa, devoted their special efforts to those phases of the industry which they could handle best. In particular, the Olin Corporation should be given credit both for its operation of the Tacoma, Washington, aluminum reduction plant, and for its purchase of Kalunite, Inc. The latter company, as we have seen, operated the alumina reduction plant at Salt Lake City, Utah, although

23 "Wartime Progress in Alumina and Aluminum," Chemical and Metallurgical Engineering, Vol. LIII, (February, 1946), p. 157. A further discussion of this postwar leasing program will be found in the next chapter.
its success in reducing alumina from alunite did not reach the full expectations which had been held for it.

Other smaller companies, which attained some degree of success in the aluminum field, were Ancor Corporation, the Columbia Metals Company, and the Monolith Portland Midwest Company. The Ancor Corporation and the Columbia Metals Company both were aided by the Defense Plant Corporation in the establishment of plants for the reduction of alumina from clays. Ancor established a plant at Harleyville, South Carolina, at a cost of $2,642,000, and Columbia established a plant at Salem, Oregon, costing $4,086,500. The Monolith Portland Midwest Company erected a plant at Laramie, Wyoming, at a cost of $3,965,000. This latter plant was dedicated to the reduction of alumina from anorthosite, which is a type of igneous rock found in the Rocky Mountain region and more abundantly in the "Laurentian" belt in Canada, from the Great Lakes to Labrador. A fifth small company to be mentioned in connection with these experiments with low grade aluminum ores is Aluminum, Inc., which had been scheduled to operate a plant at Marysville, Utah. This plant was of the same nature as the Kalunite, Inc., project, and was supposed to produce alumina from alunite. However, this project, which would have cost the Defense Plant Corporation a total of $775,000, was abandoned.

24 Various discussions of the facts presented here are found in Engle and others, op. cit., pp. 26, 60, and 136.
These smaller plants, designed to be experimental plants in the field of alumina reduction, were designated in the aluminum industry as pilot plants during the war. They were important in the wartime years because of the necessity of finding practical methods of reduction of alumina from lower grade ores. Their lasting significance has been shown in the following statement:

Justification for such expenditures lies in the danger that high-grade ores will be exhausted and the nation's aluminum industry will be entirely dependent on foreign sources of supply should the war drag on for several years. Much the same justification exists for the development of a practical process for the quantity production of alumina from clays and other raw materials available in the United States, as for the building of a synthetic rubber industry. So long as aircraft remain the indispensable armament they are today and so long as aircraft must be made of aluminum, the United States should spare no effort to provide a domestic source of alumina. Even though alumina-from-clay plants may not be able to compete with alumina-from-bauxite plants after the war, they could be held in reserve as part of the permanent arsenal of the nation, as standby plants to be operated only in time of national peril. Should they, on the other hand, prove to be competitive with bauxite refineries their future contribution to the aluminum industry of the United States would be great.

Government aid was extended through the Defense Plant Corporation to a wide variety of companies engaged in different fabricating activities during the war. Classification of these companies into various divisions of fabricating

25Ibid., p. 61.
activities was made by the Truman Committee, in the Third Annual Report. This report is condensed and tabulated by Professors Engle, Gregory and Mosse, and appears as "Appendix 7" of their book. A great number of companies were aided by the Defense Plant Corporation, in the following divisions of the fabricating business: extrusion plants; rolled rod and bar plants; tubing plants; aluminum forging plants; aluminum sand castings (excluding cylinder heads); aluminum die castings; permanent mold castings; and cast cylinder heads. Some of the outstanding companies in the fabrication field to receive Defense Plant Corporation financial assistance were: Alcoa; Reynolds; Bohn Aluminum and Brass Corporation; Revere Copper and Brass Company; Aluminum Forging Company, Inc.; Delco-Remy; Buick Motors; Chevrolet; and Ford Motor Company. All of these companies contributed much to the war effort in their fabrication of the various types of aluminum products mentioned above. Most of these companies, it will be noted, do not fall into the smaller companies group, but in terms of their efforts at fabrication of aluminum during the war, they were definitely in that classification as far as the Defense Plant Corporation loans were concerned. Only such companies as Alcoa and Reynolds received loans above the $20,000,000 level for fabricating facilities during the war.

26 Ibid., Appendix 7, pp. 442-53.
One other company should be mentioned as being of potential importance in the field of aluminum, although specific information is lacking about it in many respects. It is the Independent Aluminum Corporation, which today controls a one-half interest in a new patented process for the thermic manufacture of aluminum. This company is given little prominence in the book by Professor Engle and his associates, although Appendix 9 of the volume is entirely devoted to an exposition of the new process for aluminum reduction. This appendix gives extracts from a memorandum which had been supplied by Mr. Jacques Fondal, who is the president of the Independent Aluminum Corporation. The memorandum shows the new thermic process to be of value in the reduction of aluminum directly from bauxite or lower grade ores. The surprising thing about this process is that it was patented in France in 1938, by Hirsch Loevenstein, and was then patented in the United States in 1940. According to Mr. Fondal, the new process was covered by United States Letters Patent No. 2,198,673, which was issued on April 30, 1940. Later information obtained by the writer from the United States Patent Office indicated that the patent was vested by the Alien Property Custodian January 18, 1943, under Vesting Order 666. The assignment records also indicate that prior to the vesting of this patent an interest was transferred to the Independent Aluminum Corporation (61 Broadway,
New York), Mr. Loevenstein, the inventor, also transferred an interest to Israel Jacob Foundaminsky, of Paris, France.

Description of the technical chemical processes involved in the thermic manufacture of aluminum by this method is extremely difficult. The general principle involved is the complete reduction of the virgin metal from the raw ore in one continuous chemical action. Through the use of iron or silicon, in the first step, and zinc, in the second step, pure aluminum is produced in a furnace similar to those which are used in the refining of zinc. According to Mr. Fondal's article, the new process is completely revolutionary, both in terms of treatment of aluminum ores and of secondary aluminum. In both instances, it is said that the process results in the production of a purer type of metal. Summing up the entire article, Mr. Fondal gives the following statement concerning the economic advantages of the process:

The advantages of this new process based upon thermic principles lie in the possible use of raw materials other than bauxite, in economy in the use of electric energy, labor, equipment and maintenance.

Present aluminum manufacture requires...... the preliminary production of pure alumina in plants specially built for that purpose and from bauxite having a low silicon content. On the

27Ibid., p. 457.
other hand, aluminum-containing ores of all description and without exception (bauxite, kaolin, clay, etc.) may be used in the new thermic process of this invention.

A plant for producing aluminum under present practices, to be economically sound, must produce at least 6,000 tons of the aluminum annually. In our process, on the other hand, production depends merely on the number and size of the furnaces. For this reason, a plant producing even a few hundred tons per year would be economically practical.

As a consequence of the above enumerated advantages, it is conservatively estimated that aluminum may be produced by our thermic process at a cost of 30 to 40% lower than the present cost. In addition, our process permits the production of silico-aluminum and zinc-aluminum alloys of any desired proportions at a cost far below that possible under present practices. The application of our process to the recovery of aluminum scrap, resulting in an aluminum of even greater purity than the original and at a considerable savings in cost, should also be kept in mind. Naturally, the great reduction in the net price of aluminum made possible by our process should open vast new markets for these metals.

This innovation, if it is as described above, may even yet become a major step in the advancement of aluminum production. Its delayed development may have been caused by one or more of several causes. The inability of Loevenstein and Fondal to convince government officials or industrialists of the practical nature of the invention may have been one reason for its lack of success so far. Both of these men were in Washington, and are reported to have spent weary months in vain attempts to convince government officials of the value of the invention in 1943. Cutbacks in the aluminum
industry in the latter part of 1943 may have been a reason for the lack of interest shown by both Government and industry. Other possible reasons for the failure to exploit the patent commercially may have been politics, the power of monopoly, or the institutional setup of the industry. Lack of specific information precludes the possibility of stating a definite answer to the problem, although such an answer would be valuable to the study.

Economic literature of the twentieth century is filled with instances of holding out new patented processes because of their effects upon the institutional structure of industrial organizations. It is at present a matter of conjecture as to whether the thermic process encountered this difficulty. If such a far-reaching calamity as World War II did not result in the fullest exploitations of such a patent, then several ideas may be advanced as reasons for the lack of interest. The process might have been proved to be impractical from a chemical or technical standpoint, although it was reported that the process had been tested in a pilot plant in France. On the other hand, the process might have involved some economic implications which were too great for its adoption. If old plants would have to be abandoned, power sites left unused, labor laid off, and the entire cost structure of the industry revolutionized, then the older manufacturers of aluminum by the time-tested processes would not have been
Interested in the changeover. However, it still seems most surprising that the Government, being interested in such methods of using lower grade ores during the war, did not at least set up some sort of pilot plant to aid the Independent Aluminum Corporation in exploiting Loevenstein's thermic process.

It is not to be denied that the smaller companies, through their varied efforts, did much to bring the war to a rapid close. Their efforts were financed chiefly through the Defense Plant Corporation. Expense apparently was no object, as far as the Government was concerned. Winning the war was the prime motive, obviously, although it may be hinted that in some respects the breaking down of the Alcoa monopoly in aluminum ingot reduction might have been one of the factors which were involved in the entire program. The postwar aspects of the industry were to be affected to a great extent not only by some of the smaller companies, but also by the government plants.

Extension of the Aluminum Industry in the South and East to Meet Expanded Needs of World War II:

In addition to the other economic considerations which were given to the aluminum industry during World War II, it will be seen that the extension of the facilities for the production of the metal in both the Southern and Eastern
states is of great importance to the whole analysis. Previous mention has been made of the expansion which occurred throughout the industry, and of the erection of various new plants for wartime production by the national government. Dispersal of the aluminum industry was a noted characteristic of wartime activities, and the entry of additional companies, both for experimentation and for fabrication of ingot aluminum, caused the whole situation to be changed immensely. Integration of aluminum processes in one plant was an important step forward for the entire manufacturing process, as it was accomplished by the Reynolds Metals Company.

All of the foregoing activities were to be found in the aluminum industry of the South and East during the war. Even before the entry of the United States into the conflict, a great deal of expansion had been accomplished for the Southern aluminum industry. One of the examples of this type of expansion was the building of the Mobile, Alabama, plant by Alcoa as part of its own vast program of expanding its facilities. But this expansion on the part of Alcoa was not all that occurred. During the defense period, Reynolds Metals Company had begun its aluminum production program at Listerhill, Alabama, with the famous integrated plant development being its greatest contribution to aluminum technology. In the Eastern states, particularly in New York, extension of the
aluminum industry was accomplished during the defense program, but the wartime activities eclipsed the previous expansion of Alcoa in that area.

Pressure of the defense and wartime program of expansion during the years from 1940 to 1943 brought about one of the most rapid increases in Southern and Eastern facilities yet known in the industry. As a result of such a program, new facilities were erected at various points in New York, New Jersey, Arkansas, Alabama and Louisiana. From the prewar single alumina plant at East St. Louis, Illinois, this phase of aluminum production was extended during this modern era to include the additional four alumina plants, all of which were located in the Southern states. Alcoa had built the Mobile plant, Reynolds the Listerhill plant, and the Defense Plant Corporation built the government-owned alumina plants at Hurricane Creek, Arkansas, and Baton Rouge, Louisiana. With the single exception of the plant built at Salt Lake City, Utah, by Kalunite, Inc., for experimentation with alunite, all of these important defense and wartime plants were erected in the areas of the South where access to raw materials, principally bauxite ores, would be readily available. The Alcoa plant at Mobile used ores from Arkansas and Surinam. The Reynolds plant at Listerhill used lower grade Alabama ores, and some from Arkansas. The two plants erected by the Defense Plant Corporation at Hurricane Creek and Baton Rouge used vast
amounts of Arkansas ores, but the latter also received ores from Surinam.

Although no alumina plants were erected in the Eastern states, several aluminum ingot reduction plants were expanded and others established in New York and New Jersey, as well as in North Carolina and Arkansas. Facilities for reduction of the virgin metal were expanded at Alcoa, Tennessee; Badin, North Carolina; and at Niagara Falls and Massena, New York, by Alcoa. Reynolds expanded the facilities for reduction at its Listerhill, Alabama, plant. New plants erected by the Defense Plant Corporation in Eastern and Southern states, and operated by Alcoa, were located in Maspeth and Massena, New York; Burlington, New Jersey; and Jones Mills, Arkansas. This vast program of expansion in the South and East was rivalled only by the dispersal of a great portion of the aluminum reduction industry to the Pacific Northwest, where adequate power facilities were immediately available. Power for reduction of the pure aluminum from alumina in the South and East came mainly from the Tennessee Valley Authority and from Niagara Falls power developments, while in the Pacific Northwest it was obtained from the Bonneville Power Administration, in charge of Bonneville and Grand Coulee dams.
Development of a New Aluminum Industry in the Pacific Northwest to Aid in Wartime Production:

Although the Western states region, and particularly the Pacific Northwest, had received some attention from both Alcoa and Reynolds prior to the entry of the United States into World War II, the real impetus to aluminum development in that area came after this country was actually engaged in the conflict. This impetus came largely from the Government, because it was through the Defense Plant Corporation that some of the best aluminum reduction plants of the country were located in that region. Each of the new plants was an ingot aluminum plant, which processed alumina produced in one of the five plants mentioned in the previous section. The states of Washington, Oregon and California were selected as the locations of these new aluminum reduction plants. Enormous capacity was built up at such places as Vancouver, Longview, Spokane, and Tacoma, Washington; Troutdale, Oregon; and Riverbank and Torrance, California. The plant at Vancouver was owned by Alcoa, and the plant at Longview was owned by Reynolds. The other plants in the Western region were owned by the Defense Plant Corporation. In reality, for the period of the war Alcoa operated all of these government-owned plants, with the exception of the Tacoma plant, operated by the Olin Corporation.
The availability of enormous amounts of hydroelectric power was responsible for the concentration of the aluminum industry in such a large degree in the Pacific Northwest. All of the recent writers who have dealt with this new dispersion of the aluminum industry in that region have emphasized the use of the famous Bonneville-Coulee system for electrical energy. It is not to be doubted that other factors militated against such selections of locations of plants, but the power problem in terms of production of the ingot aluminum was probably the most important. Not a single alumina plant was located in the West, unless the unsatisfactory Salt Lake City plant, along with the pilot plants for dealing with clays and anorthosite are considered. These latter plants did not provide the alumina for the functioning of the Pacific Northwest plants during the war, because their supplies of alumina would not have been sufficient even to supply one of the new plants. It was necessary to transport the alumina from the five alumina plants in the East and South. This operation caused the production costs of the virgin metal in the Pacific Northwest to rise. Even early in the war it was pointed out that the mis-location of the alumina plants created important postwar problems for the industry in the Western States. It was suggested by many writers that if the aluminum industry were to survive in that region it would be necessary to establish at least one
alumina plant there. At the present time this latter suggestion has not been carried out, though the aluminum plants there continue to function on the basis of importation of alumina from the East and South. The developments in the Pacific Northwest will be considered at length in the next chapter. In conclusion of this chapter, we turn briefly to an analysis of the total contributions of the aluminum industry of the United States to the emergency of World War II. To state precisely the exact contribution of the aluminum industry to the war effort is not our purpose, but a brief resume of the accomplishments will show what was done in wartime, and what might be expected in the postwar period.

**Summary of the Contribution of the Aluminum Industry of the United States in World War II:**

A resume of the wartime contributions of the aluminum industry should take into consideration the vast increase in the productive capacity for alumina, which is necessary for the reduction of the virgin metal. Before the war, the entire alumina capacity of the industry in the United States was about 700 million pounds per year. Defense and wartime expansion of this phase of the aluminum industry built up an annual alumina capacity of almost 5 billion pounds, as shown by the various figures on the Hurricane Creek, Baton Rouge,
Mobile, East St. Louis, and Listerhill reduction plants. From a prewar number of only one plant at East St. Louis, the four additional plants had been set up to furnish alumina to the vastly increased number of ingot aluminum plants. This increase in alumina production had been made possible by the increased mining operations of domestic bauxite ores in Arkansas and Alabama, as well as of the lesser ores in several states. Foreign bauxite ores from Surinam in South America had contributed to this alumina production, also. The smaller experimental plants at Salt Lake City, Salem, Laramie, and Harleyville must be included to make the analysis complete.

Additional plants for the reduction of alumina to virgin metal were set up during the defense and wartime years. Expansion of this phase of the aluminum industry was as notable as the increase in alumina production capacity. Pre­war average production of the various plants engaged in ingot aluminum production reached only 257 million pounds during the years from 1935 to 1939. This production came from five prewar plants owned by Alcoa, but such a supply was utterly inadequate to serve the needs of the defense and war programs of the United States and her allies. By the end of the war, this total of only five plants had been supplemented by the addition of eleven more aluminum reduction plants, widely scattered over the United States and owned by other inte-
rests. Of these eleven new plants, the Defense Plant Corporation owned nine, and the Reynolds Metals Company owned two. During the war years, the government-owned plants were operated by Alcoa (eight plants) and the Olin Corporation (one plant). Wartime production of the virgin metal jumped from the prewar average of 257 million pounds to a capacity in all of these plants of 2.3 billion pounds by the end of 1943, although this capacity never had to be utilized to its maximum extent. Figures for alumina production in 1943 have been stated previously as being 3,936,522,000 pounds for that year. The figure for ingot aluminum production for 1943, which was 1,840,075,000 pounds, bears out a previous statement that it takes approximately two pounds of alumina to produce one pound of aluminum. It also shows the extent of unused capacity in the sixteen aluminum reduction plants right in the middle of World War II, at a time when cutbacks in ingot aluminum production were ordered in December, 1943. To repeat that this expansion in the aluminum reduction facilities was phenomenal is to say the very least about this phase of the entire aluminum industry.

Increased fabrication facilities made it possible to process the ingot aluminum into the various shapes necessary for wartime industrial uses. The fabrication plants contributed greatly to the building of the vast armada of
Allied airplanes that swept the skies of the entire world. Other types of wartime industries received increased quantities of the metal, to facilitate manufacturing of a variety of products necessary for the prosecution of the war. Improved techniques of various kinds were introduced during the war, such as the integrated facility established by Reynolds at Listerhill, Alabama, where alumina, aluminum ingot, and rolled aluminum were all produced in the same plant. New alloys were developed, several of which were high strength alloys beneficial in war and in peacetime uses of aluminum. New processes were evolved to aid the Bayer process of alumina reduction, among them the soda-lime-sinter process that made possible the greater savings of alumina from the various ores. A newer, and more revolutionary, process was described by the Independent Aluminum Corporation, but thermic manufacture of aluminum from ores in one continuous operation was not developed, although the original patent in the United States had been secured as early as April, 1940.

Excess productive capacity was the greatest problem that faced the aluminum industry at the close of World War II. This problem, along with other postwar aspects of the industry, will be the subject matter of the following chapter. Aluminum in war created enormous problems, which were solved in various ways both by the industry itself and by the Government. Aluminum in peace constitutes just as
important a subject. It is a problem that both the industry and the Government must solve, if maximum benefits are to be derived by consumers of aluminum throughout the world.
CHAPTER IV

POSTWAR ASPECTS OF THE ALUMINUM INDUSTRY
OF THE UNITED STATES

Surplus productive capacity, government ownership of important facilities and wide dispersion of the great aluminum industry of the United States were the chief characteristics of the aluminum situation after World War II was concluded in 1945. These problems gave rise to other considerations in the immediate postwar period, and the entire aluminum industry of this country was rapidly and radically changed from the prewar status. Discussions in this chapter will revolve around several of the postwar aspects of the aluminum industry, as follows:

1. Problems of surplus productive capacity;

2. Problems of disposal of government-built aluminum facilities, including alumina plants, aluminum reduction plants, and fabricating facilities;

3. Analysis of government policies in regard to plant disposal and the creation of competition in the postwar aluminum industry;

4. Partial settlement of the problems of plant disposal, and the entry of other companies into the aluminum industry of the United States; and
5. Postwar problems of competitive enterprise in the aluminum Industry, as they evolved from the sale of government facilities to Reynolds and to the Kaiser interests, instead of Alcoa.

All of the above problems have a direct bearing upon the aluminum industry of the United States as it exists today. The partial settlement of these problems has resulted in an entirely new aluminum industry of such a nature as to make it incapable of comparison with the prewar ownership and control as exercised by Alcoa. The primary aluminum industry, the production of both alumina and ingot aluminum, underwent such a radical change in the immediate postwar period that the monopoly of Alcoa in this respect was broken completely. Alcoa, in prewar years, had possessed a highly integrated aluminum industry. The ownership and operation of its own mines, reduction plants, ships, and other facilities had made Alcoa synonymous with power and outright independence in the aluminum industry. The company had produced and sold all aluminum that it had the capacity to make, but no great increases had been made in the real capacity of the various plants until the defense and war programs forced the company to expand its facilities. The same processes for reduction of aluminum had been more or less standard with the company for a period of fifty years, and had not been subject to patents for three decades. But no other company had dared to
compete with Alcoa for a variety of reasons. These reasons have been stated previously as being the advantage of an early start, the control over essential patents, the control of the vast majority of all rich bauxite resources of the United States, the ownership and operation of the company's own waterpower plants to furnish electric energy for aluminum reduction, the protection of a favorable tariff on imported aluminum, and friendly international relations with the producers of aluminum in Canada and Europe. The maintenance of a high and rigid price of aluminum ingot through the decades of the 1920's and 1930's kept the price from falling below 20 cents per pound, until after 1939. Various writers have shown that the price of 20 cents charged for ingot aluminum by Alcoa was almost twice the cost of production, and that the new profit which accrued to the company in the sales of all its varied products over a period of years was nearly 20 per cent on the invested capital.

All of these facts pointed to the need for competition in the aluminum industry over a period of many years, but until the end of the war and the disposal of the government-built aluminum facilities such a hope was in vain. It is true, as we have stated in the previous chapter, that the

basis for competition was laid in the defense and wartime eras, when the Reynolds Metals Company and the Government entered the aluminum industry. But the facts that have been pointed out show that the control exercised by Alcoa during the war itself was extended over a wide domain, to include the government-owned plants themselves. At War's end the industry bore little relationship at all to the prewar aluminum pattern. The productive capacity had been increased by seven times, and in the field of fabrication the increase had been about forty-five times in some stages. An article in Fortune magazine for May, 1946, pointed to the significant difference between the prewar and postwar aluminum industries in the following manner:

That (prewar) industry, however interesting historically, no longer exists. It has been absorbed into an entirely new industry, to which it bears only an ancestral relationship: the aluminum industry of 1946.....the industry is vastly changed in its contours, its control, its geography, its technology, its economics of supply, cost and price, its potential markets, and its interesting possibilities for creative competition. Not the least part of the aluminum revolution was a 1945 Circuit Court decision (final for lack of a Supreme Court quorum) holding Alcoa a monopoly in ingot production as long as it controlled over 90 per cent of the market. The Attorney General had finally succeeded in establishing, beyond appeal, that a monopoly is a monopoly—even under the Sherman Act.

2 Ibid., pp. 103-04.
During the war itself, Alcoa's domination of the industry was undiluted. Besides nearly trebling its own facilities in a $300-million construction program, the company built and operated nearly $500 million worth of government capacity. As the sole prewar aluminum producer—with a monopoly on technical, engineering, and management brains in the business—Alcoa was, of course, the logical choice to handle the urgent government program. Its assignment included eight of the nine government smelting plants and nine of the government fabricating plants—all completely integrated into the company's own far-flung system. At war's end Alcoa was in control of more than nine-tenths of U. S. capacity for alumina and primary metal, 86 per cent for sheet and plate, 90 per cent for extruded shapes. But at this point the Defense Plant Corporation stepped in to claim its own—on a somewhat tenuous technicality in the Alcoa leases—and over half the industry went on the war-surplus market.

These evidences of control on the part of Alcoa constituted basic reasons for disposal of the government-owned aluminum facilities to producers which might be able to make competition effective in the industry. It was definitely felt that such a move on the part of the Government would be made, but before such a step could be taken, it was necessary to determine the extent of the real surplus capacity which had been built up during World War II.

Problems of Surplus Productive Capacity:

Surplus productive capacity in the aluminum industry was built up to a great extent during the war. The exact extent to which any facility could be determined as being real surplus was not known at that time, but at least one
comprehensive postwar market survey had been made, with results that need explanation. This survey, conducted by Professor Engle and his associates at the University of Washington during 1942 and 1943, indicated the existence of excess productive capacity in the aluminum industry, even with aluminum selling at 15 cents per pound. The figure of 15 cents per pound had been attained in the industry early in the war, and remained at that level throughout the period of hostilities. The market survey indicated that greater quantities of aluminum would be taken off the market at prices below 15 cents per pound, but the significant explanation of this situation given by Professor Engle is as follows:

Total capacity for the United States is 2,300 million pounds of virgin aluminum annually, far in excess of any immediate postwar demand now in sight. The most optimistic forecast indeed does not envision a market for much over half the present capacity until five years after the war, and not then unless the price is cut to 10 cents per pound. Drastic curtailment, therefore, seems inevitable.

The curtailment of production envisioned by most observers during the war years simply amounted to the abandonment of the high cost plants which had been erected during the war period. It was well pointed out that several of the

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3Engle and others, *op. cit.*, Chapters XII and XIX.
aluminum plants were badly situated and were high cost producers. The most obvious method of dealing with such a situation would be to curtail production of such plants as those in Massena and Maspeth, New York, and Burlington, New Jersey. These three plants, all owned by the Defense Plant Corporation, and operated by Alcoa, could not be expected to be maintained in the production field if the price of aluminum continued at 15 cents per pound, according to Professor Engle and his associates. The high cost of electrical energy, plus the necessity for building new power facilities, was given as a reason for the stoppage of operations and the abandonment of the three Eastern aluminum plants, in spite of the access to raw materials and the nearness to potential postwar markets.

The same reasons were pointed out by observers for the discontinuance of aluminum facilities at Jones Mills, Arkansas. Despite the excellent location of this new wartime plant, in terms of nearness to bauxite, it was pointed out that high cost of electric power would be a deterrent feature. Another factor for consideration was the necessity for saving the rapidly diminishing supplies of good bauxite ores in the state of Arkansas. One of the interesting conclusions reached in regard to the Jones Mills plant was the blanket statement that "Certainly it appears very doubtful that any private operator familiar with the aluminum industry
would be willing to buy it for operation at the present location.\(^5\) This plant was considered to be a marginal plant if aluminum prices remained at the level of 15 cents per pound. The forecasting made by the observers at the University of Washington apparently was not taken seriously by others interested in the aluminum industry, because the Jones Mills plant was leased by the Reynolds Metals Company early in 1946.

Other outstanding examples of wartime estimates of surplus capacity may be cited in regard to the California plants, as well as the facilities in the state of Washington. Professor Engle and his associates indicated that the elimination of the three Eastern plants, together with the Arkansas plant, might be accompanied by the abandonment of the aluminum reduction plant at Riverbank, California. Such a move, it was pointed out, would reduce the aluminum reduction capacity of the country down to 1,629 million pounds, which would still be far in excess of any foreseeable postwar demand for the metal at a price of 15 cents. It was further stated that the Torrance, California, plant would be eliminated if aluminum prices dropped to a level of 13 cents, because at that

\(^5\)Ibid., p. 410.

\(^6\)Later discussions will show the extent to which Reynolds Metals Company took over existing government-owned facilities.
price the plant would be unable to compete with the reduction plants of the Pacific Northwest. In regard to the Torrance plant, the following statement was made:

The elimination of this plant would reduce national capacity to less than 1,500 million pounds, still far above the estimated maximum demand for virgin aluminum of slightly over one billion pounds at 13 cents, five years after the war. Since Pacific Northwest plants can deliver virgin pig aluminum to California for less than it can be produced in the California plants the latter appear doomed to the status of stand-by plants, if they are not completely dismantled.

It was further indicated that the aluminum reduction plants in the Pacific Northwest would be competitive with a postwar price of 13 cents for aluminum, but it appeared doubtful from the survey that they could be profitably operated at a lower level of 10 cents per pound. Three government plants were concerned in this statement. The plants at Tacoma and Spokane, Washington, and at Troutdale, Oregon, were considered to be potentially outstanding bargains for a postwar competitor to Alcoa, provided the market situation were favorable to such a new entry into the field. The entry of the Kaiser interests into the field of aluminum production, as we shall see, aided in the disposal of these government-built aluminum facilities in the Pacific Northwest.

Predictions concerning future activities sometimes appear to be wrong in the field of economics. In the treatment

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7Engle and others, op. cit., p. 410.
of the industry during the war, forecasts of disposal of the government built facilities ran a bit contrary to later developments. It is interesting to note how the estimates of Professor Engle and his associates differed from the immediate postwar disposition of alumina plants. The alumina plants constructed by the Government during the war at Hurricane Creek, Arkansas, and at Baton Rouge, Louisiana, had added enormous alumina reduction capacity in the industry. It was conceded by the above-mentioned observers that the two Alcoa plants at East St. Louis and Mobile would continue in operation, and that the Reynolds plant at Listerhill would be sufficient to meet the needs of the new competitor's aluminum reduction plant at the same location. But it was stated that the Hurricane Creek and the Baton Rouge plants constituted quite different problems. The analysis of the problems confronting the Arkansas and Louisiana alumina producers was as follows:

There are two remaining alumina plants, both owned by the Defense Plant Corporation, one located at Hurricane Creek, Arkansas, with a yearly capacity of 1,555 million pounds, and the other at Baton Rouge, Louisiana, with annual capacity of one billion pounds. The Hurricane Creek plant will undoubtedly be rendered obsolete by reason of the need to conserve remaining Arkansas bauxite and because it is too far inland to justify economical operations with imported bauxite. The plant

might be retained by the government as a stand-by plant, for utilization only in an emergency great enough to justify the further use of bauxite reserves in Arkansas.

The Baton Rouge plant, while well located with respect to tidewater transportation appears, nevertheless, to be excess baggage in postwar alumina production. A better location for this plant would have been the new center of aluminum production, in the Pacific Northwest....Strategic military requirements must have determined the location of the Baton Rouge plant, but it appears now that the difficulties of getting bauxite through the Canal and to a West Coast point were exaggerated in the minds of policy makers. The criteria for locating industrial plants for modern warfare should be the soundest economic basis for both war and peace, with protective military devices to safeguard plants located at critical points.

The Baton Rouge plant, because of its un-economic location, will probably have to be dismantled. Otherwise, it might be operated only at a fraction of its capacity to fill out the demand from industries, other than aluminum, in the postwar period, or to supplement the Alcoa and Reynolds plants should an unexpected demand arise......

In conclusion, over-all postwar capacity of aluminum is apparently excessive to the extent of about 2,750 million pounds annually. The location of plants is such that successful operations after the war seems doubtful for either of the D. P. C. plants. On the other hand, now alumina capacity of approximately a billion pounds annually will have to be added for the aluminum refining industry of the Pacific Northwest.

It would appear that such an analysis of postwar prospects for the Baton Rouge and Hurricane Creek plants was slightly in error, particularly if the immediate postwar picture is reviewed. Both of these plants are operating
in 1947. Reynolds Metals Company operates the Hurricane Creek establishment, and the Permanente Metals Corporation, a subsidiary of Kaiser, Inc.), operates the plant in Baton Rouge. This is only the short-run picture, however, and analysis is possible at the present time only on the basis of their operation for a little more than a year by these two competitors. It is known that neither plant is operating at full capacity in 1947, but both Reynolds and Permanente apparently are planning big things for the future. In the long run, the analysis which was made during the war might possibly prove to be correct, in spite of the immediate post-war operation of both plants in their "uneconomic locations." The period intervening between the end of the war and the middle of 1947 is not a sufficient time in which to judge the full effects of operation of the two plants. It is the transition period of which Professor Engle spoke, and both Reynolds and Kaiser are operating the plants on the basis of the huge backlogs of demand for aluminum products that was built up in the United States during the past five years. The extent to which both the Hurricane Creek and the Baton Rouge plants will be operated in the future will depend upon numerous factors in the long run, such as the expansion and contraction of the uses of aluminum, the use of substitutes, the price situation, the availability of bauxite or lower grade ores,
advances in aluminum technology, and the possibility of expansion and contraction of American aluminum exports into the world markets.

Aluminum rolling mill capacity, like aluminum and alumina capacity, was greatly expanded during the war, and a surplus in this phase of the industry was noted early in 1944. The total capacity of aluminum rolling mills in that year was about 1,600 million pounds, most of which was required in the aircraft industry. During the war it was estimated that about 80 percent of the pig aluminum produced in the United States was used by the aircraft industry, and that most of the metal was used in the form of sheet aluminum for sheathing airplanes. In regard to the amount of excess capacity in the rolling mills in the postwar era, the following statement is significant:

In the years before the war the average consumption of aluminum rolling mills was only about 35 per cent. What the demand will be after the war is difficult to forecast, but it will undoubtedly fall substantially below the war ratio of 50 to 60 percent. A very liberal assumption is that 40 per cent of the postwar production of virgin aluminum will be required for sheet. Thus if total demand for aluminum reaches 1,500 million pounds, the production of virgin aluminum will be about 900 million pounds. On this basis it may be estimated that postwar demand for sheet will be 360 million pounds, and the excess sheet capacity will be

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9 Ibid., pp. 414-15.
1,250 million pounds. In other words, the rolling mill capacity of the nation is over 4 times the probable postwar requirements.

These data concerning alumina, aluminum, and rolling mill capacities prove that excess productive capacity was envisioned by the experts in all of these three stages of the aluminum industry in the postwar era. It must be admitted that in the period intervening between the end of the war and the time this study was made the estimates of excess capacities proved correct in many instances. All of the predictions of the experts did not come true at once, however, as we have noted particularly in the case of the alumina plants. Disposal of the plants erected by the Government presented a special problem, which had to be solved both by industry and government officials in a variety of ways.

Problems of Disposal of Government-Built Aluminum Facilities:

A brief analysis of the aluminum industry given by Alderfer and Michl in 1942 presented a view which was widely accepted as being typical of the pessimism prevalent in this country. Few people in the early years of the defense program suspected that the aluminum industry would be expanded to the great extent that was necessary in order to win the war, and most of the observers of the industry would have agreed with
Alderfer and Michl when they made the statement which is quoted below:

Current developments in the industry seem to indicate that this field, heretofore dominated by one company, will be opened to competition. Some competitors already have a foothold, and if national defense demand for the metal continues to expand, others may be encouraged to enter, especially in view of the hydroelectric power available in the West and the not-too-friendly attitude of the government toward the leading company. However, we cannot be too optimistic about the future growth of competition because the Aluminum Company of America is likewise expanding capacity and reducing prices to meet the present emergency, and after the emergency has passed, this company may have an effective monopoly despite the existence of several comparatively small competitors.

Officials of the government had cooperated with private enterprise to the extent of building up a huge aluminum industry during the war, however, and the result was that by 1943 many writers were speaking of the cutbacks in the aluminum production and the consequent necessity of solving the problem of disposal of surplus capacity after the war ended. A wide variety of proposals were made at different times, but all of them hoped for some degree of competition in the postwar aluminum industry. Generally speaking, the various types of proposals for postwar handling of the

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surplus plant facilities grouped themselves under at least six different plans, as follows:

1. Dismantling of the aluminum plants by the Government, to whom they belonged under the Defense Plant Corporation;

2. Retention of the plants as a permanent addition to the national defense network, to be used as stand-by plants for operation in times of actual war;

3. Disposition of the plants through sale to the highest bidder in the industrial field;

4. Leasing of the various plants to responsible and reliable operators in the postwar era;

5. Retention and operation of the various plants in competition with private business enterprise; and

6. Employment of a combination of the above solutions in an effort to work out a permanent policy in the aluminum industry satisfactory to the Government and to the American people.

It was felt from the very beginning that the Government would never solve the problem by using the method noted as number five above. No intention on the part of the Government to engage in postwar competition with private industry in the aluminum field had ever been voiced by any official in any responsible position. Quite the contrary was the case, because most officials who worked on the problems connected
with the aluminum industry felt that the Government would have many reasons for moving out of the industry as soon as the war was ended. At least one official, Secretary of Commerce Jesse Jones, openly voiced the opinion that he "had no idea of Government operation of any of these plants." Such a program would have been inimical to the best interests of the Government and the aluminum industry, because it would have been another step in the socialization of industry in this country. Since the Government did not intend to use the proposal to operate the plants itself the other plans were given much consideration before actual disposal of the plants was affected. Actually, a combination of plans was used, since most industrial concerns interested in the aluminum industry favored a lease-purchase plan, which would give the purchasing companies a chance to determine whether or not entry into the aluminum industry would be profitable to them. This type of plan had been pointed out by Professor Engle and his associates when they stated:

In view of the risks and uncertainties of entering such a field, however, the government may find it necessary to provide very liberal terms for the sale of aluminum plants to private interests. It may be advisable to offer these plants on a lease-purchase plan, the value of


12Engle and others, op. cit., p. 417.
the properties to be determined after 10 or more years of operation, the purchaser meantime dividing net profits after taxes with the government as annual payments to be credited against the purchase price. Whether or not the existing companies in the industry would be adversely affected cannot be predicted. If the new plants can be operated successfully, however, the government would ultimately receive a higher price than would likely be bid in advance. On the other hand, the buyer would be enabled to face competition without an excessive burden of overhead costs.

Disposal of all three types of plants—alumina, aluminum, and fabricating facilities—faced this problem, and it was for this reason that certain writers felt that very few of the Defense Plant Corporation activities were scheduled for postwar operation. Mr. J. R. Hight, in an article in Iron Age as late as June 28, 1945, stated this conviction in these words:

> Aluminum reduction plant disposal, in the opinion of informed government officials here (Washington, D. C.), will probably result in the postwar operation of not more than two or three of the major government-owned reduction units.

> The over-expanded productive capacity of the industry, plus the present anti-monopoly position of the Federal Government will combine to limit the interest of Alcoa, Reynolds, and other possible producers in leasing or purchasing DPC plants.

> Not even the most optimistic of industry or government officials feel that there is reasonable hope of operating war-expanded

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facilities at near 100 per cent of capacity in the near future, but the general feeling expressed here is that the overall aluminum consumption figure would be improved if an additional aluminum producer, or possibly two additional companies were to enter the field.

Patent problems, especially in regard to the reduction of alumina from the lower grade ores, constituted a handicap in the immediate postwar disposal of the various plants. A description of these problems as they were handled by Surplus Property Administrator W. Stuart Symington will follow. Coupled with the other problems of disposal already mentioned, the question of patents made the task extremely difficult until early in 1946. Altogether, the Government and the private industrial concerns which had hopes of engaging in aluminum production faced, at the end of the war, the problems of (1) an entrenched Alcoa, which had expanded rapidly during the war; (2) extensive aluminum capacities in alumina, aluminum, and fabrication stages; (3) high cost and marginal firms in the expanded industry, especially with the possibility of aluminum prices either being held down to 15 cents per pound, or even going to a lower level under competition; (4) lack of immediate funds on the part of would-be aluminum producers, with the necessity for governmental lease-purchase plans to tide the new entries over the first few years after the war; and (5) patent problems, which primarily concerned the alumina reduction plants. These problems loomed large at first, but in view of the governmental policy as aired in
Congressional circles, the solutions to them were worked out much better than many people had hoped they would be.

**Analysis of Government Policies in Regard to Plant Disposal and the Creation of Postwar Competition in Aluminum:**

One of the most significant features of the wartime expansion of the aluminum industry was the administration policy of expanding the facilities to meet the emergency needs, and the avowed declaration on the part of government officials that competition would be an objective in the postwar world. Congress itself had gone on record as being definitely dedicated to the discouragement of "monopolistic practices" in the aluminum industry, and as favoring a long run program to "foster the development of new independent enterprise" as the solid rock upon which to build the postwar structure of competition. More than this, the Congress had passed the Surplus Property Act, which required that the Surplus Board make known to Congress its specific policies in regard to the disposal of surplus plants and facilities. The report required by Congress from the Surplus Board was necessary for all properties in which the Government had invested more than $5,000,000, and the aluminum industry was

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affected in all of the three stages beyond the mining of bauxite or other ores for aluminum production.

The actual policy of the administration in regard to the aluminum industry was not officially known until September 26, 1945, when a report was submitted to Congress. This report, submitted by Surplus Property Administrator W. Stuart Symington on that date, stated unequivocally that competitors of Alcoa would have the very first choice in obtaining government-owned surplus aluminum plants and equipment. "While it is impossible to present the full context of this report here, a brief resume of the proposed solutions given by Mr. Symington will prove helpful to an understanding of administration policy, not only for aluminum but also for other light metals. President Franklin D. Roosevelt, before his death, had inspired the inauguration of provisions in contracts with Alcoa that the company would not be allowed "purchase options" on plants operated by it during the war. The report of the Surplus Property Administrator carried the attack on Alcoa several steps further by rejecting several of the company's proposals in regard to the surplus aluminum plants.

15 J. R. Hight, op. cit., pp. 105-06.

Alcoa had stated its willingness in 1945 to lease or purchase the alumina plant at Hurricane Creek, Arkansas. Purchase of the alumina plant at Baton Rouge, Louisiana, had also been suggested, because the company wanted to remove the plant to the Pacific Northwest, as part of its proposal to set up a fully integrated aluminum industry in that region. Reduction plants at Jones Mills, Arkansas, Troutdale, Oregon, and Massena, New York, also would have been bought by Alcoa, according to the report. All of these moves on the part of Alcoa were made not out of necessity, but as a means of eliminating the Government entirely from the aluminum industry. Alcoa apparently did not need the government-built facilities for postwar production of aluminum, but the company saw the opportunity, according to the report, of ridding itself of a most serious competitor in the form of governmental enterprise, which might be able to produce the metal at extremely low costs because of its peculiar advantages in tax-free operations, low power costs from government-owned electrical energy facilities such as TVA and Bonneville, and low bauxite costs from the government stockpiles of the ore.

Other companies had exhibited interest in the postwar disposal of the aluminum facilities, the most important among them being Reynolds Metals Company, the American Smelting and Refining Company, Kaiser Company, Inc., the Columbia Metals Company, the Bohn Aluminum and Brass Corporation, and Olin
Industries, Inc. Most of these companies were concerned either with the alumina plants or the aluminum reduction plants, and had not given much attention to the larger fabricating plants. Reynolds Metals Company had been interested in taking over all of the facilities which Alcoa mentioned, both for alumina and aluminum production. The broad program which was envisioned by the Kaiser Company, Inc., was of particular import especially since the Government had been anxious to get another producer into the aluminum field. The other companies wanted specific plants, and would not have become important in the industry as integrated companies. Olin Industries, Inc., had expressed a desire for aluminum reduction facilities, but this company removed itself entirely from aluminum production during the year of 1945. The fear of being unable to obtain adequate bauxite supplies on a competitive basis probably was the chief reason for the company's departure from the aluminum industry.

All of the companies, with the exception of Alcoa, indicated before the end of the war that they would be interested in a type of lease-purchase arrangement with the government in regard to the alumina plants and the aluminum reduction facilities. One of the chief factors for consideration of all the companies was the governmental assurance that an alumina supply would be available on a competitive price level comparable to that which Alcoa enjoyed. Minimization of various risks of loss through liberal rental terms
was also stressed. Some of the companies indicated a preference for governmental handling of stockpiles in such a way that the companies could sell directly to the government until commercial markets opened up after the war.

Although the Government did not take cognizance of all of the different desires of these companies, one fact concerning disposal was made most apparent. Alcoa's many proposals were rejected by the Government. The report declared that these proposals were turned down because the acceptance of them "would have increased Alcoa's monopoly in the primary metal. In acquiring three of the four best reduction plants and controlling the Hurricane Creek alumina plant, Alcoa would take government plants off the market and discourage employment opportunities which is the primary concept of the Surplus Property Act itself."

Additional important points presented in the report of Mr. Symington were as follows:

Alcoa would be given the opportunity to take over certain facilities, subject to approval of the Department of Justice, but only on terms of lease or sale that would preclude competitive advantage;

The government will maintain in standby condition plants needed for the national defense;

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17 *Iron Age*, (December 4, 1945) op. cit., pp. 118-19.
Plants and equipment not otherwise needed will be exported to members of the United Nations subject to approval of the State, War and Navy Departments;

These priorities may be disregarded, the report points out, where research can be fostered by selling, lending or donating equipment that otherwise has no industrial use, provided the fruits of such research become public property;

Where key plants are involved, the report states, it is essential that they be disposed of to bidders who have the organization, experience and financial resources affording best prospects for continuing operations and maximum production in the industry. Preference will be accordingly given.

In addition to these general provisions which were set forth in the report, certain specific policies in regard to the disposal of individual plants were also stated. These specific plans for each of the major plants show the special intent of the Government to eliminate the monopolistic power of Alcoa, particularly in the field of primary aluminum. These provisions for the individual plants were as follows:

The Hurricane Creek aluminum plant will be offered to an Alcoa competitor under terms that guarantee sale of alumina on a competitive basis;

The Baton Rouge plant will go to an Alcoa competitor but, if none can be found who is willing to operate it at the present location, consideration will be given to removing it entirely or in part to the Pacific Northwest for sale to a competitor. Finally, if the foregoing conditions cannot be complied with, the plant will be offered to Alcoa for removal to the Northwest subject of Department of Justice approval.

19Ibid.
Reduction plants at Jones Mills, Troutdale, Spokane and Tacoma will be offered to Alcoa competitors. Undisposed-of plants will be retained in standby condition until the aluminum market permits economical operation.

The Massena plant will be offered to Alcoa subject to Department of Justice approval, on terms conferring no competitive advantage. It will be retained by the government pending determination of possible disposal to others when low-cost power supply becomes available.

The Maspeth, Burlington, Los Angeles and Riverbank reduction plants, if unacceptable to any bidders, will either be held in standby condition or disposed of according to the recommended priorities, the report says.

Scrambled facilities in private plants will be disposed of by giving plant owners first choice. Those in excess will be disposed of according to the priority pattern.

Lime-soda-sinter facilities which are adjuncts to Alcoa-owned plants located at Mobile, Ala., and E. St. Louis, Ill., will be offered to Alcoa subject to Department of Justice approval.

In disposals of fabricating plants, the report states, holders of valid options or rights of first purchase will have first choice in exercising their rights. Operators of government reduction plants will be granted first choice on plants subject to prior rights of others in order to enable them to integrate more favorably. Third choices will go according to the priority pattern.

Rental terms and sales prices, the report points out, will be fixed with due regard to earning ability of the plant and not necessarily with regard to original cost or replacement value. On alumina and reduction plants, leasing terms may be offered, if necessary, as favorable as those received by Alcoa under its original lease.
All of the above plans for the disposal of surplus aluminum facilities were designed to aid competitors of Alcoa. It was suggested in the report that the terms for leasing of the aluminum properties might contain provisions for the Reconstruction Finance Corporation to stand losses for an initial period of operation by these competitors. Profits, if any, accruing to the new companies operating the facilities would be divided, with 85% going to the government and 15% to the operators. The additional provisions suggested were that the Reconstruction Finance Corporation might (1) review and approve the price at which virgin aluminum was to be sold; (2) review the top salaries offered in the new companies; and (3) look over the extraordinary expenses of the new operators. It was felt that this type of control exercised by a governmental agency such as the Reconstruction Finance Corporation would place the new operating companies in the position of having to assume reasonable risks of working capital. It would be possible under such an arrangement for the government to withdraw its assumption of other risks after some reasonable period of time had elapsed.

Two additional general provisions of this report by Mr. Symington assume a great deal of importance to the historian of the industry. Success of the new aluminum producers was a goal toward which the government report was
The success of competitors of Alcoa could be further assured through the following provisions:

The government stockpile of bauxite at Hurricane Creek will be available to the plant operator. In addition, the board will ask the help of the appropriate federal agencies in exploring the possibilities of securing foreign ore by means of international agreements.

Engineering investigations will be made to determine changes necessary to place plants in the most advantageous position to compete, and the government will finance such changes where costs appear to be recoverable.

Many of the provisions of the report were most acceptable to the various government officials and to the members of Congress who had direct interest in the aluminum industry. It was generally felt that most of the actions taken would be justified on the basis that disposal of the aluminum facilities was preferable to the dismantling of the plants built up during the wartime emergency. Leasing plans appeared to be the best solution to the general problems, because most of the potential private competitors favored such governmental policies, and government officials were interested in preventing losses or excessive maintenance costs while the plants remained idle. Outright subsidy payments of any type were generally opposed, however, and government policymakers were in harmony with this opposition. Rent-free leasing arrangements were opposed, also, because it was felt that they constituted a type of subsidy. Proponents of such rent-free leasing of plants were quick to

\textit{Ibid.}
point out that wartime producers had the same benefit, because of the fact that their investments for war built facilities would be completely amortized by the end of the war.

It is not surprising to find that Alcoa officials were in opposition to the administration policy in the disposal of surplus aluminum plants. This opposition was expressed in a statement made on October 17, 1945, by Mr. I. W. Wilson, vice-president of Alcoa. Mr. Wilson, in his statement to the Joint Senate Committee on Aluminum, challenged the government's so-called subsidy program which had been advocated by Mr. Symington. Stating that the program was "wholly unnecessary," Mr. Wilson went on to say that his company's position was "incorrectly stated and charged that the program is an invitation to reckless, extravagant and calculated mismanagement." He characterized the program proposed by the Surplus Property Administrator as being a "cradle to the grave program which, once started, can never be terminated." The whole program, as described by Mr. Wilson, consisted of many inimical policies, among them

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21 J. R. Hight, *op. cit.*, pp. 105-06.


being such items as the following: (1) government guarantee against losses; (2) purchase options based on the record of earnings under subsidized leases; (3) government procurement of bauxite or other ores; (4) subsidized manufacture of aluminum for sale at prices equal to or lower than Alcoa's cost of manufacture; (5) reduced power rates on government-owned power to operators of government plants; and (6) government stockpiling of aluminum ingot purchased from operators of the government plants. A final blast at the administration policy of aluminum plant disposal was taken by Mr. Wilson when he made the following statement:

We are compelled to conclude that the ultimate objective of the plan is the destruction of Alcoa, by subsidizing competition in the industry that it created or its dissolution by government-induced court decree, or governmental entry into private business in the form of federal operation of government-owned aluminum plants.

Mr. Symington's reply to the above conclusions of Mr. Wilson was a disavowal of any intention on the part of the Administration to atomize Alcoa, although it was more or less apparent that the dominating position of the company would be destroyed if effective competition would be arranged through governmental disposal of the plants to other operators. Congressional action was taken on October 18, 1945, to extend for thirty days the whole problem of aluminum plant disposal.

\(^{24}\)Ibid.
Senator O'Mahoney had taken the lead in sponsoring the plan to freeze the disposal of the government-owned facilities until the whole question could be studied again by the various military, small business, and postwar planning committees which were interested in the entire question of plant disposal through governmental agencies.

A great deal of discussion was carried on in the remaining months of 1945 concerning the disposal of surplus aluminum plants, but very little was accomplished until early in 1946. In January of 1946 the settlement of patent rights was made between Alcoa and the Government, with the result that disposal of the government-owned plants was made possible. Details of the patent settlement and the actual disposal of the various aluminum facilities will be given in the next section.

**Partial Settlement of the Problems of Patent Control and Aluminum Plant Disposal:**

Previous discussions have hinted that the disposal of government-built aluminum facilities hinged upon the question of Alcoa's control of essential patents in the production of alumina. Many companies feared the eventual squeeze which Alcoa might put upon them in regard to the purchases of alumina or ingot aluminum, and did not even respond readily to the governmental attempts to attract new
competitors into the field. Immediately following the
victory over Japan in September, 1945, the Reconstruction
Finance Corporation had sent out telegraphic messages to a
total of 224 companies—leaders in the metal and metalworking
industries—to determine the extent of the interest of these
companies in aluminum production facilities. Only two com­
panies responded favorably to the messages, but even these
two made "jittery leasing offers that involved, along with
other propping, a government guarantee to buy all the alumi­
um produced that couldn't be sold elsewhere." The offers
were made by the Reynolds Metals Company and the Columbia
Metals Company. Other interested companies, such as American
Smelting and Refining Company, the Kennecott Copper Corpora­
tion, and the Anaconda Copper Mining Company, made brief
investigations, but did not think entrance into the aluminum
field under the conditions existing at that time to be a
wise move. The key to the whole situation is stated by
Fortune (May, 1946), as follows:

This reluctance was induced not so much by
faintness of heart for a fair competitive fight
as by Alcoa's control of most of the available
high-grade bauxite deposits in the U. S. and of
critical patents on the processing of lower-
grade bauxites in the government's alumina
plants. Without a source of alumina independent
of Alcoa, nobody who felt any concern about his
own independence was likely to barge into the
aluminum business. Alcoa had been fairly good
for a long time, but the company was a past
master of the price squeeze.

26Ibid.
This situation made it appear early in 1946 that the governmental program for disposing of about $700 million worth of surplus aluminum facilities was at a standstill. Matters appeared even worse to many observers who felt that the domination of Alcoa before and during the war was being perpetuated in the postwar era. But the situation came rapidly to a sudden conclusion in early January, after an explosive outburst by Mr. Symington and retaliatory moves on the part of Alcoa officials. Mr. Symington's part in the initial stages of the controversy has been described in the following manner:

Then, on January 6, former Surplus Property Administrator W. Stuart Symington fired the shot heard round the aluminum world. Symington accused the Aluminum Co. of using its patents to obstruct disposal of government-owned aluminum plants, and of an attempt "to distract the members of Congress and the public from the fact that Alcoa was seeking to obtain the more desirable government plants and thus to increase and solidify its own monopolistic position." He also suggested that Alcoa officials were bargaining with the patents for settlement or dismissal of the antitrust suit. "The time has come," declared Symington, "to say frankly to Congress that it may well be that no disposal of any of the plants to competitors will be possible unless Alcoa changes its attitude, or unless the courts, acting under the Sherman Act, reorganize Alcoa so that its monopolistic power is broken."

The next four days following Mr. Symington's pugnacious tirade against Alcoa have been characterized by Fortune

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27 Ibid.
magazine as a period that shook aluminum into a "raucous new industry." That period—from January 6 to 10, 1946—will remain as one of the greatest and most significant periods in the entire history of the aluminum industry of the United States. One magnificent gesture on the part of Alcoa changed the whole outlook in regard to surplus plant disposal and competition in the aluminum industry of the peacetime world. This gesture, simple as it was, merely consisted of Alcoa's presentation to the United States Government, license-free for life, the patents for the reduction of aluminum from low-grade bauxite. It was much more far-reaching than it appears on the surface, however. The patents themselves covered three important phases of the process of alumina reduction, as follows: (1) the use of the lime-soda-sinter process in combination with the Bayer process; (2) continuous digestion; and (3) the use of starch as a settling and filtering aid. The use of all of these patents was essential to the proper operation of the Hurricane Creek alumina plant, because all of the features had been built into the plant when it was constructed during the war.

It had been felt for many months that no aluminum plant facilities would be sold until Hurricane Creek property was disposed of, because of the necessity of adequate alumina

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supplies at a cost competitive with Alcoa alumina, which was produced from high-grade ores resulted in a saving estimated at between ten and twelve dollars a ton, and it was this saving that would make the future cost of alumina competitive. It was this feature of the patents that had caused the important Alcoa officials—Arthur V. Davis, I. W. Wilson, and Leon Hickman—to make a hurried trip to Washington, D. C., in order to bargain with governmental officials. Loss of the patents would mean a loss of income to Alcoa, and it was felt by the Alcoa officials that some type of bargaining was necessary.

The whole story of these conferences between Alcoa officials and representatives of the Surplus Property Administration, the Reconstruction Finance Corporation, the Antitrust Division of the Justice Department, and congressional committees constitutes a unique chapter in Alcoa-Government relations. The determination of the various government officials to break the Alcoa stranglehold was seen in the answers given to three propositions which Alcoa officials advanced during the conferences. The account of this clash is stated briefly as follows:

The Alcoa people were there to bargain. They were interested particularly in getting out from under the Circuit Court decision, which had suspended sentence until the effect of

surplus-plant disposal could be determined. After complaining about the "pugnacious" quality of the Symington blast, therefore, they advanced Proposition No. 1: if they made a reasonable deal on the patents, would the antitrust case against Alcoa be closed? No, said Attorney General Tom Clark. Proposition No. 2 followed: if they made a good patent settlement, would Alcoa be given equal rights to buy or lease the government plants along with everybody else? No, said S. P. A. Administrator Symington. Proposition No. 3: would they be permitted to finance their own expansion with their own risk; it would be up to the court and the Justice Department to decide whether the expansion gave Alcoa a monopoly-sized share of the market.

These repeated rebuffs to Alcoa officials constituted a real setback to the hopes of the company. It appeared unbelievable to Alcoa that it would not even be able to finance its own expansion without governmental surveillance. But governmental officials were adamant. They refused to be moved by Alcoa's arguments. Mr. Symington went so far as to state that a lease with Reynolds should be consummated, regardless of Alcoa's patent holdings. He even cited the fact that a patent is nothing but a right to sue, and that if Alcoa wanted another lawsuit on its hands it could bring proceedings against the agencies that gave the lease to Reynolds. Other government officials agreed with Mr. Symington, leaving the Alcoa officials in a predicament. The meeting of January 8 was adjourned with the situation at an impasse, but the Alcoa officials promised to make an offer the next day.
On January 9, 1946, Alcoa made an offer to grant the use of patents to competing companies on the basis of free licensing of the patents for the Hurricane Creek plant up to 25% of capacity (400 million pounds of alumina), plus a royalty of one dollar per ton on all alumina produced above that figure. This offer met with objections from some government officials, and the deal was not settled. On the same afternoon, however, Alcoa officials, after a long conference with Mr. Symington, gave in to the suggestion that the patents should be granted entirely free. Thus, the final settlement was one which gave prestige to Alcoa for its "public-spirited cooperation" and to Mr. Symington for his diligent efforts at "busting a trust." Testimonial letters were arranged, a press conference was called to give the news to cynical Washington newspaper men, and Mr. Symington took the trouble to take back all the things that he had said about Alcoa. In the words of Fortune magazine, "the only question was whose tongue was in whose cheek."

In spite of any temporary misgivings which observers might have had concerning the events as outlined above, it must be readily admitted that the granting of the alumina patents to the United States Government aided greatly in the disposal of the surplus aluminum plants. The officials in

30Ibid.
the Surplus Property Administration had predicted that when the Hurricane Creek plant problem had been settled it would be much easier to dispose of the aluminum plants. This is exactly what happened. A general clamor for the government-owned plants was begun by representatives of several companies. Reynolds Metals Company, still unsatisfied with its vast holdings built up during the defense and wartime periods, was anxious to get the properties which would aid in the further integration of its far-flung organization. The Kaiser interests, the American Smelting and Refining Company, and even Alcoa itself were particularly interested in some of the major facilities, "tumbling all over one another in a race to get at the choicest government properties."

Hurricane Creek facilities for reduction of alumina were leased immediately by Reynolds Metals Company, which obtained the right to use the government stockpile of bauxite located at that plant. According to the terms of the lease, Reynolds received the property on a lease-purchase plan, the lease itself being for the period of five years. Reynolds agreed to sell alumina to all industrial enterprises at cost plus six per cent, with the stipulation that the maximum price would be $40 a ton. This was considered to be a fair price for the alumina, since the wartime price had been as high as $50 per ton. It was felt that the lower

\[\text{Ibid.}\]
figure would permit more industrial operators to be demanders of alumina and the ingot aluminum which was produced from the alumina. Reynolds also leased the Jones Mills reduction plant which was near the Hurricane Creek facilities. These two outstanding plants—Hurricane Creek and Jones Mills—were sufficient to make the Reynolds Metals Company the first fully integrated competitor which Alcoa had had to face in its long history in aluminum production in the United States. The plants made it possible for Reynolds to produce all of the alumina needed for its reduction plants, and to produce all the virgin metal needed for its fabricating facilities. The prospect for real competition in the aluminum industry was at hand, and the further developments within the next few weeks were sufficient to make the situation even brighter to the American public.

Further disposal of Defense Plant Corporation aluminum plants had resulted in the addition of the Kaiser interests by the end of March, 1946. The Kaiser company entered the field as a producer of ingot aluminum and sheet aluminum in the Pacific Northwest. A five-year lease was granted to Kaiser-Cargo, Inc., on the aluminum reduction plant at Spokane, Washington. This plant was valued at $22,000,000. The Kaiser-Frazer Corporation leased the sheet rolling mill, also located at Spokane and valued at $48,000,000. This initial entry of Kaiser into the industry was further expanded at a later date
to include the alumina plant at Baton Rouge, Louisiana, and the aluminum reduction plant at Tacoma, Washington. It had been rumored in the automobile industry that the Kaiser interests were interested in aluminum, because difficulties in obtaining steel had left the Kaiser-Frazer Corporation in a bad predicament in the production of the new Frazer and Kaiser automobiles. This problem of procuring steel was cleared up, however, and the Kaiser-Frazer Corporation was not forced to use sheet aluminum for the bodies of their cars. The Permanente Metals Corporation, a subsidiary of Kaiser interests, took over the operation of the aluminum facilities from the original leasing companies, and at the present time this company operates the plants at Baton Rouge, Tacoma, and Spokane.

The Reynolds Metals Company extended its operations in the field of aluminum rolling mills through the leasing of the Chicago sheet mill which had been built by the Defense Plant Corporation. The Chicago plant was valued at $44,000,000. In addition, the Reynolds company leased an extrusion plant at Grand Rapids, Michigan, and bought a sheet, rod and bar mill at Listerhill, Alabama. The latter plant had been operated by Reynolds during the war, and was valued at $20,000,000, but the sales price to Reynolds was $7,000,000.

All of these moves on the part of Reynolds and the Kaiser interests served to place the aluminum industry of
the United States on an entirely new basis. In the amazingly short space of only a few weeks, the entire industry was placed on a competitive basis, in such a manner as to evoke the comment that "never before had a one-company industry been cracked open so fast, so wide, and so handsome for competition." The results over the period of the next year in the aluminum industry were amazing. The structure of the industry from April 1, 1946, to April 1, 1947, showed a decided trend toward the making of a great triumvirate of aluminum competitors. The following table will show the breakdown of aluminum production facilities in the United States. Percentages for the "Big Three" in the aluminum industry, for alumina, aluminum reduction, and sheet aluminum production are given for April 1, 1947. The breakdown is

<table>
<thead>
<tr>
<th>Company</th>
<th>Alumina</th>
<th>Aluminum Reduction</th>
<th>Sheet Aluminum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alcoa</td>
<td>43.7</td>
<td>50.6</td>
<td>48.4</td>
</tr>
<tr>
<td>Reynolds</td>
<td>35.9</td>
<td>29.4</td>
<td>29.9</td>
</tr>
<tr>
<td>Kaiser</td>
<td>20.4</td>
<td>20.0</td>
<td>18.5</td>
</tr>
</tbody>
</table>

unique in one respect, at least. It shows that Alcoa, in the postwar year of 1947, has a majority of plant facilities in only one field of aluminum production, that of ingot aluminum reduction, where the percentage gives that company 50.6% of the production capacity. Alcoa continues as the leading producer in all three lines of activity, of course, but its dominance is by no means as complete as it was in prewar years or even during the wartime era. By way of contrast, it is interesting to recall that in 1939 the picture of the aluminum industry, as shown by Alderfer and Michl, listed Alcoa as the producer of 100% of bauxite for aluminum, alumina, and of virgin aluminum. The people of the United States may marvel at the breakdown of the aluminum monopoly, but it should be recalled that the task was accomplished only as a result of purposeful actions on the part of governmental officials and private producers after this country had begun its defense program. The elimination of Alcoa's dominance was not an overnight proposition. It proceeded from the first decisions to refuse options to purchase to the company in connection with the new facilities which it helped to build and which it operated during the war. The task was completed in the refusal of officials of the various governmental agencies to sell the surplus plants to Alcoa after

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33Alderfer and Michl, op. cit., p. 103.
the war had ended, and by the process of obtaining the patents from Alcoa for use by competing companies.

Postwar Problems of Competitive Enterprise in the Aluminum Industry of the United States:

In concluding this chapter on the postwar aspects of the aluminum industry, it is interesting to note the most recent article entitled "Lots of Aluminum," in Business Week for May 31, 1947. The significance of increased capacity and of competition in the aluminum industry is well illustrated in the statement that it is necessary to "chalk up aluminum as the first major metal to enter a buyer's market" after World War II was ended. The reasons given are obvious, as shown in the following statement:

For two years primary aluminum producers and rolling mills have been operating at full speed. Pent-up wartime demand, substitution of aluminum for other metals in even tighter supply, gave suppliers all the business they could handle.... Now the pipelines are filled up. Current buying is on the basis of current consumption. The result:

Reynolds Metals Co. is "temporarily suspending" production at the Longview (Wash.) aluminum plant, which has a capacity of 60 million lb. of ingot a year. Smallest of Reynolds' ingot plants and the company's highest-cost producer, it will be rebuilt to improve efficiency and productivity. Operations may be resumed in about a year.


35 Ibid.
Aluminum Co. of America has curtailed production at its Alcoa (Tenn.) rolling mills.

Kaiser Co., the nation's third aluminum producer, found time to slow down a couple of departments in its Trentwood (Wash.) rolling mill for year-end inventory purposes. Full production is scheduled after the Memorial Day holiday.

Reynolds also has decided it doesn't want the government-built rod and bar mill near Newark, Ohio. It has signed a letter of intent to lease the plant from W A A. Not it finds its McCook (Ill.) plant can meet the demand. Reynolds also has cut back on rolled products.

Sheet is the one type of aluminum now in easy supply. Output of extrusions is close to meeting demand. Castings are still short.

One of the chief reasons for the surplus of sheet aluminum in 1947 has been the reduced demand for aluminum for housing and building construction. Both siding and roofing of aluminum sheet had been in big demand, but the rapid building up of stocks of this type of fabricated aluminum products has acted as a deterrent to further expansion in that field.

No immediate reductions in primary aluminum prices is envisioned in this latest article by Business Week, although it is pointed out that secondary aluminum prices had shown a tendency to turn down in the first half of 1947.

The steady price of 15 cents per pound for ingot aluminum

36 Ibid., p. 9.
had been maintained since 1941, and it appears doubtful that under present circumstances the price will be decreased as rapidly as some industrial users might hope. Demand for aluminum has held up much better than wartime predictions indicated that it might, with the result that more optimism is being shown in the industry. The long-run viewpoint is that a stable market will evolve from the present situation, and that the demand for aluminum will show continued steadiness and growth through the coming years. Several items are mentioned specifically to show the causes for optimism, as follows:

1. Continuing demand for foundry items;

2. The expanded market for aluminum foil as a packaging material;

3. The large growth in use of aluminum wire as a substitute for copper;

4. The increased call for aluminum pigment for paints; and

5. As a clincher, the fact that Alcoa is spending $30,000,000 on a new rolling mill at Davenport, Iowa. Alcoa hopes to start operations there before the end of the year.

It is not to be doubted that the immediate postwar aspects of the aluminum industry point to a brighter future of the industry both in terms of its usefulness to the economic system and in terms of competitive enterprise. Government

37Ibid., p. 18.
plans bore fruit in the establishment of a degree of competition that appears to have the possibilities of permanence in the field of aluminum production. The changes of the last seven years have resulted in significant changes in the economics of the industry, which will be the subject matter of the final chapter of this study.
CHAPTER V

POSTWAR ECONOMICS OF THE ALUMINUM INDUSTRY

The aluminum industry of the United States affords an excellent opportunity for one to analyze some important data in the light of economic theory and practice. The postwar economics of this industry is so different in many ways from the prewar conditions that many new problems have arisen. The enormous growth of the industry over such a short period, plus the entry of potential long-run competitors to Alcoa changed the institutional and technological structure of the entire industry.

The economic problems to receive special attention in this chapter constitute an array of seven, all of which are connected with the economics of the aluminum industry. The postwar economics of aluminum will be treated in terms of these seven problems, as follows:

1. Competition of producers and fabricators;
2. Production problems after the war;
3. Postwar cost problems in the aluminum industry;
4. Postwar aluminum markets;
5. Labor and labor relations in the aluminum industry;
6. Problems of monopolistic competition; and
7. Problems of international competition and cartels in the postwar aluminum industry.

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Analysis of the postwar aluminum industry in terms of the above problems constitutes an attempt to show the industry as it exists in 1947. In some cases, particularly with reference to the determination of the degree of effective competition existing in the industry in the postwar era, the answers cannot be entirely definitive. In order to analyze production problems one must be concerned with such phases of the industry as bauxite resource depletion; alumina and aluminum processes, both old and new; fabrication and finishing problems; the decline in production as a result of the cutting off of the wartime demands for aluminum ingot products; and the differences in production problems of older plants and the newer government-built aluminum facilities. Important postwar cost problems used for explanation are those connected with the various aluminum ores, aluminum reduction, shipping and transportation, and the fabrication or rolling mill costs. Aluminum markets will be analyzed on the basis of demand and supply data, which are connected with the expansion and contraction of aluminum markets in the fields of transportation, industry, and finished consumer goods. Marketing centers in the aluminum industry are used in explaining the economics problems which have to do with the distributive end of the aluminum industry. Problems of labor and labor relations are helpful, particularly in the light of the labor troubles existent in the industry during
the war. The postwar features surrounding the presence of
great numbers of additional trained personnel in the in-
dustry are useful in throwing light on a new labor problem.

Monopolistic competition in aluminum has always been
a fertile field for analysis, particularly in terms of dif-
ferentiation of products, substitution, and competitive
materials which take the place of aluminum in industrial
usage. Added to the prewar features of the monopolistic
competition in the industry is the wartime development of
additional producers in the field of aluminum production,
making the postwar analysis revolve around the conditions
of oligopoly. Three producers in the field of primary
aluminum production after the war change the picture from
a 100% monopoly to a competitive one. No extended analysis
is contemplated in the field of the international cartels
in aluminum, primarily because of the fact that it has been
repeatedly stated that Alcoa was never a member of the
cartel movement. However, the possibilities of international
competition, especially with Canadian aluminum, will be
discussed. The tariff situation, since it now is positive
protection for domestic producers against Canadian competi-
tion in United States markets, will be given some considera-
tion in the latter part of the chapter.
Competition of Producers and Fabricators:

Prewar lack of effective competition in the aluminum industry of the United States, especially in the field of primary aluminum production, was perhaps its most noted characteristic. Figures which have been cited before indicated that in the field of aluminum ores, alumina, and ingot aluminum reduction, the position of Alcoa was one of quite complete monopoly. Only in the case of fabricating facilities was it possible before the war to discover any degree of competition, but even that was limited by the necessity of fabricators to purchase Alcoa ingot aluminum for fabrication. The 100% monopoly in the three primary stages of aluminum production resulted in Alcoa control of the aluminum industry of the United States, with the result that no other producer dared to enter the field. Wartime changes effected by the governmental agencies and private industry created the opening wedge for competition in the industry, and the postwar disposal of surplus plants set up the Reynolds Metals Company and the Kaiser interests as competitors.

It must be stated at this point, however, that the real degree of effective or classical competition in the aluminum industry of the United States in 1947 cannot be measured with exact scientific accuracy. A variety of reasons may be given for this lack of definitive evidence,
but the most important ones are: (1) the fact that the surplus plants leased by the government to Reynolds and to Kaiser were leased for a period of five years, beginning in 1946, and they have been in operation for only a relatively short period of time under postwar conditions; (2) the conditions of demand, which were such at the end of World War II that a great backlog of demand for a variety of aluminum goods had sprung up, enabling new producers to sell their goods mostly in a seller's market; (3) the possibility that the leasing companies may, at the end of five years, find it advisable not to exercise the option to purchase the plants, especially if they are faced with a declining demand for aluminum and an unsatisfactory price situation; and (4) the continued operating existence of the uneconomical plants, such as the ones at Baton Rouge, Hurricane Creek, and Tacoma, at least under present conditions as they exist in 1947.

It is obviously a matter of conjecture as to the degree of genuine competition existing in an industry where the competing firms are operating on different bases. The situation in the aluminum industry in 1947, with Alcoa operating on the basis of private industry assuming its own risks, both present and future, is quite complicated. The leases held by both Reynolds and Kaiser were designed to provide a modicum of competition, chiefly by limiting profits and prices which were possible under the leases granted. For
example, it has been stated before that Reynolds took over the Hurricane Creek plant with the stipulation that he could sell alumina at cost plus six per cent, provided that the price could not be more than a maximum of $40 per ton of alumina. The granting of the patent rights by Alcoa to the Government had been given as a reason for keeping alumina prices down that low, as against the wartime price of $50 per ton. The patent rights granted license free made it possible for Reynolds to produce alumina from ten to twelve dollars a ton cheaper, as we have seen. Such conditions as these make it evident that competition, free and unrestrained, does not exist in the aluminum industry of the United States in 1947. This conclusion is in opposition to the following statement, which appeared in Fortune magazine in May, 1946:

Under monopoly conditions in an industry, it is more or less worth while to reduce costs—with the aim of either lower prices and greater sales, or simply of increased profits on the old volume of business. Under competitive conditions it is often a matter of life and death. The latter is quite desperately the case of the 1946 aluminum industry. No longer can the industry develop its markets in a leisurely way and expand its capacity just enough to meet the demands it can clearly see ahead. No longer can it play merry tunes with prices all up and down the scale for aluminum—even with demands pent up by the

war—occupies merely a corner of the enormous war-expanded capacity. The present price of virgin aluminum ingot is 15 cents a pound (14 cents for pig) and it had better not go any higher if the industry wants to sell more aluminum.

The chief reason for disagreement with the above statement is the fact that the writer does not feel the degree of satisfaction concerning effective competition that is exhibited in the line which states that "the latter is quite desperately the case of the 1946 aluminum industry." Although the disposal of government facilities did result in the placement of means of competition into the hands of two large competitors of Alcoa, the time is too short to say that competition is at hand in the aluminum industry of the present era. The statement even in the year 1947 would be subject to careful scrutiny, because the very nature of the government lease-purchase agreements with Reynolds and Kaiser interests indicates the possibility of their retirement from the field if conditions become worse than they anticipate.

The writer is more inclined to accept the viewpoint expressed by the War Assets Administration in the most recent report to Congress concerning aluminum plants and facilities. Conservatism is shown in the statements concerning the possible competition arising out of the government plans for disposal to competitors of Alcoa. It becomes apparent that the officials of the War Assets Administration
do not feel that completely effective competition exists in the aluminum industry of 1947. The report states:

The distribution of productive capacity in surplus plants to now independent producers represents a major step toward the establishment of a competitive aluminum industry, particularly in the very important lower stages of manufacture. More possession of such productive capacity will not, of itself, give rise to competition. Other prerequisites must be met before genuine competition can be achieved. (Italics mine.)

One of these is keeping the newly acquired facilities in substantial production, for it is output and the ability to sell that output that will ultimately be a deciding factor. Another factor is the extent to which existing nonintegrated fabricators and the purchasers or lessees of Government-owned fabricating plants will have available for their operations adequate supplies of ingot, sheet and other forms of aluminum, whether from the present integrated producers or from other sources. The smaller firms and independent fabricators who presently look to the ingot and fabricated aluminum producers as their prime source of supply will be able to withstand competition from the large firms only if they are able to obtain supplies at a sufficiently low price. In the fabricating field it is possible that under some conditions competition may be diminished, rather than promoted. This circumstance, as well as the general market outlook for aluminum and its products, will affect the efforts of WAA to broaden the base of disposals so as to bring additional independent operators for the remaining surplus plants into the field.

It is of extreme importance in making any analysis of present-day competition in the aluminum industry to

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2 Aluminum Plants and Facilities, First Supplementary Report of the War Assets Administration to the Congress, (February 12, 1947), pp. 4-5.
remember the exact status of the disposal program for the
government-built plants. The latest report available in
this connection is the War Assets Administration summary
of disposals, excerpts of which are given below:

.....the wartime investment of the Government
in the aluminum industry was $716.1 million, of
which $34.2 million represented loans to private
enterprise by the RFC, and $681.9 million went
into DPC and Navy plants and scrambled facilities
cost $665.4 million, of which the bulk, or $629.4
million, were plants costing $5 million or more
each.....

As of November 30, 1946, $651.8 millions in
Government plants and facilities had been de­
clared surplus, and $387.3 millions disposed of
(including one plant withdrawn from surplus),
leaving approximately $278.1 millions in aluminum
plants still awaiting disposal. These disposals
comprise chiefly leases, the leased plants cost­
ing $295 million. Plants costing $79.6 million
have been sold for a total of $28.5 million. In
addition, sales and transfers (includes transfer
to Veterans Administration of Navy plant with­
drawn from surplus) of equipment in Government­
owned plants were made amounting to $11.7 million.
Thus, plants representing over half of the original
Government dollar investment in the aluminum
industry have been disposed of to date.

.....The total number of Government-owned
plants was 56 (including the lime-soda-sinter
facilities adjacent to Alcoa-owned plants, which
are treated as complete plants) of which 35 cost
more than $5 million. Of the 56 Government
plants, 53 were originally declared surplus and
one later withdrawn by Navy Department; 14 have
been sold and 14 leased. Of the 28 disposed
plants, 16 will continue operation in the alumi­
num industry.

\[\text{Ibid.}, \text{pp. 3-4.}\]
The basic or key plants in the program are those for production of alumina from bauxite, valued at $65.7 million, and for the reduction of alumina plants at Hurricane Creek, Ark., and Baton Rouge, La., are fundamental to the program. Both plants are now in operation under letters of intent, and leases are being drawn. Four of the nine reduction plants have been disposed of, and negotiations for one of the others are under way. The disposal of the fabricating plants which comprise the balance of the Government investment is less advanced, since it not only depends to some extent upon the prior disposal of the basic plants, but may involve problems of conversion. However, 20 out of 38 such plants have been disposed of, representing all types of fabrication.

Ideas in the above statement are further clarified by the report in the declaration that "surplus aluminum plants, and segments of plants, originally costing the Government $252 million, remain to be disposed of. In many cases, disposals have covered land and buildings only, and disposition of the plant equipment will be made at some future time through the WAA Office of General Disposal."

The conclusion reached in the War Assets Administration report of February 12, 1947, is pertinent to an understanding of the competitive features of the aluminum industry at the present time. Economic theory will be of importance in this statement of the general idea, and further analysis of the other problems of production, costs, and markets, will aid in the final conclusions which will be drawn in this chapter.

\[4\] Ibid., p. 5.
The successes attained in the program of disposal are outlined in the report as follows:

The accomplishments of the past year in the disposal of aluminum plants and facilities represent substantial progress toward the attainment of most of the major economic objectives of the program presented to Congress in the report of the Surplus Property Board, of September 21, 1945. The distribution of productive capacity in surplus plants to new independent producers represents a major step toward the establishment of a competitive aluminum industry, but production in these plants and the marketing of their output will eventually determine this issue.

The plants remaining to be disposed of are chiefly those in the fabricating group. Future prospects for these plants will depend upon the extent to which the present large demand for aluminum is sustained. The War Assets Administration will, within the framework of the policy and program set forth in the first report to Congress, continue to follow a course of endeavoring to establish competition in the aluminum industry and to achieve the pertinent objectives of the Surplus Property Act.

If the postwar policy of disposal of the Governmental aluminum facilities continues to work out as planned, and if the companies whose entry into the industry has been so widely heralded are able to stay in the field beyond the periods of the leases, it will be a successful step in the inauguration of competition in aluminum. In concluding this section on postwar competition, however, it will be well to remember

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5Ibid., pp. 38-39.
the following statement which appeared during the war in a study on corporate concentration and public policy:

The economic characteristics of the aluminum industry show, on the one hand, that monopoly is not a necessary condition and, on the other hand, that classical competition is not feasible. Present demand conditions would support between five and ten large firms at optimum size and optimum scale in the refining, reduction, and power stages. In mining and in the finishing stages a large number of independents would be economically justified. The observed merits of integration and the advantages of large-scale production suggest that five to ten integrated firms of medium size would create a technically efficient industry.

The industry has not progressed to this ideal, and probably will not reach such optimum potentialities within the next few years, but the conditions of oligopoly existent in the aluminum field today offer more hope for the future in this respect. It is a far cry from the monopolistic nature of the prewar industry, and is a harbinger of more competitive economics in the aluminum industry of the future.

Production Problems After the War:

Several problems in the field of aluminum production assume major importance for consideration in the industry in the postwar period. Bauxite resource depletion is one problem

that has claimed the attention of various experts during the past few years. The presence of possible new methods of producing aluminum through the newly invented processes has called for deeper consideration of the postwar technological phases of the industry. New fabrication and finishing techniques have added to the marketing potentialities of the metal. Declines in aluminum production in the period after cessation of hostilities, with their consequent declines in quantities of aluminum available for the postwar market, gave rise to economic problems of significance. Various differences in production problems of the older aluminum plants as contrasted with the newer wartime facilities have caused a wide variety of comments on this phase of the industry since the end of World War II.

Depletion of bauxite resources of the United States has been feared in both governmental and private industrial circles for a number of years. This fear was noted in the early discussions concerning the postwar aluminum industry, and it is of importance to consider just what is meant by most writers when they refer to such bauxite resource depletion. Several writers, among whom we may mention Professor Engle and his associates, have stated that the rapid use of our high-grade bauxite ores during the war might place the United States in the position of a have not nation, and might make this country dependent upon outside or foreign
help in case of another war. This argument is carried to its logical conclusion in Chapter XVIII of their book, which is descriptive of "a program for allocation of world bauxite reserves." Pointing to the necessity of arranging for international agreements concerning bauxite resources, the writers refer specifically to implementing one of the provisions of the Atlantic Charter, which contains the following statement in Article IV:

They (the United States and Great Britain) will endeavor, with due respect for their existing obligations, to further the enjoyment by all States, great or small, victor or vanquished, of access, on equal terms, to trade and to the raw materials of the world which are needed for their economic prosperity.

Little doubt exists that this country would be interested in some sort of international agreements which would assure adequate supplies of bauxite in the future. Depletion of resources in Arkansas has occurred during the years since 1940, with the result that the industry must rely upon imported bauxite ores from Surinam to supplement the domestic output in the postwar period. Use of lower-grade ores which are to be found in this country would be possible in the event of another world conflict, but might delay the successful rearmament of the United States to a great extent. International control, assuring adequate allocation of the

\[8\text{Ibid.}, p. \ 389.\]
bauxite resources to various consuming nations, had been suggested, even before the end of the war. Two types of international settlement of the bauxite problem were suggested, each of which was quite different from the other. The first plan called for reliance upon the general machinery of the international government of the United Nations to set up a free world market with effective competition. This system would permit the highest bidder in the free world market to obtain supplies of bauxite. However, in spite of its element of laissez-faire economics, it was not felt that it would be successful in actual postwar practice. In other words, "a free market, therefore, might easily result in a few rich nations, individuals, or corporations, getting control of the lion's share of the world's choicest bauxite resources."

The second type of international control which was advocated had to do with the establishment of a permanent international bauxite allocation board or commission with adequate power to enforce its decisions. This power of enforcement would be granted by the United Nations, with appeals possible to a type of international court. Elaborate provisions for this entire program were outlined by the experts at the University of Washington, but no efforts to implement these plans for actual practice have been forthcoming in

9 Ibid., p. 390.
United Nations circles up to the present time. Perhaps such suggestions for international control of raw materials have been too far advanced for acceptance by the United Nations under present day conditions. If such a program were adopted the likelihood of another war might be postponed indefinitely, but one must admit that it is merely a matter of conjecture in 1947. Such schemes of international cooperation in economic matters too often become involved with political issues to become practical realities, although they may still be desired by a great many nations. If such a plan for bauxite could actually be worked out, then international cooperation in many other raw materials problems might be easier. The conclusions reached by the group in Washington prove to be of interest, particularly the following statement:

The allocation of bauxite reserves to consuming nations on the basis of equalizing the duration of reserves for each country should not only be considered desirable but should be looked upon as entirely feasible. Admittedly any program set up for a long period would have to be kept flexible. An arbitrary allocation of reserves to uses, however carefully thought out in advance, would be certain to need modification from time to time. In conclusion, the authors feel that some such program as that envisaged is an indispensable prerequisite, not only to a permanent aluminum industry in the United States, but to a peaceful world. A program must be developed which will not only allow us to preserve and expand

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10Ibid., pp. 401-04.
our aircraft industry but will also permit the fulfillment of the rights of other nations. Through our President we have gone on record with Britain for free access to the raw materials and markets of the world as a keystone for international peace policy. It is only as every natural resource is brought under scrutiny and control such as indicated above that the promise of the Atlantic Charter can be fulfilled. Bauxite, as one of the basic materials in the postwar world, might well be the first to be tackled.

To the extent that such a plan for bauxite resources indulges in the positive program of suggesting what ought to be done in the field, it becomes "art" in the realm of economic considerations. Descriptive analysis of the entire problem of resource depletion was made on a scientific basis, and must be accepted as indicative of "science" in the field of economics. The issue here, as in other instances of the conflict between art and science in economics, resolves itself into a consideration of the net result to be accomplished in pointing out what might be achieved through such a positive program. The writer feels that if the cause of world peace can be served by turning artist at this point, then it is well to suggest what ought to be done in regard to bauxite, as well as other essential mineral raw materials. Cooperation among the nations of the world is desirable in this respect, and should be encouraged by all economists and statesmen.

Technological progress in the aluminum industry from 1940 to 1947, coupled with the changing institutional pattern of the industry, has called for a different economic evaluation
of production problems than was possible in prewar years. The changes in technology have been mentioned in this study before, mainly in terms of the new processes that have been employed, or tested in pilot plants. One of the greatest of the wartime improvements on the Bayer process of alumina reduction was the soda-lime-sinter process that made possible the greater utilization of low grade ores. Other processes for reduction of aluminum from alunite or from various types of clays were employed in the pilot plants at Salt Lake City, Laramie, Salem, and Harleyville. Even the new process for thermic manufacture of aluminum, as yet untried in the United States, may change the production problems of the industry to an extent as yet unpredictable. The newer wartime alloys, with greater strength and durability than any of the prewar varieties, add to the production potentialities of the industry in terms of satisfying an expanding market. All of these developments, in the light of economic theory, are to be considered as being instrumental in changing the technology of the industry to provide for both extensive and intensive use of raw materials in the aluminum industry and to provide for better types of aluminum products for the consuming public. This changing technology in the aluminum industry has given a wider variety of products in the postwar period, and the hopes for future utilization of the processes appear bright.
New fabrication and finishing techniques in the production of aluminum goods have enhanced the position of the metal in many industrial uses. Markets for aluminum products have been expanded in the housing field, where sheet aluminum has been used in prefabricated houses, both for siding and for roofing. Aluminum foil for wall insulation, to reduce heat loss and to lessen fire hazard and vermin infestation, finds a ready market in the postwar world. A great variety of reconversion activities after the war resulted in the extension of potential markets, as shown in the following statement:

Reconversion of the aluminum industry to meet the demands of the peace time world is progressing swiftly. The huge mills that turned out block and a half long sections of aluminum sheet during the war for fighter planes and bombers are now rolling aluminum sheet destined for farm roofs, truck bodies, and a hundred other peacetime products. The foil mills that rolled aluminum foil which played so vital a role combatting enemy radar, now roll foil for the packaging of cigarettes, candy bars, and chewing gum. The giant hammers which forged aluminum propellor blades, are now turning out pistons for automotive engines and other peacetime products. An attractive market for aluminum at the present time is the building industry. Another promising field for aluminum finishes. Important progress has likewise been made in electro-plating aluminum. Manufacturers of aluminum cooking utensils promise several innovations in post war aluminum pots and pans. Transportation

continues to be one of the principal users of aluminum with bright prospects for increased consumption in all fields.

The list of applications of these newly fabricated and finished aluminum products is tremendously long. The fact that fabrication is one phase of the industry with a relatively large number of producers makes the outlook for the future more promising. Fabricators in the past history of the aluminum industry had to depend on Alcoa for their ingot aluminum, but with Reynolds and Kaiser interests in competition in the field of primary aluminum production, the field of fabrication should have a greater supply of the metal for peacetime civilian needs, and should have an even wider market than it has enjoyed in the past for its products.

It was to be expected that aluminum production would be curtailed to some extent immediately after the cessation of hostilities in World War II, mainly because the postwar prospects for sales of aluminum products could not compare with the wartime needs for the metal in the aircraft and other types of industries. The original cutbacks came as early as 1943, and the immediate postwar period has seen further declines in production of certain types of aluminum products, such as sheet aluminum. Present operation of many of the plants is conducted on a basis of less-than-capacity production, but this condition has been brought about by several factors. The presence of a large amount of secondary
aluminum, salvaged from a variety of wartime applications, has affected the market for ingot aluminum to some extent, and has made the production of virgin metal unnecessary in the large amounts that were produced during the war, when no secondary metal was available. The backlog of civilian demand was not as large as the wartime demand of the various industries which employed the use of aluminum, and this situation has meant a decline from wartime volume of production, at least until the market situation clears up. Post-war markets, in contrast with wartime conditions, actually needed to be extended through salesmanship and advertising, and these activities have taken some time and effort on the part of aluminum producers.

The markets for aluminum products are being rapidly expanded at the present time, and it is reasonable to expect greater production of the metal in the years to come. Wider applications of the metal in a greater variety of industrial, commercial and consumer activities will make this possible. Most observers of the aluminum industry feel, however, that the peacetime production of the various phases of the industry will not reach the wartime level, at least for several years. It may be possible in the long run, provided the potential markets are thoroughly exploited, both in the domestic and international spheres.

Differences between the production problems of the newer wartime plants and those of the older, established
aluminum facilities have been indicated. Emphasis has been placed on the differences arising out of such changed conditions as location of plants, transportation problems, and cost problems brought about by the improved and new processes and technological structure of the industry. The geography of the industry, as it expanded into new and widely-dispersed sections of the United States, has given rise to various comparisons of the newer plants for primary production of aluminum. Location of new alumina plants at Hurricane Creek and Baton Rouge, for example, caused their production problems to be different from those of the older plants at East St. Louis, Mobile, and even Listerhill. The plant at Hurricane Creek was adjacent to the bauxite areas of Arkansas, while the plant at Baton Rouge was not as close to ocean transportation facilities as the plant at Mobile, but was better situated than the East St. Louis facility to receive foreign ores. The Baton Rouge plant made use of the bauxite from Surinam, which came by ore ship to New Orleans and was then transshipped by rail up the Mississippi River Valley to its final destination. Lack of dock facilities at Baton Rouge prevented ships from proceeding directly to the alumina plant there. The various transportation problems involved represented a change from the institutional structure of the industry, and in some cases the newer plants were recognized as the better plants, except for the Baton Rouge plant, which still is referred to as being uneconomical,
although its continued operation by the Kaiser interests is expected.

Some of the newer aluminum reduction plants were beneficiaries of the extended governmental power development program, and were able to get lower power rates for the electrolytic process of reduction of the virgin metal. The plants in the Pacific Northwest have been pointed out as being more economical than some of the older facilities, because they received hydroelectric power from the Bonneville Power Administration, which channeled power from Bonneville and Grand Coulee dams into the aluminum industry in that region. Plants at Tacoma, Spokane, Longview, and Vancouver were more advantageously located with respect to power than the Eastern plants, or even those in California. Total costs of the various regions per pound of aluminum produced were shown by Professor Engle and his associates to be as follows:

<table>
<thead>
<tr>
<th>Region</th>
<th>Cost per Pound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Northwest (private)</td>
<td>10.63¢</td>
</tr>
<tr>
<td>Pacific Northwest (DPC)</td>
<td>10.78¢</td>
</tr>
<tr>
<td>New York State</td>
<td>10.97¢</td>
</tr>
<tr>
<td>Alcoa, Tennessee</td>
<td>11.57¢</td>
</tr>
<tr>
<td>Listerhill, Alabama</td>
<td>12.15¢</td>
</tr>
<tr>
<td>Torrance, California</td>
<td>12.63¢</td>
</tr>
</tbody>
</table>

These figures are indicative of the fact that the newer facilities built by the Government and private industry incorporated some of the modern technology that the older plants did not possess. More than this, however, was the

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12 Engle and others, op. cit., p. 229.
combination of factors of raw material, power, and transportation facilities in such a way that lower costs resulted in some of the newer plants. It will be noted that the Torrance, California, plant, regardless of its newness, could be operated only under wartime conditions which covered its uneconomical operations. It was one of the very first plants to be put out of operation when ample supplies of the metal were made available, and it has never been placed back in operation. The long run analysis of the newer facilities will have to be made at some future date, because operations in all of the plants have been curtailed to some degree up to the present time in the postwar period.

Postwar Cost Problems in the Aluminum Industry:

Extended statistical analysis of costs in the aluminum industry is not contemplated here, but a careful consideration of cost problems is necessary for an interpretation of the postwar economics of aluminum. These problems of costs, in their general nature, are somewhat different from the prewar considerations, and it is in this respect that they will be discussed. The important problems are those connected with the costs of aluminum ores, aluminum reduction, shipping and transportation, and fabrication or rolling mill activities. Wartime studies in all of these specific fields of aluminum production were conducted at the University of Washington, by
Professor Engle and his associates, and their conclusions are to be found in Chapters X and XI of their book. These studies, however, were limited in scope, for a variety of reasons which were mentioned by the authors. Excerpts from their conclusions are valuable for consideration here, because they show the difficulty facing the analyst in the field of aluminum. Some of their most pertinent statements are as follows:

Despite the unsettling effect upon accounting procedures and summary statements of war-wrought industrial change within plants, such as new construction and the gradual occupation of completed portions of plants, changes in sources of supplies and the accompanying alteration in transportation; accommodations of operations to new government rules and to trade union practices; breaking in of new workers; shortages of materials and supplies; changing prices and qualities of materials—despite these dynamic factors, the aluminum industry today is accounting for production in familiar categories and in some instances in terms of budgets and standard costs. The authors found complete costs systems in privately operated plants throughout the country. Access to records, however, was not possible, hence alternative methods had to be followed.

Neither are adequate published data available on separate operations in the industry. Contrary to the policy of producers of other basic commodities, more particularly, iron and copper, which publish cost data on internal operating processes, the principal aluminum producers have followed the plan of retaining such information for strictly company use. For the aluminum industry, annual financial statements have appeared in the published financial journals for a number of years. Data, however, have been restricted to the usual condensed balance sheet and brief profit and loss items with such explanatory notes as were deemed necessary to clear questions of

\[\text{Ibid.}, \ pp. \ 206-07\]
accounting procedures.....Sporadic analysis of alumina and pig aluminum costs have been made from the very earliest history of the industry by various writers in professional journals. Mostly theoretical or blueprint analyses, none of these studies purport to bear the hallmark of authoritative cost accounting, which naturally could come from the industry alone.

Various brief analysis of cost conditions in the aluminum industry have been published since the end of the war, and they are helpful in the understanding of the general problem. It has been generally recognized that the wartime conditions in the industry were such that many high-cost factors were involved, but hope has been expressed that some of the high-cost factors of production would be reduced in peacetime operations. The Defense Plant Corporation plants erected during the war are the nucleus of effective competition in the present day aluminum industry, and a comparative analysis of their costs is significant. A brief statement of the cost situation involved was given in Fortune magazine (May, 1946) as follows:

The major cost items in aluminum smelting are: alumina, electric power, labor, and carbon electrodes. Alumina and electric power together make up approximately 60 per cent of the mill cost of pig aluminum, and are also the most variable cost factors between one point and another. The whitish-gray powder, alumina, is produced in separate plants by the standard Bayer process, using bauxite, soda ash, lime, and fuel as its chief raw materials. Actually, transportation is the principal element in the cost of alumina. Bauxite, at the mine in Surinam, Arkansas, or wherever,
is dirt-cheap, but it has to be hauled to the alumina plant; so, of course, do the other raw materials. Then the alumina must be transported to the reduction plant, which in the case of the northwest aluminum plants during the war, was several thousand miles away. The cost of alumina in the West Coast plants was over 5 cents per pound of ingot. This contrasts with Alcoa's prewar (1937) cost of 3.2 cents, which is believed to be about the same today.

Electric power, the second major factor in aluminum reduction, is required in enormous quantities, in order to tear the aluminum loose from the oxygen in alumina. The aluminum industry, largest single user of electrical energy in the U. S., consumed an estimated 22 billion kilowatt-hours at the 1943 peak. Cheap power—which usually means hydroelectric power—is an essential for economical aluminum smelting. In practically every case, the uneconomical DPC plants have been made so by excessive power costs.

The only wartime power costs approximately competitive with those in Alcoa's private plants were attained by the three northwest DPC plants and the Reynolds Smelter at Longview. These plants—buying from the Bonneville Power Administration—produced at an average electricity cost of 2 cents per pound of aluminum. The other seven plants in the industry paid from 3.2 to 7.1 cents. To be sure, the government built several of its plants with the full knowledge that power costs would make them uneconomical for postwar operation.

These statements reflect the general economic conditions of costs within the aluminum industry, and form a basis for consideration of a few points of economic theory. Costs to the aluminum industry are unique in one respect, as seen in the statement that "the fortunate thing about aluminum costs is that they are subject to change without notice."

This statement appears startling on the surface, and probably

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Ibid.
should not be taken literally without some sort of explanation. An example of the line of reasoning productive of such a statement is the further explanation which stated:

One important change, of course, is represented by the terms of the Hurricane Creek lease, which assures new competitors a price of no more than $40 a ton for alumina. This knocks off 1 cent a pound from the wartime cost of aluminum. If Reynolds can do as well at Hurricane Creek as Alcoa—which produced at a cost of $28 during the war—the saving will be even more. The construction of one or more alumina plants in the Northwest—using bauxite from the Dutch East Indies or native aluminous clays—would mean another 1-cent saving on freight costs to the northwest ingot plants. Alcoa has already announced plans for an alumina plant in Washington to supply its Vancouver pot lines, and both Reynolds and Kaiser are toying with similar ideas.

Plans as outlined above for Alcoa, Reynolds, and Kaiser have not materialized up to the present time, but savings in costs may be the impetus that moves these companies in the future to establish such alumina plants in the Pacific Northwest. Complete integration of the aluminum industry of that region would indicate that an alumina plant, or perhaps more than one, is necessary to supply the ingot aluminum reduction facilities that have been operating there since the war. If costs can be reduced to the extent indicated, then postwar competition may force this move, particularly when such competition becomes more effective in the long run.

Cost conditions in the aluminum industry can change

Ibid.
rapidly, as shown by the preceding statements, but another point of economic theory should be emphasized at this point. The typical cost conditions found in the aluminum industry, according to most writers in the field, are those of decreasing costs, at least to an extent equal to that found in other types of manufacturing enterprises. This feature of decreasing costs is chiefly a result of the fact that the aluminum industry is characterized by relatively large overhead costs. This does not mean that the industry is top-heavy with overhead costs, however, as illustrated by the following examples of direct and overhead costs by regions:

<table>
<thead>
<tr>
<th>Region</th>
<th>Direct Costs</th>
<th>Overhead Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pacific Northwest (private plants)</td>
<td>82.4</td>
<td>17.6</td>
</tr>
<tr>
<td>Pacific Northwest (DPC plants)</td>
<td>82.7</td>
<td>17.3</td>
</tr>
<tr>
<td>Terrance, California</td>
<td>85.2</td>
<td>14.8</td>
</tr>
<tr>
<td>New York (old plants)</td>
<td>85.2</td>
<td>14.8</td>
</tr>
<tr>
<td>Alcoa, Tennessee</td>
<td>86.0</td>
<td>14.0</td>
</tr>
<tr>
<td>Listerhill, Alabama</td>
<td>86.3</td>
<td>13.7</td>
</tr>
</tbody>
</table>

(Source: Engle and others, op. cit., p. 230.)

Increases in production of aluminum under the conditions represented here would cause the per unit cost of aluminum to be reduced, according to most observers. At the time of the great wartime expansion of the aluminum industry, testimony given by Mr. Reynolds concerning the production of the metal by his company indicated the possibilities of lowering the costs through a greater volume of production. Although the subsequent events in the history of the industry did not
produce the result envisioned by Mr. Reynolds, his statements in 1941 still are of great interest in our postwar economic considerations. As recorded in *Time* (May 26, 1941), the significant quotation is as follows:

Richard Samuel Reynolds told a Senate Committee that he will produce aluminum for 12 cents—maybe 10 cents—when his Alabama and West Coast plants get in production. At 10 cents a pound, the No. 1 light metal of World War II would cost only half what it did last year ...........

Increases in capacity, reinforced by competition, may some day make even 10 cents per pound for aluminum look expensive.

This ideal price situation for aluminum did not become a reality during World War II, but the postwar scene is such that it is within the realm of possibility in the years to come. No adequate explanation is forthcoming as to the reason why aluminum did not go below 15 cents per pound during the war, other than the fact that many high cost plants were operating in the country during those years. If postwar economic conditions in the industry in terms of competition among three producers of primary aluminum result in vast production programs in the lower cost plants, the prophecy of Mr. Reynolds may become a reality. The rate of profits accruing to Alcoa as it carried through three successive reductions of aluminum early in the defense period did not decline, and there is no reason to feel that

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production in great volume in the postwar world would make the situation any different. Both Alcoa and Reynolds made substantial profits during the war with costs of production at a high level and the price of aluminum at 15 cents per pound. Reynolds Metals Company is reported to have lost money in the production of ingot aluminum, but apparently more than made up for such losses in other lines, as shown by the following statement:

In spite of its losses on ingot production, Reynolds, too, did all right for itself during the war. In the six years, 1940 through 1945, the company's net earnings after taxes were nearly $18 million, and its earned surplus grew from $3 million to $21 million. But Reynolds is in nothing like Alcoa's financial clover. The company still owes $34 million on its RFC loans, while Alcoa has a $155 million earned surplus against a debt of $85 million. In fact, Alcoa financed its $300 million war expansion with a net increase of only $50 million in debt.

It should be noted that Alcoa itself conducted profitable operations during the war, because "the company's net for 1940-1945 was $199 million." If such profits can be attained by these companies during a wartime period, when prices of labor, materials and transportation are higher than in normal times, and when the price of aluminum is at the

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20 Ibid.
15-cent level, it is reasonable to assume that the peace-time prospects for lower costs and lower prices are good and potentially realizable.

**Postwar Aluminum Markets:**

Aluminum markets traditionally have been extremely dependent upon the price situation of the metal, probably to a greater extent than some of the other metals. This fact has been clearly demonstrated by several writers, and it becomes of paramount importance in discussing the economics of the industry to show the potential postwar aluminum markets available to all of the producers. One of the most significant statements concerning this relationship of aluminum markets and aluminum prices is the following paragraph from *Fortune*, (May, 1946):

> Price is a weightier factor in aluminum than in any of the older, established metals. While aluminum has properties that make it the best metal available for certain applications (such as automobile pistons and deoxidizing agent for steel production), in most cases it competes with such materials as steel, wood, plastics, magnesium, and copper solely on a price basis. At any given time there are millions of pounds of potential aluminum consumption hanging in the balance between the comparative prices of aluminum and some other material, ready to jump one way or the other as the spread increases or diminishes. Other considerations, of course—such as economics in maintenance and the values contributed by aluminum's

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light weight—are taken into these computations, but in the long run, price is the deciding factor.

A number of wartime events contributed to the extension of market potentialities of aluminum. The 25% reduction in the price of aluminum after the state of the defense program (from 20 cents to 15 cents per pound) opened up new marketing fields, and if the price goes any lower a greater expansion of the markets can be expected. Conditions of demand were not the same during the war as they characteristically are in peacetime, however, and allowances must be made for the changed nature of the postwar marketing situations. It was possible during the early stages of the war to utilize full productive capacities of the various plants to satisfy the demands of a single market—the United States Government. It is easy to imagine that the demand for aluminum for airplanes and other war material probably would have been as great even at a slightly higher price than 15 cents. Winning the war was the prime consideration during those years, and necessity rather than costs set the production pattern. Production of adequate amounts of aluminum to satisfy the immediate wartime needs resulted in cutbacks in the industry, and the transition to normal peacetime pursuits was begun.

Elasticity of demand for aluminum becomes one of the chief aspects of the postwar aluminum markets. It is the determining factor in the extension of the market for the
metal, and assumes great importance both in the realm of theory and practice. Economic theory approaches marketing situations from two standpoints: first, changes in demand arising out of conditions that result in greater amounts of commodities being taken off the market at the same or higher prices, and, second, elasticity of demand, which reflects the extent to which the quantities taken will vary with changes in the prices of commodities. Changes in demand, of course, can be either increases or decreases of demand, according to existing economic conditions surrounding the market. If, as in the case of aluminum during the war, increasing amounts of the metal are absorbed into the market regardless of the relative stability of the price at 15 cents per pound, a definite shift in the demand curve has taken place. Sudden increases in the need for a commodity like aluminum can result in such increases in demand, and greater production will be needed to satisfy the market. Such changes can occur in any type of industry, especially in times of war, extreme prosperity, or institutional and technological changes in an economic society. Periods of depression, on the other hand, may result in decreases in demand for such products, and the markets will suffer.

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Changes in demand and elasticity of demand are given adequate treatment in various textbooks on principles of economics. The discussion here is given in an effort to show the importance of these economic theories to the aluminum industry in the study of postwar economics of the metal.
Normal peacetime pursuits in an economic system, however, usually will not result in such rapid changes in demand. Except in those instances where a product can invade an entirely new market (as aluminum did in the automobile and the aircraft industries), the short-run analysis will run more in terms of elasticity of demand than in terms of rapid changes in demand for any given industrial product. Plans may be made by the aluminum producers to exploit the marketing potentialities of the metal in new fields, such as streamlined trains, truck bodies, boxcars, refrigerator cars, skyscrapers, bridges, or a multitude of other uses, with the result that more metal will be used in these different ways. The typical result of such entry may be dependent upon reductions in price, however, and will reflect the elasticity of demand for aluminum by industrial consumers. If the industrial users are convinced of the necessity of using more aluminum at the same price, the result is a change in demand. But if the increased use of aluminum is dependent upon price reduction, the producers must investigate the slope of their demand curve for aluminum in order to determine whether or not such decreases will be profitable in the long run.

It is reasonable to assume that the demand curve for aluminum is elastic, the elasticity being greater than unity. Such an assumption may be based upon a prewar analysis of
demand for the metal as given by Mr. James Wechsler. The
conclusion reached by Mr. Wechsler was that the demand curve
for aluminum was highly elastic. He had based his statement
upon a previous conclusion by Robert J. Anderson, a technical
expert in the aluminum industry, who had indicated that a
five-cent decline in the prices of aluminum would result in
a five-fold expansion of the demand for the metal. More
recent studies in the field of aluminum consumption have
indicated that there might have been an error in this prewar
statement, but there is little doubt that the general con­
clusion concerning the elasticity of the demand curve for
aluminum is correct. The demand curve for aluminum may not
approach the horizontal position which is indicated in the
statement by Mr. Anderson, but it is safe to say that the
market for aluminum will absorb increasingly larger quantities
at lower prices than were charged for the metal in the prewar
years. The failure by Alcoa to investigate the slope of its
prewar demand curve for aluminum became apparent, because the
company was dedicated in those years to a policy of high and
rigid prices and low volume of production. This fact has

23 James Wechsler, "United States vs. Alcoa," Nation,
been adequately shown by prewar studies, such as those conducted by the Department of Justice. The following statement substantiates the conclusion:

......the Department of Justice has produced an immense amount of evidence, some extracted from the company's own books, in an attempt to prove that Alcoa and twenty one other affiliated and subsidiary companies have amounted to a monopoly of the U. S. aluminum business effective enough to maintain prices and profits inordinately high and volume unnecessarily low.

More specific conclusions concerning the elasticity of the demand curve for aluminum have been reached in the wartime studies made at the University of Washington. These studies indicate a high degree of elasticity of demand for the metal. The results of the industrial survey conducted by Professor Engle and his associates during the war pointed to a great demand for aluminum and the products of aluminum, and price was indicated to be a deciding factor in much demand. Two approaches were pointed out as defining the market limits for aluminum—technological factors and costs. The statement is made that the first rule of the aluminum market is, "ask the technician." If aluminum satisfies the technical requirements of lightness, strength, durability, or other physical and chemical qualities, the


25Engle and others, op. cit., p. 249.
problem then becomes one of costs and prices of the metal. Competitive materials have been mentioned in the study, with steel, magnesium, copper, and plastics in the role of chief economic competitors to aluminum, both in technical and cost aspects. No single product, whether it be steel, aluminum or any other metal, can enjoy complete monopoly in a market if there are reasonable and obtainable substitutes. A great future awaits all of the industrials mentioned above, according to the statement made by Mr. T. O. Richards, of General Motors Research Laboratories, who said:

The United States will need twice its steel capacity by 1960 and a great deal more aluminum than the war peak capacity. If full employment and high level consumption can be achieved by the people of the world, in the years ahead, the big problem will be where to find enough materials of all kinds, not where to look for markets.

Results of the University of Washington survey in the field of aluminum consumption were published in Chapter XII of the book, Aluminum. Several facts of importance are to be noted concerning the nature of the survey and the results of the study from the standpoint of elasticity of demand. The survey was conducted in the years 1942-1943 with the purpose in mind of determining the approximate postwar consumption of aluminum. A total of 200 companies, widely

\[26\text{Ibid.}, \text{p. 251.}\]

\[27\text{Ibid.}, \text{pp. 249-69.}\]
dispersed both in an industrial and a geographical sense, constituted the sample taken for the survey. Questionnaires, interviews, letters, and conferences in the field were all used as means of obtaining the information, with the result that usable reports were obtained from 135 different companies. The summary of the data obtained has been given as follows:

Out of a total of 200 interviews 135 usable reports were obtained. Of course, 96 companies reported a prewar annual consumption (1940) of 51 million pounds of aluminum; 75 reported an expected annual postwar consumption of 65 million pounds at 15 cents per pound for the virgin metal; while 81 companies expected to use 104 million pounds if aluminum were 10 cents per pound. The size of the sample is further illustrated by the data on employment and volume of business reported by 62 of the companies. These companies gave employment to a total of 286,300 workers or an average per firm of 4,600, the range being from 6 employees to 93,000. Volume of business for these 62 firms totaled 12 billion dollars in 1940, an average of $26 million per firm, ranging from $45,000 to $650 million. Of the 62 firms, 27 expected an increase of business after the war, 7 expected a decrease and the others no change. The average increase expected by the 27 was 40 per cent while the decrease anticipated $26 million per firm for the 62 companies reporting holds for the 135 which supplied usable reports, the total volume of business in 1940 represented by the sample was $3,510 million or 30 per cent of the total value of expenditures for durable consumers' and producers' goods in which aluminum was used in 1940.

Figures obtained in the course of the survey indicated an interesting comparison in probable postwar consumption of aluminum in all industries when two prices for the metal were quoted. At a price of 15 cents per pound, it was indicated that demand for aluminum by all industries might reach the figure of 1,428,629,000 pounds. At the lower price of 10 cents per pound, it was estimated that the total consumption might approximate 1,890,300,000 pounds. Other estimates were made in the survey, but all of them indicated a potentially great expansion in the aluminum industry in the long run if costs were kept low and prices were quoted with some relationship to the costs involved. Some particular industrial fields, according to the survey, indicated that differences in prices of aluminum would have little or no effect at all upon their consumption of the metal. Some of these industrial categories showing definite inelastic demands for aluminum are as follows: railroads, blast furnaces and steel mills, aircraft, aluminum foil, busses, radios, engines—gasoline, diesel, and steam—and hardware. Consumption by these eight industry groups was estimated for the postwar period to be relatively stable, regardless of a price of 15 cents or a price of 10 cents. Price assumes

29Ibid., p. 256.
much less importance in such industries, it was stated, because lightness is essential and relatively small quantities are consumed.

Industries placed into the category of having elastic demands for aluminum constituted a total of 21 in number. Price was indicated to be of great importance in these industries, where a price of 15 cents per pound would call forth between 711 and 735 million pounds of aluminum, while a price of 10 cents would result in a potential demand between 1,178 and 1,200 million pounds of the metal. The industrial users which indicated the greatest potential expansion in the demand for postwar aluminum products were the automobile industry, the architectural and building industry, truck trailer manufacturing, and electrical regulators and switches production. Competition with other materials was pointed out as being a decisive factor in the price-demand relationships in these industries.

All of these facts from the survey constitute important food for thought in the economic theory of postwar economics of the aluminum industry. Events that have taken place in the field of aluminum fabrication since the war ended bear directly on the whole problem. Assuming that

\[30\] Ibid., p. 258.
certain industrial groups did indicate that their demand for aluminum was relatively inelastic, the situation does not preclude the possibility of changes in the demand curves for these users of aluminum. The railroad industry may be taken as illustrative of the situation. It was indicated as an important demander of aluminum, but demand was regarded as relatively inelastic. Potential postwar demand was predicated upon the assumption that the railroad industry would use as much aluminum at 15 cents as it would at 10 cents per pound. This could be true, but the situation does not preclude the possibility of an entire change in the demand curve for aluminum in the railroad industry, as it might occur when streamlined trains, refrigerator cars, and boxcars can be made of aluminum in competition with steel. This is an important consideration to Alcoa and to Reynolds both, because each company already has made a bid for markets in the railroad industry. The race for additional marketing outlets became so torrid at one time that both of these companies made claims of having built the first 31 aluminum boxcar. Such competitive enterprise as this could result in gaining many new markets and changing the so-called inelastic demand areas into profitable outlets by changing their demand curves.

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Areas of elastic demand in the aluminum industry can be cultivated by aluminum producers through the processes of cost reductions accompanied by price reductions. This would be in direct contrast with the situation in prewar years, when monopoly power maintained a wide gap between costs and prices in the aluminum industry. An economic philosophy of abundance, with constant close relationships between costs and prices, and with profits being earned on the basis of large volume of output and low unit profits, could result in greater consumption of aluminum products throughout the country and substantial returns to all three producers in the field of aluminum production as of 1947.

The philosophy of scarcity practiced by Alcoa from its inception, restricted production and high prices (with low volume of output and high returns per unit) could be the future bane of the aluminum industry of the United States. It could hurt consumers and producers alike, and would result in the curtailment of aluminum consumption and the lowering of the standard of living for the people as a whole. Both elasticity of demand and changes in demand can be carefully watched by the producers, with the possibility that greater and wider markets for the metal can be cultivated and maintained. These new market possibilities will not open up automatically, but they can be "cultivated sedulously, not only through cost and price reductions but also by developing
new alloys, new fabrication methods, and other adaptations of the versatile new metal to new uses."

Regional markets for aluminum in the postwar period are of interest in economic analysis of the industry, mainly because of the geographical differences between producing areas and eventual marketing areas for the metal. No exact data are available for a full consideration of this problem, but the statement has been made that "only about 37 to 48 per cent of the probable total market for aluminum lies in the geographical regions in which the reduction plants are found. In other words, over half the market lies in industrial centers chiefly in the vicinity of the Great Lakes in which no reduction plants exist." This market situation is shown in a general way in the following table of estimates made in the University of Washington survey. The percentages given represent estimates made during the war, but this general analysis fits the postwar situation adequately enough to be of economic significance.

It will be seen from these data that the reduction plants in the Northeastern region of the United States have an adequate market close to the production facilities. The

32 Ibid.
33 Engle and others, op. cit., p. 348.
market in that geographical region is even greater than the local capacity to furnish aluminum ingot. Other regions in the United States are in the position of having to obtain markets outside of their own territory of production. The Southeastern region and the Pacific Northwest, in particular offer scant marketing potentialities in comparison with the Midwest, but their aluminum reduction facilities are great.

<table>
<thead>
<tr>
<th>TABLE V</th>
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</thead>
<tbody>
<tr>
<td>REGIONAL MARKETS FOR ALUMINUM</td>
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</table>

<table>
<thead>
<tr>
<th>Geographic Region</th>
<th>Probable Percentage of U.S. Postwar Market for Aluminum</th>
<th>Probable Percentage of U.S. Aluminum Reduction Capacity after the War</th>
</tr>
</thead>
<tbody>
<tr>
<td>Northeast</td>
<td>30-35</td>
<td>15-20</td>
</tr>
<tr>
<td>Southeast</td>
<td>1-3</td>
<td>35-40</td>
</tr>
<tr>
<td>Pacific Northwest</td>
<td>1-3</td>
<td>30-35</td>
</tr>
<tr>
<td>Southwest</td>
<td>5-7</td>
<td>10-15</td>
</tr>
<tr>
<td>Midwest</td>
<td>53-62</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Engle and others, op. cit., p. 348.

The Midwest region has no aluminum plants within its borders, yet constitutes potentially more than one-half of the market for aluminum in the peacetime years. Consumer costs of the metal must include transportation costs, and for this reason the marketing problem in the industry is intensified. The summary analysis made in the University of Washington survey indicated that the various producing regions would ship to
those markets which would yield the highest net profits over costs, with both rail and water transportation facilities being considered in the various cost analyses. Careful and extensive studies would be necessary to determine the exact potentially best market for each producing facility, both in terms of ingot aluminum and sheet aluminum. There are possibilities of more aluminum consumption in the Southeast, Pacific Northwest, and Southwest, but the producers of aluminum probably will have to consider the necessity of carrying out adequate sales and advertising programs in order to cultivate the markets.

**Labor and Labor Relations in the Aluminum Industry:**

Many facts of economic significance present themselves to the historian of labor and labor relations in the aluminum industry of the United States. The industry itself long has been noted as one which demands an intelligent and highly trained labor force, because the nature of the operations in the various types of plants is such that skilled laborers are in constant demand. The character of the industry in prewar years was such that little more than 30,000 workers were employed, even as late as 1939, and the industry ranked about fiftieth among the nation's industries in terms of the number of employees. Employment increased rapidly, however, during the defense and wartime periods, and it has been
estimated that by 1943 a total of 140,000 persons were at work throughout the aluminum industry. This enlarged labor force placed the aluminum industry among the ten leading industries of the United States, judging by the number of workers employed. Postwar operations have not demanded the large labor force that was employed during the height of wartime activities, but employment in the aluminum industry remains at a high figure. No exact data are available on total employment for the industry at the present time, but it is to be assumed that with all three producers in the field of primary production operating steadily (although not at full capacity) the wage-earning group is large. In the words of the University of Washington observers:

The evidence is conclusive, however, that the aluminum industry is rapidly coming of age, and may even be classed among the dozen industries in the United States which employ 100,000 workers or more. Effective use of man power is also indicated by the fact that the number of workers did not increase as greatly as did output.

Wages and earnings in the aluminum industry have shown steady advances in recent years, in the same manner that payments to all employees have increased. During the war the Labor Department classified the aluminum industry as being in the group of industries which pay the highest wages in the United States. Hourly wage rates advanced rapidly in aluminum

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Ibid., pp. 103-04.
manufacturing after 1940, so that by the middle of 1943 they were 40% higher than in the former year. Variation in wage rates has been noticeable among the different geographical regions, but explanations have been made that such variation is due to differences in skill, the nature of the work, and the prevailing wage rate structure of the regions involved. A trend toward greater uniformity of wages throughout the industry has been noted, but some questions have been raised as to the advisability of making a sudden change that would give the same wage rates in every section of the country. The issue was raised by the Aluminum Workers of America as early as 1942, on the assertion that labor should receive equal pay for equal work regardless of the section of the country involved.

The War Labor Board, taking cognizance of the issue presented in regard to uniform wage rates, granted increases during the war to Southern laborers in the aluminum industry. The increases were based upon such factors as ability of the companies to pay the higher wages, costs of living in the geographical regions involved, and the immediate effects on war production to be encountered as a result of higher wages. No general principle of standardization was ever affirmed by the War Labor Board, however, that wage rates throughout the country should be standardized immediately. The general
The majority is satisfied that complete elimination of the differential would have an undesirable disrupting effect at this time on the general economy of the areas involved. Since Southern industries generally are adjusted to prevailing differentials, a sudden elimination of the differential in a major industry, such as aluminum, is bound to disrupt directly and indirectly the wage and labor policies of many other industries.

Eventual standardization of wage rates on a nationwide basis was envisioned by the Board, but the process was looked upon as one which would be gradual over a period of years. A general trend in all types of industries toward elimination of regional differences is a recent characteristic of the economy of the United States, apparently, and if the trend continues in the future some of the regions with lower wage rates will have noncompetitive advantage over other regions in the production of aluminum. Other considerations will occupy more attention than costs of labor if such a move takes place. Power resources and technological improvements may, under such conditions, claim more and more attention than the wage situation in the aluminum industry.

One of the most pertinent facts that bear on friendly relations between labor and management in the industry is the

Ibid., p. 106.
relatively small size of the cost of labor as compared with the final selling price of the finished aluminum product. This relationship is of importance, as seen in the following analysis:

Before the war, labor costs, in the reducing stage alone, were less than 5 per cent of the selling price of aluminum. Although the share of labor cost has increased tremendously since the war, by 1943 it was still under 10 per cent of the price of the product. Therefore, the operators can afford to be fair or even generous with their personnel. Furthermore, up to a recent period, there being only one aluminum producer in the industry made it easier to pass on to the consumer increases in labor cost. In a monopolistic situation, management and labor are frequently allied against consumers. Strangely enough the most delicate situations have not arisen between labor and management but have come from jurisdictional conflicts between unions.

A high degree of unionism has characterized the aluminum industry for many years. Union organization in all the plants except Niagara Falls has become complete in the various phases of mining of ores, alumina reduction, and ingot reduction. Unionization exists in rolling, extruding and forging plants, but not to the great extent that it is found in the three phases given above. The familiar union device of the closed shop is very rare, although collective agreements between unions and the management of a majority of

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Ibid., p. 113.
plants are in operation. Two types of union organization exist. Reynolds plants, and some independent firms, are characterized by the union shop. Facilities operated by Alcoa have been known for their maintenance of membership provisions. Both the American Federation of Labor and the Congress of Industrial Organization have gained footholds in the aluminum industry, and each organization has a great deal of strength. Neither organization, however, has any claim to outstanding superiority, although the C. I. O. unions have slightly greater strength than those of the A. F. of L. The plants of the Reynolds Metals Company are under the union domination of the A. F. of L., while other companies (Alcoa and Kaiser interests) are chiefly controlled by C. I. O.

37 "In a maintenance of membership, shop employees who were members on a specified date must remain in good standing as a condition of employment, but old employees who have not joined the union can retain their jobs without belonging. New or old employees who join the union subsequent to the agreement must maintain good standing or lose their jobs.

"Under the union shop all employees must be members of the union in good standing as a condition of employment. The employer makes his own selection for hiring, but the new employee must join the union within a specified time. The union collects dues and each new employee, after the specified time, must be a member of the union." See J. E. Walters, Personnel Relations, (New York: The Ronald Press Company, 1945), pp. 48-49.
officials, such as the Aluminum Workers Union, the Mine, Mill and Smelter Workers Union, and the Die Casting Workers Union.

Jurisdictional strife arising out of the conditions in the aluminum industry caused trouble during the war, when various union groups competed for recognition in some of the plants. A great amount of squabbling took place at the Cleveland, Ohio, plant of Alcoa, in 1942. This conflict was a battle between four different union factions, as follows:
(1) the American Federation of Labor; (2) the Aluminum Workers of America (C.I.O.); (3) the Mine, Mill and Smelter Workers (C.I.O.); and (4) the United Mine Workers, district 50 (under John L. Lewis). Another crippling strike occurred in Alcoa's plant at Edgewater, New Jersey, early in March, 1941, at a time when the defense program was in full swing and aluminum products were needed. Fortunately for the

38 Two articles appearing in Business Week at the time are of interest: (a) "Alcoa Feud; FBI and Army Investigate Work Stoppages at Cleveland," Business Week, (June 13, 1942), pp. 85-86; (b) "Alcoa's Headache; Jurisdictional Strife Growing in Cleveland Plant," Business Week, (August 1, 1942), p. 56.

defense and war efforts, these strikes were settled in such a manner as to assure continued production of the plants, and the industry was not plagued with other big strikes during the period of hostilities. Amicable relations apparently have continued thus far since the war, because no additional labor troubles have threatened on a large scale during the past two years.

Many additional women secured jobs in the aluminum industry during the war. This situation arose as a result of the manpower shortage, but the employment of great numbers of women resulted not only in the alleviation of the temporary shortage, but also in the determination of the fact that women were suitable for a wider variety of jobs in the industry. An account of the employment of women by Alcoa was given by Mr. R. C. Turner, who stated that women employees of his company were "doing an excellent job." He recalled that the employment of women in the aluminum industry dated back before World War I, but indicated that jobs given to female employees in those days were specialized tasks such as packing, inspecting, and sorting. In discussing the World War II situation, Mr. Turner stated that

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"occupations are varied, ranging from crane operators to
inspection supervisors." Pictorial displays accompanying
his article gave ample proof of the wide range of aluminum
industry operations handled by women during the war, with
a sample of sixteen pictures showing as many different tasks
performed by women. It is not possible to determine the
exact number of women in the aluminum industry today, but
it is reasonable to assume that many lost their jobs when the
wartime emergency was over. The number remaining in the
industry would be greater than prewar years, presumably,
because of the greater productive facilities and operations
in the field of aluminum at the present time.

Problems of Monopolistic Competition in the
Aluminum Industry of the United States:

Studies in economic theory during the past two decades
have brought forth several works of importance in the field
of monopolistic competition. These treatises have dealt
with the middle ground between strict monopoly and effective

\[41\text{Ibid.}\]

\[42\text{Significant in the field have been such books as the following: Edward Chamberlin, The Theory of Monopolistic Competition, (Cambridge: Harvard University Press, 1933); Joan Robinson, The Economics of Imperfect Competition, (London: The Macmillan Company, 1933); and Robert Triffin, Monopolistic Competition and General Equilibrium Theory, (Cambridge: Harvard University Press, 1940).}\]
competition as they traditionally have appeared in principles of economics. The applicability of the ideas concerned with imperfect competition to the aluminum industry may be readily seen in a variety of ways. They will be treated in this section from the standpoints of product differentiation, substitution, and competitive materials in the industrial and commercial world.

Product differentiation in the field of monopolistic competition was one of the basic ideas presented by Professor Chamberlin. Differentiation is one of the means of making commodities appear to be different. Lack of homogeneity is one of the chief elements in such differentiation. Goods under perfect competition would be homogeneous, but under a system of product differentiation each producer attempts to make his own product appear superior in some way. Variations in products may take a variety of forms, as shown by Professor Chamberlin's statement:

A general class of product is differentiated if any significant basis exists for distinguishing the goods (or services) of one seller from those of another. Such a basis may be real or fancied, so long as it is of any importance whatever to buyers, and leads to a preference for one variety of the product over another. Where such differentiation exists, even though it be slight, buyers will be paired with sellers, not by chance and at random, (as under pure competition), but according to their preferences.

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Edward Chamberlin, *op. cit.*, p. 56.
Differentiation may be based upon certain characteristics of the product itself, such as exclusive patented features; trade-marks; trade names; peculiarities of the package or container, if any; or singularity in quality, design, color, or style. It may also exist with respect to the conditions surrounding its sale.

Postwar economic analysis of the aluminum industry of the United States shows certain aspects of product differentiation similar to those mentioned above. The patent situation, which appears quite different today from what it was before the war, has brought about a significant change. Previous treatment has been given to the fact that certain basic patents were turned over to the Government, license free, by Alcoa early in 1946. This action established the possibility for a more adequate type of competition in the industry. One of the recent comments made on aluminum patents by the War Assets Administration is as follows:

There are no subsisting product patents on either alumina or aluminum as such. The majority of the alloys made from aluminum are likewise free of patents. However, Alcoa has a few patents covering special alloys of aluminum with other metals. These alloys are said to amount to only about 10 per cent of the total sales of aluminum alloys. Alcoa had indicated a willingness to grant licenses to postwar operators, in most cases at a royalty of one-quarter of 1 cent per pound. In certain other cases the royalty aspect remains as yet undetermined.

Original patents in the aluminum industry did give monopolistic power to Alcoa, but such power has been greatly diminished as a result of recent events in the industry. Some of the patents had run out, of course, even before the beginning of the defense program, but the history of the industry has shown that no other company had dared to compete with Alcoa until Reynolds established entry into the industry. Professor Chamberlin mentions the fact that occasionally patents will stimulate competition in an industry through the development of rival processes. This possibility did not become a reality in the aluminum industry during prewar years, since the electrolytic process continued to be used. Even today no rival process has been proved to be of enough significance to take the place of electrolysis in aluminum reduction. But both Reynolds Metals Company and the Kaiser interests are in the field substantially at the present time, and the result may be great exploitation of potential new processes. It may be possible for such a process as the Loevenstein thermic manufacturing process to be proved economically practicable, although nothing definite can be said of it at present. In any event, it is reasonable to state that the postwar economics of the industry insofar as patents are concerned shows a trend away from the strictly monopolistic elements of prewar years. Certain process patents still have an aura of uncertainty about
them, particularly (1) the direct—"chill"—casting of 
ingot prior to fabrication, (2) the synthetic cryolite 
and aluminum fluoride process, and (3) some miscellaneous 
processes pertaining to heat treating, fluxing and de-
gassing the metal. The extent of licensing of these 
patents, or of permitting them to be used on a royalty 
basis, may be the determining factor in monopolistic com-
petition in terms of patents and product differentiation in 
the future.

Trade names, as indicated by Professor Chamberlin 
and other writers, have great influence in most fields of 
marketing of products, and aluminum is no exception in 
this respect. Prewar sales of a variety of aluminum 
products were made under the trademarks of Alcoa and others 
in the field of aluminum fabrication. "Bohnalite" pistons 
were sold by the Bohn Aluminum and Brass Corporation. 
"Lynite" pistons were sold by Alcoa, and in some instances 
enjoyed the greater advantage of reputation established for 
them by the company. Aluminum ware, particularly kitchen 
utesils, was sold under a great variety of trade names, 
such as "Mirro," "Pure Aluminum," "Wear-Ever," "Princess," 
"Eureka," and "American Maid." Some of these products


46 See Hendershot, op. cit., p. 186. Alcoa exercised 
control over some of the companies producing aluminum ware, 
and gave them the advantage of its reputation.
enjoyed an advantage of reputation established by Alcoa, also.

To the extent that both Reynolds and Kaiser products are on the market today, and will compete with the prewar trademarks in the field of aluminum, this type of product differentiation will assume importance. The element of monopolistic competition will continue to exist, inasmuch as any trademark at all adds the monopolistic character in the markets. "Kaiser Aluminum," distributed by Permanente Products Company, may assume an important role in the aluminum industry, and the Reynolds Metals Company's trademark (a representation of St. George and the dragon) may be just as important in the postwar scramble for markets. Both Kaiser and Reynolds have made great strides in gaining recognition for their aluminum products, and if both stay in the field this element of product differentiation will become increasingly important.

Specific qualities of lightness, conductivity, high strength (in alloy aluminum), and resistance to corrosion add a phase of monopolistic competition to aluminum. This was true in the prewar markets, and is carried over to the postwar marketing situation. Such qualities give aluminum an advantageous position in certain industrial and commercial applications, and may serve to aid in the extension of the metal into many new fields. Greater use of aluminum already has been noted in connection with the automobile, railroad
and building trades industries, and the trend probably will be continued. Aluminum, which was an essential and even "critical" metal during the war, will continue to have specific applications in many phases of industry and commerce through the years to come.

Conditions of sale in the aluminum industry were important features prior to World War II. It was charged many times that prices were determined for the market, and not in it, and that the degree of control exercised by Alcoa in regard to sales of its products was almost absolute. Even in the field of aluminum ingots this charge had validity before the war, and in the sales of various fabricated aluminum products it was more apparent. The entry of other producers into the field has changed this condition in the industry to a great extent, and aluminum consumers at least have a better chance of evading undue pressure from any one company when purchases are made. Scarcity economics, as a philosophy acceptable to the aluminum industry, may be supplemented by a philosophy of abundance, but in all probability such a great change will be accomplished only over a period of many years. Selling costs will continue to be an important element in the aluminum industry, because all of the companies will be called upon to do more advertising of their products. A great deal of "institutional advertising" was done by Alcoa and others throughout the war, in spite of the fact that no
great amounts of aluminum products for civilian consumption were being put upon the market. Specific advertising of specific products will be more characteristic of the peace-time advertising program of all companies concerned with aluminum and products derived from the metal.

Discussions of competition of aluminum with other metals, wood, and plastics have been prevalent in the literature of recent years. The possible substitution of the other materials for aluminum has been given a great amount of attention, particularly from the angle of prices for the metal in comparison with prices for other reasonably good substitutes. Goods of all types face this eventuality, however, because it is characteristic of the modern economic society to seek substitutes if any one material becomes too highly monopolized or too high in price. Even patented products are "subject to the competition of more or less imperfect substitutes," and aluminum must face the competition from several directions. Metallic substitutes are at hand in the form of steel, copper, tin, lead, magnesium, etc., all of which can compete in most fields on a basis of price in many fields on a basis of technical and chemical properties. Magnesium, in particular, as it

47 Chamberlin, op. cit., p. 59.
has been developed during the last few years, looms as one of the greatest competitors of aluminum in the field of light metals. A most illuminating chapter on magnesium is contained in the book by Professor Engle and his associates. The postwar position of magnesium is secure, and it may become one of the greatest threats of aluminum in a variety of ways. Plastic materials, together with wood, will continue to play important roles as effective competitors to both aluminum and magnesium.

**Problems of International Competition and Cartels in the Postwar Aluminum Industry:**

Conditions of domestic monopoly in the production of primary aluminum have been alleviated considerably in the aluminum industry of the United States during the years from 1940 to 1947. Disposal of government plants to two competitors of Alcoa resulted in prospects for peacetime competition in this country. Plans as announced by both Reynolds and Kaiser indicate the continuation of these two companies in various phases of the industry. But the big problem of international competition must yet be faced. It is this probability of international competition, or the lack of it through influences brought to bear by cartels, that concerns us briefly at this point.

*Engle and others, *op. cit.*, Chapter XVII.*
Discussions of possible international competitive conditions in the industry since the end of the war have revolved chiefly around the possibility of Canadian competition in the field of primary production. Genuine concern has been shown by domestic producers, to the extent that fear has been expressed that Canadian aluminum may invade the American market in large quantities. The fear is based upon the fact that costs of production admittedly are lower in Canada, and that it might be possible to invade the markets of the United States in spite of the tariff on aluminum.

Costs of production are based to a great extent on costs of hydroelectric power, and power costs at the world famous Shipshaw development are lower than those in the United States. An unusual feature connected with waterpower development in that area is the fact that financial assistance of the United States was instrumental in the wartime expansion of the Canadian aluminum and power industries. This cost phase has been described in a most interesting

49Typical of such discussions are the following articles which show the trend of thought on Canadian aluminum:

(a) "Aluminum Reborn," Fortune, (May, 1946), op. cit.


and convincing manner by Fortune (May, 1946), and is quoted here in full, as follows:

From the power-cost angle, however, the chief threat to the new aluminum competition is not Alcoa but its dear friend and relation, the Aluminum Co. of Canada, Ltd. Alcan, a minor subsidiary of Alcoa until 1928, is now bigger than its putative parent. From a 1939 ingot capacity of 175 million pounds, Alcan shot up to a capacity of over one billion pounds—making the company the largest producer in the world. More important from the standpoint of competitors, its capacity is geared to the world's largest private hydroelectric power development—the fabulous Shipshaw project on the Saguenay River in Quebec. Alcan, using Shipshaw power (peak capacity: over a million kilowatts), can produce aluminum at an energy cost of half a cent per pound. Other factors make it possible for Canadian aluminum to be delivered at a cost of 7 to 8 cents, while the best U.S. cost prospects are 10 to 11 cents.

The reason is simple if slightly amazing. Alcan's war expansion—which included the $70-million Shipshaw development and a $123-million investment in aluminum production facilities—was financed by advances and loans from the U.S., British, and Australian governments. A total of $68,500,000—or almost enough to build Shipshaw—was advanced interest free by the U. S. Metals Reserve Company in 1941 and 1942, on contracts providing for the eventual delivery of 1.4 billion pounds of Canadian aluminum. (Three per cent interest was applied retroactively after a mighty squawk by the Truman Committee in 1943.) The Canadian Government—public-power-conscious as it is supposed to be—also contributed its bit by allowing "accelerated amortization" from Alcan's war profits of $164 million out of the total $193 million investment. The British Government too, chipped in by providing abatement of its

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$55,600,000 loans to the extent that no postwar use was made of the facilities built by the loans.

But the U. S.--laying aside the argument that Alcan was able to fill this country's aluminum needs at a critical time for all the Allies--paid the Canadian piper through the nose. Escalator clauses in the contracts brought the average price to 18.6 cents a pound. The difference between that and the American price resulted in payment of over $40 million more for Canadian aluminum than would have been paid to U. S. producers. Because of the rigid contract terms, Canadian aluminum was pouring in when U. S. production was being cut back, and today the entire government-surplus stockpile of 371 million pounds of primary aluminum has the Made-in-Canada sign on it. Furthermore, U. S. power projects--which would have made earlier production in this country possible--were curtailed while Shipshaw got double-A priorities for generator shafts and other critical materials.

Alcan, dismissing the conclusions of the Truman Committee, the Senate Small Business Committee, and other U. S. investigating agencies, says it got nothing out of the deal but a white elephant that is now generating "more taxes than electricity." But looking further into the future, it is noteworthy that Aluminium, Ltd.--the holding company that was established by Alcoa to take over most of its foreign properties in 1928--owns not only Alcan but a worldwide system of bauxite mines, transportation facilities, power projects, and alumina, reduction, and fabricating plants in Great Britain, Germany, Australia, Italy, Switzerland, Sweden, Norway, Spain, India, and China. The majority of stockholders of Aluminium, Ltd., and Alcoa are identical, and the former's President, Edward K. Davis, is the brother of the latter's Chairman, Arthur V. Davis. Whether or not Alcoa encourages Alcan to jump the 3-cent U. S. tariff wall with a certain amount of low-cost Canadian aluminum remains to be seen. But it could.

The role of the United States in various dealings with the Canadian aluminum industry has been the subject of rather caustic analysis by Charlotte Muller, who as early as
1945 pointed out the economic implications of Canadian competition with United States aluminum producers. Excerpts from her article, "Aluminum and Power Control," show the reactions of many observers, as follows:

Broader implications of the way in which Shipshaw was built and paid for are of public interest. The source of the Shipshaw funds is the advances and loans of the United States supplied to a private enterprise for power construction under unprecedented conditions. No control over the project is retained by the United States. The Government of the United States retains no title to the plant it has brought into being through financial contributions. This runs counter to the practice of the Defense Plant Corporation, instrument of federal financing of wartime industrial investment within our borders. (The Metals Reserve Company, which negotiated the Canadian contracts for the United States is, like the DPC, a subsidiary of the Reconstruction Finance Corporation.)

Meanwhile, construction of public projects and transmission lines in the United States was curtailed by the Office of Production Management and by the War Production Board on grounds that a shortage of essential materials and generators prevented their completion. Four million kilowatts scheduled for utilization in 1944 or later were cancelled, about half of this amount being public construction at Grand Coulee, TVA, Shasta and Keswick Dams in California, etc. 

Advocates of public power fear the postwar consequences of the grant of financial resources to Shipshaw. Because of low power and labor

costs, Shipshaw will be in an advantageous position to meet competition from any DPC aluminum plants in the United States which might fall into independent hands after the war. Alcan will indeed be able to lead the world in aluminum production. With the aid of cheap Saguenay power Alcan, it is predicted, will cut aluminum prices below those of copper, and aluminum will replace gold as the chief item in the Canadian balance of payments. While this potential development would be a boon to aluminum users the world over, it might remain merely potential, or at least might not be brought to full realization for some time, if Alcan should be able to take a leading part in forming a new world cartel.

The Aluminum Company of Canada, Ltd., did cut prices on ingot aluminum to a level of 13.25 cents per pound about the middle of 1946. This represented a price in the United States equivalent to 12.04 cents per pound, when converted into U. S. currency. The low price was still not competitive with American aluminum, however, because the tariff of three cents per pound tended to equalize the Canadian and American price situations. It was pointed out at the time that the lowering of the price was not made in contemplation of promotional activities in the United States. The new low price did give the Aluminum Company of Canada an opportunity to dominate the market for ingot aluminum in other countries. The potential productive capacity of the company's plants—at Arvida, Beauharnois, Isle Maligne, La Tuque, and Shawinigan Falls—could be used effectively in world-wide competition for aluminum markets. Comment in Pittsburgh, Alcoa headquarters, was significant, since it was indicated that "additional labor
costs and operating costs have narrowed down the margin of profit on aluminum so that price cutting at this time is unwarranted in the American market." This was the reaction in 1946, at the time aluminum was selling at 15 cents per pound in the American markets, and apparently still is the philosophy of all three producers of aluminum in the United States. The price of aluminum made in the United States probably can be held at 15 cents for several years, especially if prosperity continues. Alcoa would not start such a price reduction campaign, because the company might face charges of a price war with the new competitors. The Reynolds Metals Company and the Kaiser interests would not want to cut prices, because they are both relatively new in the aluminum industry and might be classified as infant industries desiring the high prices in order to continue profitable operations. Lowering of the tariff barrier might be the economic solution to the problem, but such a move would find much political opposition in Congress.

The question of a postwar international cartel in the aluminum industry is one which involves a special study, which is not within the scope of the present survey of the aluminum industry. Some pertinent facts may be presented,

however, to show the possibilities inherent in the situation. Much has been written about the prewar international aluminum cartels. Two distinct and widely divergent streams of thought have arisen in regard to prewar participation of Alcoa in the international aluminum cartel activities. One stems from the writing of Dr. Louis Marlio, prewar chairman of the International Aluminum Cartel from 1926 to 1939, and for twenty years managing director of the French Aluminum Company. Dr. Marlio, according to Dr. Harold G. Moulton, of the Brookings Institution, was in a position to write with authority about the aluminum cartel. The statement made by Dr. Marlio concerning Alcoa is of significance, and it is quoted as follows:

It should be stated here that the Aluminum Company of America did not participate in any of the aluminum cartels with which the author was associated. While shareholders of the Aluminum Company of America own a majority of the shares of stock of the Aluminium Company, Ltd., of Canada, the latter is not a subsidiary corporation. Moreover, officials of Alcoa did not participate in the negotiations between the European groups and the Aluminium Company, Ltd. None of the agreements contained restrictions of

any sort pertaining to sales to or exports from the United States. Nor were there any secret understandings between Alcoa and the Alliance with respect to markets or otherwise.

Another viewpoint concerning the relationships existing between Alcoa and Aluminium, Ltd., (Alted), has been well presented by George W. Stocking and Myron W. Watkins, who have stated that "Alcoa and Alted have common control" and that "the two companies have operated precisely as though they were, in law, the single business enterprise which they obviously are in fact." Furthermore, referring specifically to the role of Alcoa in the field of international aluminum cartels, these writers have stated:

The production controls directly affected the trading prospects of cartel members in the United States and in all other markets, domestic and export. The cartel managers were all practical businessmen, and they most certainly were not leaving the door "wide open" for Alcoa, their most formidable potential rival, to expand its business at their expense. They had ample ground for assurance on this vital point from (1) Alcoa's kinship with Alted, (2) Alcoa's record not only as a cartel cooperator but as a cartel leader for more than three decades, and (3) Arthur V. Davis' personal participation in the initiation and detailed elaboration of the Alliance scheme.

The actual operation of the Alliance bears out this interpretation of Alcoa's relationship to it as a "silent partner." Through the association of the brothers Davis, Alcoa frequently, if


56 Ibid., p. 265.
mot regularly, obtained information regarding Alliance stocks and price policy, and even reports on its financial condition. Moreover, as in the cartels before World War I, Alcoa through Alted apparently exercised a predominant influence in the conduct of the Alliance.

Precise judgment of the degree of "authority" to be attached to the divergent statements of Dr. Marlio and those of Dr. Stocking and Dr. Watkins is difficult, and perhaps is unnecessary here. The writer would subscribe more readily to the viewpoints of the latter writers, and would agree with a recent book review of Dr. Marlio's book, in which the following statements were made:

As former Chairman of the International Aluminum Cartel, M. Marlio is frankly defending his cartel against all comers. To the American reader, it will appear curious that the blood relationship of the Aluminum Co. of America and its Canadian sister concern is given so little emphasis. While M. Marlio enumerates only four aluminum cartels, Stocking and Watkins list at least eight. He is unconvincing when he argues that cartel price policy has not discouraged civilian consumption; the use of aluminum in the automobile industry, for example, appears to have declined because cartel arrangements pegged its price.

For the future, M. Marlio recommends full publicity and compulsory registration of cartels.

Dr. Marlio's conclusions are in direct contrast to the commonly accepted ideas on cartelization. He defends the cartel idea energetically, declaring that international

trade was not impeded by artificial restrictions on the market by the cartel, at least after 1908. He stated with emphasis that aluminum usage was not restricted by the policy of artificially maintaining high prices. Stabilization of price in periods of depression was defended on the ground that such a policy advances, rather than retards, the entire process of recovery. Retardation of technological progress was vigorously denied by Dr. Marlio, and he stated that "one of the primary purposes of the aluminum cartel was to promote technical research and discover new uses for the metal." He goes further to add that "such an association (cartel) has neither the power nor the wish to suppress competition but only to limit it for a fixed period of time. Competition, direct or indirect survives." Denials of promotion of inefficiency through the protection of high cost producers were given a prominent place in Dr. Marlio's conclusions, and he stated that leadership in the cartel "passed more and more into the hands of the lowest-cost producers." He was critical of efforts of government cartels as such, particularly in the matter of price reductions through government cartel action. Fear of control of such a government

cartel by high-cost producers was one of the chief criticisms given. Political considerations, rather than economic reasoning, might be the guiding and controlling factors in such government cartels, according to Dr. Marlio.

All of these ideas as expressed by Dr. Marlio have been given brief treatment here, because the writer believes that they may be indicative of the type of writing that is apt to catch the public eye in the postwar world. The worst danger lies in complacent acceptance of such attempts to delude the general public by such "whitewash" methods. All the evidence given by such men as Stocking, Watkins, and Wendell Berge (for many years a great public servant in the Antitrust Division of the Department of Justice) shows a preponderance of opinion against such ideas of the great public service of cartels in general and the aluminum cartel in particular. A special study of cartels was made by the Temporary National Economic Committee in 1941. It gives ample evidence that the outstanding characteristics of cartels are restriction of production, high prices, restriction of technological progress, division of markets, and the maintenance of high and rigid prices. The whole purpose of


cartels is to foster control over markets and to eliminate competition. The danger to the aluminum industry in the postwar era is this type of activity on an international scale. Vigilance on the part of the United States may be necessary to maintain the degree of competition now existent in the aluminum industry, and to foster even more effective competition than is now apparent in the industry. Canadian competition may be feared by the aluminum producers of the United States, but it is more to be desired, from the standpoint of the consuming public, than international cartelization of the aluminum industry.
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Paul Timothy Hendershot, son of Daniel Sampson and Mary McFarland Hendershot, was born in Malvern, Arkansas, June 30, 1916. He was graduated from Malvern High School in 1934. He attended Henderson State Teachers College, Arkadelphia, Arkansas, from 1934 to 1938, and received his Bachelor of Arts degree in the latter year. For a period of one year, 1938-1939, he served as Principal of the Dierks High School, Dierks, Arkansas.

In 1938 he was awarded a teaching fellowship in the Department of Economics, Louisiana State University. He served as a teaching fellow and as a temporary instructor prior to his receipt of the Master of Arts degree in August, 1941. He served as an instructor in Business Administration in the university during the year 1941-1942, and in the summer session of 1942.

In September, 1942, he entered the United States Navy. He attended the Deck Officers' School at Cornell University, Ithaca, New York, after which he served for 18 months in the South Pacific theater of war, in the Solomon Islands and Australia. After additional service in the United States, he was discharged from the Navy in February, 1946, with the rank of lieutenant.

He was married during the war to the former Mary Theresa Lacy, of Baton Rouge, Louisiana. They now have two children, Mary Theresa and Claude Allan.

Subsequent to his discharge from the Navy, he re-entered Louisiana State University to resume his study for the doctorate in Economics. After completing most of the requirements for the degree, he accepted a position of Professor and Head of the Department of Economics, Louisiana Polytechnic Institute, Ruston, Louisiana. He taught in that college during the Spring semester, 1946-1947. He was given a leave of absence during the summer session, 1947, to continue his studies at Louisiana State University. He is now a candidate for the degree of Doctor of Philosophy at the August commencement.
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Title of Thesis: THE ALUMINUM INDUSTRY OF THE UNITED STATES, 1940-1947

Approved:

Major Professor and Chairman

Dean of the Graduate School

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