11. SAMURAI—ORIENTAL JUNKERS

GERMANY'S blueprint for conquest was truly global. It included the vast reaches of Asia and the riches of the Indies. To deprive its enemies of this wealth and to encircle Russia were the ends of Germany's eastern strategy.

In the ancient rivalry of peoples, no quarrel has burned more steadily or bitterly than the antagonism between the Teuton and the Slav. From Adolf of Holstein, the leader of the Teutonic Knights in the twelfth century, to Adolf Hitler, the concept recurring over and over again in German dreams is the Drang Nach Osten —the Drive to the East.

The land ocean of Russia has surged across the path to German world dominion. To the West lay Britain—the gateway to the seas. To the North were the silent wastes of ice. The Russian land bridge to the East was, therefore, the path across which German armies were to trod. The fertile valley of the Ukraine would supply the food for the German nation on the march. What was more important, beyond the bridge of Russia was the fabulous wealth of Asia. All the ersatz materials

which Germany so painfully contrived in its laboratories existed in natural abundance beyond the Caucasus. There were whole forests of rubber and quinine, mountains of tungsten and tin. From the Caucasus to the Indies were endless deposits of oil. The virgin resources of Asia beckoned. Only the Russian Bear stood guard.

Along this road to Asia the invincible hosts of the Wehrmacht could storm their way. The ramparts which guarded Asia could thus be scaled and British sea power frustrated.

In the World War Germany's campaign in the East could not batter down the door to Asia. The schedule of Berlin to Bagdad did not run on time. In making global plans, the scope of Germany's ambitions in the East increased. Iran, Iraq, and Afghanistan were stations on the time table of German conquest. The terminus was India—the battleground of East and West.

German militarists had studied Japanese ambitions in the same minute detail with which they analyzed Allied strategy. Japan was the perfect foil for German aims, and could be used to stab the democracies from the rear, and give Russia a two-front war.

Japan nursed its own vainglorious schemes. The Tanaka Memorial propounded the limitless hopes of Japanese imperialism. Germany fostered these views for their immediate value. The strength of Japan could be utilized now, and its weaknesses noted for future refer-

ence. The westward flow of *Kultur* would in time engulf Japan.

In Japan, as in Germany, the development of modern industry occurred primarily during the latter half of the nineteenth century. In each country there was a military caste—the Samurai in Japan, corresponding to the German Junkers—who saw in the machine technique an instrument of national aggrandizement. There are, both industrially and in military affairs, almost identical characteristics in the last century of Japanese and German history, differentiated more by geographic conditions than by any other consideration. This parallelism illustrates the importance of the form of social institutions in the modern world, because in both of these aggressor nations the existence and promotion of military ambitions and the assumption of superiority to other peoples have produced corresponding modes of conduct.

It is enough to turn attention to the outstanding industrial group in the Japanese Empire, the Mitsui Gomei Kaisha (Mitsui Partnership Company), which ranks first among the four largest monopolist combines in Japan. The Mitsubishi, the Sumitomo, and the Yasuda, in approximately the order named, are all smaller than the Mitsui combine. It has been estimated that these four groups control over 70% of Japanese industry, and are the principal beneficiaries of Japanese aggression throughout the East. Indeed, these powerful companies have been the vanguard of Japanese armies, for in every area in which they have succeeded in establishing a commercial foothold, an excuse has later arisen for military action.

The Mitsui group has perhaps the longest history of any large modern corporation, tracing its family tree to the seventh century.

The Mitsui were among the first Japanese businessmen to carry on trade with foreign merchants. Even before the treaties of 1854, by which Japan established uneasy relations with western civilization, the Mitsui had carried on some trade with Dutch commercial agencies. Following the removal of the barriers to trade, Mitsui became the most important trading concern in Japan, accounting for nearly one-half of the total imports and exports. This branch of its business alone makes Mitsui the greatest single trading company in the world.

After the restoration and the fall of the Shogunate, the Mitsui banking house became for a time the unofficial treasury for the Emperor Meiji Tenno, and is still the most important "private" bank anywhere in the East. Since that time the number and scale of Mitsui enterprises have grown until they are, collectively, among the world's largest business groups. The central holding company and general headquarters administering all the Mitsui interests is the Mitsui Partnership

Company, membership in which is restricted to the heads of the eleven Mitsui families.

Feudal succession determines the selection of the president of the concern, and the lesser offices are allotted to representatives of each family group. The entire assemblage of Mitsui enterprises is operated according to a family constitution originally drawn up by the son of Hachirobei, the founder of Mitsui's dynasty. This constitution, in the main, consists of Oriental maxims intended to assure prosperity and the retention of control within the membership of the eleven families. The constitution was redrafted in 1900, and now requires every member of the family at the time of majority to swear an oath of allegiance to the House of Mitsui. It is interesting to note that among its clauses is the command to serve the Emperor before all else, and, as the Mitsui have stated themselves, this precept "has never been forgotten."

The branches of the House of Mitsui are divided into domestic and foreign enterprises. The Mitsui Partnership Company itself does not often deal directly with the representatives of industry outside Japan. This function is performed by the Mitsui Bussan Kaisha (Mitsui & Company, Limited), which has branches in all of the principal countries of the world.

The major fields of operation in which Mitsui is engaged are banking, mining, insurance, engineering, steel, coal, silk and cotton textiles, electrical machinery,

aviation, chemicals, cement, transportation (rail, marine, automobile, and airplane transport and manufacture), and armament production. For many years it has been virtually impossible for any foreign concern to operate in the Japanese market without the consent of Mitsui. As a consequence, commercial and contractual relationships existed up to the time of the war between Mitsui companies and nearly all of the major industrial enterprises carrying on business in Japan or China.

In some instances British, American, and German companies conduct joint enterprises with Mitsui. For example, the Shibauri Engineering Works is a joint enterprise of Mitsui and International General Electric; the Japan Steel Works is a joint enterprise of the Mitsui and the British companies of Armstrong and Vickers. Many of the Mitsui firms operate under license from American, British, and German companies. Mitsui has relationships with duPont, General Electric, I. G. Farben, Imperial Chemical Industries, Sperry, Pratt & Whitney, the Mond Nickel Company, Aluminium Limited, to mention only a few.

Mitsui is itself a cartel, and is a member of the principal dyestuffs and chemical cartels of the world. It may be noted, however, that in none of its connections with foreign industry, even in the case of German industry, has Mitsui exhibited the slightest compunction at any time in forcing acceptance of its own terms, and in estab-

lishing a bargaining position intended eventually to eliminate all foreign control or participation in Japanese industry. As stated by an American cartel member expert on the ways of Mitsui, the Japanese plan was to accomplish "the exclusion . . . of foreign manufacturers with the possible exception of what may be a cooperative plan with the German I.G."

This in itself is only nationalistic; Mitsui's aims, however, are international. In the chemical industry Japanese ambitions, executed primarily by Mitsui, approximate those of Germany. Their object is the control of world markets in chemicals, and the support of the military regime to obtain those markets by conquest.

Asia constitutes today the greatest market on the earth. No subtle insight is required to deduce the economic incentives which have motivated Japanese foreign policy since the first World War. It should be pointed out that, contrary to a commonly held opinion, there is no conflict between Japanese industry and Japanese militarism. The "co-prosperity sphere" of greater Asia, which is the aim of the warlords, is also the goal of Mitsui and its lesser companions in monopoly in the Japanese economy.

The relationship of Mitsui to American, English, and German financial and industrial groups has significance, not only because of the technical knowledge and capital introduced into Japan by these channels, but also because of their cartel character. The cartel form in

Japan, as in Germany, is admirably suited to industrial organization under a totalitarian regime.

In its intercourse with the western powers, Japanese industry has found cartel agreements most useful in gaining freedom from competition, and at the same time acquiring through patent agreements, licenses, and jointly owned concerns, the scientific knowledge necessary to the erection of a military state. Because of cheap labor and the imitative ability of their race, Japanese industry even before the war had become a serious threat to America's international trade position; indeed, to the very same firms with whom agreements had been established either by Mitsui or by the other members of Japanese industrial oligarchy, Japanese competition was a nuisance.

In 1937 the Japanese were included in the Axis. The elements of German strategy were complete.

When war began, Japan hung back, awaiting the test of German ability to execute the plan successfully. One by one, such doubts were dispelled. Every German victory was an argument with cogent force. Japan determined to come in and take its share.

The last weeks before Pearl Harbor disclose the pattern. German armies battered their way to Moscow's gates. Despite the approach of winter, the Wehrmacht did not retire when tactical principles indicated strategic retreat. Political reasons held them there. Retreat might have discouraged Japan. The moment had come when

Japan must act to divert the energies of the United States, and lock the "Open door."

On the very day that Japan had lashed out at British, Dutch, and American possessions, the German army withdrew to its winter lines. The United States was no longer the isolater, but the isolated.

Pearl Harbor, Singapore, and Java smashed the complacency with which the Japanese peril had been regarded. Those who had believed in the myths that Japanese could not fly, that their navy was inferior, and that they would not dare to cross our path had deceived themselves.

What was even more appalling, the strategy of blockade had been turned against its makers.

12. MOSQUITOES, MALARIA, AND MONOPOLY

THE Global War is measured around the girdle of the Equator. Africa has its effect on the Russian front, and Singapore was the key to the whole Pacific. In all the wars of history, disease has been the invisible foe of armies. But the Equator is the fever line of the earth. When soldiers from temperate zones are sent to jungles and deserts, their bodies must be conditioned, and ample supplies of medicine must travel with the men.

Among the scourges of mankind throughout recorded history, none has been more widespread in its incidence, and only the "black death" has been more devastating in its immediate effects, than the disease known as malaria. In any German plan of war, this problem had to be resolved. As early as the World War, I.G. produced a substance called Optochin, which had some properties of the quinine which Germany could not get. Optochin was not successful in its action, and I.G. continued its search.

Spurred by Germany's desire for colonies, I.G. at last succeeded. Atabrine, a synthetic specific which produced

amazing cures in malarial patients, resulted, for I.G. knows no fatigue. Thereby hangs a tale of equatorial war.

As Dr. William Osler said, "No infection except perhaps tuberculosis compares with it in the extent of its distribution or its importance as a killing and disabling disease." The frequency and persistence of malaria have probably exacted a greater cumulative toll of human health in the span of history than all the wars ever fought. There is a close connection between malaria and war. Like other diseases to which man is subject, malaria increases its inroads whenever the sanitary barriers of peace are overthrown by war. It is recorded that Egypt was saved from the Assyrian armies of Sennacherib in 712 B.C. by an outbreak of malaria which debilitated that tyrant's hosts. During the Civil War in our own country, malaria was the leading cause of death on the Southern side.

In the present war, with our troops spread around the world, especially in tropical regions, the threat of malaria to soldier and civilian alike is enormously increased. Dr. John E. Baker, former director-general of the Burma Road, stated recently that if some means were not found to check the spread of malaria in China, the Japanese would soon be able to let the mosquitoes do their fighting.

Even in peacetime, however, large areas of the world are constantly subject to the disease. It is estimated that

there are some 800,000,000 sufferers from malaria in the world today, more than 100,000,000 of whom are in India alone, accounting for 1,000,000 of the 3,000,000 deaths annually. In the United States, it was estimated in 1937 that there were more than 4,000,000 cases, the majority of which were in the southern states.

More than a thousand years ago it was suggested that mosquitoes carried the disease, but it was not until the discoveries made by Sir Ronald Ross, C. L. A. Laveran, and others, definitely proved the guilt of the anopheles and similar mosquitoes, that it was possible to institute the preventive measures developed in sanitary engineering. When the French first attempted to construct the Panama Canal under the direction of Ferdinand de Lesseps, they were forced to abandon the project because of the malaria and yellow fever which struck down the laborers. Sir Richard Gregory, in his book "Discovery," says—"It has been stated that before the work was finally abandoned by the French, a human life had been sacrificed for every cubic yard of earth excavated." Not until Colonel Gorgas was able to destroy the principal breeding places of the carrier mosquitoes could the canal be completed.

No real relief from malaria was found until the early part of the 17th century. Nevertheless, long years were to pass before the knowledge of the specific cause and care of the disease were to be known or used widely in Europe. When Torti gave name to malaria, in belief

that it was caused by "bad air," there was as yet no real understanding of the mode of transmission or the physiological effects of the quinine used as a remedy. Spanish Jesuits in Peru had used the bark of the quina tree in treating fevers. It is believed that they obtained their knowledge of this bark from the native Incas. Even at that early date, the sale of quinine was a monopoly of the Jesuit order. Dr. Victor Heiser, in "An American Doctor's Odyssey," says, "The priests received its weight in gold from those who could afford to pay; to the poor it was free. The supply was never equal to the demand, and in the effort to adjust the balance, the trees of South America were stripped of their bark and largely destroyed." The later monopoly in quinine was to prove not so philanthropic in dispensation of the drug.

The haphazard and reckless methods which depleted the supply of cinchona bark in South America led to attempts to cultivate the tree in other countries. As was the case with rubber, the seeds of the cinchona tree were taken to the East Indies, where by careful botanical study it was found that the tree could be improved and would grow readily in the rich earth of Java. Just as the English attempted to protect the rubber plants, so the Dutch sought to guard their knowledge of the methods of cultivation and extraction. It may be remarked, however, that whereas the English failed to keep their secret, the Dutch were entirely successful, so much so that even up to the present time no one has

succeeded in determining exactly what methods they used in caring for the tree or what are the actual costs of production of quinine. Since 1865 the Dutch have maintained one of the tightest of all monopolies by the usual methods of market control, but with consequences more immediately and dramatically tangible in the casualty lists of those stricken by malaria.

Dr. Heiser graphically describes the care used by the Dutch Quinine Syndicate to keep its knowledge hidden, stating, "Not many miles from the Botanical Gardens lies a mysterious plantation, encircled by a high stone wall. Within this enclosure, which no visitor ever enters, grow the cinchona trees of Java. The secret of cultivation and extraction thus jealously guarded have made the Dutch supreme in the production of quinine."[1] The 37,500 acres of trees supplied over 95% of the world's quinine. As with the Jesuits, the supply has never been equal to the demand, not because more could not be made available, but because the government-sponsored syndicate of planters and manufacturers, the Kina Bureau of Amsterdam, maintained a high-price, low-output policy. Regardless of actual need or effective demand, only a limited amount of quinine was sold to each country. The annual harvests of cinchona bark, no longer necessitating the killing of the tree, were often larger than the quotas. In such cases, the excess bark was stored, or more often, burned. It has been esti-

mated that about 50% of the bark produced was burned in some years.

The little quinine produced outside the Netherlands Indies was, through international agreements, subject to the same price-fixing arrangements. Since the unconscionable high price precluded its purchase by the people of the areas where malaria occurs most frequently, the cartel's monopoly was criticized by social and medical workers in the East. The Health Section of the League of Nations, at Dr. Heiser's suggestion, periodically published the production and price record of quinine and its derivatives, which so clearly bespoke the unrelenting control, which had, with more efficient methods, made greater output possible, but increased prices and withheld "surplus." It is not too much to say that these practices were directly to blame for the continuance of a much higher death rate than that which would have obtained if maximum production and competitive price levels existed.

The international cartel in natural quinine was indicted by the United States Government in March, 1928. Twenty-five manufacturers, Dutch, German, French, English, Japanese, and American, of quinine and other derivatives of cinchona, and a number of individuals were charged with violation of the antitrust laws. The indictment summarizes the activities by which the cartel was accused of enforcing its artificial control over the world market.

First, the indictment charged that imports of cinchona bark and quinine derivatives into the United States were restricted as to quantity, and shared by various American manufacturers, such as the Merck Company and Mallinckrodt Chemical Company, on an allotment basis. Prices of all cinchona products were fixed at both wholesale and retail levels. Any firms failing to observe the prices fixed by the cartel were threatened with boycott, and shutting off of further supplies of the drugs, and this "policing" of the market was rigidly enforced. *All* the manufacturers of quinine derivatives in the world were compelled to pool their profits under an arrangement known as the "Aussgleich," or equalizing agreement, which apportioned quotas of bark and quotas of profit, among the members of the cartel. Manufacturers who sold less than their quota, and who did not reach their fixed profit level, received contributions, presumably on a pro-rata basis, from those selling in excess of quota.

The indictment was filed in March, 1928, and in September of the same year a consent decree was entered which enjoined further operation of the cartel within the United States. But the jurisdiction of one government was limited, and the cartel continued to function in the world market. Obviously, the isolated "competitive area" of this country could not escape the effects of an entirely monopolistic market outside its borders. And to make the decree effective, it would

have been necessary to break the grip of the cartel on the source of supply. This could not be done, and no measures short of an international decree could make this "natural" monopoly, as it was euphemistically termed by its beneficiaries, a competitive industry.

That the cartel's continued functioning in the international market remained unimpaired is borne out by considering the long-term price record of quinine, and by the situation which existed when war began in 1939, and again when Japan attacked and conquered Java. In 1914, quinine sulphate, the principal form in which cinchona is given to malarial sufferers, cost about twenty-five cents per ounce. In the middle twenties the price had risen to nearly fifty cents an ounce, reached sixty-seven cents in 1939, and is now over eighty-five cents per ounce. Only control by the Federal Government of the available stocks of natural quinine has held down the lid on prices.

The Dutch monopoly on cinchona, and the manufacturers' cartel which held so long to a competition-proof market were not free from the ever-present threat to all cartels: market rivalry based on technological change. It will be recalled that it was during an effort to produce quinine synthetically that Perkin discovered aniline dyes. I.G.'s continued search developed atabrine, a coal-tar derivative. It is taken in tablet form, and occasionally causes the skin to become yellowish, because it is made from a yellow coal-tar dye, known as acridine.

Atabrine is in some respects more efficient than natural quinine. A ton of atabrine can be used in treating about 600,000 cases of malaria, while a ton of quinine is sufficient for only 30,000 cases. Since 1932, because of its higher price, and especially because of the restrictive production policy of I.G. and its licensees, atabrine did not displace any substantial part of the quinine market during peace time. In the United States the Winthrop Chemical Company, a subsidiary of Sterling Products, with whom I.G. had other dealings, obtained an exclusive license under I.G.'s atabrine patents. By limiting access to technical knowledge of a vital product, I.G. had added a link in the German counter-blockade.

As the Assistant Attorney General Thurman Arnold stated in the Oct. 1942 *Atlantic Monthly:*

> A single patent, controlled by I. G. Farben, dictated the terms by which this essential drug could be manufactured in the United States. Sterling Products had an interest in this patent, but even during our lend-lease program officers of Sterling Products gave assurance to Germany that their interests would be protected during and after the war. Sterling Products is now rid of German domination. Today the situation is further safeguarded by the seizure of the German rights by the Alien Property Custodian. But the spectacle of the production of this essential drug, left so long to the secret manipulation of a German-American combination during a period when Ger-

many was preparing for war against us, is too shocking to need elaboration.

The Dutch, with short-sighted stubbornness, clung to their cinchona plantations in Java and their rigid commercial practices in marketing. These policies have boomeranged not only on themselves but on all the United Nations. When the Japanese overran Java, they came into possession of more than nine-tenths of the world's supply, since the only other source of natural quinine is the scattered and relatively undeveloped industry in South America.

Present evidence indicates that this hurdle is being surmounted. Bataan was lost in part because of a shortage of quinine and atabrine. With the forces of this country and its allies engaging the enemy or guarding salients in tropical regions, which have been among the most active theaters of this war, every precaution should be taken to insure an adequate supply of these synthetics at prices sufficiently low to be within the reach not only of the fighting services but of the civilian populations. Malaria has not yet been defeated. It has only been checked in a relatively narrow segment of the world's populace, and that by strenuous efforts with little help from either the quinine syndicate or the I.G. controlled cartel.

Germany cracked the Dutch cartel, and permitted the United Nations to be "hoist on their own petard."

13. COAL, OIL, AND FIREPOWER

OIL is the blood of mechanized armies—the richest prize of battle. No sacrifice in lives or money has been judged too great to pay for its possession. Denied oil by the Allies for four years, the Imperial German Army had finally gasped and halted.

Like a phoenix rising from the ashes of its defeat, Germany emerged from the postwar years clutching the secret by which its basic need could be fulfilled. In 1926 I.G. belligerently announced to an unperceiving world that in due course "it would make all the oil the world required" from coal.[1] From that day forward there was no chance for peace.

The core of Germany's greatest military problem had been pierced. The oil which her ancient foes withheld could now be synthesized.

What did this mean in specific terms of global strategy? The oilbearing lands of the world were almost without exception located in countries which had been Germany's enémies. Consider where the oil deposits of the world are found. The United States has the largest fields; South America, China, the Dutch East Indies,

the Middle East, all of these were far away—their oil was owned by enemy interests. Every well was protected by a hostile navy. The deposits of Roumania were British-owned, and Roumania itself was a member of the ring of buffer states which France would use as shock absorbers when war should come again. Any effort to reach Russian oil would mean the expenditure of countless German lives with no guarantee of success.

What did Germany have? It had I.G. and coal. But coal was of no use in planes. If I.G.'s magic could conjure oil from coal, then Germany could begin to calculate, free from the torment of knowing that the noose of Allied strategy could garrote her war machine.

Coal became the denominator of Germany's future. The sandbox of German earth would yield the vital elixir to fuel her mechanized might.

There is a profound message for all nations in Germany's escape from her prison. Surrounded, and lacking the most essential material of motorized war, Germany once more placed all her hopes on her technological skill. She was not disappointed.

This technological cataclysm was not recorded on the seismograph of politics, yet its tremors were to rend the fate of nations.

Not in the ledgers of government, but in the balance sheets of finance were tallied the first accounts of this discovery. In 1927 the largest industrial corporation in

the world, Standard Oil (N. J.) felt the shock to its foundations. It was as though all their wells had exploded at the same time. Every coal mine became a potential gusher.

Like the legendary giant which it resembles, Standard's strength is drawn from the earth, each renewed contact adding to its vitality. Standard's geologists ripped up a continent in their search for the precious fluid. In time they traversed the earth, seeking in remote corners of Asia, Africa, and South America, any trace of oil. Control of oil resources, oil refineries, and markets spread around the globe, has been Standard's sustenance. As late as 1941 Standard owned some 14% of the tanker shipping tonnage of the world.

Because modern civilization flows on a river of oil, Standard's every act is reflected in some manner in the ebb and flow of economic affairs. An outstanding authority on international industry has said of Standard:

> [It] has extended its influence over the whole world. In China it has made large advances to the government in return for valuable concessions. In Mexico . . . it has been engaged in a struggle with British capitalists for the control of oilbearing lands [and] it has been at times one of the principal instigators of civil disturbances there.[2]

This agitation is attributed to Standard in other countries, and was undoubtedly one cause for the expropriation of British and American oil properties by the

Mexican Government a few years ago. This same authority states:

> In Germany it attempted to defeat by force the plan of an oil monopoly aimed against it. Wherever oil is discovered, it tries to create a sphere of influence; it has branches in more than fifty countries. . . .

The convergence between the interests of I.G. and Standard Oil was a meeting of elemental forces in world industry. It loomed as a titanic conflict, it turned out to be a study in appeasement. Standard made the overtures and I.G. responded readily. The resulting deal set in motion a wave of events which ten years later would harass Standard's management. In Standard's own words, the essence of their basic understanding was that:

> The I.G. are going to stay out of the oil business proposition and we [Standard] are going to stay out of the chemical business in so far as that has no bearing on the oil business.[3]

I.G.'s position was clear. As long as it retained control of the production of oil in Germany, Standard could have the rest of the world—for a while. The orbit of I.G.'s interest was fixed by German aims. Standard thought only in terms of the geopolitics of its financial investment.

The division of fields of technology was settled in a series of agreements beginning in 1927 and concluding

in 1929. I.G. retained for itself all rights to the basic chemical techniques, products, and markets by which it controlled its world domain. Standard was a great oil company, and was interested in chemistry only as it affected petroleum. I.G. was a great chemical company, and therefore was concerned in the commercial sense with the chemicals that might be derived from petroleum.

In 1929 what has been described by both Standard and I.G. as a "full marriage" was consummated. This marriage was witnessed by four documents dated November 9, 1929: (1) the Division of Fields Agreement, (2) the Four-Party Agreement, (3) the Coordination Agreement, and (4) the German Sales Agreement.* The parties to these nuptials dowered each other with exclusive monopolies in their respective holdings, vowing "loyal adherence" to each other's welfare for such time as the marriage should endure. In more concrete terms, the effects of this marriage may be summarized as follows: First, under the Division of Fields Agreement, Standard and I.G. agreed to eliminate all competition between themselves. This was done by recognizing the position of Standard in the oil industry and the position of I.G. in the chemical industry. Standard received carte blanche in the oil industry of the world *with the exception of the domestic German*

* Thus designated by the Government.

market. I.G., in turn, was assured a free hand in the entire chemical industry of the world, *including the United States*, a differential which was to embarrass Standard at a later date.

To grasp the magnitude not only of the Standard-I.G. cartel but, in particular, the potency and proportions of I.G.'s grip on technology, we must understand the nature of hydrocarbons. Hydrocarbons, compounds containing hydrogen and carbon, are the basis not only of petroleum products and of hydrogenated coal products, but are the fundamental constituents of a whole range of organic substances. A variety of techniques, such as hydrogenation, hydro-forming, hydrocarbon synthesis, polymerization, alkylation, and catalytic cracking, may be applied to carbonaceous matter. From the solid, the liquid, or the gaseous states of primitive materials, coal and oil, it is possible to produce a myriad of petroleum and chemical products.

Thus, whatever is made in either industry, chemical or petroleum, can in large part be created from the raw materials of the other. Moreover, the vast array of synthetics which can be formed by these processes includes those specialized commodities which spell the difference between a vigorous industrial system and an unbalanced second-rate economy. Judged by military potential or by modern peacetime production, no nation which does not have some source of hydrocarbons and the facilities

and knowledge necessary to their transformation can be strong.

Coal, oil and air are the triangular arch of the modern chemists' war. The advances in chemical science have given hydrocarbons the quality and status of the magic philosopher's stone which can make a poor nation rich. The list of war matériel which can be brought forth from coal, oil, air and wood reads like the order-book of an army's ordnance command: toluol, tetracene, T.N.T., high octane aviation gas, plastics, synthetic rubber, dyestuffs, explosives, medicines, artificial silk, optical lenses, poison gas, food (the high-vitamin content oleomargarine fed to the German troops comes from this source), paraffin, clothing—what cannot be drawn from this cornucopia of slime and soot?

The patents of I.G. and Standard were pooled so that Standard received not only the benefits of its own research in oil technology, but also received the benefit of any discoveries made by I.G. Moreover, it was intended that this patent consolidation would so fortify Standard that all other oil refiners would be reduced to a subordinate position, thus rendering them susceptible and indeed suppliant to the formation of a gigantic patent pool covering the entire oil industry.

The second agreement in this contractual marriage is the Four-Party Agreement, formed for the purpose of executing the Division of Fields Agreement. It was agreed that I.G. would transfer to a joint corporation,

Standard-I.G. Corporation (S-I.G.), any rights upon patents affecting the oil industry. Standard in turn would transfer to this offspring its present and future rights under the hydrogenation process.

With regard to the exchange of experience between Standard and I.G., it was stated that:

> . . . the parties agree to work together on the technical development of the hydrocarbon field, to communicate to each other during the life and within the scope of this agreement all technical knowledge and experience, past, present and future, patented and unpatented, of which the parties are now possessed or which hereafter be possessed in the sense of having the power to dispose of them, and also to help each other in their efforts to obtain adequate patent protection.[4]

The merger of petroleum and chemical technology thus brought about could be held in check, "regulated" in business terms, only by a condominium of such size as the Standard-I.G. combine. Within the hydrocarbon and allied fields, the Standard-I.G. agreements must be considered as the radial hub from which other ancillary accords sweep out to all sectors of the oil and chemical industries.

The architecture of Standard's relationships with I.G. is constructed on foundations which, when uncovered, advertise the true purposes of the edifice and explain its use. Once past the façade of "cooperation," the

structure is seen to be a fortress to withstand any assault by the forces of competition on the territory of Standard or I.G., and a salient base from which both might conduct sorties into adjacent industries.

This stronghold was built, to adapt a phrase used by Standard, by "piling patent upon patent," and the analogy is therefore not too remote. In the judgment of the Senate Committee investigating the National Defense Program, "to obtain such a patent structure Standard paid a heavy price which, as in the case of other companies creating such patent structures, had to be borne by the entire nation."

The Standard-I.G. cartel was in its scope and implications larger, more powerful, and in some respects, at least, of greater significance, than any other economic "junto" with which we have dealt or shall deal. But the characteristics of I.G.'s marriage with Standard are so similar to its agreements with other American and European industrial interests that no doubts can be entertained of I.G.'s purposes.

The primacy of oil in international affairs and the influences which oil's development has exerted on the history of the twentieth century are traceable in British imperial strategy since 1911. In that year Winston Churchill, at the request of Lord Asquith, entered the British Admiralty. Germany was increasing the size of her fleet and the firepower of her naval rifles. Churchill grappled with the enormous task of modernizing Brit-

ain's seapower in order to meet the new German naval threat. Churchill's problem was clear. He must build new ships with firepower beyond anything contemplated by Germany. Churchill knew that a second-best navy was like a second-best poker hand, and that the security of Britain's empire rested on the fleet. Every change in the structure of battleships was a gamble with the future.

Churchill himself relates a parable which shows his grasp of the basic nature of technological change. He says:

> In one of those nightmare novels that used to appear from time to time before the war, I read in 1913 of a great battle in which, to the amazement of the defeated British Fleet, the German new vessels opened fire with a terrible, unheard-of 15-inch gun.[5]

Churchill knew that war was the "art of calculated risk" and that there are other ways for a soldier to die for his country than on the battlefield.

In determining to equip the British fleet with 15-inch guns, he would encounter not only the opposition of Parliament but the natural conservatism of the British Government. Nevertheless, he made up his mind to proceed.

To put 15-inch guns on a battlefleet meant the redesign of all the ships on the ways, but in redrafting them, other problems arose. "The gun dominated the

ship," and in order to reduce weight elsewhere without sacrificing armor, it was necessary to change the fuel energy from coal to oil. By eliminating coal bunkers and introducing oil, the fleet would gain at every point. Oil meant greater speed; oil gave ships a greater range of action; oil permitted the refueling of fleets at sea; but most of all, oil eliminated the dead weight of coal.

In moving forward Churchill encountered another obstacle, this time an oil cartel. He says:

> To change the foundation of the Navy from British coal to foreign oil was a formidable decision in itself. . . . First there must be accumulated in Great Britain an enormous oil reserve large enough to enable us to fight for many months if necessary without bringing in a single cargo of oil. . . . Fleets of tankers had to be built to convey the oil from the distant oilfields across the oceans to the British Isles, and others of a different pattern to take it from our naval harbours to the fleets at sea.
>
> . . . And beyond these difficulties loomed up the more intangible problems of markets and monopolies. *The oil supplies of the world were in the hands of vast oil trusts under foreign control.* To commit the Navy irrevocably to oil was indeed "to take arms against a sea of troubles." . . . If we overcame the difficulties and surmounted the risks, we should be able to raise the whole power and efficiency of the Navy to a definitely higher level; better ships, better crews, higher economies, more intense forms of war power—in a word, mastery itself was the prize

of the venture. A year gained over a rival might make the difference. Forward, then!

Churchill's understanding of the relationship between military strength and technology gave the British Navy its saving edge. The new 15-inch guns were a success. When the Battle of Jutland was fought years later, Churchill's actions were more than justified. If the German High Seas Fleet had met ships less powerful than the new British Fleet, the whole war might have been lost in the space of hours.

Churchill's decision precipitated a struggle for oil in which the British Empire became a major contestant. England entered into the oil market itself and ultimately formed the Anglo-Iranian Oil Company which, in turn, entered the world cartel.

If Churchill had held high office in the post-war years, who can say, when Germany declared its intentions, that Churchill would not have awakened Britain. After all, it was during the years between the wars that he wrote "While England Slept."

14. RUBBER—A LESSON IN LOGISTICS

PANZERS and armored cars are the cavalry of modern war. Their wheels and treads are rubber-shod—without rubber they must halt.

With every increase in the use of oil in engines of destruction, the need for rubber grew. For Germany the problem of rubber was, therefore, another hurdle to be leaped.

Rubber grew in far-off Malaya, and Britain rationed it to the world in war and peace.

Germany endeavored to achieve in the synthetic rubber industry the same success she attained in the manufacture of synthetic nitrates. The Bayer Dyeworks at Elberfeld, an arm of I.G., took up the problem of synthetic rubber, intending to make Germany independent of Britain's monopoly in the coming World War. At a dramatic meeting of the International Congress of Applied Chemistry in New York in the year 1912, Dr. Carl Duisberg of I. G. Farben delivered an address in German on the subject of synthetic rubber, which he illustrated graphically by displaying tires produced in I.G. laboratories. Although Germany was not com-

pletely able to master the problem at that time, by the end of the World War her annual production of synthetic rubber was between three and five hundred tons. When the war stopped, this production ceased, but I.G.'s research did not.

In both England and the United States large supplies of natural rubber as well as the interests of the rubber planters and fabricators precluded any large scale efforts to develop synthetic rubber beyond the stage of the laboratory.

After the World War I.G. resumed the study of synthetic rubber. During the years 1925 to 1933 I.G. obtained a number of patents on various processes necessary for the manufacture of synthetic rubber, and was able to produce several types of so-called Bunas. In this same period, in the United States, the DuPont Company, the Dow Chemical Company, and the rubber manufacturers also undertook some study of synthetic rubber. DuPont produced a substance known as Duprene, later called Neoprene, made from coal, limestone, salt, and water, which entered into some commercial use, since its resistance to oil, grease, and sunlight was superior to that of natural rubber. Other brands of synthetic rubber produced during this earlier period were, in the main, restricted to specialty uses.

As a product falling within the general scope of the Division of Fields Agreement between Standard Oil and I.G., synthetic rubber fell within the latter's exclu-

sive province. Research was carried on by both Standard and I.G., contemplating the development of synthetic rubber, although I.G. excluded Standard's commercial efforts in this respect.

Under the agreements, however, it was understood that all know-how and experience obtained either by I.G. or by Standard in the synthetic rubber field eventually would be pooled for their mutual benefit. The remilitarization of Germany, however, as well as the motives of I.G., did not permit the latter to turn over its information to Standard. In fact, no more than the barest patent specifications of the technique necessary for the polymerization of the Buna-S and Buna-N rubbers were ever conveyed to Standard by I.G.

On its own behalf, Standard had developed in the period 1930-1938 a form of synthetic rubber known as Butyl, having a petroleum base, concerning which it transferred to I.G. full and complete information.

In the agreements which Standard and I.G. made, Standard held the position of junior partner in the chemical field. I.G. had the last word on all questions of general policy. When, therefore, four rubber manufacturers and one chemical company in the years 1932-34 applied to Standard for licenses under the Standard-I.G. synthetic rubber patents, I.G.'s decision determined the result. Realizing that their own position would be jeopardized by the new developments, the fabricators of rubber wanted to enter the field. An agreement was

proposed between the Goodrich Rubber Company and Standard which I.G. refused to ratify. Standard's own attitude was intended to discourage the fabricators from entering into production of any synthetic goods. As the Goodrich Company stated:

> Certain it is that little enthusiasm will be aroused in a development where the question of terms on which it can be placed in commercial production is left to future negotiations, where there is a possibility that these terms may be of onerous character as to preclude its employment or where there is even a remote chance that the result of our development will be passed on to another to the exclusion of ourselves.[1]

For the entire decade after 1932 Standard endeavored to keep its control untouched. There were two chief difficulties. First, the rubber manufacturers might seek to develop their own synthetics, which would make void Standard's control. That Standard was aware of this possibility is shown in a statement made in 1936:

> . . . following our refusal to deal with Goodyear on synthetic rubber several years ago, Goodyear went to work rather vigorously on its own behalf in this field and recently has succeeded in making some very interesting looking products.[2]

The second burden under which Standard pursued its policy of averting independent research in synthetic rubber came from I.G. I.G. prevented Standard from committing itself to a positive program of synthetic rubber development, and withheld the necessary know-how. As early as 1935 Standard knew that I.G. was not living up to its agreement to exchange full and complete information on Buna rubber because, in Standard's own words:

> . . . The Hitler Government does not look with favor upon turning the invention over to foreign countries.[3]

I.G.'s attitude was motivated by military expediency; war was coming and the German Government would not arm its enemies.

Despite I.G.'s refusal to adhere to its own side of the bargain, Standard, as a "loyal partner in marriage," decided to give its own knowledge of butyl rubber, a Standard Oil development, to Germany. Evidence indicates that Standard's butyl rubber can be made more easily, using less critical materials, than Buna. Butyl rubber, in the opinion of some experts, is substantially cheaper than Buna or natural rubber. The quality of butyl as it has been improved is almost the equal of Buna. Standard conveyed this information because of commercial considerations: it had too much at stake.

> . . . Certain difficulties still exist which prevent our I. G. friends from giving us full technical information and proceeding in the normal manner with the commercial development in the United States. . . .

> In view of the very genuine spirit of cooperation which [I. G.] displayed, I am convinced that it is not only the right thing to do, but the very best thing from every standpoint to pass on to them full information on the copolymer [butyl] at this time. I do not believe we have anything to lose by this which is comparable with the possible benefit to all of our interests.[4]

In Standard's own words, it was felt that:

> Until we have this permission [from Germany], however, there is absolutely nothing we can do, and we must be especially careful not to make any move whatever, even on a purely informal, personal or friendly basis, without the consent of our friends. We know some of the difficulties they have, both from business complications and inter-relation with the rubber and chemical trades in the United States, and from a national standpoint in Germany, but we do not know the whole situation, and since under the agreement they have full control over the exploitation of this process, the only thing we can do is to continue to press for authority to act, *but in the meantime loyally preserve the restrictions they have put on us.* [Italics added] [5]

Axis plans were reaching a culmination; Pearl Harbor was drawing closer. No synthetic rubber was being produced in this country on any commercial scale. The reason again was I.G.'s persistence in denying to Standard either permission or information necessary to begin

large-scale development in the United States. As Standard stated at the time:

> The thing that is really holding us up, however, is not the lack of a plan either from Goodyear or ourselves, but the inability of our partners to obtain permission of their government to proceed with the development in the United States.[6]

Came September 1939 and war. In the following month, October, a vice-president of Standard Oil went to Europe and wrote back to Standard's president what is now the classic statement of "business as usual":

> Pursuant to these arrangements I was able to keep my appointments in Holland, where I had three days of discussion with the representatives of the I.G. They delivered to me assignments of some 2,000 foreign patents and *we did our best to work out complete plans for a modus vivendi which would operate through the term of the war, whether or not the U. S. came in.* All of the arrangements could not be completed, but it is hoped that enough has been done to permit closing the most important uncompleted points by cable. It is difficult to visualize as yet just how successful we shall be in maintaining our relations through this period without personal contacts. [Italics added] [7]

As a consequence of these arrangements, the strictures which I.G. had placed on Standard were slightly relaxed. Standard was now free if it chose to license the

rubber companies under the I.G. patents to make Buna. On its own behalf, Standard retarded the pace of these negotiations because of its instinctive desire to protect and perpetuate its monopoly in the United States. That these were its purposes is substantiated by two documents. The first is a memorandum by a Standard official describing the type of license to be offered to the rubber companies:

> The most important terms of the licensing agreement are:
>
> 1. The rubber company takes a license to produce for consumption in its own products but not for sale otherwise. It gives us an option to buy one-fourth of its plant capacity for distribution to the trade generally.
>
> 2. A high royalty rate (7.5¢ lb.) is fixed so as to make the operation practical for the rubber company only so long as the product is used as a relatively high cost specialty.
>
> 3. The rubber company agrees to license back to us its improvements.
>
> The effect of these terms is to limit rather drastically what the rubber companies may do under their license and to leave Jersey free to itself manufacture and sell, or participate along with rubber companies in a manufacturing organization, or confine its activities to licensing and supplying raw materials. Therefore, the licenses offered may be considered as a stopgap arrangement to permit the rubber companies to get into quick production of Perbunan for specialty use if they so desire. Beyond this, there has been no decision as to how the development will be advanced.[8]

In analyzing the effect of these proposals, Standard's patent attorney stated:

> The agreement as it is now drafted will lead to the centering of all patent rights of licensees in the hands of licensor, with no outflow of these rights except to customers of licensor (and on two minor phases of patents to licensors' licensees).
>
> All manufacturing patent license of licensees will help to build up licensors' dominating position, but no licensee will get the benefit of any other licensees' manufacturing patent rights. In other words, this is not a cross-licensing agreement, but one in which patents are piled on patents in the hands of one centralizing company.[9]

How perfectly Standard's desire to look out for its own commercial future coincided with Axis plans!

The Pacific relations of the United States were becoming tense. Standard remained firm in its determination that no rubber company should make synthetic rubber tires until such time as Standard felt that its own control was secure. Two companies had the temerity to try. Goodrich started to fabricate Buna. Three months prior to Pearl Harbor Standard started suit against Goodrich for infringement of the I.G. patents. At the same time, a notice of similar action to follow was sent to the Goodyear Rubber Company.

The ensuing months after Pearl Harbor were to teach the American public the real meaning of "too little and too late."

A Lesson in Blockade

Synthetic rubber has become a military and economic keystone of American strategy. There would be no synthetic rubber problem if we could grow enough rubber or if the natural rubber industry, over the last twenty years, had not used a geographical monopoly as an opportunity to create one of the most important of raw material cartels. We have seen that patents can be instruments of power politics and warfare. Natural monopolies based upon the concentration of raw materials in favored areas of the world have played an equal part in international relations. In the case of natural rubber, the consequences of monopoly and cartellization have affected the course of the greatest war in history.

The colorful story of the natural rubber industry has been told and retold. Originally, natural rubber was found only in Brazil. As the uses of rubber in industry increased, this source became unable to supply the world's demands. Seeds and plants of the Hevea Braziliensis were smuggled to England, and eventually cultivation of rubber was begun in British Malaya, Ceylon, and the Dutch East Indies.

In a few years the monopoly which Brazil had enjoyed passed into the hands of the rubber plantations of

the Far East. In time more than 90% of the cultivated rubber output was produced in British and Dutch colonies and plantations.

This situation was always a problem to the United States, because this country consumed more than three-fourths of all the rubber grown in the world. The large American rubber manufacturing companies in some instances were able to invest in Far Eastern rubber plantations, and eventually their share of ownership became substantial. During the first World War, before our own entry, we were cut off from our supply, but we failed to grasp the moral at the time.

At the end of the World War, the Dutch and British planters had accumulated large stocks of crude rubber. As output continued to increase in 1919 and 1920, the rubber market broke sharply. During 1920 and 1921 the British Rubber Growers' Association made strenuous efforts to obtain the intervention of their government on behalf of the industry. A special Parliamentary committee was appointed, and in 1922 a program of compulsory restriction, known as the Stevenson Plan, was put into operation.

The Stevenson Plan, acting in light of what it deemed to be imperial policy, undertook to rule out competition within the industry, to regulate the export policies of all the planters, and to set up a quota system of production. Negotiations were undertaken with the Dutch

Government, but the latter stubbornly held out and would not consent to the terms of the plan.

Despite this refusal of Dutch cooperation, the British Government enacted the plan into law late in 1922. The outcry in the consuming countries, principally the United States, was loud and long, and to mollify this agitation some concessions were made, without abandoning the principal provisions of the plan. As Great Britain's share in the world rubber market began to decline and that of the Dutch to rise, the first Stevenson Plan ultimately defeated its own ends. In 1928 it was supposedly shelved.

The cessation of the measures intended to maintain artificially the price structure of the rubber market coincided with the onset of the Great Depression. Efforts were made to declare a "tapping holiday" in 1930, but these were futile. Crude rubber stocks rose. Prices and exports fell. The entire industry suffered severely.

In 1933 conferences were begun to re-institute the cartel. In 1934 an intergovernmental agreement was drawn up between Great Britain, India, Holland, France, and Siam, governing world rubber production. An administrative body, the International Rubber Regulation Committee (I.R.R.C.), was set up to allocate production and export quotas. Accumulation of excess stocks of rubber was prohibited, as were new plantings of rubber trees. Nothing was overlooked. The export of "leaves, flowers, seeds, buds, twigs, branches, roots, or

any living portion of the rubber plant that may be used to propagate it" was forbidden. Here indeed was the ultimate in cartel regulation of nature's processes.

The intergovernmental agreement was renewed in 1938 for a period of five years. Ostensibly its aims were the establishment of "equilibrium" and "fair and equitable" relationships between the planters and consumers. Such apparently lofty principles, however, could not conceal the fact that, like all such artificial restriction schemes, the agreement was based on the canons of monopoly. Thus, for example, when Germany sharply reduced its imports of natural rubber in the years immediately preceding 1939, the I.R.R.C. cut production and export quotas correspondingly, lest there should be any "surplus" on the world market.

It was, of course, typical of the purblind statecraft of those years that the governments supporting the cartel could not read the handwriting on the wall which, when translated, meant that Germany had overcome one of her worst problems in the World War, and was now prepared to try again. Furiously stirring its cauldrons on the Rhine, I.G. had learned to brew synthetic rubber, and, as with so many other materials, Germany could now discount in advance the blockade which war would bring.

Even after the blitzkrieg started, the I.R.R.C. continued the smooth tenor of its way. The Rising Sun of Japan glared ever more fiercely on the plantations of

the East, but the cartel saw nothing beyond its own immediate shadow. The pettifogging behavior of the cartel aroused no alarm in any of the governments dependent on Malaya and the Indies for rubber.

From the military point of view, as well as from the economic, it is almost incredible that great states should permit themselves to be placed at such obviously geographical disadvantage. Pearl Harbor, Singapore, and the Dutch East Indies were a large fee to pay for a lesson in elementary logistics. The cardinal principles of military and economic warfare, the provision of ample supplies, had been violated.

15. THE BATTLE OF ALUMINUM

THE battle of aluminum is one of the major campaigns affecting the outcome of this war. Aluminum is the basic source of airpower. Because of its importance, Germany's aluminum industry was expanded to unprecedented size in the years of nervous "peace" before the war.

The industrial war is a series of campaigns. Measured by the yardstick of aluminum production, the United States and the United Nations are fighting desperately to match the output of the Axis. We lost the first round in this struggle, for the disparity remained in Germany's favor in 1942.

Since the outbreak of war, our pitiful capacity, stunted by high price, low-output policies, brought cries of anger from a public taken by surprise. The realization that aluminum production was now a fighting front precipitated a crisis. Men were toppled from high positions in our government because they had underestimated the need for this strategic metal. Charges of waste, inefficiency, and monopoly were freely hurled because of the shortage. Senate Committees held harrowing ses-

sions, delving for the truth. Recrimination was the order of the day.

Once more monopoly was our undoing. The Aluminum Company of America, sole producer of aluminum in the United States, was harshly criticized.

Other ages have used iron, bronze, copper, steel and tin, but aluminum metal is entirely a product of modern times. It is the forerunner of the "Age of Light Metals." There is some slight evidence that "alumen" was known in the Roman Era, but it was not until 1825 that Hans Oersted, the Danish chemist, successfully isolated small quantities of aluminum in the laboratory. His feat was later duplicated by Woehler, the German chemist, who was able to determine more accurately the properties of the "silver found in clay."

Interest in the new metal, and realization of its possible applications, was immediate. Napoleon III, sensing that aluminum might be used for military equipment, subsidized Henri Deville, the brilliant French chemist, to discover economical methods by which aluminum could be produced on a commercial scale. Deville had exhibited a bar of aluminum at the Fair in Paris in 1855, and is credited with the major pioneering which ultimately led to the establishment of the industry. At the time Deville started his productive experiments in 1856, aluminum cost about $500 per pound, and ranked as a precious metal. Napoleon did not live to see his own augury vindicated, but the correctness of his premonition has long since been proved.

Aluminum is one of the most plentiful substances in nature, exceeded in its frequency of occurrence only by oxygen and silicon. It forms the metallic base of a variety of compounds, such as bauxite, alunite, leucite, feldspars, and common clays. In commercial production, the ore used is bauxite, which is richer than the others in its aluminum content. Characteristically, bauxite occurs in "pockets," or localized deposits, and this fact has been of extreme importance in the monopolistic development of the industry. Bauxite beds are found on every continent, and most of the higher-grade deposits are now worked.

The properties of aluminum which account for its uses are its light weight, its resistance to corrosion, its electrical conductivity, and its malleability. Aluminum can be forged, cast, and machined with precision, and when properly alloyed has a tensile strength equal to light steel. Because of these properties, aluminum has come to the fore as an ideal material for the manufacture of aircraft, ships, and other military and civilian vehicles. Aluminum cooking utensils and food receptacles are standard supplies of the home. The World War enormously enhanced the consumption of aluminum for military and transport uses and the interim between 1919 and 1939 saw its increasing application throughout industry.

The initial discovery which transformed the industry

was made by Charles S. Bradley, who filed an application for a United States patent in 1883. Bradley's application set forth a process for manufacturing aluminum by conducting an electric current through an aluminous ore, such as cryolite.* His patent was not granted until 1892, a circumstance which changed the later course of the industry.[1]

In 1886, Charles M. Hall, an American, and Paul Heroult, of France, filed claims almost at the same time, in their respective countries, describing the method of making aluminum by the electrolysis of alumina (aluminum oxide) in cryolite. Hall's patent was issued in 1889, and in the same year the Pittsburgh Reduction Company, which had been formed to exploit his process, began production of aluminum.

In 1907 the name of the Pittsburgh Reduction Company was changed to the Aluminum Company of America, and as a corporate entity Alcoa has been altered only once since then, when it merged with a Canadian power company in 1925. The duration of the corporate name is the only static feature of the company. In all other respects it has enlarged upon its original holdings. The ownership of Alcoa, however, has always been closely held by its directors, their families, and descendants, including the Davis group, the Mellon group, and the Hunt group.

*Cryolite is sodium-aluminum fluoride, occurring in large deposits only in Greenland.

The Hall patent expired in 1906, and the Bradley patent in 1909, and theoretically the aluminum industry was thrown open to all who would enter. Why others did not, and in fact could not do so, is explained by the policies which had governed the company's development from the outset. The patents were the first and the crucial factor which inflected the curve of the industry toward monopoly. But between the date of its establishment and the expiration of the patents, Alcoa took steps to nullify the loss of its patent protection. As a rule, patents and control of raw materials are the two strongest pillars of monopoly. Therefore, Alcoa, anticipating the removal of the first, sought to acquire the next best prop by engrossing the bauxite supplies in the United States, and later, in South America.

Having preempted the field, Alcoa grew to become one of the industrial giants of our economy. Its organic integration was carried forward by buying up the most favorably located water power sites that could be found. Alcoa was a member of every world aluminum cartel until 1915. Thereafter, while Alcoa did not directly participate in cartel agreements with foreign producers, no aluminum cartel could have existed had Alcoa chosen to compete.

Whether or not there were any tacit or "gentlemen's" agreements, the price, output, and sales records suggest that the Europeans have not sought to invade Alcoa's American stronghold, and Alcoa has abstained from any

extensive effort to enter the European's sphere of influence. There is, however, indication that Alcoa's acquisition of European water power sites, bauxite holdings, and reduction facilities has had the purpose, and the beneficial effect (for Alcoa), of keeping the European producers "in line."

Alcoa was, until the war program of the government resulted in bringing the Reynolds Company and the government-built plants into the field, the single source of virgin aluminum in this country. Moreover, in the fabrication of aluminum products, such as aluminum sheet, automotive parts such as pistons, cooking utensils, and aluminum cable, to mention some of the larger items, Alcoa and its subsidiaries have maintained an unbroken "leadership."

By 1928 Alcoa had a corporate structure which could be used in any study of integrated "big business." Following the 1925 merger with the Duke interests in Canada, Alcoa had an authorized capital stock of 1,500,000 shares, par $100 per share, and the same number of shares with no par or nominal value. Its wholly owned subsidiaries included thirty-two companies, ranging from railroads, bauxite mining companies, fabricating companies, sales companies, and power companies in the United States, Canada, South America, and Europe. In addition, it controlled a score or more of affiliated companies in partnership with others. These affiliated concerns included several European fabricating companies, Norwegian, Jugoslavian, Italian, French, and other firms producing bauxite, power, aluminum, and finished goods. What the total value of Alcoa's assets was by 1928 must to some extent be conjecture, but they were conservatively between one billion and one and one-half billions of dollars. At one time the market value of its stock alone was over one billion dollars. During its early period, Alcoa's profits permitted stock dividends on several occasions, and estimates have been made that for every dollar invested in Alcoa the annual profit to its stockholders has been in the neighborhood of 100%. Since much of this has been put back into the business, a fifty-year average return on the total equity would be about 13.5%, far higher than in comparable industries not completely monopolized.

In 1928, Alcoa executed what can be regarded as one of the shrewdest strokes any similarly situated company ever attempted, or one of the most unbusiness-like, depending upon the perspective from which it is viewed. Quite deliberately, Alcoa created the Aluminum Company, Ltd., in Canada, and "sold" to its own offspring all foreign properties which it possessed, with the exception of its Dutch Guiana bauxite mines and a few minor holdings. The consideration for this sale consisted of 490,875 shares of Alted's stock, which were distributed proportionately to the principal stockholders of Alcoa. Formally, and as Alcoa insisted, actually, Alted and

Alcoa were completely independent entities. As late as 1940 the owners of 81.53% of Alcoa's stock also held 83.93% of Alted's stock. We are faced, therefore, with a unique example of corporate development which economically reproduces the biological phenomenon of fission, by which bacteria reach a given size, and automatically divide into two. But analogy ceases with the act.

What was Alcoa's motive in forming Alted? Its own reasoning, at least as stated publicly, was to conduct business more efficiently in the British Empire and other foreign countries. Is this acceptable or plausible from an economic standpoint? It is not, because there is no economic or technical advantage in business operations which could not have been served by simply creating a subsidiary. As long as Alcoa retained Alted's stock in its own treasury, the latter was a subsidiary. By issuing the stock to Alcoa's own shareholders, did Alcoa free Alted completely? The questions which arise immediately are first, could it be contended that Alcoa deliberately created a competitor? Secondly, despite the technical independence of Alted, was there any change in *interests* which it served? To the first, it may be replied that not even the most altruistic corporation would set about consciously to destroy its own foundation and market. To the second query, the record answers that the controlling interests in Alcoa and Alted remained identical, with the exception of minor changes in proportionate holdings of stock by individuals. E. K. Davis, the brother of Arthur V. Davis, became President of Alted. The principal officers of Alted were all former Alcoa employees. The controlling shares, as has been stated, were held by the same groups in both companies.

Why, then, was Alted formed? It will be recalled that under the 1912 decree Alcoa was enjoined from entering into further cartel agreements with European producers by means of a Canadian subsidiary. While it may be legally moot, it is clear that Alted as an "independent" company could do what a subsidiary could not. Within three years after its formation, Alted entered into a world cartel agreement, to which only Alcoa, among all the major producers, was not a signatory.

Since Alted's formation, Alcoa has been able to enjoy to the full its monopolistic position in the United States market. Acting as a monopoly must, it has done four things: Restricted production, administered its price schedules, parried all threats of competition, and, as will be demonstrated hereafter, successfully checked a technological rival. The results of these policies became starkly and fearfully apparent when our national defense program began. The United States was no longer the world's largest producer of aluminum; this title had passed to Germany.

Through the cartel device Germany achieved a victory which a thousand bombers could not have won.

Force Majeure

The formation of Aluminum Company, Ltd., by Alcoa, as an "independent" corporation, even if it were credited completely, does not alter the aftermath of Alted's association with the aluminum cartel. After the World War, the European producers had joined in a series of cartel agreements, with the German producers, who had been completely united in a war-cartel, again coming to terms with the other aluminum manufacturers. Both the Vereinigte Aluminium Werke (V.A.W.), the government-sponsored cartel, and the Aluminum Werke, a subsidiary of I.G. (and of Metallgesellschaft, which I.G. controls), acted as one in their foreign relations after the war. There are close connections between the I.G. and V.A.W., through the Metallgesellschaft.

In 1928, the year in which Alted came into being, the European producers were joined in an Association. Alted did not enter immediately the Association, but did not in any way transgress its rules.

In July, 1930, Alted was a party to the "Zurich Agreement," by which the Japanese market was divided. Alted received 52% of this territory, the other 48% being divided between the British, French, German and Swiss producers. Alted was made exclusive sales agent in the Japanese market for the other signatories, therewith receiving the right to fix the price of all sales. This agreement prevailed until Pearl Harbor, although the

growth of native Japanese production lessened Alted's grasp. During the years 1928-1931, there were also separate agreements concerning sales to Russia and India, in which Alted received proportionate quotas.

The year 1931 marked the end of the "Association," and the formation of a full-fledged cartel between Alted and the European producers. In October, 1930, Mr. A. V. Davis, of Alcoa, took a trip to Europe. The Europeans knew of it, and "anxiously" awaited his arrival. The chairman of the European cartel, M. Marlio, conferred with Davis, spoke of "harmony," and pointed out that "it was difficult to have harmony in the industry if the European producers were in a cartel and Aluminum were not." And the European producers, as E. K. Davis stated, regarded participation in a cartel "the acid test of good will." Whether M. Marlio succeeded or not in enlisting A. V. Davis' influence to persuade Alted to join in a formal cartel, shortly thereafter E. K. Davis, President of Alted, began work on a plan for a cartel, the principal features of which were known, at least in a general way, by his brother. At the latter's suggestion, Alcoa's own attorneys acted on behalf of Alted in the conferences in Montreal which were held in April, 1931, between Alted and the representatives of the Europeans.

These conversations were continued later in London, and on July 3, 1931, the so-called "Foundation Agree-

ment" was signed in Paris. In performance of this agreement, the Alliance Aluminum Compagnie was incorporated in Basle, Switzerland. The Alliance issued 1,400 shares of "A" stock, subscribed by the members in the ratio of one share of stock for each 100 metric tons of their respective annual capacities. These proportions also governed the relative votes of each member company in defining Alliance's policies, and determined the quota of total production which each member would receive. The total annual production was to be fixed by Alliance. The entire executive staff of Alliance consisted of Ludwig Braasch and George Hodson, who had been for many years in Alcoa's employ. As E. K. Davis stated, Alted obtained the right which it asked for, i.e., ". . . to exercise a predominant influence over the administrative set-up of the Alliance . . ." It was at the request of Alted that the cartel placed Swiss bankers who were "friendly to Alcoa" on the directors' board of Alliance. (Swiss law required that some nationals be on boards of Swiss corporations.)

The ratios of ownership, and therefore of whatever maximum output might be fixed by the Alliance, were as follows:

Aluminum Ltd.	28.58%
French	21.36%
Germans	19.64%
Swiss	15.42%
British	15.00%

The Alliance also had the duty of fixing prices periodically, by setting minimums on aluminum ingot and fabricated products, below which the cartel members were not to sell. To enforce these decrees, Alliance was empowered to deal in aluminum metal, so that it could buy and sell excess stocks or surplus production of the cartel members. The "buying price," set by Alliance, allowed the members of the cartel to dispose of any unsold aluminum at a price which was high enough to deter them from any "dumping" at lower levels.

One feature of this cartel departed from the standard pattern, and from the provisions of the former agreements in the industry. Instead of reserving particular markets to each member, the quota system applied universally. By restricting total production and fixing prices in all markets, there was no need to distinguish between domestic and foreign outlets. The resultant supervision covered the world market, with the conspicuous exception of the United States.

The Aluminum Company, since it was not a direct member of the cartel, was not legally bound by its provisions. The cartel, on the other hand, could never have functioned unless by design or accident Alcoa did not disturb their markets.

One pertinent question stands out concerning the Foundation Agreement and the Alliance. How could any such contract or cartel hope to operate effectively if Alcoa, not being a member, could at any time it chose

rip assunder the whole carefully planned program of the Alliance? The answer is that Alcoa did not do so, and that the members of the cartel acted as if it would not. As E. K. Davis stated (or understated?), "I am not conscious of ever having felt any apprehension about the selling of Alcoa metal on market conditions as they have been the past several years."

The Alliance, like all international cartels, thought and acted as a sovereign body. This presumption is explicit in a letter from E. K. Davis to M. Marlio, in December, 1935, concerning Russia, whose possible exports perturbed the cartel. Mr. Davis said, "The other thought that occurred to me was that the Alliance might be well advised to seize this opportunity presented by the Russians . . . particularly their desire for alumina concerning which you have already written me—to enter into a treaty with them whereby, for supplying them with the desired quantity of alumina and a considerable tonnage of aluminum, they will join the Alliance under some special understanding or agreement relative to their exports, thus safeguarding the Alliance from possible future annoyance from that source."

One year after the formation of the Alliance, that is, in 1932, the Board of Directors of the cartel decreed that the unit of production per share was to be reduced from 100 metric tons to 53 metric tons. The production records for the years 1930-1932 present an interesting

commentary on the coincidence of output policy between Alcoa and the cartel:

	1930	*1931*	*1932* [2]
Canada	34,900 *	31,000	18,000
France	24,640	18,152	14,360
Germany	30,700	27,100	19,200
Switzerland	20,500	12,200	8,500
England	14,000	14,200	10,300
United States	103,891	80,534	47,577

* Figures in metric tons.

Alcoa "happened to be" the only producer in the United States, and its figures of reduced production followed the cartel line. These years were, to be sure, a depressed period, but the reductions in output by the Alliance were only incidentally made with such adjustment in mind. The Alliance was interested in "maximizing" revenue, by maintaining price and lowering output, and in "stabilizing" the world market.

That Alcoa was a factor was recognized by I. G. Farben in a memorandum concerning I.G. contracts which "extend to the United States." I.G. stated:

> The firms jointly agree to avail themselves of the cancellation possibility of the Alliance Aluminium Co., within five years, calculated from Jan. 1, 1932, only in the event that Aluminum Co. of America, which hitherto has not exported any aluminum from U.S.A., should commence to export aluminum or disturb in any other way the stipulations of the agreement with Alliance Aluminium Co.

To be sure, the cartel never was disturbed by Alcoa's expansion, and therefore no members withdrew.

In 1934 the German government harnessed the industry to its armament Juggernaut, and correctly saw the outstanding value of aluminum in the war they meant to loose on Europe. The policy of the Alliance as it was then formulated ran directly counter to the war program, so far as Germany was concerned. Germany would need aluminum and still more aluminum to fit its plans of conquest. Vereinigte Aluminium Werke and I.G.'s Aluminum Werke at once sought to be released from the quota restrictions placed on them by the cartel. Continued restrictions on the production of the democracies would not be hard to induce. Therefore, the German members could afford to show their hand.

The non-German members, including Alted, at first balked at the proposals made by the Germans. But the spirit of appeasement soon led the cartel to capitulate. At first, the members tried to satisfy the demand of the Germans by supplying them with extra metal, without lifting the bars the cartel had set up. These half-way measures did not find approval in Germany. V.A.W. was adamant in its attitude: not only must they be allowed to produce to capacity, but to expand their capacity without stint. As in political and military affairs, so in industrial agreements the Germans were ready to regard treaties as "scraps of paper" binding on others, but not on themselves. As E. K. Davis expressed it:

> The German producers stated that they were going to produce in excess of their production rights whether the Alliance authorized them or not. The Germans stated in effect that they considered themselves to be subjected to *force majeure* in the matter, and asked to have their situation recognized.

This was done.

The Germans agreed not to export, and this sop proved sufficient to keep the cartel in operation as it applied to other countries, for a time. This stipulation also removed Alted's objection, since the Germans promised to buy a ton of aluminum from the cartel for every ton exported, so as not to affect the world market. As a further mollifying move, the Germans agreed to advance the price of aluminum sold for non-government purposes in Germany. This was no more than a gratuitous gesture. Germany restricted civilian consumption, which should have served warning on the other members of the cartel, had they not been so obtusely bent on preserving the market arrangements which their commercial instincts inclined them to place foremost.

E. K. Davis, in opposing the original demands of the Germans, portrayed accurately the nature of the scheme and the "business-like" basis of the objection. In a letter to M. Louis Marlio, chairman of the Alliance, Davis stated:

> *We and the others who are about to be sacrificed to this cold-blooded scheme have carried in silence*

our respective burdens under the Alliance, awaiting the time when we can enjoy some of the benefits of a strict application of the association's rules. [Italics supplied]

Morituri te salutamus!

The action of V.A.W. and Aluminum Werke so disturbed the program of the Alliance that the Foundation Agreement was abandoned. On January 1, 1936, the Foundation Agreement was superseded by a new cartel agreement. Alliance and its Board continued to regulate output, but instead of fixing a "buying-price" at which surplus products would be bought by the Alliance, a royalty was placed on production above quota.

The demand for aluminum expanded generally after 1936 to such a degree that output-restrictions (but, on the whole, not price levels) could no longer be enforced. Hence, the Alliance has been dormant since about 1938. But it is still in legal existence, ready to resume its "burdens" as the future permits.

The "cold-blooded scheme" engineered by the Germans worked, and effectively hampered the armament of the democracies. Germany became the world's principal producer of aluminum, and created an "aluminum economy." The statistical record of output tells the story in the barest terms:

	1933	*1934*	*1935*	*1936*	*1937*	*1938*[3]
Canada	16,200 *	15,500	20,556	26,900	42,550	50,000
France	14,300	15,100	22,000	28,300	34,500	40,000

	1933	*1934*	*1935*	*1936*	*1937*	*1938*
Germany	18,900	37,200	70,800	97,500	127,500	175,000
Switzerland	7,590	8,200	11,700	13,700	25,000	28,000
England	11,000	13,000	15,100	16,400	19,400	24,000
U. S.	38,614	33,647	54,112	102,027	132,759	130,129

* Metric tons.

Since 1938 the ascendancy of Germany in aluminum has been unimpaired and the disparity made greater by German conquest. It is reliably estimated that in 1941 Germany produced more aluminum than the *combined* United Nations. The collection of kitchen utensils in this country, occasioned by the shortage of aluminum for bombers, excited public question of such a scarcely-credible lack. The slow-down of aircraft production lines because of insufficient aluminum continued, in 1942, to hinder our "all-out" effort. The reasons for the scarcity of aluminum in this country are partly attributable to domestic monopoly, partly to the cartellization of the world market, and the concurrence, conscious or not, of the production policies of both monopoly and cartel.

Again, Germany took advantage of the "natural propensities" of cartel-makers, so as to weaken other countries, while leaving German industry free from external restraint, but completely "geared" to a war economy. In the case of France, the world's leading producer of bauxite for many years, the adherence of her aluminum producers to the cartel until the last hour before war is one direct cause of her downfall. When the Luftwaffe

debouched from its hangars across the Rhine, to triumph swiftly over the comparatively miniscule French Air Force, the outcome was foregone. France could not remedy her aluminum shortage in the time allowed sufficiently to muster more than a token assemblage of planes. The moral needs no pointing.

16. MAGNESIUM—METAL OF MARS

TO Germany, magnesium was a discovery of great military importance. Its sources are virtually unlimited. It is found in seawater and in widely distributed ores. No blockade can cut off its supply, and only production facilities limit its output.

To a monopolistic aluminum industry, magnesium meant a technological rival of formidable properties. Its mere existence was a nuisance.

In these two sets of conditions magnesium developed to take its place among the lightest of light metals. Germany, since 1915, has constantly pushed onward in magnesium production. The democracies not only lagged behind, but sought to throttle magnesium, because it threatened to make obsolete the interests vested in aluminum. Once more monopoly must guard against both competition and technological change.

With Mephistophelean guile, Germany's minister of industrial war, I. G. Farben, lulled Alcoa into dreams of security, while Germany made magnesium in ever-increasing amounts.

Both I.G. and Alcoa "knew what they wanted." I.G.

desired magnesium. Alcoa wanted to erect a *"cordon sanitaire"* around the industry. I.G. lent willing aid.

Aluminum, as has been noted, is considered almost indispensable for some purposes which copper, steel, and other metals cannot economically fulfill, and is competitive with these metals in common use. Within its own special niche, aluminum is not, however, free from the threat of substitution by a competitive, and in many respects, a superior product, the metallic element magnesium. Although it has been known scientifically for some time, magnesium was first produced commercially in Germany in the early part of the World War. The General Electric Company, in 1915, produced magnesium in the United States, and during the period 1915-1919 some eight American companies entered the field. The initial impetus to the industry was both economic and military, since magnesium was used in making flares, tracer bullets, and incendiary bombs, and sold at a price of about $5 per pound.

Technologically, magnesium is in all important respects the greatest rival to aluminum. Magnesium can, when properly alloyed, fulfill any of the functions of aluminum with greater efficiency, since it is one-third lighter in weight, it is more easily shaped in the machining process, and has greater tensile strength. Chemically pure magnesium is extremely inflammable because of its affinity for oxygen. This characteristic impeded somewhat its introduction into commercial use, but accounted for its inauguration as a military essential, since magnesium generates extreme heat when it burns. Magnesium alloys, consisting of varying proportions of magnesium and aluminum or magnesium and other suitable alloy metals, possess great advantages as material for the construction of aircraft, the manufacturers of which are engaged in a never-ceasing search for lighter weight. The Minerals Year Book for 1940 reported:

> The highly destructive German-made aerial bomb used in Spanish Civil War raids on Barcelona consisted of ammonium nitrate, powdered charcoal, and aluminum, enclosed in a magnesium-alloy shell.

The use of magnesium reduced the weight of the bomb-load, permitting either more bombs or greater range.

At the end of the World War, the demand for magnesium declined, as did the output, and as a result, the price fell to one-third of its former level. Of the eight concerns which had been engaged in magnesium production, only two continued in the industry. These were the Dow Chemical Company and the American Magnesium Company, a wholly owned subsidiary of the Aluminum Company of America.

In the years 1920-1927, A.M.C. and Dow competed for the existing magnesium market. Dow produced magnesium by the electrolysis of magnesium chloride, and considered the metal a by-product of its chemical

operations. A.M.C. used magnesite as its raw material, obtaining magnesium by the thermal reduction of the ore. Since Dow's process was more efficient, and its costs less than A.M.C.'s, it had the better of the struggle. Both companies, until 1927, probably sustained a small net loss on the total output. During this entire period, the weight advantage of magnesium over aluminum was offset by a much higher price. In 1926 Dow reduced the price from 90¢ per pound to 55¢ per pound. Immediately Alcoa recognized that if, as output increased, price reductions occurred in proportion, its own aluminum business would be threatened. Alcoa was also aware, about the same time, of the possibility that imports of magnesium from abroad would further augment the threat to its own position in the light metal market.

Constitutionally opposed to competition, and at the same time desiring to obtain a grip on the magnesium industry, Alcoa in 1927 permitted its subsidiary to cease production, and in July of that year contracted to purchase its entire requirements of magnesium from Dow. A.M.C. became Dow's largest customer, and under subsequent sales agreements was granted preference as against all other customers of Dow. At the same time the purchase agreement was signed, a cross-licensing agreement covering certain fabrication patents was executed between A.M.C. and Dow. Both A.M.C. and

Dow still retained the privilege of dealing with others, and A.M.C. could, of course, reenter production at any time.

During the years 1927-1928 the ubiquitous I.G. again became a member of the *dramatis personae* of the magnesium industry in the United States. I.G. approached Dow and several other companies in an effort to enter the American market with the aid of an American concern. Dow reacted negatively to I.G.'s advances. It was therefore almost inevitable that I.G., in making its rounds, should establish contact with Alcoa.

The first negotiations occurred in 1928; after a period of study of the process used in production and fabrication, and of discussion of the terms of agreement, Alcoa and I.G. signed what is known as the Alig Agreement, in October 1931. This agreement became the charter of the magnesium industry in this country until war supervened. Here again I.G. pursued one of its favorite practices in dealing with American industries: a joint corporation, the Magnesium Development Company, was formed, in which Alcoa and I.G. each held 50% of the stock. Magnesium Development Company was a patent-holding organization to which I.G. transferred a number of fabrication patents and to which Alcoa contributed some process patents, although not as many as I.G.

In addition to its participation in M.D.C., I.G. eventually received a 50% interest in American Magnesium,

Alcoa's own subsidiary, via General Aniline & Film.* The Alig Agreement provided that any licenses issued by M.D.C. for the production or fabrication of magnesium were to be restricted to the United States. The Alig Agreement stipulated that

> As long as magnesium is produced by any . . . producing company under a license or licenses granted . . . the holders of the I.G. shares in Alig . . . shall have the right to limit the increases in production capacity of every such producing company after the initial contemplated production capacity shall have been reached. The initial contemplated production capacity *shall in no case be more than 4,000 tons per annum.*[1] [Italics supplied]

It is significant to note that the sole producer of magnesium in the United States, while not a party to the Alig Agreement, never produced above 2,200 tons before the war emergency. This section of the Alig Agreement revealed in the light of later developments that I.G. was carrying out not only its own purposes in the magnesium industry of this country, but had actually invested, in a military sense, a strategic branch of production. I.G. had been insistent from the outset that Dow be included in the general plan formulated by itself and Alcoa. Dow was recalcitrant, not only because it felt that its own patent position was as strong as that of M.D.C., but because it did not relish dealing with

* See Chapter 7 (Dyestuffs).

I.G. To overcome this reluctance on the part of Dow, Alcoa inaugurated a familiar type of "squeeze play" intended to bring Dow into a more conciliatory frame of mind. In 1932, Alcoa's patent attorney, in a letter to Walter Duisberg (I.G.'s principal representative in M.D.C.), stated unequivocally:

> Dow is either going to play with us or is not going to play with us. If they do not play with us, we have two courses before us. One is to enter into an oral argument over the entire industry with Dow. The result of this argument would simply be that a great deal of time, paper and energy would be wasted to no particular effect. The other course is to sue Dow with two objects in view, the first object being to bring Dow to terms, the second object being to actually prosecute the suit to its logical end. As a patent company, MDC has nothing to offer at the present time except patents and technical information. Since they cannot make money on their technical information without their patents, they cannot deliberately refuse to recognize an outright challenge of the validity of their most important patent structure.[2]

This maneuver succeeded, and in 1933 Dow and A.M.C. entered into a five-year purchase contract reaffirming A.M.C.'s position as a preferred customer. On January 1, 1934, Dow entered into a patent-pooling agreement with M.D.C., cross-licensing each other on certain fabrication patents. The strength of Dow's patent position had been recognized much earlier. In 1930

H. E. Bakken of Alcoa, in a report concerning possible arrangements covering the industry, stated:

> For the immediate present, with Dow as sole producer and ourselves and I.G. Farbenindustrie A.G. following up fabrication processes and fundamental research to increase the use of magnesium, it is extremely doubtful whether anyone else would attempt to break into the magnesium business. As has been pointed out before, the two companies together would have a very strong patent situation. It is felt that this situation alone would make the entry of other interests unattractive. Even Dow Chemical Company and people whom he might interest in fabrication of magnesium would, from a patent standpoint, find heavy weather.[3]

In a later report it was acknowledged that:

> The patents of Dow, taken as a group, are the strongest group of patents on magnesium base alloys in this country. It appears that they will cover the newly developed alloys which will be important in future years. . . . We would state that of the three parties (AMC, I.G. and Dow), Dow has the alloy patent situation containing the best inherent future possibilities.
>
> * * *
>
> AMC and Dow together own valuable heat treatment patents which effectively prevent, under present practice, the successful heat treatment of magnesium base alloys in this country (by other parties). . . . I.G. has no heat treatment patents and is utterly without status in this country in this connection but applications are on file. . . . The valuable heat treatment patents have now issued. It is doubtful whether any exceptionally broad heat treatment patents will issue in the future to any of the parties or to any other persons.[4]

As a result of Dow's capitulation to the constrictor tactics of Alcoa, Dow was assured of its own monopoly in the production of magnesium metal in the United States. It gave up, however, its freedom of action with respect to expanding the magnesium business, and in the formulation of price policies it was apparently understood that Dow would adhere at all times to two considerations. First of all, the general price relationship between magnesium and aluminum appeared in a ratio of 3-2. With only a few exceptions, the price record supports the contention that magnesium was artificially and arbitrarily valued until the advent of war. Secondly, A.M.C.'s position in the industry was safeguarded by what might be called a "more favored nation" policy, by which A.M.C. was granted not only a discount which might properly accrue to quantity purchases of the metal, but received preferential treatment equivalent to any reduction achieved by Dow in the latter's production costs. There was, of course, a further implication of such pricing: it prevented the sale of fabricated products either by Dow or any other manufacturer on a basis competitive with A.M.C.

The fact that Dow acted under duress in establishing a rapport with I.G. in the magnesium business might, perhaps, be excused in part on the ground that Dow, like many another enterprise, found itself faced with protracted litigation and the certainty of cutthroat competition and, following the law of self-preservation, bargained as well as it could.

Turning now to I.G.'s part in "developing" the magnesium industry, I.G. had, of course, attained its desired status in the American magnesium industry, and by reason of the Alig Agreement, could at any time veto expansion of production capacity by Alcoa. I.G. was not content with thus proscribing the size of the industry, but also sought to guard against any disturbance of the international magnesium market. In 1934, I.G. offered to purchase from Dow 350 tons of magnesium, to be followed in 1935 by purchases of 600 tons, with options for similar amounts in 1936 and 1937. The quantities of these orders represented a significant portion of Dow's capacity.

The specific clause which shows I.G.'s control of the world market reads as follows:

> Dow agrees to confine its sales in Europe solely to the I.G., with the exception that it reserves the right to sell the British Maxium or its successors not more than 300,000 pounds (150 tons) per annum at a price not lower than the price quoted to I.G. for the same quantities, plus an extra charge of not less than 4 cents per pound for I.G.'s larger consumption. Dow further promises to use its best endeavor to keep British Maxium or its successors from reselling Magnesium in ingot form and will try to limit its purchases to its own use in fabricating.[5]

The price at which magnesium was sold to I.G. was to be at least four cents less than that to Great Britain. Magnesium sold in the American market for thirty cents per pound at that time. The price to I.G. was twenty cents per pound, or a discount of 33⅓%. I.G. thus strengthened its own position in the European magnesium market, and by cornering as much as 60% of Dow's current output, forestalled the latter's acceptance of any offers from other countries.

There is a significant corollary to this transaction. Great Britain was primarily dependent upon Germany for its magnesium during the years this contract was in operation. In 1934, Great Britain received 130 tons of magnesium from the United States and 861 from Germany; in 1937 it received 147 tons from the United States and 2,011 tons from Germany; in 1938 its imports from this country totalled 186 tons, and from Germany, 1,500 tons. In peace, I.G. was building its capacity for war. Because I.G. had employed the same methods in the magnesium industry in Great Britain as it did in the United States, Great Britain found itself cut off at a single stroke from the major part of its magnesium supply by the declaration of war. Great Britain

had given a hostage by depending on I.G. Dow made its unwitting contribution to Britain's weakness because I.G. had once more fulfilled its role.

As might be expected, there was a European magnesium cartel in which I.G. was the dominant member. While no direct evidence is available concerning the extent to which I.G. retarded magnesium production in France or other future victims of conquest, it is certain that within Germany magnesium production expanded as rapidly as facilities could be increased. The comparative production figures of the United States and Germany for the years 1937-1940 are as follows:

	1937	*1938*	*1939*	*1940*
United States . . .	2,059	2,918	3,039	5,680
Germany	12,080	14,100	16,500	19,000[6]

The frantic efforts which have been necessary to meet our war-time needs for magnesium are the most concrete comment that could be made as to the effect of Alcoa's partnership and Dow's consortium with I.G.

17. BERYLLIUM—THE MAGIC METAL

THERE is no tin in Germany. Neither is there tin in the United States. Its major source is in Asia, unavailable to either. Yet tin is an important metal to a country at war. Our Army and Navy Munitions Board includes it among the fourteen strategic materials necessary to national defense.*

Glass and paper can be used instead of tin-plated steel to preserve food. Germany, for instance, in 1938 alone used 133,000,000 cellulose containers. But tin has another use of great value to armies in the field for which a substitute or ersatz material has for many years eluded capture. This is in its use with copper to make bronze, a traditional war metal.

The laboratories of the great Siemens-Halske Company, an important factor in Germany's scheme for war, by 1929 mastered the problem. They discovered how to make bronze with beryllium instead of tin, and punched another gap in the United Nations' basic strategy—the blockading of Germany.

* Antimony, chromium, coconut shell char, manganese, manila fiber, mercury, mica, nickel, quartz crystal, quinine, rubber, silk, tin, tungsten.

The firm of Siemens & Halske is one of the world's great producers of light and heavy electrical machinery and equipment. Siemens & Halske was organized in 1847 by Ernst Werner von Siemens, a Prussian Army officer, a specialist in artillery, often credited with the invention of the dynamo, and certain military devices. The Encyclopedia of Social Sciences says of Werner von Siemens, "In his business activity Siemens stressed quality, not price [and], the supremacy of collective economic interests over private ones." Today Siemens & Halske, still in control of the Siemens family, is one of Germany's largest concerns, and a member of as many international cartels as I.G., with over 100,000 employees. A district in Berlin, the Siemensstadt, is the headquarters of the firm.

A qualified expert, in his testimony before the T.N.E.C., describes a Siemens & Halske enterprise as follows:

> Dr. Rohn [of Siemens] has the most wonderful metal-working plant I have ever seen in the world at Hanau, near Frankfort, the equivalent of many millions of dollars in this plant, and equipment that will produce alloys, that will produce results that I don't believe can be duplicated anywhere else in the world. I think most prominent metallurgists will bear me out in that statement.[1]

While it may be argued that Germany has to depend on outside sources for beryllium as well as tin, the conditions are somewhat different. Beryl ore which is found in large quantities in South America (where Germany, by the way, got most of its beryl ore), Africa and Asia, is more accessible to Germany than tin. Secondly and most important, beryllium bronze requires only 2% of beryllium instead of 12% tin used in ordinary bronze. For certain kinds of bronze, at least, a stock pile of beryllium is five to six times more effective than tin.

Tin, originally found in the Cornish mines of England by the Phoenicians, has been tied to England, no matter where it was located. The Cornish mines are no longer an important source of tin. The major deposits are now in Malaya and the Dutch East Indies, with Bolivia following far behind. Like rubber, tin is controlled by a British-dominated cartel known as the International Tin Committee, which has jealously guarded its position in the mining and smelting of this strategic metal. Not only the Malayan and Dutch East Indian tin, but also Bolivian tin is reported to be under the dominance of the cartel. For this reason, it is charged, until the Global War no tin smelters were constructed in the United States.[2]

Beryllium is the fourth lightest element known. Only hydrogen, helium, and lithium precede it on the periodic table. Standing alone, it is of little value, as yet, being used in minute quantities in certain precision equipment. When small amounts are alloyed with certain other metals, however, it takes on amazing quali-

ties. For instance, two parts of beryllium added to 98 parts of copper result in an alloy harder than structural steel. Even more astonishing is its tensile strength, which measures 185,000 pounds per square inch. When the same quantities of beryllium are alloyed with nickel it forms one of the hardest metals, and has a tensile strength of 300,000 pounds per square inch.

Comparative figures with other metals will make the qualities of beryllium clearer:

	Tensile Strength
Duralumin (5% copper, 95% aluminum)	53,000 lbs.
Structural Steel	60,000 "
Yellow Brass	70,000 "
Silicon Bronze	90,000 "
Stainless Steel	90,000 "
Phosphor Bronze	100,000 "
Monel Metal	125,000 "
Beryllium	110,000 "
Beryllium Copper	185,000 "
Beryllium Nickel	300,000 "

In other words, a bar one inch square of beryllium nickel would support a weight of 150 tons before giving way.

As a spring, beryllium copper's qualities are second to none. Where a phosphor bronze spring will break after 400,000 vibrations, the best steel spring, after two or three million, beryllium copper and beryllium nickel will go over *20 billion.*

Beryllium alloys were developed in Germany during the middle twenties; in the United States they were not in commercial production until 1934. In this disparity is found another story of Germany's preparation for war.

In 1929 a promoter, Andrew Gahagan, and a scientist, J. Kent Smith, began research in the beryllium field in the United States. After making considerable progress they learned by reading a technical journal that Siemens & Halske seemed to be far ahead. Thereupon Mr. Gahagan began a tour through the tortuous caverns of German deviousness.

First, he discovered that the Siemens & Halske patents in the beryllium field were owned by a New York company known as Metal and Thermit Company. Metal and Thermit referred Gahagan to Dr. Frank, Siemens & Halske's representative in the United States. No one seemed to know precisely whether Metal and Thermit or Siemens & Halske owned the rights. Gahagan described his difficulties as follows:

> For some 3 years, nearly, I had various conferences with the representative of Siemens & Halske. . . . I couldn't find out whether Metal and Thermit owned the patents or whether they didn't own them, or whether Siemens were going into the beryllium business in the United States or whether they were not going into the business.
>
> That left us in a rather precarious position, because if we continued our development, by this time we had

spent considerable money and a few years' work; if we continued the development we might find after 5 or 10 years a lot of overhanging patents, owned by Siemens, which would be held against us and we would be told some day, "Well, you can't operate any more," or "You can't make beryllium copper and heat treat it, or you can't use beryllium copper alloys for certain specific purposes, or you can't heat treat beryllium nickel," and so forth, and the customers we had, or hoped to have in the future, might also be embarrassed.

You see, we had a situation with which I was familiar before the war; a number of patents in dyestuffs were taken out in this country and as a result no dye businesses were started in this country. The patents were held merely, as you are more familiar with than I am, merely as a means of preventing a business in this country.[2]

Mr. Gahagan's suspicions were by no means unfounded. Investigation of the beryllium industry by the Temporary National Economic Committee in 1939 disclosed that Metal and Thermit was acting as a dummy for Siemens & Halske. Under an agreement Metal and Thermit was to receive $10,000 for prosecuting the patents in the United States, so that their German identity could be concealed, then holding them for Siemens in escrow until such time as the latter company desired them back.

Siemens & Halske had not forgotten the activities of the Alien Property Custodian during the war. If war

was to come again would these patents be subject to seizure? Who would know that the assignment of patents was spurious, subject to an escrow agreement? Siemens was also concerned lest beryllium develop in the United States under uncontrolled auspices. In this light the Siemens-Metal and Thermit relationship becomes clearer. The cover is lifted somewhat by the following portion of a letter sent to Metal and Thermit by Siemens & Halske in 1929:

I would at once agree to have the application assigned to your firm, if thereby the matter could be better pursued, when it appears under American auspices before the Patent Office, in a new shape or form. Since you, as I was happy to learn from Dr. Frank, have decided to take up the Beryllium matter in America, I assume that you, too, are interested in the fight for that patent rights (sic), *so that outsiders, like the Beryllium Corporation (and) the General Electric Co., etc., cannot secure any ground in the realm of the Beryllium-Heavy-Metal industry.* [Italics supplied][3]

Mr. Gahagan's difficulties were not accidental. It should be noted that during these years of procrastination and delay, patents stood guard at the entrance to the beryllium industry in the United States. Mr. Gahagan's statement indicates the power of this sentry. Despite the fact that all indications pointed to growing industry in Germany by 1934, not a pound of beryllium

copper had been produced commercially in the United States.

In December 1933 Gahagan decided to deal directly with Siemens & Halske in Germany, after four years of fruitless negotiating in this country. Arriving at Siemens & Halske he learned that they did not desire to license Gahagan's Beryllium Corporation of America or exchange patent rights with him. Thereupon Gahagan left for Paris to try to make a similar deal with the French. This apparently was of great concern to the Germans, for upon learning of Gahagan's trip they wired him to return and resume negotiations.

The resulting contract followed the prescribed formula. The parties, the Beryllium Corporation of America and the Heraeus-Vacuumschmelze Co., which was the beryllium division of Siemens, agreed to exchange know-how and patent rights. The world was divided into certain exclusive areas with Siemens taking all of Europe including the British Isles, while the Beryllium Corporation received the continent of America. The rest of the world remained unallocated, probably due to the infant nature of the industry, although concerning these "other countries agreements will be made from year to year."

What Mr. Gahagan got into after the signing of the contract caused Leon Henderson, Executive Secretary of the T.N.E.C. during the investigation, to exclaim, "It certainly seems to me, Mr. Chairman, that he got

into a series of things that out-Oppenheimed Oppenheim in reality and this whole question of international agreements and understandings ought to be gone into." The verbatim testimony is most eloquent, considering its date, May, 1939:

> MR. COX: [Special assistant to the Attorney General, in charge of the examination] There is one modification (of the contract) I wanted to have Mr. Gahagan tell us about now; the modification to which I refer is the one which permitted you to exercise certain rights in England. Will you tell us about that, Mr. Gahagan?
>
> MR. GAHAGAN: Well, last year when I was going to Europe I was told that a Mr. Jamieson in England was one of my stockholders and that he wanted me to be sure to see him in England. As a matter of fact, he more or less gave me a command to look him up in London. Mr. Jamieson is the chairman of the board of the Vickers Co. The Vickers Co., as you all probably know, is the largest manufacturer of airplanes in England. I was rather surprised at this because I didn't know I had any such stockholder or any stockholder at all in England, so I called on Mr. Jamieson and asked him why he had such an interest in beryllium. *He told me he was very interested in beryllium because he considered that it would probably be a most important metal from a military point of view in the next world war, and I asked him why. He said, "We are entirely dependent upon the Malay Straits and Bolivia for tin, for the manufacture of bronze. The Malay States might be cut off. The few*

tin mines in Bolivia might be blown up and beryllium copper would be the only thing we could use for certain purposes, and beryllium copper is much better than tin bronze. Therefore, I think beryllium copper is extremely important and I wanted to become one of your stockholders to follow your development." As a matter of fact, curiously enough, about every 6 months I have some representative of the British aviation, military attaché, or someone in Washington call on me to find out what we are doing and how we are getting along. They have been doing that for the past 10 years.

Well, Mr. Jamieson then said, "You have a contract with Siemens & Halske, and collateral agreements with other companies."

I said, "Yes, sir; we have."

He said, "You have a provision in that contract whereby you turn over everything to Siemens & Halske in Europe and you agree not to sell in Europe."

I said, "Yes, sir; we have. I am very surprised, however, that you know that because as far as I know there are only three copies of that. One is in my safe, one is in the safe of Siemens & Halske in Berlin, and the other is in Dr. Rohn's safe at Hanau."

He said, "I know it. How I found it out I can't tell you, but," he said, "you are going to modify that contract, because England will not be dependent upon Germany for any military needs."

He said, "We are doing a great deal of experimental work in Rolls-Royce, Vickers, and other companies in England on beryllium copper and beryllium

nickel, and we are buying those materials for experimental purposes in Germany, but we are not going into production on any item unless we can secure our supplies from you entirely or from you as a second source of supply. We don't mind being dependent on you for a source of supply because we are dependent on the United States for a great many metals in any case, but we are not going to be dependent on any nation on the Continent."

He said, "I want you to modify that contract."

I told him, "Well, I have no way of modifying the contract. After all, I have signed it and I expect to live up to it."

He said, "Well, I'll take care of it. When are you going to Germany?" And I told him within a few days, that I would be there for some 3 or 4 weeks. So, after I had been there about 10 days, two unofficial representatives of the British Government came over and talked with Dr. Rohn, and we argued and discussed for about 3 days—I didn't do much discussing or arguing, but I listened to it. The British said, "If you don't modify that contract and permit importation from the United States we are going to confiscate all of your patents, and Mr. Gahagan's patents in England; we are not going to permit some international agreement whereby we are held up for military purposes."

I didn't know under what provisions or how they were going to be able to do that, apparently neither did Dr. Rohn, because he said, "You can't do that. After all, we are not in a war with England—Ger-

many isn't and you can only expropriate patents in time of war."

He said, "Oh, yes; we can do that."

THE CHAIRMAN [Senator O'Mahoney]: Well, the British have a way of asserting what we would call public interest and they call it Empire's interest, over any private contract or private understanding.

MR. GAHAGAN: You can't take out a patent in England and just sit on it.

MR. COX: Was the contract modified then?

MR. GAHAGAN: Very curiously, the contract was modified, made effective the first of this year; under the terms of that we are permitted to sell to England. [Italics added] [4]

This by no means ends the story of beryllium. Once the agreement with the Beryllium Corporation was signed, the Germans were most anxious that the development of beryllium in the United States follow the cartel pattern. Any competitive exploitation might seriously disrupt their plans. For one thing, any new developments and patents or large scale production outside the compass of the cartel might seriously endanger the precise world division of territory. With this in mind, Dr. Rohn of Heraeus Vacuumschmelze came to talk to the P. R. Mallory Co. of Indianapolis. This company was interested in making beryllium copper electrodes. Dr. Rohn suggested to P. R. Mallory that their purchases of the beryllium copper alloy should be from Siemens if the Beryllium Corporation would give permission, or from the Beryllium Corporation itself. In any event, outsiders were not to be dealt with, lest P. R. Mallory's English subsidiary feel the economic power of Siemens & Halske. When questioned by James Wilson of the Department of Justice before the T.N.E.C.:

> "Have you any idea what would have happened to the English company if you had broken off negotiations with the Beryllium Corporation and started purchasing from competitors?"

Mallory's representative answered with a beautiful euphemism:

> "Well, I am quite sure our English company wouldn't have been able to sell very profitably." [5]

Hugh Cox's questioning of Mr. Gahagan about this clinched the point:

> MR. COX: Would it be accurate to say that you suggested to Dr. Rohn that no agreement should be made with the Mallory Co. with respect to the English situation or give it rights under the patent which Dr. Rohn's company controlled unless the Mallory Co. reached some kind of an agreement with you in this country?
>
> MR. GAHAGAN: That is right.
>
> MR. COX: And the agreement which you had in mind was an agreement under which the major company would purchase all of their requirements of the master alloy from your company?
>
> MR. GAHAGAN: That is right; or pay the royalty.

* * *

MR. COX: And was it also a part of that understanding that you suggested to Dr. Rohn that the Mallory Co. not go into any of the fields of fabrication in which your company was engaged?

MR. GAHAGAN: That is right.

MR. COX: And Dr. Hensel was correct, was he not, when he testified yesterday that as a matter of fact Dr. Rohn did lay down those conditions before he would reach any agreement with the Mallory Co. either as to their English company or their use of any patent rights which Dr. Rohn's company controlled?

MR. GAHAGAN: I didn't hear Dr. Hensel's testimony, but that is correct.

MR. COX: You were so informed by Dr. Rohn?

MR. GAHAGAN: That is right.[6]

In 1935 Dr. Ferdinand Kertess, a representative of the Deutsche Gold und Silber-Scheideanstalt, a German corporation closely related to Siemens & Halske and I.G., suggested to the one American producer outside the cartel that "some cooperative basis" for the orderly development be arranged.

> . . . It came to my mind whether it would be a good thing for all of us if you could consider some cooperative basis with beryllium products companies.
>
> * * *
>
> If you, for instance, could come to a comparatively loose agreement with Beryllium Products Co., your company handling the metal, Beryllium Products handling the alloys, or whether you could even make up your mind to acquire shares in the Beryllium Products Co. to make the tie a closer one, it would naturally be a matter you have to decide yourself.
>
> Should such cooperation between you and Mr. Gahagan be possibly established, we would throw in our own experience and development. I feel that beryllium and its alloys could be made an object, giving extensive profits to all concerned, saving tremendous expense to each and everyone of us, and giving special benefit to all to make such thought worth while.[7]

It is significant to note that, on November 6, 1942, Dr. Kertess was indicted by a Federal Grand Jury in New York for smuggling metals to Germany.

Outsiders are dangerous to cartels. Nevertheless, Brush Beryllium Company turned down the proposal.

When the present war began in September of 1939, the Siemens & Halske Company demanded that the Beryllium Company refrain from selling to Great Britain, claiming they had the power to require this even under the amendment to the contract related above. The Beryllium Corporation disputed this interpretation and continued to supply Great Britain.

Beryllium is now part of our arsenal for war. Its future for peace is assured. Some day it may be used in its pure form to displace aluminum and magnesium especially in aviation. It is, after all, the lightest of all metals in a "Light Metals Age."

18. KRUPP

The Hammer of Thor

FOR more than a century the name of Krupp has been the symbol of martial industry and of German economic militarism. The history of this firm is a history of warfare. Since the era of Napoleon, Krupp's products have been present in every European struggle, more often than not used by both sides, but for the most part providing the artillery hammer of Prussian-German armies.

The firm of Krupp was founded in 1811 by Friedrich Krupp for the production of heavy iron and steel castings. In 1826, when Friedrich Krupp died, the management of the firm passed to Alfred Krupp, and it is because of his endeavors that the name of Krupp became inextricably linked with the production of armament and ordnance. It was Alfred Krupp who perfected the crucible steel used in producing the cannon which made Prussian artillery the master of the armies of Europe.

In 1867, Wilhelm the First became one of the largest shareholders in Krupp, and this relationship was boldly

acknowledged. By the time Alfred Krupp died in 1887 he was known as the "Cannon King," and the products of Essen were rated as the best of their kind in the world.

Alfred Krupp's successor, Friedrich Alfred Krupp, combined in his person as in his name the abilities of his predecessors. Under his suzerainty the Krupp works further expanded to include iron mines, coal mines, blast furnaces, and similar sources of material required for the manufacture of arms. The Krupp laboratories, conducting research in metallurgy, especially the properties of steel and steel alloys, were comparable, although on a lesser scale, to those of I.G. When Friedrich Alfred Krupp died in 1902, the name of the firm was synonymous with German might.

In the following year, 1903, the Krupp works were formally incorporated with an authorized capital stock of some 160,000,000 gold marks. The corporate assets of Krupp included railroads, shipyards, coal and iron mines, massive foundries, blast furnaces, and all the appurtenances of the "heaviest" of industries. The plant at Essen measured nearly 300 acres, and Krupp's employees numbered 100,000.

During the decade from 1903 to 1913 Krupp arms, produced in ever-growing quantities, were sold to some extent outside of Germany, but it was to the minions of German imperialism that the bulk of Krupp's output was devoted. Of the estimated 53,000 cannon made by

Krupp up to 1912, some 26,000 were sold to Germany, and 27,000 to 52 different foreign countries. Krupp was "the matador of the international armament industry, preeminent in every department." Nor were the Krupp interests confined exclusively to heavy ordnance. They were represented in the international gunpowder cartel of 1897. Through the development of metallurgical processes and the procurement of patents, Krupp's associations with steel and arms makers outside Germany were firmly cemented. Although Krupp had not been, originally, a member of the German steel syndicate because of a disagreement over the proportionate output quota which it was to receive, it immediately joined when the 1904 cartel was formed, and obtained a much larger quota than that originally allotted. Thereafter, the behavior of the cartel was largely dominated by Krupp.

Since the possession of coal and iron is the prerequisite of industrial greatness, Germany was assured, once her economy passed from the handicraft to the machine age, of prominence in the concert of powers. Combination in the coal and iron industry began very early, and a succession of steel, coke, and coal cartels were formed during the second half of the nineteenth century. With the discovery of the Thomas process for the production of "basic steel" * the cartellization of the

* Sometimes called basic Bessemer.

steel industry went forward with increased vigor and intensity.

In the cartel in which Krupp held a controlling position, a central company, the Stahlwerksverband, became the legal personification through which the members effected their agreements. The objects of this cartel were the maintenance of the domestic market, the standardization of steel operations, and especially the elimination of any competition among its members in markets outside Germany. The thirty-one original members among them governed every branch of the steel industry. They were primarily concerned with the international market.

Through the medium of the International Steel Beam Pool, in which the steel makers of Belgium and France were included, and of which the United States Steel Corporation and the Pennsylvania, Maryland, and Cambria Steel companies were members, the world market was divided. The American producers received the United States, Central and South America, and the European producers, the rest of the world.

It is worth note that the American companies requested that the cartel keep secret the terms of the various agreements. The directors of the steel syndicate consequently refused to "discuss or divulge" agreements with American companies.

Already the manner has been pointed out in which German steel interests exercised patent control over

processes and products which this country later needed when it entered the first World War. Krupp in particular held numerous patents on important steel and ordnance techniques. The trailers for field guns which the American Army used were covered by Krupp patents. Also, among the most valuable patents seized by the Alien Property Custodian were those covering the Krupp methods for making stainless steel.

Throughout the war, Krupp's factories and foundries poured forth the torrent of cannons and other arms which pounded the Allied lines for four long years. It was not through any fault of Krupp that Germany lost the war, and among the Allied Nations Kruppism became the object of as much anathema as that which attached to the imperial monarchy itself.

When the war ended, many of Krupp's machines were dismantled, and Krupp was specifically forbidden to engage in the further manufacture of arms. This prohibition did not long stay its operations. The foundries and factories were turned over to the production of locomotives, trucks, Diesel engines, cash registers, and other ostensibly neutral articles of ordinary commerce.

Even before the war, Krupp had manufactured some armaments outside of Germany proper. Thus, for example, the famous "Big Bertha," which was manufactured in 1911-12, was built in Hungary. After the Treaty of Versailles, Krupp transferred many of its

operations to surrounding countries, and reestablished its connections with the major steel and metallurgical interests of the world, including the United States, England, and France. Although within Germany Krupp was supposed to be producing only peaceful articles of trade, the ink on the Treaty of Versailles was hardly dry before it had begun a refurbishing and reorganization of its armament industry. It is certain that Krupp was a factor during the 1920's in the international armament industry, as was shown by the abundance of testimony and evidence introduced in the Nye Committee hearings on the munitions industry in 1934.

The United States Army was acutely aware and made a conscientious study of Krupp's activities. The United States War Department on May 20, 1921, authorized the publication of the following:

> The Secretary of War has caused an investigation to be made of the patents and applications for patents recently announced as having been obtained by German citizens and assigned to Frederick Krupp. The investigation disclosed a rather striking circumstance in view of the conditions which Germany is supposed to observe as to disarmament and manufacture of war materials under her treaty obligations.
>
> Of the 228 patents and applications for patents assigned to Krupps, 26 were found to relate to artillery fire control devices, 18 to electric control apparatus, 9 to fuses and projectiles, 6 to gas engines and appurtenances, 17 to guns and their appurte-

nances, 3 to processes for the production of metals, 10 to naval fire control devices, 3 to projectiles and machines for handling same, 14 to railroad artillery, and the balance to varied uses, most of which might well relate to military use.

Incident to making this investigation, it was noted that a large number of patents and applications for patents had been assigned to numerous other German companies, and a casual examination indicates that a considerable number relate to aeroplanes and their accessories, chemicals, dyes, radio apparatus, and naval equipment.

One specific bit of evidence concerning the post-war activities of Krupp is given by Nicholas Snowden in his "Memoirs of a Spy." In 1921, he relates, while on a mission to Hungary, he visited Raab. He says:

> I learned there that the Krupps, although ostensibly devoting the plant to the making of agricultural implements, were actually and secretly manufacturing guns also. I learned through some of the workmen that whenever the Disarmament Control Commission of the Allies was to come for an inspection of the factory, the management was notified 48 hours in advance by the Hungarian military authorities. This gave time to stop the work in the departments where artillery and rifles were in the making, and to cover the machines and arrange things so that the Commission would find the place deserted.[1]

Krupp's relationships in the post-war era to other sectors of German industry provides an interesting

commentary on the purposes and organization of the German cartel system during the years of the Weimar Republic. It is certain that Krupp is closely tied in with the Siemens-Halske interests and the other heavy industry groups in Germany. Even more startling is the relationship substantiated by a communication from H. E. Osann, a former officer with the American Army of Occupation in the Rhineland. In a letter dated January 19, 1929, from Osann to David Buckley, Jr., attorney for the Driggs Ordnance Company concerning certain projected negotiations with European ordnance companies, it is stated:

> I have made a little private investigation of my own regarding this interesting enterprise; I will not bother you with details, but can resume the result by stating that Bofors is Krupp and *Krupp is I. G. Dyeworks*. The frequency with which I refer to I. G. Dyeworks in my various reports to you is not due to the interest which I am taking in this concern with regard to a certain matter, but six weeks in Germany have convinced me that *I. G. Dyeworks is the real octopus embracing almost everything in the economic and a large part of the political, life of post-war Germany*. Whenever you mention the name of I. G. Dyeworks to anybody in Germany, he registers awe, fear, admiration, and the desire to be somehow involved in a transaction which might bring him closer to that giant organization.[2] [Italics added]

In support of this observation it may be pointed out that on purely technical grounds, Krupp and I.G. were

bound to impinge on each other's orbit, not only through the activities of Krupp in the metallurgical field, but also through the increasing use of light metals in the production of plowshares and armaments. Krupp's interests in alloys and metallurgy and I.G.'s control of the light metal industry of Germany create a logical intercept joining their respective spheres of action. When Hitler came to power, the Krupp company developed the scheme whereby German industry contributed to the organization funds of the Nazi party.

It is significant that duPont's foreign representative was later informed of Krupp's action by representatives of I.G., as is indicated in a letter dated July 17, 1933, from Homer Ewing to W. R. Swint of duPont's Foreign Relations Department, which set forth results of his conferences during a trip to Germany, in which it is stated:

> . . . we called at the main offices of I. G. Farbenindustrie and spent some time with Dr. von Schnitzler and Dr. ter Meer, and were later joined at luncheon by Mr. Weber-Andreae. . . . The German gentlemen discussed the political situation in Germany, with particular reference to the positive position of the Government against the Jews. They also explained how Herr Krupp has developed a scheme whereby industry could contribute to the party organization funds.[3]

As the foremost German producer of steel and steel products, and as a member of several international cartels, Krupp tended constantly during the post-war era as it had in the pre-war period to expand and reach out into different branches of metallurgy. During that signal year for the reconstitution of the German economy, 1926, a new international steel cartel came into being. On April 1, 1926, Germany, France, Belgium, and Luxembourg formed a cartel which was subsequently joined by the steel industries of Poland, Austria, Hungary, and Czechoslovakia. This reincarnation was enthusiastically greeted by the public press in Germany and in France. As with similar agreements, the main difficulties arose within a few years from the insistence by the German members, including Krupp, that they be allowed to produce in excess of quota. Eventually German steel production, which rose from year to year, far outstripped the other nations of Europe, including England, whose steel makers continued to observe the limits set in the various agreements.

When the blitz began in 1939 the Hammer of Thor struck hard.

19. TUNGSTEN CARBIDE—THE MARTIAL DIAMOND

THE steel forged by Krupp must be carved into tanks and cannons. To hew the fearful contours of howitzers and panzers from hardened steel is not an easy task. Only the toughest and sharpest edge can be pitted against its strength and resistance, to drill, thread, shape, and cut its adamantine mass.

Just as Siemens-Halske developed beryllium to harden copper, Krupp evolved the use of tungsten to harden steel.* To machine a steel so obdurate, tools with even greater cutting power were needed. Tungsten carbide was Krupp's solution to this dilemma.

In modern war, machine tools are the engineer battalion of industry. The machines which slash at the enemy must first be fashioned in factories behind the front. The place of machine tools in our mechanized civilization has been neatly depicted by Dr. Ernst Ammann, a director of Krupp:

* This is not to say that Krupp was first or alone in the making of tungsten steel. Krupp's laboratories, however, made long strides in tungsten's applications.

> Tools and machine tools form the basis for any professional production of goods in a country generally. They serve the production of all other machines, expedients and devices for traffic, agriculture, power production and trade. Without highly developed tools and machine tool industry in no country is there a production of goods economical to the maximum.[1]

When a shortage of machine tools appears, the production lines slow down. In this country, the scarcity of machine tools is rated as the third most critical deficiency, preceded only by airplane engines and armor plate.

The essential part of these industrial scalpels is their cutting edge, which in America is largely made of stellite, a high speed tungsten steel.

Tungsten is mined chiefly in China, which possesses the most abundant sources, and provides the largest portion of the world's supply. The United States, India, South America, and Europe, in approximately that order, furnish the balance. While not produced in large amounts because of the scarcity of its occurrence and the difficulties surrounding its extraction, it is "one of the most essential metals of modern industry." Hugh Farrell says, "Tungsten would supplant copper tomorrow if there were enough of it, but there isn't. It might also supplant steel, but for the same handicap. *Tungsten is king of metals.*" [2]

The large reserves of tungsten were far away from Germany over the horizon of the oceans. The "sandbox" of Europe contained a pittance. A stock pile no matter how enormous was finite. If Germany could reduce the use of tungsten in cutting tools, more would be available for ordnance. Tungsten carbide was the answer.*

By using it Germany could most efficiently husband the limited tungsten which it could draw from its reserves once war began. The Germans were denied access to the rich sources of this metal in China, but the United States and Britain were also denied access once Japan became a warrior partner of Germany.

It is interesting to compare the estimates of an American and a German expert on the utility of tungsten carbide. The contrast between the geopolitical acumen of the two statements, however, explains the difference between the quantities of the compound employed in the two countries.

The American writer, an official of the General Electric Company, in a "sales letter" to the War Department, states:

> Cemented carbide is, of course, a new material—at least from the standpoint of war. It was not available at all during the World War and, in fact, it had its beginning in a search for a substitute for diamonds for wire-drawing dies. Even though the industry is only about 10 years old, Germany has taken advantage of the fact that a pound of tungsten will go much further in industrial production in the form of cemented carbide than in the form of high-speed steel; the same is true with reference to stellite, an alloy of chromium, cobalt, and tungsten. The extent of this superiority cannot be stated with accuracy, but in some cases it is at least 100 to 1.
>
> For the last several years Germany has used probably three times as much of this material as all the rest of the world together.[3]

Dr. Ammann, of Krupp, in a general report on tungsten carbide, analyzed the position of the United States as follows:

> . . . from the point of view of the interests of political economics . . . the United States too is lacking tungsten resources and has to import 75% of its requirements from foreign countries. . . . If cemented carbides were introduced generally the American domestic production of tungsten would be sufficient to cover the entire tungsten requirements of the American machining industry.[4]

Again the same old story—China's tungsten could be transported only on Britain's highway. Germany did not even try to cross this reef of the war. By combining the means at hand in their most efficient proportions, it was possible to stay within the British quarantine, and out of a bad situation make something better.

Tungsten carbide is second in hardness only to the

* Sometimes called cemented carbide.

diamond. It is harder than sapphire. It is the best material discovered yet for machine cutting tools and wire-drawing dies. Qualified experts have stated that tungsten carbide is the key to a 20% increase in the total industrial production of the United States. In the January 1942 issue of *Fortune* magazine is made the following estimate:

> *How was impoverished Germany able to build her awesome war machine in . . . six short years . . .* ?
>
> The answers have been many. . . . All the popular explanations have overlooked the possibility that a few hundred tons of phenomenal steel-cutting material called tungsten carbide may have been a decisive factor in the building of the arsenal of Hitlerism. . . . Monstrous Big Bertha of World War I was tooled with tungsten carbide, and the new substance gave German industry a decided advantage over the Allies (who had developed nothing comparable) in armament production.
>
> . . . In many machining operations substitution of tungsten carbide for highspeed steel multiplies the rate of production at least 500 per cent. . . . *Britain, France, and the U. S. were sluggish about retooling, and it is estimated that in 1938 Germany had twenty times as much tungsten carbide in use as in the U. S.* This—according to many experts—is one of the great secrets of German rearmament. These experts also think that without tungsten carbide it would have taken the Reich twice as long to achieve half the results. Furthermore, fragments of shells picked up on various battlefields indicate that Germany is using tungsten carbide for projectile tips and even may have developed a superior lightweight armor plate consisting of thin layers of carbide and steel.

In 1928 Krupp was selling small amounts of tungsten carbide in the United States at a price of fifty dollars per pound. The General Electric Company, at about the same time, had also made some discoveries concerning the amazing properties of this compound.

What followed is a syllogism in political economy. Krupp is a German cartel. General Electric is the chief proponent of "stabilization" of industry in the United States. From these corporate premises, only a cartel agreement could be deduced. They were drawn to each other by the polarity of conflicting patents.

The first agreement between Krupp and General Electric was dated November 5, 1928. This meeting of minds provided that G.E. prescribe and set prices and conditions of sale of all tungsten carbide sold in the United States. Krupp received in return "certain specified money," determined by the quantity which G.E. sold. Krupp was to refrain from production of tungsten carbide in this country. Technical knowledge and patents were pooled.

Because G.E. feared the possibilities of Krupp's competition in the United States, as Krupp had the right to sell here, and openly desired to engross the world market, the 1928 contract was unsatisfactory. Krupp, on

its part, did not like G.E.'s potential exports. Therefore, with mutual consent, the old agreement was modified in 1936.

Krupp promised neither to sell nor to ship tungsten carbide in bulk or tools to the United States; G.E. agreed not to export such products. G.E. was given the United States market, and Krupp the world.

In addition, Krupp reserved significant control over the future of tungsten carbide development in the United States. G.E. could grant no one permission to manufacture or sell tungsten carbide, other than those licenses already granted, *without the approval of Krupp.* Although Krupp agreed to stay out of the United States market, it retained its grip on the right of American producers to enter this important industry. Krupp thus had power which the Supreme Court decided could not be exercised by the government of a state of our Union:

> . . . it is beyond the power of a state, "under the guise of protecting the public, arbitrarily (to) interfere with private business or prohibit lawful occupations or impose unreasonable and unnecessary restrictions upon them." [5]

Those few concerns operating under licenses from the G.E.-Krupp entente were required to sell at prices in accordance with General Electric's.

The extreme differential in the use of tungsten carbide in this country and in Germany springs directly from these arrangements. Price fixing has as its aim the receipt of optimum revenue for a minimum of output. G.E. sold tungsten carbide for sums as high as four hundred and fifty-three dollars a pound—nine times as much as its selling price in Germany, even more than the price of gold.

At no time during the General Electric-Krupp arrangement did the price in the United States drop below two hundred and five dollars a pound. A comparison of American and German prices on tungsten carbide reveals much in a few figures:

G. E. Price per Pound	*Krupp Price per Pound*
$407.70	$90.60
362.40	67.95
298.98	49.83
280.86	45.30
253.68	45.30
249.15	45.30
240.09	43.035
231.03	41.676
226.50	40.317
217.44	39.411
208.38	38.958
203.85	37.599
199.32	37.146

Meanwhile, Krupp sold ever larger amounts of tungsten carbide to German industry.

The same two officials quoted above emphasize the discrepancy in the use of tungsten carbide in their respective countries. The G.E. official states:

> Concerning the amount of business being done by the Germans and ourselves, a few figures and calculations may be of interest. By combining the information obtained from Drs. Oehake and Ammann it appears that together they are making about 8,000 pounds of hardmetal composition monthly; this is approximately the amount being sold in one year in the United States. We also got the amount of business in marks, which totals for both groups about 900,000 marks per month.[6]

Dr. Ammann cites in unmistakable terms the reason for Germany's extensive use of the compound:

> Under the pressure for *higher efficiency* and *shorter deliveries* [the opposite of too little and too late!] the use of cemented carbides in Germany has achieved a tremendous uplift, in comparison with which the American development is the less understandable, as America is generally known for its trend of grasping for the latest and most progressive manufacturing methods and developing them further. [Italics added] [7]

The uncontaminated "instinct of workmanship" of a G.E. engineer rebelled at this "conscientious withdrawal of efficiency" which was reflected in the non-use of tungsten carbide by American industry. In a report

addressed to the Employee's Suggestion Committee of G.E., this engineer pointed out the "absurdly fictitious prices" which G.E. was charging. Stating that the aura of intricacy in which G.E. shrouded tungsten carbide's manufacture was feigned, the technician says:

> *A great deal of mystery has surrounded the production of this material since its inception.* As a matter of fact, it is just about as complicated as making a good grade of concrete for a sidewalk: Grind up material, pass it through a mesh, put a certain percentage of binder with it, press it into a cake and bake it.
>
> We are equipped in Schenectady at the present time to manufacture 200 lbs. per week in various tip sizes ready to be ground for tools. This is based on an 8 hr. shift of one man and one boy. [Italics added]

To remedy this situation, the engineer suggested that the price be reduced to

> . . . $50.00 a pound which is a fair market price for these goods and is approximately the price that I found the Krupp Company were selling tip material for last year.[8]

G.E. turned down this proposal, for:

> . . . due to the contractual relations now existing between the General Company and the Carboloy Company on the one hand and the Krupp Company, the Firth-Sterling Company, and the Ludlum Steel Company, it would be impractical at the present time. . . .[9]

G.E.'s licensees in the United States champed at the bit which curbed their eagerness to produce and sell tungsten carbide on a much larger scale. They also understood the cause and effects of the cartel. As stated tersely by Gerald Firth, the principal sublicensee of G.E., and second largest producer in the United States, in a letter written in 1931:

> Please bear in mind that as I have said before, the price in this country is from ten to fifteen times the German price and that is a difficult thing to justify now that industry in general is recognizing the value of our product.[10]

A decade later Mr. Firth could render an even more damning verdict:

> The control of the tungsten carbide patents by the General Electric Company and the Krupp Company has resulted in keeping the prices at exorbitant levels. Now when the emergency has come, industry has not learned how to use tungsten carbide and has not the machines, the skilled men, or the technique which it would have had if the material had been available at the same low prices at which it was available to German industries.[11]

20. THE WIZARDS OF JENA

NOTHING has been more characteristic of German militarism than its exactness and love of detail. No branch of the German Kriegswirtschaft * is more painstaking or precise than the Carl Zeiss factories of Jena, which make the precision optical goods that control the aiming and firing of bomb and shell.

Because of the function in Germany's preparations for war, the Zeiss-works have been for decades the special ward of the General Staff. Army officers are assigned to Zeiss at all times, to participate in research.

The wizards of Jena epitomize the perverted virtues of the Teuton mind. Their goal is scientific perfection—they approach the ultimate symmetry of art and science. Zeiss cameras have no peer, and their sale provides the profit which supports research in optics. But this research achieves its pinnacle in instruments of war. Figuratively, Zeiss makes the monocles which Krupp cannons and Stukas wear.

Among the 50,000 or so essential items required by the Army, Navy, and Air Force of a modern nation at

* War economy.

war, none are more necessary, with the exception of munitions, than the "eyes" and "automatic brains" which locate a target, calculate its position, and control the firing of the big guns or the "bracketing" of an objective by bombs. These duties are performed in the main, by precision instruments whose utility results from the use of high grade optical glass.

The position of strategic importance occupied by the optical glass industry derives from the absolute dependence of military, naval, and aeronautical operations on the optical precision instruments which they must employ. Precision instruments are as necessary in preliminary reconnaissance as they are in the successful execution of combat operations, but it is in the latter that their use is critical. Whether in an encounter between great battle fleets at sea, or in an artillery engagement on land, or a "dog-fight" in the air, accuracy and timing of fire are decisive in the outcome. Superiority, or at least equality, with respect to the precision instruments available to its fighting services is therefore vital to a nation at war.

In ordinary usage, the words "optical glass" are associated with spectacles. Actually, there is a great difference between the ophthalmic glass used for correcting poor vision and the optical glass used in precision instruments which serve as the eye-pieces of science, industry, and war. The names of the principal types of precision instruments indicate their respective functions.

The general class includes microscopes, telescopes, spectroscopes, and photographic lenses for scientic, industrial and military use. The specific group of military optical goods includes all manner of periscopes for submarines, torpedo directors, range-finders and height-finders (altimeters), bomb sights, bore sights for battleship guns, and all the other complicated mechanism employed in controlling the speed and accuracy of fire.

During the nineteenth century, the production of optical glass was carried on almost exclusively in Europe, especially in Germany, with France and Great Britain contributing minor amounts. Within Germany, the pioneer work in optics and the manufacture of optical glass and precision instruments was primarily carried forward by the researches of Carl Zeiss and Professor Ernst Abbe. Carl Zeiss (1816-1888) in 1846 established in Jena a workshop manufacturing scientific instruments, and acquired a reputation for the quality of his microscopes.

In 1866 Zeiss was joined by Dr. Abbe, a mathematician and physicist, whose talent for original research was amply displayed in the contributions he made to the theory and practice of optics. A third figure, Dr. Otto Schott, whose ability supplemented that of Zeiss and Abbe, is noted as one of the first makers of the kinds of optical glass which were called for by the "dream optics" with which Abbe was concerned.

Schott joined Zeiss and Abbe in Jena in 1882, and

although the Schott Glass Works were at first nominally separate from Zeiss, they became a working unit, and are directly merged in the Zeiss Foundation. This was formed in 1891, and is a type of "trustee foundation," a quasi-state-controlled and state-administered enterprise, supported by the original endowment and, at least partly by the government, but operating theoretically as a "guild." The board of directors are the controllers of its general policies.

Zeiss became not only the largest, but by all odds the leader of the world in the field of military optical equipment. From its laboratories and shops poured forth a stream of instruments and inventions which assured Zeiss world monopoly.

The Zeiss trademark became the "stamp of perfection" for all types of optical instruments, ranging from simple microscopes to the most complex aerial camera or range-finder.

The Zeiss Stiftung (Foundation) stipulated that the manufacturing plant might not be moved from Jena, but subsidiary factories have been built, both in other cities in Germany, and other countries in Europe. Branches exist in Vienna, Raab (Hungary), Riga (Latvia) and in Dresden (where Zeiss controls the Ica Co., the largest European makers of photographic apparatus), Göttingen, and Saalfeld, in Germany. Zeiss controls or licenses several lesser optical firms in Germany and France, and even before the World War

Zeiss distributing outlets covered "the entire globe." Before 1939 Zeiss plants were built in the "safe area," where Germany seeks to hide many of its war-plants from the eyes of enemy bombers.

Zeiss dominates the "interest-group" of German optical industries, in which the C. P. Goerz A.G., Ica, Contessa-Nettel A.G., and Ernemann A.G. are fused directly under the controlling interest which Zeiss has in each. An I.G. subsidiary, Rietschel G.m.b.H., does not enter directly into the Zeiss-Icon group, but serves I.G.'s own interests in this field.

During the World War, Zeiss alone employed more than 10,000 people. The period following the war did not affect Zeiss's business although at the war's end 90% of its products went to the Imperial German Government. Zeiss built new plants in surrounding countries, and soon was operating internationally much as it had before 1914. It is today the largest of all optical instrument manufacturers.[1]

German monopoly in the industry was reflected in the advantages enjoyed by German arms. The amazing accuracy of Admiral Hipper's battle cruisers in the engagement with Beatty during the Battle of Jutland, when half of Beatty's fleet was destroyed in a few minutes, is attributed to the superiority of the fire-control and range-finding equipment of the German ships. When Beatty said, "Chatfield, there seems to be something wrong with our —— ships today," he was un-

wittingly complimenting the skill of Zeiss in making optical equipment which Jutland proved to be the best in the world at that time.

The cutting off of imports from Germany to the United States created a deficiency in optical glass, such as that which existed in dyestuffs. In the U. S. Ordnance Department report on the problem of optical glass in the World War, it is stated, "In industries of a highly technical nature, such as—the optical glass and instrument industry, the Germans had established such effective control that at the beginning of the war we were seriously embarrassed because we did not manufacture these commodities, and did not know how to make them."

Geometrical optics is the basis of the military optical goods industry. This involves the investigation of the structure and function of all optical precision instruments and their application in scientific, industrial and military pursuits.

The productive factors of the military optical industry are deceptively simple. Pure sand, and common oxides of metals, such as potassium, sodium, barium, boron, and others, are the chief components of optical glass.

The manufacture of optical glass is intrinsically a secretive, jealously guarded craft. "Know-how" is much more important than any formal patent prescriptions, and this has been the basis of Germany's monop-

oly in the industry. Although the formulae of the different types of glass are generally known, it is in the esoteric, yet actually ultra-scientific judgment, patience, and attention by which a batch of sand is slowly smelted, annealed, tempered, and ground into a perfect optical lens that the clew resides.

Time, men and machines are the factors on which the industry depends. The initial step in making optical glass is the moulding of the clay-pot in which the sand is fused. This pot is the heart of the process, and requires months to season before it can be used, and then only once.

Once the "melt" of optical glass has been brought safely through the fusing and cooling periods, it must be carefully broken, and finished, both by machinery and by hand, before it is possible to achieve the perfect lenses and prisms which will go into a range-finder or a bomb-sight. The whole arduous task of manufacture can be made worthless if inexpert or inaccurate polishing ruins a high-powered lens.

The fine machinery used is difficult to design and construct. If there has been no preparation, it is impossible to make these machines in a short time, for they are the product of years of research.

The human element, however, is hardest of all the components to locate. The art of optical workers results from years of training, and is handed down from father to son.

Neither legislation nor money can by themselves call into being an optical glass industry. This is the reason that a monopoly in the industry is dangerous. If war comes to a nation that does not already have an optical industry, the seizure of patents means nothing. Because of the time required to train skilled workers, make precision tools, and painfully experiment with batch after batch of glass, it is next to impossible to correct overnight the failure to prepare.

In 1848-49 two gifted immigrants journeyed to the United States, economic refugees from the Germany of 1848. Henry Lomb and John Jacob Bausch established a small retail spectacle industry in Rochester, N. Y., in 1853. Time was kind, and the business prospered. In 1876, Bausch & Lomb undertook to produce such optical instruments as microscopes, but on a relatively small scale. In 1883 photographic lenses were added to their products, but since 1921 few have been made. At the present time the company is capitalized at $9,100,000, has a net worth of nearly fourteen millions, and an annual sales volume of some $18,500,000.

In 1888 Edward Bausch, son of the founder, went to Germany and obtained licenses from Zeiss for the manufacture of optical measuring devices, military optical goods, and similar products. This arrangement continued for a number of years, until 1907.

In 1904, Professor Siegfried Czapski, the successor to Abbe, visited the United States, intending to open a

branch manufacturing plant for Zeiss military apparatus in this country. He visited Rochester for some time, conferring with Bausch & Lomb and with George Saegmuller, of the Fauth Instrument Co., which manufactured equipment for the Navy. Czapski returned to Germany, and as a result of his negotiations, Bausch & Lomb merged with Saegmuller's company.

In 1907 a contract was entered into between Bausch & Lomb and Zeiss, by which the former became the exclusive agent of Zeiss in the United States. Zeiss bought one-fifth of the capital stock of Bausch & Lomb, and this alliance continued in force until the United States entered the World War.

Throughout the entire period, until 1914, no optical glass was made in the United States. From the beginning of its operations in the instrument business, Bausch & Lomb purchased the glass it used in its products from Germany, entirely from Zeiss, whose monopoly with regard to the glass, without which any precision instrument is useless, was virtually complete. Even in England, where Chance Brothers produced optical glass, Zeiss was a major factor in the market. In France, as Hauser remarks, "—the country of Foucault" was a "payer of tribute to Zeiss." *

Even before the war, more than one-half of all Zeiss production in Germany went to the German Army and Navy. Consequently, when war began, those countries

* J. B. L. Foucault was a famous French physicist (1819-1868).

dependent on Zeiss for optical instruments, like those dependent on I.G., encountered a severe shortage of military optical apparatus which continued through the entire period of hostilities.

Bausch & Lomb had, most opportunely, begun experimenting in the production of optical glass in 1912, but when we joined the Allies, these efforts were still unsatisfactory. The Ordnance report quoted above states, "The quality of glass obtained (i.e., by B. & L., Pittsburgh Plate Glass, the Bureau of Standards, et al.) was not, however, entirely satisfactory, and by the time we entered the war the shortage of optical glass of high quality was so serious that unless something was done speedily to relieve the situation, the Army and Navy would not be equipped with the necessary optical instruments."

The strenuous efforts of the Government, and those of Bausch & Lomb and the other manufacturers, to learn the "know-how" were able to overcome the shortage, and to produce some 600,000 pounds of fairly good glass. "This was accomplished, however, under high pressure and at large expense—." Bausch & Lomb were later commended for their part in these efforts.

In 1914 the Allies had sought to place orders with Bausch & Lomb, as Zeiss no longer could be a source of supply. Zeiss objected, and it appears that Bausch & Lomb bought back the stock in their company which was owned up to that time by Zeiss. This cessation of

relationships continued until after the war. When the United States came in, the Zeiss patents were seized by the Alien Property Custodian and later sold to the Chemical Foundation. But the effect of the pre-war monopoly could not be readily escaped. The Navy issued appeals to the public to contribute field-glasses and other usable optical devices. The Alien Property Custodian later uncovered sizable stores of telescopes, binoculars, and other optical instruments, which had been placed in warehouses by German interests.

After the Armistice, the concerns other than Bausch & Lomb which had made glass for war purposes left the field largely to the Rochester firm, although the Bureau of Standards continued to produce some. In 1921, after trips to Germany by executives of Bausch & Lomb, relations with Zeiss were resumed. In a contract, written in German, dated April 28, 1921, intended to endure for twenty-one years, Bausch & Lomb and Zeiss demonstrated that, to quote a pamphlet issued by the former, they had agreed to let "bygones be bygones."

This contract is a curious document, but corresponds to the now-familiar form of an international cartel agreement sponsored by a German concern. Under the Versailles Treaty, Zeiss had been forbidden to make military optical goods, but apparently anticipated the resumption of its "forte," directly and indirectly.

The 1921 Agreement divided the world market for optical goods, the United States to be the exclusive ter-

ritory of B&L, reserving the rest of the world to Zeiss in the manufacture and sale of military instruments. B&L received exclusive rights under Zeiss patents and "know-how," and in consideration Zeiss received a royalty of 7% on all military apparatus sold by B&L, regardless of its inclusion in the Zeiss patents. If either party received bids from a source outside its exclusive territory, it was to inform the other, and to quote a price 20% above the regular selling price. Even such marked-up bids could be submitted only with the consent of the other party.

The contract provided for the establishment of a "Military Department" in the Bausch & Lomb organization, to be solely responsible to the Board of Directors, and to be headed by personnel approved by Zeiss. Both were to have access to each other's workshops, and to receive the benefit of future developments made or acquired by either. The contract specifically stipulates that Bausch & Lomb is to make available to Zeiss any "independent" inventions or patents procured from other sources.

One or two paragraphs in this contract merit quotation as having peculiar connotations. First, it is stated that "The contracting parties agree to keep the foregoing agreement in strict confidence as regards a third party, and to guard silence concerning this agreement also with their own employees as far as this may be practical under the circumstances." [2]

This 1921 contract was modified in 1926, when it came to the attention of Bausch & Lomb's attorneys. At their insistence that the market-dividing clause overtly violated the Sherman Act, a new contract was drawn up on November 26, 1926, which altered the wording of the objectionable sections, and added the proviso that Bausch & Lomb were to communicate bids from commercial houses in Zeiss territory to the N. V. Nederlandsche Instrumenten Compagnie, the wholly owned Zeiss subsidiary located at the Hague.

Governmental and shipyard inquiries from outside the United States were to be communicated directly to Zeiss in Jena. The essential monopolies of Bausch & Lomb as the exclusive licensee in the United States, and of Zeiss in the rest of the world were not touched, and it is only in the phraseology that there is any alteration in the paragraphs which the attorneys questioned.

Some notable consequences ensued from these cartel agreements. In the first place, it is clear that by the medium of accounting on royalty payments, Zeiss was constantly aware of all the particular types of sales made by the American company. Thus, it became a simple matter for Zeiss to ascertain exactly what kinds of equipment the government of the United States was buying from Bausch & Lomb. That this flow of military information to Zeiss was fraught with grave questions is indicated in a letter of July 9, 1929, from Bausch & Lomb, Rochester, N. Y., to Mr. August Lomb of

Bausch & Lomb Optical Company, Frankfurt, Germany, concerning a statement of military transactions for April, May, and June of that year, including anti-aircraft range-finders, periscopes, and telescopes. The letter states:

> Heretofore the Government has merely been insistent that none of the details as regards the designs of these instruments be made public, but it seems as if the quantities, prices, etc., and the amount of the equipment purchased are also considered secret. Obviously, our agreement with Messrs. Carl Zeiss cannot work satisfactorily unless, at least the latter information, becomes common knowledge to both parties, but some arrangements must be made whereby we are assured this information will be kept in strictest confidence.[3]

In a later letter from Bausch & Lomb to Carl Zeiss, dated December 21, 1932, it is stated:

> It occurs to us that we were not sufficiently specific regarding the condition that must be exercised for our protection in keeping the loan of this pamphlet a secret, and particularly as regards the inspector. If any question should arise with regard to the pamphlet which you are preparing, please do not admit to anyone that this has been prepared analogous to our copy.
>
> By reason of the importance which we attach to the secrecy of this question, the copy has been sent via our Frankfurt Office, and please make sure that after it has served its purpose it is again safely returned to our Mr. August Lomb.[4]

Waiving any conjecture as to the possible underlying motivation of such statements, it is clear that the intimacy of the participants in this cartel could not avoid the conflict of political and military interest with commercial relationships. Assuming their conscious separation Bausch & Lomb is placed in a most ambiguous or equivocal position. It is certain that in at least fifty-four instances, some as recent as February 1940, when South American and European governments attempted to place orders with Bausch & Lomb, who in turn sought permission from Zeiss, the latter refused, even though the "protective price" differential would in all likelihood have discouraged the potential buyer.

In 1935, after Hitler had brought German rearmament into the open, Bausch & Lomb refused contracts with Great Britain and France for $1,500,000 worth of military instruments. This extraordinary forebearance from ordinary profitable and business-like behavior is explicable only by the contract with Zeiss.

Bausch & Lomb, however, announced their abstinence publicly, and from a decidedly different point of view. As it was reported at the time in *The Literary Digest*, this altruistic perspective is described as follows:

> Millions of dollars of foreign Government orders for military optical instruments have been rejected by the Bausch & Lomb Co., of Rochester, New York, because they might conceivably be used against the United States or its interests in another War.

Proudly last week, vigorous, eighty-two-year-old Dr. Edward Bausch, founder and Chairman, declared that to be his company's settled policy, developed "Through a close understanding with the Departments of the Army and Navy of our Government." Officers of both services are stationed in the company's plant supervising the manufacture of such material, he disclosed, but under no circumstances will foreign Governments be supplied.

Chiefly, Bausch & Lomb's rejected orders have been offered by England and France, have been for range-finders, periscopes, gun-sights, binoculars, artillery fire-control instruments. Business from these two Governments would have exceeded $1,500,000. Various smaller nations have also sought to make contracts and have been refused. *Self-sufficient Germany, however, has shown no needs.*

—Promptly with the reappearance of the European war-scares several years ago, however, the policy of no supplies to potential combatants abroad was adopted. "*They are not prepared for war over there,*" a company officer gravely explained last week, "and if we refuse to help them prepare, it puts it off just that much." [5] [Italics added]

For this self-denial Dr. Edward Bausch was awarded the Laurel Wreath by the publication *Social Justice,* the organ of Father Coughlin. The award was announced in the issue of January 11, 1937.

There is an almost sibylline prescience in the words, "They [meaning France and England] are not prepared for war—," for the spokesman must have known that "self-sufficient Germany," by reason of the Zeiss Works, was under no such handicap. But aside from the oracular vision which time has proved true so far as England and France were concerned, what about the United States?

As with other American entrants into cartel agreements with German firms, once the German Government integrated its whole economy with its policy of conquest, Bausch & Lomb found that actual disclosures of information were no longer forthcoming from Zeiss. After 1938 royalties were paid only on military goods covered by Zeiss patents. When war began in 1939, such payments due to Zeiss were held in escrow by Bausch & Lomb, and relations between them governed by the "political contingency" clause of their agreement.

Since 1921 numerous Zeiss patents in the United States have been taken out in the name of Bausch & Lomb, but it is almost unnecessary to point out that they are still Zeiss patents. Neither Zeiss nor Bausch & Lomb has at any time been willing to license any applicant under these patents.

In 1940 the magazine *Fortune* stated that the Army Facilities Bureau rated the shortage in optical instruments as the fourth most serious bottle-neck in our preparedness program, ranking only after airplane engines, armor plate, and machine tools. Bausch & Lomb's capacity to produce optical glass was then estimated at

about 200,000 pounds annually. In 1918, it had produced some 480,000 pounds, but in the intervening years it depended again primarily on Zeiss, importing lenses and instruments which it did not itself make, and following the cartel pattern of restricting output. That we still lack optical equipment is shown by the continuous requests made by the Navy Department to the public for high-powered binoculars and optical instruments.

How a monopoly in the manufacture of optical instruments can be used to exert pressure has been stated by Thurman Arnold. After Bausch & Lomb had been indicted by the Department of Justice, it exhibited—

> . . . the typical reaction of a private cartel. The Navy Department was building two new cruisers. Bausch & Lomb was the sole bidder for optical equipment because it controlled the supply. It informed the Navy Department that it would have to delay furnishing the range-finders for these cruisers for six months because of the antitrust indictment. Bausch & Lomb thus threatened to tie up the construction of battleships while it contested its right to retain monopoly power. The threat, however, was unsuccessful. On May 21, 1940, the Bausch & Lomb Optical Company submitted to the maximum fine of $40,000 imposed on the company and its indicted officers and withdrew its suggestion to the Navy Department that the cruisers' equipment would have to be delayed six months.[6]

21. NEMESIS?—HUNGER BLOCKADE

THE Kaiser's armies in the World War held the Allies at bay for four long years. Not an inch of German soil was a battleground, and despite a two-front war the army was never routed or reduced to impotence. When the Armistice was signed, the German army withdrew from its lines inside of France. Neither brilliant Allied planning nor the velocity of Allied attack had actually broken or bent the German shield. What then accounted for the collapse?

Not the British blockade of raw materials from which the German might was fashioned, but the blockade on the home front was the most effective weapon in the hands of the Allies. The raw material shortage did weaken the German offensive, but could not make the army retreat. Germany cracked internally, surrendering to the most primitive urge of man. Hunger was the nemesis of German arms.

Germany is the "bare backbone of Europe." Despite all advances in science, the basic problem of Germany is still the struggle for food.

Since our ancient forebears first tilled a patch of

ground with the crude implements of the late Stone Age, the contest between man and nature has never gone far beyond the laborious effort required to wrest from the earth our daily bread. Man's customs, his beliefs, and his institutions, shaken as these have been by scientific change, still center largely about the relationship between humanity and the never-ceasing effort necessary to obtain the sustenance upon which his existence depends. For these reasons the painfully acquired knowledge by which the food supply, now so casually taken for granted by city dwellers, has been increased marks perhaps the most significant of all historical advances.

Germany knows that all of the ancient empires fell at least partly because centuries of ill-tutored cultivation stripped from the soil on which they rested its powers of regeneration. Egypt, Greece, and Rome reached the end of their dominance when the food supply could no longer sustain the structure of their civilization.

Not until the nineteenth century was any real progress made in the understanding and care necessary to prolong the fertility of the earth. It may be that even yet we have not learned enough, or how to apply what we do know. In the United States our Dustbowl is a monument to human stupidity. These reflections bear even more acutely at the present time on the destiny of nations. In Europe, in Asia, and in our own country, the common man first feels the bite of modern war in the

rationing of foods. For the underlying populace, food scarcity is the penalty which wars and depressions inflict most cruelly.

In Germany, however, the rationing of food has been a national necessity long before the present war. The choice between "guns and butter" was really made at the end of the first World War. Iron rations sustained the German people for twenty years, training them to do without, and made them ravenous for the wealth of the outside world. When it is realized that even at the present time the world is never more than twelve or fourteen months ahead of starvation, the constant fear of famine caused by depletion of the soil and the threat of blockade which haunts the German people can be understood.

In 1840, Baron Justus von Liebig demonstrated for the first time that land is progressively exhausted by the removal of nitrates, phosphates, and potash salts, all of which are consumed in the growth of plants. Liebig's discoveries also pointed the way toward regenerating the nutritive properties of land by the addition of artificial fertilizers. In most of its compounds, potassium is so tightly locked that its extraction is a difficult and costly process. Consequently, search was instituted for natural sources of potassium salts, and it was as a result of this quest that the German potash industry came into being.

Nature has made few gifts to Germany. When it was

realized that the Stassfurt region contained beds of potash salts over five thousand feet thick, there was reason to believe that Germany might fill its own bread-basket. The importance of the potash deposits to German national interests was recognized from the outset. In 1858 the Prussian Government opened the first mine, and from that day forward the German potash industry was under the heavy hand of the Prussian regime. Several independent producers came into the market, and their increased production made prices fall. The government mines were forced to compete against the private producers. Such competition was not to Prussia's liking.

The Potash Syndicate, formed in 1888 under government auspices, has been called the classic cartel. It restricted output of potash salts, fixed prices, and enforced its will on the market. The Prussian Minister of Commerce and Industry retained the right to approve or veto prices set by the Syndicate. In the reorganization in 1903, the Potash Syndicate became the Kalisyndikat, which since that time has governed the German potash industry.

During the period from 1860 to 1905 the United States had become the largest consumer of Stassfurt potash, and this industry was entirely undeveloped here, since there were no readily accessible domestic sources. Several American chemical and fertilizer companies, in addition to the American representative of

the cartel, imported the bulk of our needs. Some of the American importers had invested capital in previously independent mines in Stassfurt, and had also been able to obtain favorable contracts with some of the smaller producers.

It was the fixed policy of the cartel to charge a higher price for exported potash than for that sold within Germany. Since its monopoly was absolute in a geological sense, the cartel was able to enforce this practice. By 1909, when all of the potash producers were forced into the syndicate, a law was passed which imposed a supertax on potash sold outside of Germany. American importers protested unavailingly against the incidence of a law which they held would be "clearly discriminatory against America."

The matter was brought to the attention of our State Department, which in June 1910 interceded with the German Government. Previously, President Taft had consulted the Cabinet on the matter, which had reached an "acute stage." The demand of the State Department for a reply was met, but the contents of the reply were not made public. Our Government took the position that the affair was a "private matter" to be settled by the parties immediately involved. In the following year a settlement, the terms of which are not entirely known, was made. All suits against the syndicate brought in the United States were dropped, and the syndicate took over those contracts which had been made with inde-

pendent potash producers. In the opinion of one writer, the potash law was ". . . a tactical maneuver directed against American purchasers, and successful against them because of the unwillingness of the American Government to exercise vigorous influence in their behalf."

During the years following the one-sided settlement of the dispute between the American consumers and the German syndicate, practically no attempt was made to increase the domestic production of potash in the United States. With the beginning of the World War and the blockade of Germany, the United States was cut off from potash imports. In 1915 the total domestic production of pure potash was little more than 1,000 tons. As in the case of nitrogen, the shortage of potash threatened to cripple our farm production before we entered the war, and as the demand increased for food to supply to the Allies, and farmers were called upon to grow ever larger quantities of staples, it became evident that "potash hunger" rendered crops not only inferior in quality but made them far more susceptible to attack by plant diseases. Throughout the four years of the war, agriculture in the United States suffered from a famine of potash and, despite the enormous efforts made to overcome the potash shortage, by the end of 1918 our producing capacity was little more than 50,000 tons.

Again, as in the case of other chemicals and raw materials, German monopoly had been so exercised that

her potential enemies were compelled, in addition to meeting the military challenge, to repair the loss of industrial initiative. In a report on potash made by the Department of Agriculture immediately after the World War, it was stated:

> It was the threat of the late German Empire that, because of the potash monopoly which it held, the world could be subjected at its will to potash starvation and be forced to yield to its dictation. This challenge was met in America by the prompt development of practically all the sources of potash already surveyed by governmental agencies and the establishment of potash manufactories which made America for the time being independent of all foreign potash.

When the war ended, this country was in a position to count upon an annual production of 100,000 tons of potash and, consequently, if the industry had continued to expand at a competitive rate, all of our domestic needs thereafter could have been met by our own production. As was the case in some of the other branches of industry, potash production declined with the cessation of war needs, so that a few years later one writer on fertilizer commented on "the swift fading of the war-born potash industry."

France recovered some of the potash-producing territory of Alsace, but Germany retained the major part of the deposits in the Stassfurt region, and did not find her

position in the world potash industry affected by the Versailles Treaty. Following the general pattern of industry recovery in Germany, both her nitrogen and potash production were carried forward with no real handicap as a result of the war. In fact, by 1925 not only had the German potash cartel reestablished its own internal control, but it had succeeded in entering into an agreement with the French producers whereby the latter received a quota of 30% of the total annual output, with the Kalisyndikat receiving the remaining 70%.

Potash, nitrates, and starch-bearing plants were not enough to maintain Germany's food supply in the World War. The lack of proteins, of fats and oils, needed to provide energy and endurance proved to be the real Achilles' heel. The soldier at the front was fed much better than the civilian in the rear, but both were gradually weakened by the lack of the proteins which give the human body its heat and muscular power. In one of the official German histories of the World War, it is stated:

> In the long run the food was not adequate to keep the soldier at the front capable of resistance amidst the terrible mental agitation, the feverish, nervous tension and the great physical exertions. Nor is there any doubt that if the food situation had been better the work of those boring worms who gnawed away from within would have been made considerably harder, perhaps impossible.

No one in Germany could forget in the post-war years that the lack of food had weakened German arms. The High Command took over the study of the food problem and for twenty years endeavored to find a way to prevent a repetition of the "turnip winter" of 1917-18. The nutrition problem became a central focus in German plans for the Global War.

The man to whom the study of Germany's war food economy was assigned was Ernst Pieszczek, the Privy Councillor or Permanent Under-Secretary of the Ministry of War. It was his task to analyze the causes which had brought Germany to her knees in 1918 and, if possible, to find a way to overcome such shortages in the future. In his attack on this problem Pieszczek had the cooperation of the Department of Agriculture, the German High Command, I. G. Farben, and all other agencies concerned. In an article in the official journal of the German War Ministry, *Wissen und Wehr* (Science and Defense), in 1932, Pieszczek summed up his findings of the causes of the food shortage in the first World War.[1]

Bread was available throughout the war in Germany, and presented no problem. While potatoes were plentiful, transportation made their distribution difficult. Meat had to be rationed, and the supply throughout the war was inadequate. The people seldom received the minimum rations which had been promised.

The most important factor in the breakdown of the German food supply was protein, contained in meat, milk, cheese, and eggs. Pieszczek states:

> The fat supply was always most critical. Soon after the outbreak of the war, considerable difficulties arose because, as already mentioned, more than two-fifths of the total consumption was imported. . . .
>
> * * *
>
> *The lack of foreign cattle feed was the principal problem of the whole war food program.* By far too much cattle was bred considering the amount of feed produced in Germany. This brought about a vicious circle. If the breeding of cattle was reduced because of the lack of feed, the meat, fat and milk supply suffered. If, on the other hand, the number of cattle was maintained, then the breeder was apt to feed the cattle bread grains in order not to let his cattle starve, instead of leaving the grain for direct human consumption.
>
> * * *
>
> . . . *The German economy was unable to improve this negative balance and that meant that as far as the food economy was concerned, the war was already lost at the beginning of the third war year. What followed after that was merely a futile pulling to stretch the German food blanket which had become too short.* [Italics added]

In this same article Pieszczek strikes the warning note that Germany could now aspire to protein self-sufficiency:

> *Today, the German economy is able to point new ways which might make it possible to avoid at least partly, if not entirely, the scarcity of animal feed.* [Italics added]

During the first World War a process had been partially developed by which albuminous feed for cattle could be made from carbohydrates with the use of so-called mineral yeast. There were, however, insufficient quantities of carbohydrates to permit the application of this process on a large scale. In 1926, Dr. Scholler, of the Tornesch Wood Sugar Development and Research Corporation, worked out a process by which wood cellulose could be turned into wood sugar without loss. This was the crux of the matter, for previous efforts to make sugar from wood had been unsuccessful because of the tendency of such wood sugar to decompose before it could be taken out of the manufacturing process.

Because the problem of protein had such importance in her plans, all of Germany's skill in science was concentrated on its solution. Germany became interested in the development of soyabeans. As much as two and one-half million tons of soyabeans were imported annually from Manchuria by a special company set up for that purpose. The planting and cultivation of soyabeans in Roumania and other Balkan states was promoted by German interests, because these latter countries could not be cut off by a British blockade. Soyabeans would not grow in Germany's own harsh climate. An insuf-

ficient number of hours of sunshine prevented the crops from maturing. I. G. Farben experimented with soyas, and when it was found that this was not practical, turned to another source.

The lupine beans, which grow abundantly in Germany, contained the essential ingredients of protein cattle feed. There was, however, a major drawback. Lupine beans are bitter, and cattle will not eat them. The German Government's scientists applied themselves to the task of removing the bitter taste, and actually succeeded in making the lupines more palatable. After twelve years of very costly study, a carefully nurtured crop was fed to cattle with excellent results. The milk, the butter, and the meat were richer. Germany's problem apparently was solved.

The next year an enormous acreage of lupine beans was planted. The sweetened lupine bean became a form of nectar on which German cows would fatten. When the new crop was ripe and harvested, much to the consternation of the German Ministry of War, the cows and pigs and other livestock turned up their noses and refused to eat the beans.

What had happened is reminiscent of the cackling of the geese on the walls of Rome. Bees have no geopolitical sense, although they exist in the most totalitarian of all animal kingdoms. When the sweetened lupines bloomed, the bees swarmed onto the fields. Unable to distinguish between the bitter wild plant and the sweet

cultivated variety, the bees carried pollen from one plant to the other. The pure sweetened lupines and the wild bitter ones were mixed in an interracial orgy. When the beans ripened, they were once more bitter. The coach turned out to be a pumpkin.

Defeated by forces of nature which even the Nazis could not control, the War Ministry redoubled its efforts to develop the potentialities of wood. Germany produced approximately 285,000,000 cubic meters of wood, the waste from which could serve as raw material for wood sugar.

In 1942 the British Broadcasting Company circulated a humorous anecdote. They reported that the German Propaganda Ministry had announced that air blockade of Britain was proving hugely successful: the British people had been reduced to eating garbage. The German spokesman went on to assure the German listeners that they themselves had no cause to fear. I. G. Farben was successfully preparing a substitute for garbage.

This would be truly humorous if it were not so grim, for Germany actually is putting its waste to effective use as food.

Pieszczek visited the Tornesch wood-sugar plant. So impressed was the War Minister that he undertook to use his own influence to obtain government funds for further research. Finally, Pieszczek proposed that the German government monopoly buy 50% of the stock of the Tornesch company. Leading members of the

German General Staff were conducted on tours of Tornesch and were elated at what they saw. It was determined by the War Department that future plants for the production of wood sugar from waste should be built as rapidly as possible.

Meanwhile, the Nazis had come to power, and accelerated the program. The agreement between the Economics Ministry and the Scholler-Tornesch company indicates the value placed on wood sugar:

> The Scholler-Tornesch method is for the Reich, so far as the afore-mentioned wood sugar for fodder will be further developed, in the framework of interest of the Four Year Plan. The projected taking over of the enterprise serves thereby in the foremost line of the "Volk's" interest.

These plants were located in what is known as the "safe area" of Germany between the Elbe and the Oder Rivers. Dr. Keppler, Hitler's own economic adviser, supervised the location of the plants.

The government acquired all rights to the manufacturing of "feeding yeast" from wood waste. It was arranged with the Air Ministry that an airdrome with a complete fighter squadron attached should be built for the exclusive protection of the principal plant at Tornesch.

The possible shortage of protein is the one most dangerous weakness in Germany's entire war economy. The

loot of Denmark, Holland, and the Balkans can only postpone the day when Germany will once more be faced with the need of "killing little pigs."

From the long-range point of view, therefore, the strength of blockade by the United Nations may be the stumbling block in German plans.

German airpower could dent the blockade and make the capital ship a hunted thing, but only within the range of land-based planes. There are still vast stretches of the ocean which cannot be commanded from the air. British and American ships still control the sea, and Germany can get nothing from outside. The final test of blockade is yet to come. In the meantime, the vicious circle begins once more to close. Reports have been forthcoming that cattle and hogs have been slaughtered en masse. Veal is a large item of diet in Germany today. This means that meat, milk, and butter will be even more scarce next year. Veal is the meat of young calves. When these are killed, they cannot grow up and reproduce.

Wishful thinkers are inclined to see in these facts the signs of Germany's downfall. If the wood sugar plants were enlarged enough to supply German needs the last thread in the garrote around Germany would snap.

The Germans found in their forests a universal raw material from which an increasing variety of products are made. Fodder, textiles, explosives, lubricants, plastics, and other military essentials all can be cheaply pro-

duced. Aircraft made of plywood are lighter and inexpensive, and may someday replace metal planes. In this country, over 74% of our wood is wasted. Germany wastes almost none, even recovering part of the wood normally lost through fire and disease. The trees of the occupied countries are treasure groves which Germany can convert into war matériel.

There is another chapter in this sylvan tale. In the two remaining Axis countries, Italy and Japan, wood sugar plants were built under license and supervision from Germany by 1939. The United Nations as yet have not even tried to undertake comparable development of the wood sugar industry, which might enormously augment their nutritive resources.

22. THE SORCERER'S APPRENTICE

IT would be a tragic blunder for the United Nations to elevate Hitler and the Nazis to the dignity of the principal enemy. Hitler is the embodiment of all that is demonic—all the mephitic mists of the German martial ego assembled in corporal form. That is why it is dangerously easy to mistake the form for the substance —for Hitler is only one incarnation of the ruthless Teutonic vanity that finds release in war. *Germany is still a feudal nation;* Nazism is cameralism rampant.

The warrior caste of Prussian Junkers were not overthrown in Germany by an industrial middle class. The former serfs were drilled into factories, instead of on farms, and the whole industrial plant run, not as competitive enterprise, but as a regiment of cartels. The land-poor Junkers became cartel magnates, and the whole economy a more efficient service of supply.

Nazis were chosen jointly by the generals and industrial barons at a time when the framework of war economy had been completed. The Junkers put Hitler in office when his star was already waning. For the real rulers the Nazis possessed an entirely functional value.

The Nazis could unite dissident "splinter" parties by force, and forge into a single sword the energies of the people.

The Junkers saw in Hitler the psychological magnet with which to align the fears, unreasoning resentments, and the need of the German people for a common purpose. Hitler sang in crescendo the monotone of Versailles—that only by force could the scales of justice be balanced.

Hitler focussed the national will while protecting cartel interests. He provided the philosophy and the excuse to set in motion the sleek, streamlined metallic monster so circumspectly contrived. Hitler had the dynamic touch which ignited giant motors. The Rhineland, Austria, and Spain gave the machine its trial run.

The Junkers erred in making Hitler the Fuehrer. Along with his canting theories went his intuition, which they could not control. Hitler became the State, enforcing his nightmare orders with the sadism of the Gestapo. Neither wealth nor station could protect the man who dared to question the Fuehrer's wisdom. The mortality rate of German generals increases with every schism.

Hitler consulted clairvoyance more than maps and graphs. He is the sorcerer's apprentice, wielding the warlock's powers he cannot fathom.* Not able to think

* After this book had been printed in galleys, *The Self-Betrayed, the Glory and Doom of the German Generals,* a brilliant study of German militarists by Curt Riess, was published. In a different context, Mr. Riess employed the figure of the Sorcerer's Apprentice. The authors willingly concede priority in the use of this symbol to Mr. Riess.

with the same icy logic that devised the Master Plan, Hitler wildly careened into war.

Flushed with the initial triumphs of Munich and the fall of France, Hitler's military judgment was to be weighed and found wanting. The attempt to achieve a second Munich failed, for no strategy of terror could conceal the inability of the Wehrmacht to cross the Channel. Hitler had badly underestimated the stoutness of England, and his planes still could not scuttle enough of the Fleet.

Balked at Dunkirk, Hitler could not stop moving. The Panzers and Stukas had to be used while fresh. He had no other choice than to turn to the East. The malignant sequence of error once started, Hitler could not halt the flood of the war he had loosed too soon.

Hitler's intuition reduced the High Command to fearful silence. The Generals had read the thermometer of Russia's preparation, and were not warmed by the thought of a two-front war. Russia, too, was a realist nation, armed and willing to fight. Russia had seized the Baltic States, warred with Finland, met the Reichswehr half-way in Poland, and stirred the Balkan Kettle against Germany.

What was Hitler's excuse? He stated, to quell all doubts, that the German High Command "could no longer vouch" for a "radical conclusion of the war in

the west, particularly as regards aircraft." According to this convenient theory, however true it was, the presence of Russian armies on German borders kept too many planes in the east. Actually, Hitler could neither admit that he had been wrong, nor stay the tempo of fighting. His intuition again was called forth to justify the deed.

Such miscalculations have a cumulating effect. The attack on Moscow was prolonged until the last moment, to bolster German morale. Whether the political victory achieved by encouraging Japan to assault the United States was worth the military cost, only time can tell. The immediate results were disastrous to the striking efficiency of the German army.

Mistakes of our enemy are mortal only if we exploit them. As 1942 drew to a close Germany had not won its Lightning War. The bravery and skill of the R.A.F. and the "red badge of courage" which Russia wore bore witness that the first phase of the Master Plan had failed.

The flaws were not all in the plan itself, but in the instant of their execution. All of that terrible energy assembled in German technology had not grown to its fullest stature.

The gap of technology narrowed; the Global War had become a massive trial of endurance. The inexorable force of attrition began to take its toll. As American troops swarmed into Africa, and the Russian Winter

froze the Wehrmacht in the East, Germany was once more faced, as in 1918, with the fearful quadrennial of War—that "fourth year" which every German general viewed aghast, and which brought back nightmare memories to the German people.

The war is not yet over, and the point must be driven home. Germany perceives the meaning of the race that is being run. Neither bombings nor the demands of the Russian front stayed the German retooling of the aircraft industry. The Focke-Wulfs and sub-stratosphere bombers which make their appearance over the Channel and Iceland are forerunners of what is to come.

Lightning War may return, and in this consideration lies both the hope and the peril of the United Nations. As the quality of technology changes, the contest is transferred to another plane. The sprawling mills and factories and the volume of their output can be pinioned like clumsy giants by a single flash of genius.

Since the beginning of "civilized" warfare, military philosophers have sought a key to enduring world-rule. Usually some spot on the map has been chosen as the control-point from which the rest of the world might be held. In turn, Egypt, Gibraltar, Alaska, and the so-called Heartland of European Russia and Turkey have been selected by those who ponder the question of world empire. But the cult of Mackinder and Haushofer is rendered meaningless by the contemplation of the power of technology. The continents, mountains, and seas have

military value only so long as invention does not shrink their importance and make all lands equally accessible.

Against a foe so resourceful—such a master of science and war—the United Nations can ill afford to falter. Airpower is only one instrument—the next one may be a ray which grounds all planes or directs a lethal beam along an electrical path. It may be an old lance resharpened—I.G. can still make gas.

In the rules of war the only bar to the use of any destructive weapon is the threat of retaliation. This diminishes as technological disparity becomes greater, and the ability to strike back is lessened.

Or, as the rope grows tighter around the belly of our adversary, it will approach the desperation of a starving man. What is there to stop Germany from the use of bacteria?

23. REVEILLE

GERMANY lost the World War, but I.G. gained the peace. Stronger in 1919 than five years before, I.G. and its cartel-brethren in German industry took back control of crucial fields despite all the laws enacted here to prevent their doing so. The Versailles Treaty stripped Germany of its foreign possessions, but the cartels acquired more colonies than the Empire contained at its height. These conquests were made by contracts, which allowed German firms to "divide and rule" world markets.

Territorial control, however, was only the means to military ends. Given freedom from our competition, the German cartels engaged in calculated over-production, thereby sustaining their capacities in peace at war-time levels. By the very same agreements which gave the Germans markets, democratic cartellists were bound to restrict production. To Germany, cartel understandings were stimulants; to her enemies, they were opiates, lulling them into false delusions of peace and prosperity.

The consequences of the next peace are now in the blueprint stage. In all the United Nations post-war reconstruction programs are being drawn. They are based

on the noble precepts of freedom and abundance. For these we are fighting.

The post-war planners should view with alarm and perceive with understanding the reconstruction plans of German industry. Hitler will pass in time, more rapidly if the war is lost. But win, lose, or draw, the Junker-cartels are prepared. Before Hitler was ever thought of, cartel agreements provided for the coming war.

The sum of the evidence could be documented at length. Consider some excellent examples; the Bausch & Lomb-Carl Zeiss agreement:

> . . . *if, by reason of unforeseen political events,* the execution of this contract shall be made impossible, temporarily or permanently, or the firm of Carl Zeiss limited in the enjoyment of its full license claim, this agreement shall be suspended for that time, and upon an appeal, the board of arbitrators shall make such dispositions as seem necessary in order to carry out the will of the parties to this agreement under the changed conditions, if possible.[1]

and the Standard Oil-I. G. Farben agreement:

> . . . it is our understanding . . . that each party proposes to hold itself willing to take care of any future eventualities in a spirit of mutual helpfulness, particularly along the following lines:
>
> In the event of the performance of these agreements . . . by either party should be hereafter restrained or prevented by operation of any existing or future law, or the beneficial interest of either party be alienated to substantial degree by operation of law or governmental authority, the parties should enter into new negotiations in the spirit of the present agreements and endeavor to adapt their relations to the changed conditions which have so arisen.
>
> * * *
>
> Both parties agree that in the event of an attack by a third party brought against either of them directly or indirectly, in attempted derogation of the title to patent rights transferred hereunder, they will cooperate loyally in defense of such attack.[2]

One ruse of the Germans has confused our legal minds. Both before and after conquests, the Germans have observed the form of lawful "purchase" of resources, plants, and property. The architects of the master plan are objective realists, and do not preclude the possibility of defeat or negotiated peace. Dr. Egon Glesinger, a shrewd observer of German plans for conquest, says of the designers, "They assume . . . that while the law-abiding democracies will be sticklers for the return of confiscated property, purchases made in outward legality will be blessed." Here is the reason that the forests, mines, factories, patents, and processes have been "bought" by Germans from their owners in conquered countries, when they could have been taken without ado.

The economic feudalists in the United States, Great Britain, and the other United Nations know that tech-

nology goes on, war or no war, but they can view this truth only from the perspective of their own investments. Democratic industrialists are not traitors. They will fight for their country, or send their sons to die. But by identifying their loyalty to stockholders with their duty to the nation, they fail to see the difference between public interest and private trust. This cartel attitude is propounded by the frank and brilliant expression of a representative of the world's largest combine:

> Upon completion of that agreement, the war intervened because our grouping of interested parties included Americans, British, Dutch, Germans, and the war introduced quite a number of complications. *How we are going to make these belligerent parties lie down in the same bed isn't quite clear as yet.* We are now addressing ourselves to that phase of the problem and I hope we will find some solution. *Technology has to carry on—war or no war*—so we must find some solution to these last problems. [Italics added] [3]

The enormous expansion of productive facilities in the steel, aluminum, magnesium, plastics, synthetic rubber, and chemical industries in Germany will be a threat to the cartel-minded producers in this country, whether Germany wins or goes down to military defeat. In the United States, the imperious necessity of war has forced a parallel increase in our productive facilities. The fear of post-war over-production has had a stifling effect on

our own war output. Industrial courage must take the place of fear.

When the war is over, the pressure of national interest will relax. Vigilance will cease. Will new cartels flourish and old ones revive?

The fear of German technology should be met not by agreements to halt or regulate progress; such agreements restrict only ourselves. Germany knows the value of an unimpeded technology. *Twice* we should have learned in Ordeal by Battle. Will the second lesson prove as futile as the first? Technology is the final judge of history.

America need not stand in awe of Teutonic science. It was we who invented the airplane and submarine, which our enemies have merely copied and improved. Mass production systems and most modern arms are results of American invention. With our resources and ingenuity there are few accomplishments of Germany which we cannot entirely dwarf. To release the vitality inherent in democracy and its free institutions we must cast off the industrial lethargy caused by monopolies which enervate our production.

The principles of democracy are its strength. Desertion from these principles are its danger. People dedicated to peace and freedom must be strong. To be strong they must have access to technology; to have access to technology they must be free. We want no private planners nor do we need a paternal bureaucracy. The

weakness of democracy lies not in its lack of planning, but in its tolerance of industrial oligarchy, the economic twin of Fascism.

The battles of rubber, quinine, magnesium, aluminum, and all the others must not have been fought in vain. The resurgence of German power must be the book of revelation from which we draw the text of our future national policy. The violence of war is ephemeral; the conditions of war endure. Peace gestates the elements of strife. "Disastrous wars are the failures of peace."

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CHAPTER NOTES

CHAPTER 1

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APPENDIX

I. G. Farbenindustrie, A. G.

ON December 9, 1925, the Badische Anilin und Sodafabrik, Ludwigshafen a. Rhein, the largest of the member firms of the Interessengemeinschaft (Combine of Interests) of the German Dyestuffs industry, changed its own name to I. G. Farbenindustrie Aktiengesellschaft. Five other firms were merged with Badische. These were:

Farbenfabriken vorm. Friedr. Bayer & Co., Leverkusen,
Farbwerke vorm. Meister Lucius & Bruening, Hoechst,
Aktiengesellschaft für Anilinfabrikaten, Berlin,
Chemische Fabriken vorm. Weiler-ter Meer, Uerdingen, and
Chemische Fabrik Griesheim-Elektron, Frankfurt a.M.

Two further firms which had also belonged to the former Combine of Interests (Trust), namely, Leopold Cassela & Co. G.m.b.H., Frankfurt a.M. and Kalle &

Co., Aktiengesellschaft, Biebrich, were not included in the merger inasmuch as their shares were already held to their greater part by the other I.G. firms. They were, however, included in the organization and further development of the I. G. Farbenindustrie. The names of the merged firms were retained by registering them as branches. All the said enterprises were organized at brief intervals at the beginning of the '60's of the last Century as a consequence of the revolutionizing inventions in the field of coal tar dyes.

In 1904 the first Trust, or I.G., as it was called, was formed by the Bayer Company of Elberfeld, the Badische Company of Ludwigshafen, and the Aktiengesellschaft für Anilinfabrikaten, Berlin. In addition to this I.G., the firms of Hoechst, Cassela, and Kalle entered into a combine which was brought under the financial control of I.G.

The I.G. group has undergone since its formation in 1904 a series of reorganizations. The first of these, in 1916, added to the scope of I.G.'s interests, and integrated its wartime functions. The reorganization in 1919 further augmented the sphere of I.G.'s operations. Early in 1926, after the formal incorporation of I.G., a number of important concerns were added to the eight firms which formed the nucleus for the Trust. These were:

Dynamit-Actien-Gesellschaft vorm. Alfred Nobel & Co., Hamburg;

Rheinisch-Westfaelische Sprengstoff-A. G. Koeln;
Aktiengesellschaft Siegener Dynamitfabrik, Koeln;
Deutsche Celluloidfabrik, Eilenburg; and
A. Riebeck'sche Montanwerke A.-G., Halle.

A list of I.G.'s subsidiaries is not easy to decipher. Some subsidiaries are wholly owned and controlled. Some are partially owned or divided between one or more of the nuclear corporations in I.G. In the case of some subsidiaries, their corporate identities have been maintained, while their assets and facilities have been entirely merged with others. The following list is not complete. It is based upon the Handbook of German Industries, upon Moody's, upon the lists given by Dr. Liefmann in "Cartels, Concerns, and Trusts," on the Enquete-Ausschuss III on the German chemical industry, upon a booklet entitled "I. G. Farbenindustrie, A. G." published in German by I.G., and upon annual reports of I. G. Farbenindustrie.

The components of I. G. Farbenindustrie A. G. and its principal subsidiaries are:

Badische Anilin und Sodafabrik
Ammoniakwerke Merseburg-Oppau G.m.b.H.
Farbefabriken vorm. Friedr. Bayer und Co.
Farbwerke vorm. Meister Lucius und Bruening
Leopold Cassela und Co.
Chemische Fabrik Griesheim-Elektron
Akt.-Ges. fuer Anilin-fabrikaten
Chemische Fabriken vorm. Weiler-ter-Meer

Kalle und Co.
Koeln-Rottweil A.-G.
Dynamit A.-G. vorm. Nobel
Rheinisch-Westfaelische Sprengstoff A.-G.
Wuelfing, Dahl und Co. A.-G.
Karl Jaeger G.m.b.H.
Oehler
Chemikalien-Werke Griesheim G.m.b.H.
A.-G. fuer Stickstoffduenger Knapsack
Stickstoff-Kredit G.m.b.H.
A.-G. fuer Landeskultur
Koliner Kunstduenger und Chemische Fabrik
Zuckerfabrik Koerbisdorf
Chemische Werke Schuster und Wilhelmy A.-G.
Wolff-Werke Chemische Fabriken
Chemische Werke Lothringen
Delvendahl und Kuentzel G.m.b.H.
Chemische Werke Durand und Huguenin A.-G.
Alexander Wacker A.-G.
Elektrochemische Werke A.-G.
Elektrochemische Werke G.m.b.H.
Aluminium-Werke G.m.b.H.
Elekto-Nitrum A.-G.
Soc. Electroquimica de Flix
Ampère G.m.b.H.
Deutsche Edelsteingesellschaft vorm. Herm. Wild A.-G.
Duisburger Kupferhuette A.-G.
Deutsche Molybdaenwerke
Auguste Viktoria mine
Rheinische Stahlwerke
Riebecksche Montanwerke A.-G.

Erdoel- und Kohleverwertungs A.-G.
Bergin Kohle A.-G.
Chemische Fabriken und Asphaltwerke A.-G.
Doerstewitz-Rattmannsdorfer Braunkohlenindustrie A.-G.
Gewerkschaft Elise II
Frechen Lignite Mine
Jacob's Mine at Preussisch-Boernecke
Theodor I and II mines at Bitterfeld
Hermine Mine
Deutsche Grube A.-G. (lignite works)
Marie and Antonie mines
Deutsche Braunkohlengesellschaft A.-G.
Deutsche Gasolin A.-G.
Olea Mineraloelwerke A.-G.
Sueddeutsche Oel und Melanolwerke G.m.b.H.
Ford Motor Co. A.-G. (part)
Metallgesellschaft (part)
Griesheimer Autogen-Verkaufsgesellschaft m.b.H.
Deutsche Oxyhydric A.-G.
Gesellschaft fuer Lindes Eismaschinen A.-G.
Karl Neuhaus G.m.b.H.
Verwollungs A.-G.
Hoelkenseide G.m.b.H.
Textilosewerke und Kunstweberei Claviez A.-G.
Philana A.-G.
China-Export-, Import- und Bank-Compagnie
Chimica, Industrial Bayer and Westkott & Cia.
Teer-farben-Industrie A.-G.
Oestliche Handelsgesellschaft and Bayer Products, Ltd.
Productos Quimicos Meister Lucius Bruening, S.-A.

Kalk- und Emmailierwerke Gebr. Wandesleben, m.g.H.
Heggener Kalkwerke G.m.b.H.
A. H. Rietschel G.m.b.H.
Kremer-Klaergesellschaft m.b.H.
Deutsche Laenderbank A.-G.
Riebecksche Montanwerke
Gustav Genschow & Co. A.-G.
Wachtberg Group of brown coal mines in West Germany
Koerbisdorf sugar factory's brown coal mine
Dr. Albert Wacker G.m.b.H.
Chemische Werke Lothringen G.m.b.H.
Aceta artificial silk factory
Sachtleben A.-G.
Behring-Werke A.-G.
Norsk Hydro Elektrisk Kvaelstof A.-G.
Leuna-Werke Ammoniak-Werk Merseburg
Internationale Gesellschaft für Chemische Unternehmungen
General Aniline & Film Company
Agfa-Ansco Corporation
General Aniline Works
A. G. für Chemische Industrie, Gelsenkirchen-Schalke
Buna-Werke G.m.b.H.
Braunkohle-Benzin, A.-G.
Chemische-Werke Aussig-Falkenau G.m.b.H.
Ch. W. Huls, G.m.b.H
Deutsche Celluloid-Fabrik, A.G.
Hydrierwerke Politz A.G.
Pulverfabrik Skodawerke-Wetzler A.G.

Titangesellschaft m.b.H.
Aziende Colori Nazionali Affini (ACNA), S. A.
Societa Chimica Lombarda A. E. Bianchi

With the same reservation as to completeness, the following list of fields of production of I.G. is given:

Coal tar dyestuffs, including crudes, intermediates, and finished dyes;
Auxiliary products which are used in connection with dyestuffs to obtain desired effects or to improve the dyeing process;
Innumerable organic and inorganic chemicals;
Solvents such as those for paints, lacquers, and varnishes;
Accelerators and anti-oxydents;
Preservatives;
Tanning agents;
Mineral colors;
Synthetic building materials;
Compressed and rare gases;
Light and heavy metals, including aluminum, magnesium, and the rare and precious metals;
Machinery and equipment used in the chemical industry and in other branches of scientific production and research;
Pharmaceutical operations comprised of veritable legions of compounds derived from coal tar, sulphur, and other bases;
Synthetic gems;
Synthetic perfumes;
Insecticides and fungicides;
Photographic products and equipment;

Cell wool;
Rayon;
Celluloid;
Plastics;
Synthetic gasoline;
Synthetic rubber;
Explosives;
Nitrates and fertilizers; and
Vistra (synthetic textiles).

I.G.'s own operating units are situated in the following areas within Germany: Ludwigshafen am Rhein, Oppau, Zweckel, Leuna, Gipswerk Niedersachswerfen, Schkopau, Frankfurt am Main-Hochst, Gersthofen, Frankfurt a-M-Mainkur, Fr. a-M-Griesheim, Offenbach a.M., Bremen, Dortmund, Duisberg, Essen-Steele, Gleuvitz, Heilbrom A-N., Herrenwyk, Karlsruhe, Kassel, Kraftborn b. Breslau, Krefeld, Leipzig, Saarbrucken, Stuttgart, Weidenau, Wuppertal-Elberfeld, Knapsack, Marburg a.d. Lahn, Marbach, Eystrup, Neuhausen (Ost Preuss), Leverkusen, Dormagen, Uerdingen, Wolfen, Bitterfeld, Aken, Stassfurt, Teutschenthal, Dobertiz, Rheinfelden i.B., Berlin-Lichtenburg, Munchen, Bobingen, Premnitz, Rottweil, Weisbaden-Biebrich.

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