RECORD OF AN INDUSTRIAL MIRACLE

By Burnham Finney

When the complete history of this war is finally written, historians will have to credit America's capacity to produce as probably the most important single factor which helped win the war. No secret or known weapon devised anywhere by any power at any time has been able to match the miracle of this country's mass production.

Long before the Nazis or the Nipponese surrendered, they had felt the full force of our industrial power. We directed against the Germans more than four times the firepower that they could muster, against the Japanese a still greater superiority as yet unrevealed. The two-ocean navy authorized by Congress on July 19, 1940, was expanded into a fleet of five-ocean proportions. We have today over 100,000 vessels of all types, compared with 4,500 before Pearl Harbor.

We poured so many bomber and fighting planes into the European and Pacific theatres that on both fronts we were staging 1,000-plane bombing raids at will with little or no opposition and, even more amazing, were bombarding the coast of Japan from warships that seldom were opposed from the air, sea or land. Never before in history has such a continuous torrent of weapons been poured into the front lines from the factories back home. Our enemies were overwhelmed by the sheer weight of our equipment. We produced in this country such a stupendous amount of war goods following December 7, 1941, that victory for us became a mathematical certainty. After Germany was knocked out, we proceeded to beat Japan on the production front with our right hand, while with our left hand we began again the process of making for the folks at home the goods that they needed for a normal life.

Within a span of thirty-six to forty-eight months we shipped from our assembly lines far more weapons than the Nazis had produced during more than a decade. During 1944 we turned out three times the war goods produced by Germany in her greatest year.

Let's get down to facts and figures. Our warplane production in 1939,

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when Europe went to war, was a mere 2,141 units. In the spring of 1940, when France and the Low Countries were being ruthlessly overrun by the Nazis, President Roosevelt said to Congress, "I should like to see this nation geared up to the ability to turn out at least 50,000 planes a year. Furthermore, I believe that this nation should plan at this time a program that would provide us with 50,000 military and naval planes."

Fantastic as the President's suggestion sounded, the rapidly growing aircraft industry more than made good on it. In 1942 it built for ourselves and our allies 47,873 planes. The next year the output skyrocketed to 86,000 planes. In 1944 the industry more than doubled its 1942 performance by assembling 96,369 planes. From the start of the national defense program in 1940 until June 1945, American manufacturers produced over 294,000 warplanes, including nearly 100,000 bombers — a total considerably higher than that of all the other countries in the world.

These figures do not reveal the whole story of what the airplane industry has done. To the miraculous expansion in units produced add the fact that the average weight of each airframe rose from little more than one ton in 1940 to about three tons in 1942, and up to five tons in 1944. As the war proceeded, the demands from the European theatre were satisfied and factories produced more super-giant bombers and fighters for long-range Pacific operations. The job done through 1944 by aircraft makers was so colossal that they entered 1945 with scheduled production cut back from last year's level; fewer planes were needed this year than last, though the war was still going full blast in Europe and in the Pacific.

II

The shipbuilding story is no less amazing than the plane production story. Ship transportation became the vital link between ourselves and our allies, and between the factories at home and our men in the far corners of the earth. A multi-ocean navy and merchant fleet became a necessity to thwart the enemy's submarines and whip Japan. The private shipbuilding industry entered the war with ten yards containing 46 shipways and employing 60,000 people; at the peak there were 81 yards containing 300 shipways and employing 1,300,000 workers. In addition, U. S. Navy yards expanded immensely their operations in the building of fighting ships. Since our wartime ship program began, privately-operated yards have built over 7,100 merchant ships of all kinds and sizes including 2,600 Liberty ships, 460 Victory ships, and 895 merchant-type ships for strictly military service. In building 2,600 Liberty ships alone, our shipyards turned out, on the basis of tonnage, the equivalent of 325 *Queen Elizabeths*.

As a result of American industry's production during the war period, Britannia no longer rules the waves.

The United States has a navy that surpasses in size the fondest dreams of its admirals and that overshadows all other navies combined. In 1941 it numbered 7,695 ships. Today it consists of over 100,000 units, counting auxiliary vessels such as landing craft, mine sweepers, tenders, repair ships and harbor craft. We have constructed during the war 1,322 combat ships. In that total are ten battleships, eighteen large carriers, nine smaller carriers, 110 escort carriers, two large cruisers, ten heavy cruisers, thirty-three light cruisers, 358 destroyers, 504 destroyer escorts and 211 submarines.

It seems incredible, yet it is true that today our Navy possesses almost as many ships in various categories as it had men in 1939. Moreover, we have built in the last five years 56,000,000 tons of merchant shipping, the increase being five times our prewar tonnage and far more than all the rest of the world now owns. Thanks to the prodigious output of ships, two-thirds of the world's merchant vessels now fly the American flag. In six years we have multiplied our Navy thirty-two times and have accumulated more merchant ships than all the merchant fleets of the world had in 1939.

This accomplishment was not the result of the performance of our shipyards alone, but of the industries in all of our forty-eight states. The Navy's stream of supplies, in fact, is composed of over 5,000,000 items, from barometers to floating drydocks.

Before the end of 1944, the major part of the task of expanding our Navy and merchant fleet had been completed. Production of merchant ships scheduled for 1945 was considerably reduced from the previous year. While the war in the Pacific was still going strong, many shipbuilding contracts were terminated and the problem was what to do with the surplus yards.

American industry met a continuing series of crises connected with sea transportation. Early in the war our own merchant ships and those of our allies had to be armed against the submarine and aircraft threats. Guns and ammunition were manufactured on a rush basis for 6,050 merchant vessels. The submarine warfare alone necessitated the construction of 504 destroyer escorts in order to protect convoys.

Within a few months, after invasion plans had been made for Europe and the Pacific, industry was asked to build thousands of landing craft, meeting schedules that seemed impossible when first set up. The result was that about 55,000 of these craft were constructed for the invasions of North Africa, Italy, Normandy and the Pacific islands.

One point that should not be overlooked in appraising the job done in merchant shipping is the total absence of strikes in our sea-going personnel from Pearl Harbor to V-J Day. Not a man-hour was lost. No other segment of our industrial front can make such a boast for its wartime performance.

III

Along with the plane and ship programs went the vast job of producing ordnance — guns, ammunition, tanks, heavy and light trucks for transport of goods, bombs, light and heavy artillery, shells, and a multitude of weapons used on land, at sea and in the air. Our requirements for all these products far surpassed those of World War I. Ten million shells, for example, were shot by our forces in 1917–1918; during the war against the Nazis 8,000,000 shells a month were fired in the European theatre. The fire-power of naval guns has increased the last five years from 411 tons to 4,500 tons in 15 seconds. Over 36,000 tons of shells were fired by naval guns in the campaigns at Guam, Saipan and Tinian, 7,000 tons at Peleliu, 16,000 tons at Iwo Jima and 50,000 tons at Okinawa. In the last war 49,034 trucks, cars and tanks were sent to France from American factories. This time 411,184 assembled vehicles were landed in France ready to go. If the unassembled vehicles imported in crates were counted, we put into France over ten times as much mechanized equipment in this war as we did a generation ago.

In the last five years American factories have manufactured over 6,000,000 rifles, more than 5,000,000 carbines, about 2,500,000 machine guns (of which General Motors divisions made over 1,000,000), almost 2,000,000 submachine guns. Production of ammunition and bombs has run into astronomical figures. Our factories shipped over 37,000,000,000 rounds of small arms ammunition — enough to furnish every inhabitant of the United States with 260 rounds. In addition, our fighting planes and those of our allies were supplied with 337,000,000 rounds of aircraft gun ammunition, and our artillery units received more than 3,000,000 rounds of ground artillery ammunition (production of ammunition is based on the formula of one ton per gun per day). For the big guns of more than 105 millimeters of which 9,000 were built, some 22,000,000 rounds of ammunition were produced. The many gigantic bombing raids carried out by our air forces were made possible by the extremely high rate of output of aircraft bombs: 5,000,000 tons.

Mechanization of our armies proceeded at a breath-taking pace after the Germans had demonstrated conclusively the power of their Panzer divisions. Our factories built over 85,000 tanks of all kinds, Chrysler with its huge tank arsenal having been responsible for 25,000. The tank program went ahead so rapidly and successfully that long before the Germans were whipped, some of the companies making tanks had gone back to producing locomotives, and companies ready to begin building tanks had their contracts cancelled. For these tanks over 130,000 guns were made, including large self-propelled guns. Our production of field artillery (55,000 units) and of mortars (71,000) was a prodigious accomplishment.

During the North African and Sicilian campaigns it became evident that large motor vehicles would be the best means, and often the only means, of transporting war goods to the points where they were needed. At that time a staggering program of producing heavy-heavy trucks (over two and a half tons) and light-heavy trucks (two and a half tons) was begun. The result is that in the five-year period up to July 1, 1945, 111,000 heavy-heavy and 660,000 light-heavy trucks were turned out. During the European phase of the war, half a million vehicles were used, ranging from jeeps to giant tank transporters. These vehicles made up the famed Red Ball Express that served as the main supply line from the beaches of Normandy to the German border and the front battlelines.

When the war moved exclusively into the Pacific, the size of the ordnance redeployment program in Europe provided some measure of the volume of war goods that we poured into the war against Germany. We planned to ship to other theatres — and the program was under way when Japan capitulated — 35,000 combat vehicles, 325,000 general and special-purpose vehicles, 11,000 artillery pieces, 2,800,000 small arms, automatic weapons and mortars, and 400,000 pieces of anti-aircraft fire control equipment.

In explosives we were caught shorter than in almost any other critical item at the beginning of the war. Our smokeless powder capacity was pitifully small. The same situation existed in high-explosive TNT. But the construction program undertaken in 1940 and 1941 made possible the production up to July 1, 1945, of somewhat under 2,000,000 tons of smokeless powder and somewhat more than 2,000,000 tons of high-explosive TNT. These figures in themselves have little meaning unless one understands that our present facilities for making explosives are large enough to supply all the armies in the world.

An account of what America's factories have contributed to victory would not be complete without brief mention of the war goods furnished under lend-lease to our allies. The bulk of the goods went to two nations: the United Kingdom and Soviet Russia. The former received 42 per cent of all lend-lease goods and the latter 28 per cent. Most of the arms and materials sent to those two countries were used in the offensive against Germany in the west and in the east. We shipped to the British more than 10,000 medium and light bombers, fighters and miscellaneous aircraft; and that figure does not include thousands of planes purchased by the British in this country early in the war.

America's General Sherman and General Grant tanks were part of the famed British Eighth Army that drove Rommel out of Egypt, Libya and Tripolitania. British tankmen fought in American-made tanks in Tunisia, Sicily and Italy and later

against the German armored divisions in Europe. After March 1941, we shipped 12,750 tanks of all kinds to the United Kingdom. About one-fourth of all the munitions, equipment and supplies for the armed forces of the British Empire were produced in American plants. Our lend-lease shipment to Britain included over 100,000 machine guns, 600,000 submachine guns, 40,000 aircraft guns and 85,000 jeeps. The United States Navy leased to our allies 5,346 vessels totaling 1,037,000 tons. This fleet included one light cruiser, thirty-eight escort aircraft carriers, ninety-two destroyer escorts and nine submarines. The bulk of this fleet went to the British.

The saga of our shipments to Russia via the Arctic route and the Persian Gulf north through Iran has not yet been fully told, but the outpouring of American war goods contributed substantially to the success of the Soviet armies, from Stalingrad's heroic defense to the final campaign in which Soviet troops swept across eastern Germany and into Berlin. Up to June 30, 1945, we had supplied the Russians with 14,450 planes, including 9,700 pursuit planes and 3,800 bombers, and had shipped to Russia over 47,700,000 square feet of aircraft landing mat, equivalent to 60 miles of landing strip 150 feet wide.

The striking power and mobility of the Red Army were aided substantially by American shipments of 7,000 tanks, 3,200 armored scout cars, 2,200 ordnance service vehicles, 52,000 jeeps, 363,000 trucks, 35,000 motorcycles, 8,200 anti-aircraft guns, 135,000 submachine guns and 343,000 tons of explosives. The Soviet navy and merchant fleet were aided by receiving from us 105 submarine chasers, 195 torpedo boats and 7,600 marine Diesel engines. But that isn't all. To expand the Soviet's munitions production, we furnished machine tools valued at $320,000,000, metal-cutting tools worth $35,000,000, petroleum-refining equipment valued at $43,000,000, electric generator sets worth $171,000,000, 2,688,000 tons of steel, 17,600 tons of ferro-alloys and 810,000 tons of nonferrous metals. And to Russia, as well as to the United Kingdom, lend-lease supplied large quantities of food.

IV

The whole story of what industry has done cannot be told without mention of machine tools and raw materials. Machine tools are the basic tools upon which all war weapons are made. Leo T. Crowley, head of the Foreign Economic Administration, testified on June 26, 1945, before a subcommittee of the United States Senate Military Affairs Committee, that "machine tools are much more important in modern war than soldiers. Whereas machine tool capacity installed may be said to add arithmetically to the military power of a given population, the possession of knowledge and capacity to build quantities of machine tools effectively

multiplies that war potential in geometric progression."

Fortunately for America, this country possessed in 1940 the world's best machine tool industry. Upon it fell the full burden of building the machines needed to tool our war industries. It fulfilled its part by producing in four years almost 1,000,000 machine tools — as many as American industry possessed in all its factories at the end of 1939. In forty-eight months machine tool builders made as many machines as they had in the previous forty years.

Aluminum was one of the shortest materials when the Army and Navy asked for tens of thousands of warplanes. Within a year or two, aluminum capacity had been enlarged seven times, and in 1944 we had an excess of facilities. Magnesium capacity was expanded 100 times; for many months prior to the end of the war the country had not been able to use all this new capacity. Under war pressure, the nation's alloy steel tonnage (alloys give toughness and strength and other special qualities to steel) was tripled, advancing from 7 per cent of total steel output to 15 per cent. To conserve our thin stocks of alloys, the steel industry devised and put to use a new series of low-alloy, high-strength steels, known as National Emergency Steels.

Our shipbuilding record was made possible by the unprecedented tonnage of plate steel produced by American steel mills. Output doubled compared with the highest prewar year, exceeding 13,000,000 tons a year in 1943 and 1944. This performance was achieved by the quick conversion of continuous steel mills from their regular task of rolling thin sheets for automobiles and other consumer products to production of heavy plates. The steel industry as a whole pushed up its capacity 17 per cent during the war and in 1944 produced almost 90,000,000 tons of ingots, or 25,000,000 tons more than it ever did in the best prewar year. This extra tonnage is almost as large in itself as the annual production of all of Germany's steel mills when operating at capacity.

One of the most striking of all the war's many spectacular records was the building from scratch in less than four years of a completely new industry — synthetic rubber. The Japanese felt that one of their biggest trumps to play against us was the cutting off of our supply of natural rubber from the Far East. A nation that lives on rubber tires, they reasoned, would suffer immeasurably from this deprivation. But the Japanese failed to consider our industrial resourcefulness. We constructed new plants and perfected new techniques that made us able by 1945 to manufacture a larger tonnage of rubber products than ever before in history. Synthetic rubber production this year will be close to 1,000,000 tons. Our biggest pre-Pearl Harbor consumption of rubber was 650,000 tons in 1941. Synthetic rubber automobile tires, except for heavy-duty truck service, are as good as crude rubber tires. This

giant new industry is typical of what America has done, and can do again, if pushed into a corner.

The production path that led to our brilliant technical achievement was beset with many difficulties. Shortages of all kinds appeared along the way — machine tools, plant facilities, raw materials, components, manpower. War calls for constant changes in products resulting from battle experience, and for new products to meet new military and naval situations. There is scarcely a weapon with which we started the war that has not been improved or radically altered since 1941; and many new weapons have been introduced, such as the bazooka, rockets, the amphibious duck, the jeep, super-fortresses, jet-propelled planes and the atomic bomb.

Research and development work carried on both by industry and by government helped to perform the miracle. Such work gave us substitutes for strategic materials like rubber and tin, new metals and synthetics, weapons with greater fire-power, detection devices and other counter-weapons, vast improvements in radio communication and electronics; and it gave us these in quantity, through constantly improving mass-production techniques.

Production troubles inevitably accompany new products and design changes in old products. It takes time to get a newly-developed or newly-modified item up to the desired schedule. The "fluidity of war" caused the production pendulum to swing sharply from tanks to heavy artillery to landing craft. Procurement of shells rose to a feverish point, then slackened to a much slower pace, and later shot up again. From the early cry of "too little and too late" our stupendous production enabled us to furnish "too much and too soon."

Few people realize that employment in our war industries pyramided to its all-time peak as early as November 1943, and then slid off steadily. From then on, our factories lost employees at a rate of 100,000 a month. By the time of Germany's capitulation 1,800,000 fewer people were at work in war plants than at the peak. Yet production itself did not suffer. That phenomenon is easy to explain: factories were able to increase their output per worker as employees became more familiar with making weapons instead of refrigerators and spark plugs. Take the case of the airframe industry. In 1941 its production averaged twenty-one pounds per employee per month. By January 1943, the average had increased to thirty-eight pounds, and in August 1944 it reached ninety-six pounds.

As output per worker went up, as manufacturing techniques improved and as management skill increased, costs declined, in numerous instances to one-third of the original price set. Here is a typical case of what happened; it was duplicated many times. In making the .50 calibre Browning machine gun, a refrigerator com-

pany got these results: it put into mass production a hitherto hand-made weapon; it made over 500 improvements in design, materials and manufacturing methods; it reduced the raw stock per gun twenty-five pounds, or more than one ton per 100 guns; it replaced in each gun forty-four pounds of critical materials with non-critical; it produced five times the initial schedule with twice the number of people and twice the number of machines originally required; it cut the cost to the government by two-thirds.

It is not surprising that a United States admiral observed recently after returning from the Pacific: "It is the production curve that won the war." Now the nation is asking whether that production curve can be maintained in peace as it was maintained in war. The downward dip after V-E Day will naturally continue until reconversion is complete, but there is no reason why it should not rise again. The United States has the highest rate of mechanization in the world, and this basic advantage has enabled the American workman to produce more goods and earn higher wages than the workman of any other nation.

With such an advantage and such a record, the only thing that can defeat us is lack of confidence in our own capacity to organize our peacetime economy. Although there are some ominous storm clouds on our industrial horizon, it is difficult to understand how any reasonable man, in the light of the production miracle of 1940–45, can sell America short.

Our senses can grasp nothing that is extreme. Too much noise deafens us; too much light blinds us, too far or too near prevents us seeing; too long or too short is beyond understanding; too much truth stuns us.

— Blaise Pascal

Each of us is aware, if he looks back upon his own history, that he was a theologian in his childhood, a metaphysician in his youth, and a natural philosopher in his manhood.

— Auguste Comte

Most of the misery which the defamation of blameless actions or the obstruction of honest endeavors brings upon the world is inflicted by men that propose no advantage to themselves but the satisfaction of poisoning the banquet which they cannot taste, and blasting the harvest which they have no right to reap.

— Samuel Johnson

BIBLE ODDITIES

By Morris Rosenblum

In days of greater leisure, Dr. Horne, a painstaking student of the Bible, estimated that the Authorized Version of the Old and New Testaments contains 3,566,480 letters. Another learned enthusiast counted 3,586,489. Whatever the exact figure may be, the chances of misprints are many. Some of these misprints are harmless; others have been of so startling a nature that they have even given their names to the editions. And very often they have changed the meaning of a passage and have led to great anguish.

About 1660, in an article called "Fye For Shame," Tom Fuller said that what would be noted as an error in other books must be considered impiety when occurring in the Bible. Though Field's edition of the Bible printed in 1660 was considered an unrivaled specimen of the art of printing, it was vigorously attacked by Bishop Wetenthal in 1686 because of an error which the bishop believed to be intentional. He was referring to one passage in *Acts* VI:3: "Wherefore, brethren, look ye out among you seven men of honest report, full of the Holy Ghost and wisdom, whom we may appoint over this business." Field's text had "ye" for "we" before "may appoint." The bishop saw social implications in the misprint and thought it was the planned purpose "of those who would establish the people's power, not only in electing, but ordaining their own ministers."

At one time printers had to pay heavily for serious misprints. The omission of the word "not" from the Seventh Commandment in a 1631 edition of the Bible stigmatized it as a "Wicked Bible" and cost the printers a fine of more than £2000. In one edition printed during the reign of Charles I, *Psalms* XIV: 1 read: "The fool hath said in his heart, There is a God." For the change from "no God" to "a God" the printers forfeited £3000. Another "Wicked Bible" printed in London in 1653, had two glaring errors: "Know ye not that the unrighteous shall [*instead of* shall not] inherit the kingdom of God," I *Corinthians* VI:9: and "Neither yield ye your members as instruments of righteousness [*instead of* unrighteousness] unto sin," *Romans* VI:13.

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