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THE CONTROL OF RUBBER IN WORLD WAR II

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Military success of the United Nations in World War II was threatened by a rubber shortage. Japanese capture of the principal rubber producing areas of the Far East in 1942 eliminated the sources of 90 per cent of the world's natural rubber production. Military rubber requirements alone during the war years exceeded normal peacetime civilian use, while tires were required for over 30 million passenger cars, buses, and trucks used in civilian transportation of workers and war materials.[1]

To meet this emergency, Britain shared her last remaining source of Far Eastern natural rubber, Ceylon; the United States created a new synthetic rubber industry, the future of which was to become a major postwar problem; and a system of controls over rubber was evolved which included international and national allocations, consumption restrictions, and rationing of civilian rubber products.

This article describes the steps taken in the United States to solve the rubber problem in World War II and evaluates the program in terms of its success in achieving the following goals:

1. Insuring an adequate supply of natural rubber
2. Developing synthetic substitutes
3. Controlling the use of rubber.

I

The rise of Japan in the 1930's drew the attention of American and British military authorities to the necessity of acquiring a stockpile of rubber. These early efforts were encouraged in 1937–38 by the Rubber Manufacturers Association, anxious to assure continuing supplies of a vital material, and agricultural interests desiring to remove part of our large cotton surplus. An agreement was announced in April 1939, providing that the United States and United Kingdom would barter 500,000 bales of cotton for approximately 90,000 tons of rubber. These commodities were to be used for war emergency purposes only, the United Kingdom to secure the export of the rubber under the

[1] Automobile Manufacturers Association, *Automobile Facts and Figures, 1942–1945*, Detroit, Mich.; Charles L. Dearing, *Automobile Transportation in the War Effort;* Rubber Manufacturers Association, Inc., *Tires at War, 1939–44.*

IRRC (International Rubber Regulation Committee) scheme. Subsequent agreements in 1940 and 1941 between the Rubber Reserve Company, newly organized RFC subsidiary, and IRRC increased the total tonnage to 430,000 tons.

These early efforts resulted in the highest level of natural rubber imports in the nations's history during 1940–41. Although consumption also rose during this period, the stockpile reached an all-time peak of 533,000 long tons at the end of 1941. Arrivals during the first four months of 1942 raised stocks to 634,000 tons, a figure about equal to consumption for the year 1940. The great producing areas of British Malaya and the Netherlands Indies were lost to Japan in February and March 1942, and the only important producing area remaining, Ceylon, which had exported 88,000 tons in 1941, was threatened by the rapidly advancing Japanese. The total annual production for the year 1941 of the areas remaining to the United Nations in Africa, South America, and Mexico amounted to less than two weeks' current consumption for the United States alone.

Immediately after Pearl Harbor, the Rubber Reserve Company entered into an agreement with IRRC to purchase 100,000 tons of rubber per month during 1942.[2] Efforts were made to insure maximum flow of crude rubber from the producing areas in the Far East. The Combined Raw Materials Board recommended early in March 1942 that Ceylon rubber production for the next two months be allocated to Russia and to the United States.[3] It was also recommended that the United States should assume procurement responsibility in the Western Hemisphere and Liberia, responsibility for all other rubber-growing areas to be assumed by the United Kingdom, and that neither country would accept offers of rubber outside its sphere of influence.[4] These early recommendations were the foundation for later decisions and recommendations in the field of international allocations of rubber.

Agreements were negotiated between March and October 1942 with 15 Latin American countries providing that surplus natural rubber production would be shipped to the United States in return for a United States guarantee of their basic requirements for finished goods.[5] In early 1942, it was optimistically

[2] Memorandum of Agreement, Reconstruction Finance Corporation, Rubber Reserve Co. and International Rubber Regulation Committee, Dec. 13, 1941.

[3] Combined Raw Materials Board, Decision No. 5, March 3, 1942. Any rubber purchased by the United Kingdom in Ceylon during the next two months in excess of 12,000 tons allocated to Russia was to be shipped to the United States.

[4] Combined Raw Materials Board, Decision No. 16, March 26, 1942.

[5] The first agreement, with Brazil, March 3, 1942, was negotiated by the Rubber Reserve Co. with concurrence of the State Dept. The remaining 14 agreements were negotiated by the Board of Economic Warfare with State Dept. concurrence. In countries with manufacturing facilities, we agreed to furnish rubber. Other agreements were negotiated in 1942–43 with private contractors in the following countries: Costa Rica—Goodyear; Honduras, Guatemala, Salvador, Colombia—Chicle Development; Liberia—Firestone; Belgian Congo—Societe por la Producion de Caoutchouc (hevea planting); Haiti—SHADA (cryptostegia planting); Central American countries—Wm. Wrigley Co.; Mexico—Continental Mexican Rubber Co. (Mexican guayule planting). These contracts, which were to expire between March and Dec. 1946, were terminated by the Rubber Development Corporation

predicted by the Board of Economic Warfare and others that the Western Hemisphere natural rubber program would yield over 60,000 tons in 1943 and almost double that quantity in 1944.

The administrative organization carrying on the natural rubber program prior to the Baruch report was overlapping and confusing. The Rubber Reserve Company, through its buying committee, handled the procurement and storage of Far Eastern and other rubber acquired for the United States stockpile. Representatives were sent to Latin American countries early in 1942 to negotiate rubber purchase agreements. The Department of Agriculture had carried on field studies and experimental hevea rubber plantings in 15 Latin American countries with $500,000 approved by Congress in June 1940. Meanwhile administrative authority over the acquisition of materials from foreign countries was placed in the hands of the Board of Economic Warfare by Executive Order No. 8982 (December 27, 1941), which was later modified to leave over-all policy in the hands of the State Department, matters of "business judgment" in the BEW, and actual procurement in the hands of the Rubber Reserve Company. The Coordinator for Rubber in the WPB, after his appointment in March 1942, attempted to resolve the difficulties between BEW and Rubber Reserve, suggesting that the former agency confine its decisions to over-all policy. BEW, however, resisted any encroachment upon its authority over the rubber program and insisted that the Rubber Reserve Company clear every detail of the buying program with its Rubber Section. The fundamental conflict between the two agencies was over the question of whether the Latin American rubber program should have as a major emphasis the long-term planting and development program begun by the Department of Agriculture in 1940 or whether principal reliance should be upon maximum wild rubber procurement. It was a conflict between the businessman's approach to the problem and the economic planner's. The program which resulted was a poor mixture of the two.

The Baruch report, issued in September 1942, called attention to the failure to build a greater stockpile of natural rubber and recommended that: (1) a minimum stockpile of 100,000 long tons of natural rubber be maintained, (2) production of natural hevea rubber, guayule, and cryptostegia be pursued vigorously, (3) administrative responsibility over the rubber program be centralized in a rubber director.

The recommendations of the Baruch report on the natural rubber program removed earlier administrative confusion but added little to supplies. Following the report, the Rubber Development Corporation was formed as a new RFC subsidiary to carry on the work of BEW and the Rubber Reserve Company in Latin America, under the supervision of the rubber director (Chart I). Imports from the Amazon Valley increased in 1943 and 1944, but the results were

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in 1945. Latin American rubber agreements with the exception of Bolivia, Ecuador, British Honduras, Salvador, Honduras, and Guatemala were extended from Dec. 31, 1946, until June 1947. The agreement with Venezuela was on an annual basis and will expire in Oct. 1946.—Report of the Special Director of Rubber Programs to WPB, June 25, 1945.

less than half of those estimated earlier by BEW and Rubber Reserve (Table 1). A presidential directive of July 15, 1943, transferred the responsibility for the activities of the Rubber Development Corporation to the Office of Economic Warfare, predecessor to the Foreign Economic Administration. No important change in policy resulted from this change, since it was generally assumed by this time that the Western Hemisphere natural rubber program would fall far below 1942 objectives.[6]

Seed and equipment were acquired, nurseries established, and approximately 53,000 acres of irrigated land leased in California under authorization of the Guayule Act (Public Law 473, March 5, 1942) by the spring of 1943. Following the Baruch report, an amendment to the act in October 1942 increased the authorized acreage to 500,000, of which 200,000 acres were to be in cultivation by June 1944. This, with subsequent plantings, was to allow an annual harvest of about 80,000 tons of rubber.[7] As a result of crop failures and farmer agitation to return the acreage to more profitable food crops, it was decided in March 1943, when only 31,356 acres were under lease and planted, to lease no additional land and maintain the nurseries in standby condition. Guayule plantings yielded only approximately 1,000 long tons of rubber in the three years 1943–45, and in 1945 the War Production Board decided to harvest by 1947 the entire guayule acreage planted, the total yield estimated at 12,000 tons of rubber. Finally, in March 1946, it was proposed in Congress that the entire acreage be ploughed under and the program ended by June 30, 1947.

Stocks of natural rubber and latex declined rapidly during 1943–44 and in October 1944 reached a low point of 90,590 long tons, below the Baruch Committee recommended minimum of 100,000 long tons. By this time monthly synthetic rubber production of 66,000 long tons exceeded current monthly consumption and synthetic stocks were being built up rapidly. Delays in military conversion to synthetics and a large increase in stated military requirements for 1945 gave new importance to increasing natural rubber supplies. To meet this need, increased quantities of Ceylon, Indian, and African rubber were allocated to the United States by CRMB. (United States natural rubber imports from November 1944–February 1945 totaled 60,364 long tons as compared with 35,691 long tons during the previous four months.) The reduction in stated military requirements with the changing course of the war early in 1945 and an accelerated rate of conversion to synthetics removed this new threat to exhaustion of natural rubber supplies and by December 1945 natural rubber stocks had increased to 118,715 long tons.

The maintenance of natural rubber supplies to the United States during the war can be attributed to:

[6] Office of Rubber Director, WPB, *Progress Report No. 4*, July 25, 1944. "Production from South America has been disappointing; today it appears to this office the prospects for 1945 are little or no brighter."

[7] "Guayule Production in the West," Federal Reserve Bank of San Francisco, *Monthly Review*, May–June 1945. Report of the Special Director of Rubber Programs to the War Production Board, June 25, 1945.

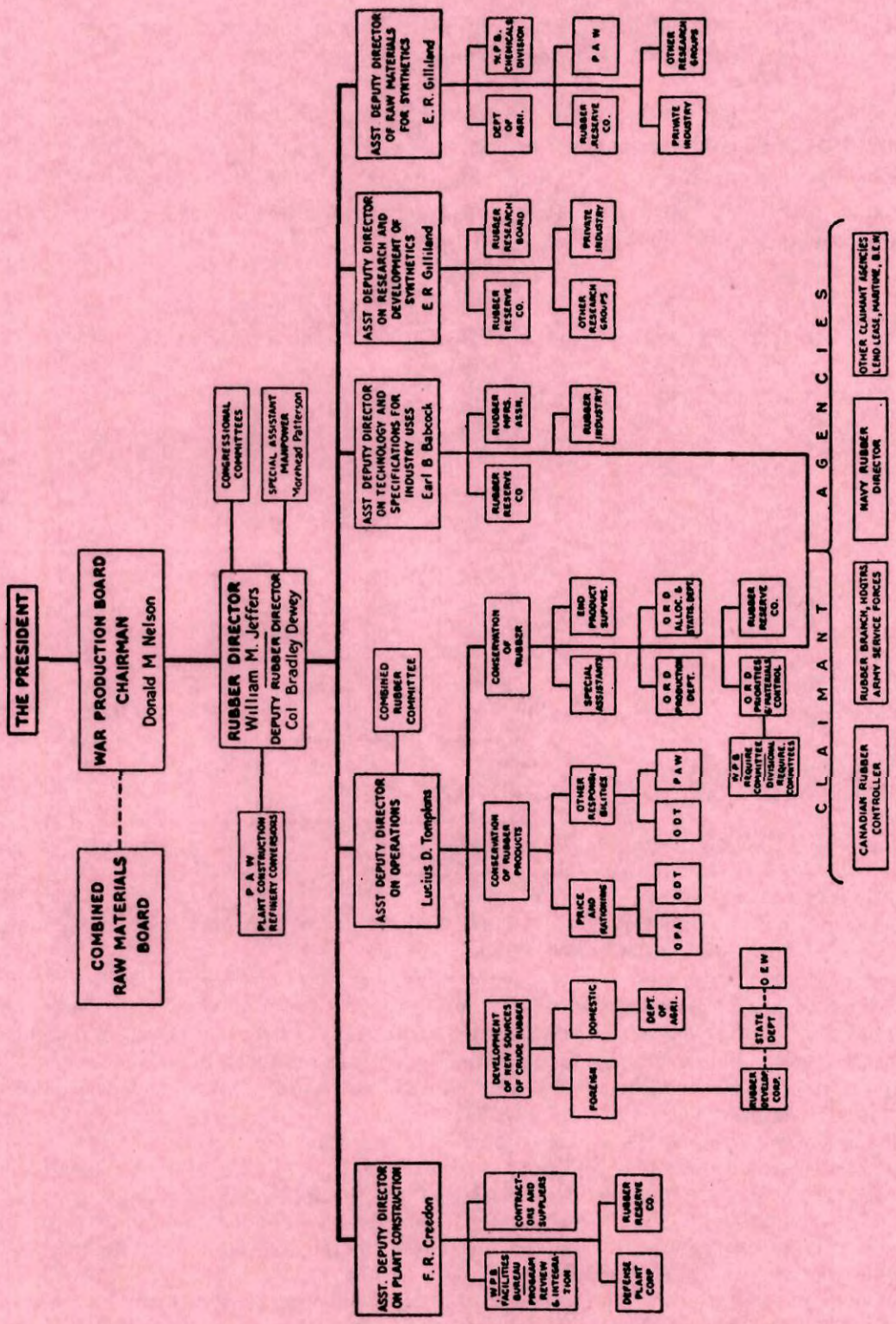

CHART I. AGENCIES CONCERNED WITH THE RUBBER PROBLEM UNDER THE RUBBER DIRECTOR—1943

1. Early and successful efforts of the rubber industry and government agencies, which during 1940–41 resulted in the highest level of natural rubber imports in the country's history.
2. Allocation by the CRMB of 60 per cent of Ceylon's production and increased supplies from American and African sources during 1944–45.[8]

Natural rubber yields in the Western Hemisphere were disappointing when compared with early estimates or dollar cost of the program.[9] However, rated on its true potentialities and considering the importance of even small additions to our stockpile, the Latin American program achieved some success. The domestic guayule program was a failure.[10]

TABLE 1

UNITED STATES NEW SUPPLY OF NATURAL RUBBER AND LATEX 1940–45

(Thousands of long tons)

IMPORTS	1940	1941	1942	1943	1944	1945
Latin American	11.1	10.8	14.5	26.2	32.8	37.6
Far East	799.8	1,007.6	255.5	20.1	60.3	69.9
African	7.3	10.6	12.6	13.6	19.0	35.7
Subtotal	818.2	1,029.0	282.6	59.9	112.1	143.2
U. K. Transf.	—	—	—	—	1.5	1.7
Salvage	—	—	0.1	0.4	0.3	[a]
Total Imports	818.2	1,029.0	282.7	60.3	113.9	144.9
Less Shrinkage	—	—	—	5.3	6.2	9.8
After Shrinkage	818.2	1,029.0	282.7	55.0	107.7	135.1
U. S. Guayule Production	—	—	—	0.3	0.1	0.6
Total New Supp. After Shrinkage	818.2	1,029.0	282.7	55.3	107.8	135.7

[a] 28 long tons.

Source: Facts for Industry, Tables 3, 4. Civilian Production Administration, Rubber Division, Bureau of Census Series 26-1-1.

[8] Natural rubber production in Ceylon during the war exceeded the United Kingdom's normal prewar consumption. The U. K. doubled reclaimed rubber production in 1943–44 over 1942 levels and in addition received finished rubber products on lend-lease account. Imports to U. K. from African sources were increased: in 1942—7,431 l.t.; in 1943—18,451 l.t.; in 1944—21,458 l.t.; and in 1945—13,377 l.t.

[9] Cost of the Western Hemisphere natural rubber program was estimated at 88.37 cents per pound by the Rubber Development Corporation for 50,000 l.t. dry weight received from April 1942 to June 1944. Total cost was $45,000,000.—Rubber Development Corporation release, August 8, 1944. In budget hearings for the fiscal year ended June 30, 1947, Rubber Development Corp. estimated natural rubber costs through June 30, 1947, at an average of 65¢ per pound.

[10] See footnote 7 above. The total cost of the guayule program is estimated at approximately $45,000,000 by the Federal Reserve Bank of San Francisco. The Poage Bill (H.R. 2347) passed by the House on May 14, 1945, would have fostered private guayule production in the southwestern states by pegging the price at 28¢ per lb. until June 30, 1956. The bill

These small additions to natural rubber supplies were combined with greater reductions in consumption from 1941–45 (Table 1) to maintain minimum natural rubber stockpiles.

UNITED STATES IMPORTS, CONSUMPTION, STOCKS, NATURAL RUBBER 1941–45
(Thousands of long tons, dry weight)

	1941	1942	1943	1944	1945
Imports	1,029.0	282.7	55.0	107.7	135.1
Consumption	775.0	376.8	317.6	144.1	105.4
Stocks, end of year	527.8	422.7	139.6	93.6	118.7

II

United States synthetic rubber production capacity in 1939, about 4000 tons per year, ranked below Russia and Germany, the latter with an estimated capacity of 20,000 tons.[11] The types of rubber manufactured in the United States and Germany and the processes and raw materials used were basically similar. United States capacity had been increased by early 1941 to 10,000 tons (Neoprene 5700, Buna N 2500, Thiokol 1200, Buna S. and other 600). American industry was aware of the critical importance of building a synthetic rubber industry and 10 leading manufacturers met with the Advisory Commission to the Council of National Defense on August 7, 1940, and agreed to prepare enginering plans by October of the same year for government financed construction of 108,000 tons additional Buna S (GR-S) production capacity. The ANMB (Army Navy Munitions Board) aproved this proposal in September 1940, and recommended the expenditure of $50,000,000 for government construction of the plants. It was not until May 1941 that the Defense Plant Corporation entered into contracts for construction of four synthetic rubber plants with total initial capacity of 10,000 tons, expanded to 40,000 tons in July 1941. More important than the eight-month delay and cutback in the copolymer (final rubber manufacturing) plants was the fact that contract authorizations for butadiene production, the most critical raw material in Buna S rubber, were let for only 15,000 tons in May 1941, and were not increased until January 1942.[12] Although it may be argued

did not become law. The cryptostegia planting program in Haiti, which had begun in 1941 under SHADA, was continued following the Baruch report. This program, which is estimated to have cost $6,900,000, yielded no production in 1943–44 and was abandoned as a failure in June 1944, owing to unfavorable weather conditions, insect pests, and lack of an efficient extraction process.

[11] U. S. Dept. of Commerce, Bureau of Foreign and Domestic Commerce, *Rubber, History, Production, and Manufacture*, pp. 40–43. Estimates were included showing the USSR as the largest producer of synthetic rubber in 1939, with estimated capacity of 50,000 tons. The estimates of Russia's synthetic capacity are controversial, and the Department of Commerce estimates were based upon alcohol consumption. German imports of natural rubber were subject to an import duty after May 1937 of approximately 23¢ per lb., the money obtained allocated to the building of synthetic rubber plants.

[12] S. T. Crossland, executive vice president of Rubber Reserve Co., summarizes the reasons for the delay in the program but not for the cutback in the recommended capacity in *Report on the Rubber Program, 1940–45*, Rubber Reserve Company, Feb. 24, 1945.

that engineering plans submitted in October 1940 were incomplete, that synthetic rubber technology was not sufficiently far advanced to justify more than experimental production, and that caution was required since the plants might represent an uneconomic investment of government capital, the fact is that the United States synthetic rubber production program at the time of Pearl Harbor was less than one half that recommended by private industry, NDAC, and the ANMB over a year previously.

The production objective for the synthetic rubber program was raised to 400,000 long tons immediately following Pearl Harbor, to 600,000 on March 3, and to 800,000 on April 21, 1942. Decisions had to be reached during this period regarding: (1) the quantities of each type of synthetic rubber to be included; (2) the processes to be used in producing the principal raw material required for Buna S (GR-S) rubber, butadiene.

Experts were in general agreement that Buna S rubber was the type best suited for tire production. In addition the War Production Board added to the program in March and June 1942 (Table 2) Butyl rubber, a type superior to natural rubber for use in tubes and favored by Standard Oil experts as the best general purpose synthetic rubber, and Neoprene, developed by the duPont Company for uses requiring oil resistance and abrasive properties.[13]

Five processes for producing butadiene were considered, three based upon use of petroleum gases and two requiring alcohol as raw materal. The original DPC contracts authorized were based upon a process sponsored by the Standard Oil Company of New Jersey requiring use of butylenes, petroleum refinery gases. The Office of Petroleum Coordinator, Sun Oil Company, and others advocated wider use of other petroleum gases, naphtha and butanes, in a plan for conversion of existing refinery facilities to butadiene production. A third process required use of benzene, produced from petroleum gases or coke. A 40,000-ton benzene-butadiene plant under construction by the Koppers United Company was rescinded in July 1942 when it became apparent that benzene, required for production of aviation gas and styrene (second basic ingredient of GR-S rubber) would not be available in sufficient quantities.

The most important process based upon the use of alcohol as raw material was sponsored by Carbon and Carbide Chemicals Company and received wide support from the Gillette Committee and farm groups. The other, based upon butylene glycol, produced by fermentation of grain and potatoes, and advocated by Joseph Seagram's Sons and the Department of Agriculture, was later found impractical.

Over 100 separate congressional committee hearings were held on various phases of the rubber program from January 1942 to July 1943. Increases in the authorizations for plants using the alcohol and refinery conversion processes during July and August 1942 resulted in large part from pressures upon WPB and RFC by these committees.

[13] Reference to current literature on synthetic rubber is found in Idair Smookler, *Economics of Synthetic Rubber, A Selected Bibliography*, Library of Office for Emergency Management, Aug. 9, 1943.

TABLE 2

ANNUAL CAPACITY OF SYNTHETIC RUBBER PROGRAM AS OF SELECTED DATES

TYPE OF RUBBER	RUBBER RESERVE COMPANY						BARUCH	OFFICE OF RUBBER DIRECTOR			
	May 15, 1941	Jan. 9, 1942	Mar. 1, 1942	Apr. 1, 1942	June 1, 1942	Aug. 18, 1942	Committee Recommendation Sept. 10, 1942	Nov. 30, 1942	Feb. 18, 1943	June 30, 1943	Feb. 24, 1945
(Long tons)											
Govt. and private											
Buna S	10,000	120,000	195,000	585,000	615,000	705,000	845,000	705,000	705,000	705,000	705,000
Butyl	—	—	38,000	38,000	68,000	132,000	132,000	132,000	68,000	68,000	68,000
Neoprene	9,000	9,000	49,000	49,000	49,000	49,000	69,000	69,000	49,000	49,000	60,000
Thiokol	900	900	900	900	900	24,900	60,900	24,900	24,900	24,900	—
Buna N types[1]	18,000	18,000	18,000	18,000	18,000	18,000	—	18,000	18,000	18,000	18,000
Raw Materials											
(Short tons)											
Government only											
Butadiene											
Petroleum process (DPC)[2]	15,000	15,000	215,000	430,000	526,200	380,000	394,300	351,700	351,700	351,700	345,000
Petroleum process refinery conversion[3]			—	—	—	30,160	127,000	176,850	76,800	53,800	57,500
Alcohol process			40,000	80,000	80,000	220,000	247,000	220,000	220,000	230,000	220,000
Benzene			40,000	40,000	40,000	—	—	—	—	—	—
Total butadiene	15,000	15,000	295,000	550,000	646,200	630,160	768,300	748,550	648,500	635,500	622,500
Styrene		32,500	70,000	197,500	200,000	167,500	225,300	191,700	191,700	192,700	187,500

[1] All privately owned. Plants have not run at capacity because of shortages of raw materials.

[2] Includes butane, butylene, naphtha, authorized by Rubber Reserve prior to Aug. 1942.

[3] Includes naphtha, natural gas, and combination butylene-naphtha recommended by the Baruch report and ORD after Sept. 1942.

Source: Rubber Reserve Co., *Report on the Rubber Program, 1940–1945*, Feb. 1945. Estimates of capacity prior to Feb. 1945 compiled by the author from Rubber Reserve and ORD reports.

The climax to the dispute over raw materials processes was reached on July 26, 1942, when the House of Representatives passed and sent to the White House a Senate bill (S 2600) to create an independent rubber agency to make rubber from alcohol produced from agricultural and forest products. The President vetoed the bill on August 6, 1942, and appointed the Rubber Survey (Baruch) Committee to investigate the entire situation and "recommend such action as will produce the rubber necessary for our total war effort, including essential civilian use, with a minimum interference with the production of other weapons of war."

The report of the Rubber Survey Committee recommended that the government "bull through" the current synthetic rubber program, add to Neoprene and Thiokol capacity, and increase butadiene capacity, using the refinery conversion and alcohol processes. The recommendations for increased capacity were acted upon immediately by the newly appointed Rubber Director, William Jeffers, but were abandoned almost in their entirety by February 1943.[14]

An important recommendation of the Baruch report was that there be "a complete reorganization and consolidation of the governmental agencies concerned with the rubber program, and centralization of control over all matters relative to the rubber program in a Rubber Administrator, appointed by the Chairman of the War Production Board," who was to be instructed to divest himself of all "direct concern with these matters." The need for centralization of authority over the choice of processes and over-all planning of the program was quite evident in the continuous disputes between the Office of Petroleum Coordinator for War, Rubber Reserve, WPB bureaus, and proponents of alternative types of rubber and processes. The independent authority over the entire program granted to the Rubber Director by executive order of the President on September 17, 1942, resolved administrative disputes in the program, but proved a source of increasing difficulty to the successful completion of the over-all objectives of satisfying military and civilian requirements during the years 1944–45, when maximum coordination was required between all phases of component materials production.[15]

The weakness in this semi-independent type of administrative organization became apparent in a conflict in late 1942 between the ORD and the Petroleum Coordinator for War over the comparative priority ratings to be assigned to orders for valves, heat exchangers, pumps, and motors for the rubber and aviation gas programs. The conflict was settled early in 1943 when the WPB set up sequences of completion dates for the plants in the two programs.

[14] Reasons for abandonment of these recommendations given in *Progress Report No. 2*, Office of Rubber Director, WPB, Feb. 18, 1943, included scarcity of raw materials and components, an excess of actual overrated capacity for the alcohol butadiene plants, and the results of tests having shown that Neoprene, Butyl, and Thiokol were unsuitable for tires.

[15] Successful coordination of research in a Rubber Research Board was an important administrative accomplishment of the ORD. A description of the research program and recommendations for its continuance are found in Norman A. Shepard's "Address Delivered at the Opening and Dedication of the Goodyear Research Laboratory, Akron, Ohio, June 22, 1943" (mimeograph), The Goodyear Tire and Rubber Co., 1943. Supervision of research was transferred to Rubber Reserve in 1945.

The rate of completion of butadiene plants was the principal factor influencing the rate of production of synthetic rubber during 1942–44. Although earlier estimates were predicated upon completion of certain of these plants by October 1942, the first government butadiene was produced in January 1943 by the alcohol butadiene process. (Synthetic rubber produced in government plants in 1942 was made from butadiene purchased from private producers.) Productive capacity of the alcohol butadiene plants was in excess of rated capacity and eventually proved to be 180 per cent of plant design.[16] The importance of the latter factor can be noted from the comparison of rated capacity and actual production for alcohol and petroleum butadiene plants.[17]

SHORT TONS

	RATED CAPACITY	DEMONSTRATED OPERATING CAPACITY	PRODUCTION	
			1943	1944
Alcohol butadiene plants	220,000	396,000	129,685	361,734
Petroleum	402,500	426,250	27,787	195,719

Alcohol butadiene accounted for less than 40 per cent of total 1945 production. Recently it has been recommended that only the presently efficient petroleum butadiene plants and one alcohol butadiene plant, a total of 550,000 short tons of butadiene capacity, be retained in operation or in standby condition after supplies of natural rubber become available.[18]

Actual production of synthetic rubber in 1943 (Table 3) fell below estimates made by the Baruch Committee and the Rubber Director,[19] owing principally to the delay in authorization of butadiene plant contracts by the Rubber Reserve Company. Contributing factors to the disappointing 1943 production included: cutbacks in the Baruch recommended program by the Rubber Director in February 1943; technical bugs in the butyl (GR-I) production process; shortages of certain material components needed for the petroleum butadiene plants; and greater delays than expected in the refinery conversion and Houdry process butadiene plants.

[16] Rubber Reserve Co., *Report on the Rubber Program 1940–45*, Feb. 1945. See also *Special Report of the Office of Rubber Director on the Synthetic Rubber Program, Plant Investment and Production Costs*, War Production Board, Aug. 31, 1944.

[17] *Ibid.*, p. 62.

[18] *First Report, Interagency Policy Committee on Rubber*, Office of War Mobilization and Reconversion, Feb. 19, 1946, p. 37.

[19] The following estimates were taken from the *Report of the Rubber Survey Committee*, Sept. 10, 1942, and from *Progress Report No. 2*, Office of Rubber Director, Feb. 18, 1943.

ESTIMATED EQUIVALENT CRUDE PRODUCTION, 1943

	Baruch	*Ord*
Buna S (GR-S)	386,000	195,200
Butyl	62,000	18,400
Neoprene	30,000	30,400
Thiokol	54,000	—
Buna N types	—	16,400

Concerted efforts by prime contractors and the ORD during 1943 resulted in a level of synthetic rubber production by December 1943 in excess of the current consumption. From that point on, the rubber problem became one of conversion to use of synthetics and conservation of our dwindling supplies of natural rubber.

III

As evidences of shortages appeared early in 1942 each industry branch of the War Production Board developed an individual control system over critical materials for which it had responsibility. These controls ranged in extent from close supervision over production, consumption, and distribution to control over primary fabricators' consumption only. The system of WPB priority ratings and Requirements Committee allocations to claimant agencies became

TABLE 3

U. S. PRODUCTION OF SYNTHETIC RUBBER, 1942–1945

(Long tons)

TYPES	1942	1943	1944	1945
GR-S (Buna S)	3,721	182,259	670,268	719,404
Butyl	23	1,373	18,890	47,426
Neoprene	8,956	33,603	56,660	45,672
Buna N type	9,734	14,487	16,812	7,871
Thiokol	1,821	2,159	623	738[1]
Polyisobutylene	883	1,734	1,569	1,830[1]
Total	25,138	235,615	764,822	822,941

(Includes U. S. government and private plants.)

[1] First 8 months reported only.

Source: Civilian Production Administration, *Facts for Industry*, U. S. Department of Commerce, Bureau of the Census, Series 26-1-1, June 28, 1946; Rubber Reserve Co., *Report on the Rubber Program*, p. 58.

ineffective in 1942 as material requirements increased and procurement agencies uprated orders in order to obtain scarce materials. The Controlled Materials Plan, adopted in 1943, replaced independent branch controls over carbon steel, alloy steel, copper, and aluminum, with a vertical, integrated allocations system controlling the use of these commodities from production of the basic material to distribution of end products.[20]

The early system of controls over rubber, established in 1942 by the Rubber and Rubber Products Branch, WPB, and representatives of the claimant agencies, provided for: allocations of rubber among the United Nations countries by the CRMB, determination of claimant agency quotas for consumption of rubber in the United States by the WPB Requirements Committee and its subordinate Rubber Allocations Subcommittee, stockpile control by the Rubber Reserve Company, and consumption controls under supervision of the industry branch (Chart II). Civilian rubber products were rationed by OPA.

[20] War Production Board, *Controlled Materials Plan*, General Instructions, Nov. 14, 1942.

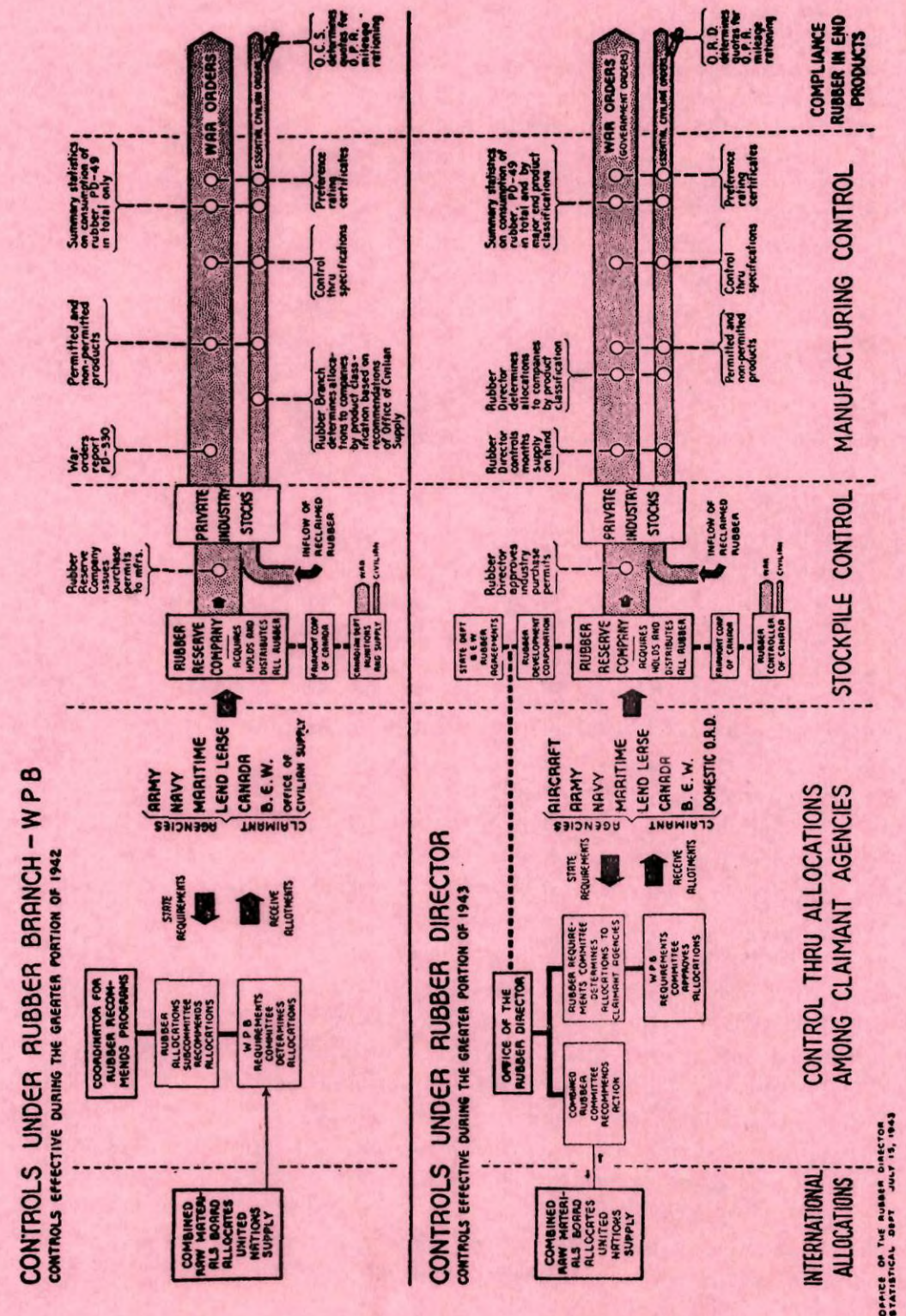

CHART II. CONTROL OF RUBBER DURING WORLD WAR II

The system was deficient in three major respects:

1. Requirements as stated by claimant agencies were inaccurate and generally overstated.
2. Orders for finished products were not cleared through any central agency.
3. Industry statistical reporting procedures did not permit a reconciliation of the use of rubber with claimant agency allocations.

Preparation of accurate rubber requirements by the Army and Navy was difficult because unit end product requirements were constantly changing; and raw material content of the same products varied widely among manufacturing companies and different bureaus in the Army and Navy, and for many sizes and types of the same article. Accurate replacement demand factors were unknown for most products, making calculation of replacement requirements a matter of guesswork. The Army and the Navy were unprepared for the statistical task of estimating raw material content of the thousands of finished products used. Estimates of rubber requirements for the Army and Navy were usually based upon previous reported use by the industry, with a generous allowance for a rising trend.

Industry branch procedure for controlling the use of rubber was handicapped by the fact that military orders were placed directly with manufacturers. The chief of the Rubber Branch had requested on December 8, 1941, that all government orders be cleared through the branch, but this was not agreeed to by the Army and Navy. Following the German "breakthrough" late in 1944, military tire orders were cleared through the Rubber Bureau, WPB. Such a production control system was indispensable to calculation of accurate requirements and efficient allocations control.

Industry reporting forms permitted no continuous check on the consumption of rubber by claimant agencies, or by types of products.[21] This meant that the principal emphasis in control was over total consumption of rubber, the individual company remaining relatively free to juggle its use of rubber among different products and claimant agencies.

The first industry branch order restricting consumption of rubber (M-15, effective July 1, 1941) was prepared by representatives of RMA, Rubber Reserve, OPM, and ANMB, and provided for a gradual reduction in rubber consumption during the last half of 1941 with the objective of limiting use during the period to 300,000 long tons. (This rate of consumption had been exceeded in only one previous year in United States history, 1940.) Consumption during the last half of 1941 exceeded the quota by over 50,000 long tons (not including a portion of June 1941 record consumption of 85,862 long tons reported as put into process and applicable to the latter half of the year). Increased allotments for November and December 1941, which were recommended by the Rubber Branch chief, with unanimous industry approval, were not granted.[22]

[21] Form PD-49 provided a division of reported consumption by end products for war and civilian use from January to June 1943, after which the product division was eliminated.

[22] Civilian Supply Division chiefs did not support Barton Murray's recommendation, as a result of which he resigned as branch chief on Dec. 5, 1941.

Supplementary Order M-15-b, prepared during November and December 1941, in the Rubber Branch, OPM, to be made effective in the event of war with Japan, was issued on December 10, 1941, and provided that:

1. No rubber could be used or tires and tubes shipped for war orders except for ratings of A-3 or higher.
2. No rubber could be used for nonwar orders in excess of the amounts used in November 1941.
3. Rubber goods other than tires and tubes could not be shipped in excess of November 1941 shipments.

A new order, M-15-b-1, was issued February 11, 1942, providing specification lists for all nonwar rubber products manufactured. Fourteen amendments to M-15-b and 16 amendments to M-15-b-1 were issued between December 19, 1941, and September 1, 1942,which extended the lists of prohibited uses, prohibited manufacture of civilian passenger tires and tubes from January to September 1942, limited finished products inventories to 60 days' supply, and gradually reduced crude rubber consumption.

Following the Baruch report, allocation control over synthetic rubbers, previously exercised by the Chemicals Division, Synthetic Rubber Section, WPB, was placed under the Rubber Director. (Order M-13 had placed synthetic rubbers under specific end-product allocation in June, 1941.) Allocations procedures for synthetic rubbers remained unchanged until the lifting of specific end-product allocations on GR-S in mid-1943.

The Office of the Assistant Deputy Rubber Director in charge of Operations (the old Rubber Branch, WPB, expanded), assumed the function of claimant for civilian end products containing rubber after the Baruch report, replacing the OCS (OCS and OPA were both headed by Leon Henderson), previously responsible for calculation of civilian tire requirements. Crude rubber purchase permits, previously handled by industry directly with Rubber Reserve Company, required approval by the allocations section in ORD, thus sharpening an important point of control.

The changes in rubber allocations to manufacturers made by the new Assistant Deputy Rubber Director in 1943, summarized in Rubber Order R 1, effective July 1, 1943, included:

1. Quarterly manufacturers' quotas for war and civilian consumption (separately) of crude, latex, and reclaim, based upon use during the previous nine months. (Smaller consumers had a single quota for both war and civilian use.)
2. Further downward revisions in crude rubber content of products in 33 specification lists of products for war and civilian use.

A system of technical committees (built around existing RMA groups) was organized in June 1943 by ORD to assist in conversion to synthetic rubber. Allocations of GR-S were made to manufacturers in June for passenger tire manufacture. Synthetic rubber production increased rapidly after August 1943, and over 40,000 tons were on hand at year end. By July 1944, the Rubber Director stated that "were it not for the present manpower situation, it would

be possible to remove practically all of the restrictions which now exist except as they are necessary to protect against the use of crude rubber for any nonessential items or for any use which can be adequately filled by synthetics."[23] Immediately after VJ Day all restrictions on the use of reclaim, GR-S, GR-M (Neoprene), and Buna N types of rubber were revoked and quantitative restrictions on passenger, truck, farm implement tires, and camelback were removed by revision of Rubber Order R-L. Restrictions were continued on consumption of natural rubber.

The years 1942–43 were the crucial years in the conservation of natural rubber. Civilian use of natural rubber was reduced in 1942 to less than one-fifth and in 1943 to approximately one-tenth of record 1941 consumption (Chart III).[24] Increased synthetic rubber production, the assurance of a portion of Ceylon's production, and the emergence of other limiting factors after the fall of 1943 greatly reduced the emphasis in the total program upon supplies of rubber. The early and substantial reduction in civilian rubber use can be attributed to the imposition of controls over rubber consumption six months before Pearl Harbor, with plans well laid for further restrictions in the event of war. The prohibition of civilian passenger tire production during the first nine months of 1942, the elimination of many civilian rubber articles, and the imposition of strict rationing control over tires and tubes were important factors conserving natural rubber.[25] The production of the all reclaim tire in the last quarter of 1942, which had been advocated by the rubber industry, was a mistake, for not only did the tire prove unsatisfactory, but 18,000 tons of Grade I reclaim were used which were to be needed in 1943 for camelback production. The allocation of additional quantities of GR-S and reclaim in the spring of 1943 for new passenger tire production further accentuated the shortage of materials for camelback manufacture. Industry branch controls were administered independently of rubber allocations by the Requirements Committee, WPB. Claimants were relied upon to reduce consumption by restricting orders placed with manufacturers and altering specifications to remain within their quotas. The emphasis in branch controls was upon limiting total use of rubber by manufacturers.[26]

[23] Rubber Director, *Progress Report No. 6*, War Production Board, July 25, 1944.

[24] See footnote 40, below. Estimated 1944 civilian consumption of natural and synthetic rubber, 80,000 l.t.

[25] Supplementary Order M 15-c, December 27, 1941, placed restriction on the sale or delivery of new tires or tubes and set up local tire ration boards. Subsequent amendments prescribed strict eligibility rules. The imposition of gasoline rationing in the East in May 1942 and nation-wide gas rationing in Nov. 1942 aided in conserving rubber on tires.

[26] The system of rubber controls in use in the United Kingdom in 1942 included the basic elements for an efficient system. The Raw Materials Committee allocated rubber to each government department for 13-week periods. Government departments furnished to the Ministry of Supply their needs, expressed in tires for each month. Tyre Control checked the rubber required for these tires with raw materials allocations and made any adjustments necessary. Tyre Control allocated each of 11 factories a share of new tires in proportion to their capacity and previous output, considering first the extent to which needs could be filled from existing inventories. Each company was then issued the license to consume natural rubber and reclaim necessary to meet its share of the manufacturing program for the period.

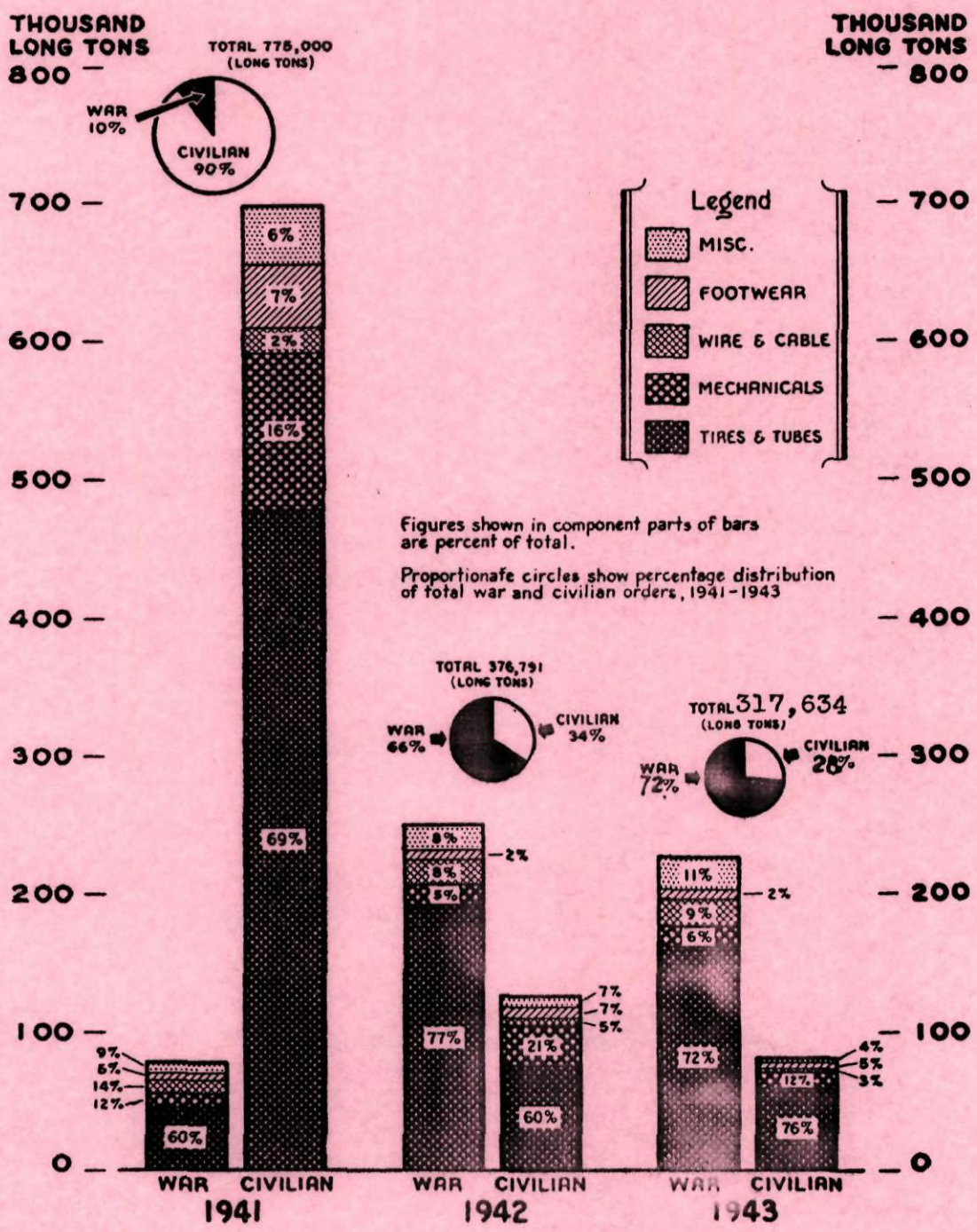

CHART III. U. S. CONSUMPTION OF CRUDE RUBBER AND LATEX FOR WAR AND CIVILIAN ORDERS BY MAJOR PRODUCT CLASSIFICATION, 1941–1943

Reconditioning of tires was also carried on in the tire factories. A single reporting form in 4 sections was issued by Ministry of Supply to each company to be returned not later than seven days after the period covered. It included monthly consumption and stocks of crude, reclaim, Balata, scrap, and 12 principal types of rubber chemicals; an analysis of consumption of crude rubber for 19 product groups for 8 claimant agencies, analysis of reclaim and scrap consumption by product groups only, and a reconciliation of production, purchases, stocks of reclaim and scrap rubber. Source: *Memorandum on the General Procedure of Tyre Control Department, 1942* (unpublished).

Adequate supplies of synthetic rubber, assured by mid-1943, did not mean that the rubber problem was solved. The ultimate success of the rubber program was to be measured by the degree to which finished rubber products were made available for military and civilian use.

Officials of the Public Roads Administration, OPA, and ODT called attention to the urgency of the civilian tire situation in 1943.[27]

Civilian truck tire production, which averaged over 8,000,000 annually during 1939–40, had been reduced to 3,000,000 per year in 1942–43. High levels of truck and bus traffic during the war years had brought the condition of tires on these vehicles to a dangerously low point. Inventories of truck tires in June 1943 totaled 1,500,000 and were being reduced at the approximate rate of 300,000 per month, with acute shortages in the popular sizes.

The condition of tires on the 26,000,000 passenger cars in use was estimated by the Rubber Director early in 1943 to be 40 per cent of normal (1939).[28] Total

TABLE 4

PLANNED PRODUCTION AND MANUFACTURERS' SHIPMENTS OF CIVILIAN TIRES, 1944

(Millions of tires)

	PASSENGER		TRUCK	
	New tires	Recaps	New tires	Recaps
Planned production	30.0	25.0	8.0	8.5
Manufacturers' shipments	18.0	14.0	4.8	1.3

Sources: *Progress Report No. 4*, Nov. 10, 1943, p. 9; *No. 5*, March 17, 1944, p. 7. Estimates of passenger tire production were reduced to 22,000,000 in March 1944. Manufacturers' shipments differed from production figures by less than 1 per cent; *Report of the Director of Rubber Programs to WPB*, Nov. 3, 1945; Rubber Bureau, WPB, *Production, Shipments and Inventory of Tires, 1944*, March 22, 1945.

inventories of prewar, reclaim, used, and synthetic tires available for rationing were down to 4,200,000 by September 1, 1943, an amount less than the previous two months' ration quotas.

Faced with this problem and with the admonition of the Baruch Committee to "keep the cars on the road," the Office of Rubber Director planned to expand production of civilian tires in 1944 to prewar levels. The planned production program was designed to return the condition of passenger and truck tires on the road by 1944 year end to the approximate 1942 condition and required an expansion of about 50 per cent in total consumption of natural and synthetic rubber over 1943 levels. Comparison of actual civilian tire production with that planned in 1944 (Table 4) indicates that the over-all production objective

[27] Automobile Manufacturers Association, *Automobile Facts and Figures, 1944–45*; U. S. Public Roads Administration, *The Tire Crisis*, May 1943; Office of Defense Transportation, *ODT Release 335*, OWI, Aug. 24, 1943.

[28] Sparks Bonnet, chief OPA Tire Rationing Branch, "Tire Rationing in 1944," address at NAITD Second Annual Rubber Conservation Conference, New York City, Oct. 12, 1943. It was estimated that by June 30, 1943, there were outstanding unfilled certificates ("hunting licenses") for approximately 150,000 truck tires and 1,500,000 passenger tires.

for that year was not reached and that the civilian tire program, as residual claimant, was sacrificed.

The increase in 1945 military requirements resulted in a new set of production objectives for that year, which were revised after VE Day.[29] Approximately 25,000,000 passenger and 6,000,000 truck tires were produced and shipped in 1945 for civilian use. This favorable showing was due to the sharp reduction in military requirements during the last half of 1945.

The reasons for the failure to realize total production objectives for 1944 or 1945 are found in the emergence of five successive problems during late 1943 and 1944.

Problem 1. There was insufficient production of synthetic rayon and cotton tire cord.
Problem 2. Milling capacity of the industry was inadequate to handle the planned production.
Problem 3. There were shortages of rubber compounding materials.
Problem 4. Labor shortages threatened the success of the production of tires and other finished goods.
Problem 5. 1945 military requirements for large size truck and airplane tires were increased substantially over projected estimates.

These problems were left virtually unattended until adequate supplies of synthetic rubber became available in the fall of 1943. The story of the rubber problem from that point forward is one of delays incidental to overcoming these problems in succession.

Problem 1—The ORD requested that WPB authorize an additional 100,000,000 pounds of high tenacity rayon capacity for use in synthetic airplane, military, and truck and bus tires in April 1943. (Capacity had been increased from 50 to 100 million pounds by WPB authorization in September 1942.) After publication of a report by the Truman Committee stating that rayon displayed no superiority over cotton tire cord, the matter was studied by the WPB, War and Navy Departments and the additional capacity finally approved in September 1943.[30] Shortage of rayon tire cord owing to delays in completing this expansion program, which involved 50 projects and cost $75,000,000, necessitated the continued use of natural rubber and cotton tire cord in many military products in 1944. By mid-1944, inventories of rayon tire cord were down to less than one month's supply.[31] The rayon tire cord supply position remained tight through June 1945, when production from some of the new facil-

[29] *Report of the Special Director of Rubber Programs to WPB*, June 25, 1945. A new study of civilian tire requirements by RMA in June 1945 placed minimum civilian replacement needs for 1945–46 as follows:

	Millions of Tires	
	1945	*1946*
Truck and bus	6.3	5.5
Passenger	20.0	22.0
Farm tractor	.7	.8

[30] Special committee investigating the National Defense Program pursuant to Senate Res. 71, "Comparative merits of rayon and cotton tire cord." Government Printing Office, Washington, D. C., July 16, 1943.

[31] Office of Rubber Director, WPB, *Progress Report No. 6*, July 25, 1944.

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ities was still awaited. Following the reduction in military requirements after VE Day, the uncompleted portion of the rayon expansion program was canceled.

Shortages of cotton tire cord, which were accentuated by the rayon cord shortage, limited production of civilian passenger and truck tires in late 1943 and 1944. Tire cord capacity had been diverted during 1942–43 to production of army duck and other materials. In addition, there was an over-all limit on twisting capacity affecting both rayon and cotton tire cord. Plans for the reconversion of tire cord facilities from duck production were started by the fall of 1943. Cotton tire cord production was not increased substantially in 1944 owing to labor shortages, and inventories were equal to only one month's supply by June 1944, even though passenger tire production was at a rate less than half that planned. By the end of 1944 each tire manufacturer was receiving a quota of cotton tire cord, which was the limiting factor in its passenger tire production. The supply position in cotton tire cord and other cotton textiles remained tight throughout 1945.

Problem 2—Noting that synthetic rubber requires longer milling than natural, the Baruch report had said: "There will not be sufficient factory capacity to deal with the quantities of synthetic rubber that will be produced in 1944," and recommended that the Rubber Director review the problem early in 1943.[32] A $75,000,000 expansion program estimated to increase total milling and mixing capacity of the industry by 50 per cent by the 1944 year end was approved by the WPB in the fall of 1943.[33] From January to August 1944 a shortage of milling and mixing capacity placed an over-all limitation upon the amount of rubber which could be consumed for all purposes. The residual claimant position of the civilian tire program and the shortage of cotton tire cord brought the full effect of these shortages upon the planned production of civilian passenger and truck tires. An expansion program for the production of large size military tires was approved early in 1944, and, based upon increased 1945 military requirements, an additional $132,000,000 expansion program was approved in December 1944 and January 1945. Most of this capacity was canceled following the cutbacks in military requirements after VE Day.[34] Shortages of labor and other components precluded the full use of facilities after mid-1944.

Problem 3—Approximately 60 per cent of the total weight of rubber compounds consists of rubber. The balance is made up of about 2000 different materials headed by various types of carbon blacks, oils, solvents, pigments, and metals.

[32] The Baruch report had estimated that it would take a third more time to mill synthetic than natural rubber. Later estimates indicated that GR-S and reclaim required approximately 10%, Neoprene 50%, and Buna N types 100% more time than natural rubber.

[33] Office of Rubber Director, WPB, *Progress Report No. 5*. It was estimated at the time that delivery of the Banbury mixers would commence in Jan. 1944 at the rate of 3 per month and gradually increase to 10 per month by March 1944.

[34] The peak in milled stock production following the addition of facilities in 1944 was 109,679 l.t. of all natural and synthetic rubber. This compares with indicated capacity before the expansion program of 84,000 l.t. of natural rubber. The net expansion authorized in late 1944 and early 1945 is estimated at 32%. War Production Board, *Report of the Director of Rubber Programs to the WPB*, Nov. 3, 1945.

The Chemicals Division, WPB, had 17 furnace type carbon black plants under construction during 1943 to fill the expected increased demand for one of the more important rubber chemicals. By early 1944, however, it developed that easy processing channel black possessed desirable qualities for milling with synthetic rubber. Extensive readjustments in plant design and the use of naphtha and other raw materials required in the aviation gas program were necessary to expand production.[35] The carbon black shortage was so critical that cuts of 5 to 25 per cent were made in the amount of black used per tire in February 1945, and the work week in tire plants reduced from 7 to 6 days in April 1945.[36] The shortage was remedied by June, and by September 1945 it was recommended that production of "easy processing channel blacks" be lowered due to the ample supplies on hand.

Fatty acids, plasticizers, softeners, color pigments, rosin, and beadwire were other materials in critical supply in 1944. Continued efforts were exerted during 1944 by the Chemicals Bureau, Steel Division, and the Rubber Bureau to obtain necessary supplies of these materials. It was not until June 1945 that an industry study of component material requirements was available. By this time military requirements had been lowered and it became apparent that adequate supplies of rubber chemicals would be available to carry on the rate of production permitted by labor and other component shortages.

Problem 4—As a result of a high level of military withdrawals and absenteeism the Rubber Director reported on July 25, 1944, that "less than 6000 additional workers, about half the number to be strong, husky men, stand between the present shortage of tires and an ability to meet all essential requirements."[37]

Many of the older employees had left the heavy tasks as calender operators, millmen, and truck tire builders for the high wage lighter work on fuel cells, rubber boats, aircraft, and other new war products.[38]

In August 1944 manpower requirements for heavy duty tire production were placed on the National Urgency List, second only to certain secret projects. Through the cooperation of the Army, 4,000 additional workers were added to the industry in late 1944.[39] All members of the industry signed a pledge assuring seven-day operations which were continued until the carbon black shortage forced a reduction in April 1945.

Problem 5—The ORD 1944 planned production program had been based on

[35] Office of Rubber Director, WPB, *Progress Report No. 5*, March 17, 1944.

[36] War Production Board, *Report of the Special Director of Rubber Programs to the WPB*, June 25, 1945; *Interstate Oil Compact Bulletin*, June 1945; John F. Gallie, "Carbon Black in Its Relation to the Natural Gas Industry," *United Rubber Worker*, April 1945.

[37] *Progress Report No. 6*. The withdrawals were effected before the Interagency Committee on Occupational Deferments recognized the needs of the rubber industry and could be of material assistance.

[38] Bulletin No. 737, Bureau of Labor Statistics, *Wages in Rubber Manufacturing Industry*, Aug., 1942; *Employment and Payrolls*, 1943. Comparative employment figures for prior years were: July 1940—49,878; July 1941—64,101; July 1942—65,600; July 1943—87,000.

[39] War Production Board, *Report of the Director of Rubber Programs to the WPB*, November 3, 1945.

the theory that military use of rubber in 1944 would not exceed 1943.[40] Military consumption of rubber and estimates of 1945 requirements increased sharply, however, during the last quarter of 1944. It was estimated that the monthly consumption of rubber for military use in 1945 would be at the rate of 40–45 thousand tons monthly or in excess of 500,000 tons for the year. These requirements were reduced in March and April 1945 as a result of screening by the Rubber Bureau when it became apparent that the war in Europe would end shortly. The increase in military requirements during the last quarter of 1944 and first quarter of 1945 forced cuts in the civilian tire program[41]

Important changes were made in administrative organization in order to meet the production problems of 1944–45. William Jeffers resigned as Rubber Director in September 1943, when synthetic rubber production seemed assured, but just at the time when it became evident that new production problems would arise in 1944.[42] Following this resignation, M. Bradley Dewey became Rubber Director and L. D. Tompkins became Deputy Director, the latter retaining his authority over Operations (Chart II). The Rubber Director, through a newly formed Operations Committee, endeavored to integrate the 1944 production plan with the availability of milling capacity, tire fabrics, carbon black and other components, and manpower. It had been assumed prior to mid-1943 by the ORD that the Facilities, Textile, and Chemicals Bureaus in WPB, the Requirements Committee, WPB, and the War Manpower Commission could and would provide the necessary materials and labor for realizing a production program made possible by the increased supplies of synthetic rubber. The rapid acceleration in total war production during 1943, however, placed limitations upon the ability of the various divisions to expand production as needed.[43]

[40] Consumption of natural and synthetic rubber for the account of Army, Navy, Maritime Commission, and lend-lease was estimated at 1942—250,000 l.t., 1943—320,000 l.t. (excluding 20,000 l.t. exported as raw material), 1944—350,000 l.t. (excluding 104,000 l.t. exported). Stated military requirements for 1944 were as follows, excluding exports of rubber as raw material: *Progress Report No. 4*, Nov., 1943, 436,000; *Progress Report No. 5*, March 17, 1944, 465,000; *Progress Report No. 6*, July 25, 1944, 372,000. The last estimate was based on reported consumption for the first six months.

[41] *Cf.* The Rubber Manufacturers Association, Inc., *Tires at War, 1939–44*. This is the statistical story of how the tires essential for victory were being made. Passenger tire production, which had increased to 6.4 million during the last quarter of 1944, was cut to 3 million during the first quarter of 1945. During subsequent quarters of 1945 it was increased to 5, 7, and 11 million. Manufacturers' shipments of civilian truck and bus tires in April 1945 declined to less than 400,000, below the level of 1943 shipments. After the reduction in military requirements, civilian truck tire shipments were gradually increased to approximately 800,000 by Oct. 1945.

[42] Mr. Jeffers' letter of resignation said in part, "The big job covered by the recommendations of the Baruch report is done. The problem of taking care of the requirements of the armed forces and keeping the country on rubber, meanwhile conserving the nation's stockpile of natural crude, is well in hand, though there is a present and prospective shortage of tire fabric, which is the responsibility of the WPB." Copy of a letter of resignation to the President of the United States, issued to staff members of ORD, Sept. 3, 1943.

[43] War Production Board, Chief of Operations, Critical Programs, *A Report to the War Production Board*, Dec. 7, 1944.

When it became apparent by mid-1944 that the production program would not be realized owing to shortages of components over which his authority was limited, the Rubber Director issued a report recommending that his office be abolished and its major functions carried on by a Rubber Division within the WPB.[44] It was apparent from this report that while the creation of a semi-independent rubber agency had probably speeded up the construction of the synthetic rubber plants in early 1943, it had prevented the proper coordination between bureaus which was necessary for the proper use of that rubber in late 1943 and 1944.

The Rubber Bureau, WPB, established September 1, 1944, assumed the former duties of the ORD with the exception of the responsibility for operation, maintenance, and research in synthetic rubbers, which were transferred to the Rubber Reserve Company. At the request of the chairman of the War Production Board and Justice Byrnes, Mr. John L. Collyer, president of the Goodrich Company, assumed the title of Special Director of Rubber Programs in the WPB on March 21, 1945. In the reorganization of the Rubber Bureau which followed, accurate military and civilian finished products requirements were obtained and arrangements concluded for centralized clearance of orders for tires through the Rubber Bureau. Adequate industry reports were also required showing consumption of raw materials and production and inventories of major classes of finished products. Service during 1945 by Messrs. J. E. Trainer, vice president of Firestone, and R. S. Wilson, vice president of Goodyear completed a record of control of the Rubber Branch by top industry executives which began with the appointment of A. L. Viles, president of the Rubber Manufacturers Association in May 1940, and was continued, after interruptions, by Mr. L. D. Tompkins, vice president of the U. S. Rubber Company, who served during 1943–44.[45]

IV

The effectiveness of rubber controls during World War II can be measured by the degree to which (1) military requirements for rubber manufactured goods were met; (2) civilian transportation necessary to the war effort was maintained; (3) these problems were solved efficiently and with a minimum of interference with other necessary phases of the war program.

Military requirements for rubber goods were fully met during the war years. The Director of Rubber Programs stated in November 1945, "Broadly speaking,

[44] Rubber Director, *Special Report, Recommending Termination of Special Powers*, July 25, 1944. It was emphasized in this report that responsibility over the related programs resided in other WPB bureaus, even though the executive order establishing the ORD had provided for control of "the nation's rubber program in all its phases." The Baruch report had recommended, "full and complete authority in all matters relating to the rubber program." *Cf.* editorial, "Responsibility," *United Rubber Workers*, April, 1945.

[45] By November 1945 the Rubber Bureau staff, at one time expanded to over 500, had been reduced to 78 persons, of whom 17 were on loan from the industry. This staff was assigned the function of continuing controls over the use of natural rubber, maintaining information on tire production, and determining quotas for tire rationing.

no vehicle, military or essential civilian, stood still for lack of tires and no military operation was delayed because rubber equipment was lacking."[46] Military requirements were inaccurate and overstated during the entire war period. This can be attributed in part to a tendency to order more than enough rather than be criticized for ordering too little and in part to difficulties in preparing more accurate estimates of needs.

Continuance of the war in Europe for another year would undoubtedly have necessitated the removal of many essential trucks and automobiles from the road, for the successive shortages of components and manpower and the increase in military requirements had their final effect upon the marginal civilian tire program. The urgent requests for additional facilities for fabrics, carbon blacks, and rubber machinery in 1943–44, based in part upon the planned increase in the passenger tire program, aggravated labor shortages when the strain was greatest upon the nation's production system. These labor shortages had an eventual effect upon the rubber manufacturing industry and precluded full use of the facilities when they became available. Reduced production objectives for new tires, greater emphasis upon recapping and conservation, combined with more moderate requests for new facilities would have satisfied essential military and civilian uses with less interference with the over-all war production program.[47]

A new synthetic rubber industry was created in record time with a plant investment of three-quarters of a billion dollars. Although avoidable delays occurred early in the program, the selection of types of rubber and processes resulted in a high level of production by the end of 1943. The alcohol butadiene plants, forced into the program at the insistence of Senate committees, proved the earliest producers and operated at almost double rated capacity. Based on cost of alcohol at 90 cents and butylenes at 10 cents per gallon, the butadiene produced in these plants cost roughly five times that produced in the petroleum plants.[48] Present consideration is being given to the disposal of these high-cost facilities and to the maintenance of a postwar synthetic rubber industry.[49]

Ceylon rubber, allocated to the United States by the CRMB, prevented the

[46] War Production Board, *Report of the Director of Rubber Programs*, Advance Release, Civilian Production Administration, Nov. 8, 1945.

[47] Based on the weights used in *Progress Report No. 5*, ORD, March 17, 1944, camelback for one passenger recap weighed 8 lbs., while estimated weight of a new 4-ply 6.00 x 16 passenger tire was 22.3 lbs. The priority pattern for rubber manufacturing was shifted in March 1944 to give camelback a preferred position over new tires, when it became apparent that the 30,000,000 passenger tire production goal would not be reached. At the same time, it was necessary to change from Grade C to Grade F camelback for passenger tires owing to shortages of GR-S.

[48] Rubber Reserve Company, *Report on the Rubber Program, Feb. 24, 1945*, Schedule 11. Costs exclude amortization costs. Plant investment per annual ton of production at demonstrated capacity is estimated at alcohol $292, petroleum $544. Schedule 12.

[49] United States Tariff Commission, *Rubber*, War Changes in Industry Series No. 6, Sept. 1944; Interagency Policy Committee on Rubber, *Rubber, First Report*. See footnote 18 above.

exhaustion of our natural rubber supply during the year 1943, when synthetic rubber production was delayed. This important contribution was partially offset by our lend-lease shipments of manufactured goods to Britain and Russia, and, after the last quarter of 1943, by shipments of synthetic rubber.

The Western Hemisphere natural rubber program was not a success. Comparison with the record for African production during the period indicates that an equal or greater increase could have been brought about through a well-planned rubber buying program, with little emphasis upon long-term Western Hemisphere development plans, and at considerably less cost.[50]

The record of the administration of the rubber program during the war years is unimpressive. This was the result of the general confusion during a war emergency, the changing nature of the problems, basic deficiencies in the system of controls, and a constant turnover in the personnel administering the program. The creation of an independent agency, as recommended by the Baruch report, had beneficial short-term results, but led to serious problems in 1944–45.

The rubber industry showed excellent foresight in 1940–41 planning for a war emergency. Control of the Rubber Branch by industry executives, however, resulted in constant pressure for increased civilian quotas and added facilities. This confirms the judgment that wartime authority over a critical material should reside in a nonindustry executive assisted by competent industry personnel.

[50] See footnote 8 above. Total production of natural rubber and latex in American countries was in long tons: 1942—31,378; 1943—38,836; 1944—46,711; 1945—44,683. African production during these years was: 1942—30,588; 1943—46,235; 1944—54,920; 1945—53,463.