UNITED STATES TARIFF COMMISSION

SUMMARIES OF TRADE AND TARIFF INFORMATION

Prepared in Terms of the Tariff Schedules of the United States (TSUS)

Schedule 4

Chemicals and Related Products
(In 12 volumes)

VOLUME 7

Drugs, Synthetic Plastics Materials, and Rubber

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SUMMARIES OF TRADE AND TARIFF INFORMATION
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FOREWORD

In an address delivered in Boston on May 18, 1917, Frank W. Taussig, distinguished first chairman of the Tariff Commission, delineated the responsibility of the newly established Commission to operate as a source of objective, factual information on tariffs and trade. He stated that the Commission was already preparing a catalog of tariff information--

> designed to have on hand, in compact and simple form, all available data on the growth, development and location of industries affected by the tariff, on the extent of domestic production, on the extent of imports, on the conditions of competition between domestic and foreign products.

The first such report was issued in 1920. Subsequently three series of summaries of tariff information on commodities were published--in 1921, 1929, and 1948-50. The current series, entitled Summaries of Trade and Tariff Information, presents the information in terms of the tariff items provided for in the eight tariff schedules of the Tariff Schedules of the United States (TSUS), which on August 31, 1963, replaced the 16 schedules of the Tariff Act of 1930.

Through its professional staff of commodity specialists, economists, lawyers, statisticians, and accountants, the Commission follows the movement of thousands of articles in international commodity trade, and during the years of its existence, has built up a reservoir of knowledge and understanding, not only with respect to imports but also regarding products and their uses, techniques of manufacturing and processing, commercial practices, and markets. Accordingly, the Commission believes that, when completed, the current series of summaries will be the most comprehensive publication of its kind and will present benchmark information that will serve many interests. This project, although encyclopedic, attempts to conform with Chairman Taussig's admonition to be "exhaustive in inquiry, and at the same time brief and discriminating in statement."

This series is being published in 62 volumes of summaries, each volume to be issued as soon as completed. Although the order of publication may not follow the numerical sequence of the items in the TSUS, all items are to be covered. As far as practicable, each volume reflects the most recent developments affecting U.S. foreign trade in the commodities included.

SUMMARIES OF TRADE AND TARIFF INFORMATION

SCHEDULE 4

Volume 7

C O N T E N T S

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INTRODUCTION

This volume (identified as volume 4:7) is the eleventh in a series of 12 volumes of summaries on the chemicals and related products classified under schedule 4 of the TSUS. Schedule 4 is divided into 13 parts of which parts 3 and 4 are covered by this volume. This section of the TSUS deals largely with chemicals and chemical products which are derived from naturally occurring materials of animal or vegetable origin, but also includes certain synthetic chemicals and products which in many instances are the counterparts of those substances formed in nature. Volume 4:7 covers crude and advanced natural drugs (subpart 3A--items 435.05 to 436.00); alkaloids, antibiotics, barbiturates, hormones, vitamins, and other drugs and related products, including drugs in dosage form (subparts 3B and 3C--items 437.00 to 440.00); synthetic plastic materials, including cellulosic plastics and polyethylene, amino, vinyl, and other resins (subpart 4A--items 445.05 to 445.75); and natural, synthetic, and derivative rubbers(subpart 4B--items 446.05 to 446.30). Fibrin (item 493.35 in subpart 13B) is included in the summary on biological products in this volume. The complete list of products covered by summaries in this volume is shown in appendix A.

Aggregate U.S. consumption of all the chemicals and chemical products covered by this volume is supplied principally by domestic production. There is no production of some natural products, such as certain natural drugs and natural rubber, the total consumption of which is supplied by imports or by the synthetic product. A few of the products covered in this volume--Haarlem oil, meso-inositol hexanicotinate, and santonin and its salts--have negligible or no U.S. consumption because of replacement in their uses by other materials or unavailability. In 1970, U.S. consumption and production of the chemicals and products covered by this volume each amounted to nearly $6 billion of which the drugs covered here accounted for 42 percent of both consumption and production, synthetic plastics materials accounted for 35 percent of consumption and 40 percent of production, and rubber accounted for 23 percent of consumption and 18 percent of production. About one-third of the value of both consumption and production of the drugs in this volume was accounted for by antibiotics, biological products, hormones, enzymes, and vitamins, all in bulk form; about 60 percent of both consumption and production was accounted for by drugs in dosage forms; and the rest of both was accounted for by other drugs. Polyethylene, vinyl, polypropylene, and amino resins accounted for about three-fourths of the value of both consumption and production of synthetic plastics materials; synthetic rubber accounted for nearly all of the value of production of rubber, and about three-fourths of the value of consumption. Natural rubber accounted for nearly one-fifth of all rubber consumed domestically.

Export statistics for some of the products covered by this volume are not available; however, based on partial estimates, U.S. exports of the products covered here are believed to have been in excess of $700 million

in 1970, somewhat greater than imports for that year. Synthetic rubber, polyethylene resins, vinyl resins, bulk antibiotics, drugs in dosage form, and biological products accounted for about 70 percent of exports in that year. Canada was by far the most important market in 1970, accounting for exports valued at nearly $100 million; Belgium, West Germany, the Netherlands, Japan, and the United Kingdom were the next most important markets, each accounting for exports valued at about one-third those for Canada.

In 1970, U.S. imports of the chemicals and chemical products covered by this volume amounted to $430.4 million. This amount was distributed by TSUS part (or subpart) and product division as follows:

TSUS part or subpart	Product division	Value of imports in 1970 (million dollars)
3	Drugs and related products (nonbenzenoid)	127.8
4A	Synthetic resins and plastics materials	22.9
4B	Rubber	279.7
	Total	430.4

The distribution in 1970 of the imports covered in this volume, by principal sources, was as follows:

Sources	Value (million dollars)	Principal products
Malaysia	109.9	Natural rubber
Indonesia	54.0	Natural rubber
Canada	38.4	Synthetic rubber; crude drugs
Japan	32.6	Synthetic rubber; vinyl and other resins; vitamins
Liberia	26.7	Natural rubber
West Germany	14.8	Various drugs; synthetic resins and rubber
Singapore	14.7	Natural rubber
United Kingdom	13.7	Antibiotics and other drugs in bulk or dosage form; synthetic resins
Thailand	11.9	Natural rubber
Bahamas	11.5	Hormones
Denmark	10.4	Enzymes; vitamins
All other	91.8	Mainly drugs and related products
Total	430.4	

Commodity	TSUS item
Aconite, aloes, asafetida, buchu leaves, cocculus indicus, digitalis (Lanata), ipecac, jalap, manna, and marshmallow (althea):	
Crude	435.05
Advanced	435.10
Cinchona and other quinine-containing barks	435.30
Belladonna	435.35
Digitalis (Purpurea)	435.45
Ergot	435.50
Gentian	435.55
Henbane	435.60
Nux vomica	435.65
Stramonium	435.75
Miscellaneous natural drugs:	
Crude	439.10
Advanced	439.30

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States is the largest world market for the natural drugs covered here, and the largest world producer; the value of U.S. shipments in 1967 and in 1970 was estimated at $17.5 million. In 1970 U.S. imports amounted to about $14.5 million and U.S. exports to $11.6 million.

Description and uses

Drugs, as provided for in the TSUS (headnote 2, part 3, schedule 4), are natural or synthetic substances which have therapeutic or medicinal properties and which are chiefly used as medicines or as ingredients in medicines. This summary covers both the crude and

advanced forms 1/ of certain named natural drugs, in bulk (i.e., not put up in ampoules, capsules, pills, etc.), as well as natural drugs not specially provided for in the TSUS, in bulk. Other natural drugs in bulk are discussed in applicable summaries in this volume covering items 437.00-437.86. Non-benzenoid drugs in dosage form, including the natural drugs, are discussed in the summary in this volume covering items 436.00, 438.01, 438.02, and 440.00.

A natural drug may be of either vegetable or animal origin. Those of vegetable origin generally consist of the dried roots, leaves, seeds or seed husks, flowers, or fruit of plants, dried exudates or extractions from their roots or bark, and glycosides isolated from them. Ergot, however, consists of the dried sclerotium, or ripe fruiting body, of a parasitic fungus developed on rye. The drugs of animal origin (included in items 439.10-439.30) consist of glands, organs, or other parts of animals, including tissues or fluids (except human blood and its derivatives--item 437.76). These products may be condensed or concentrated in paste, or may be in fresh or frozen forms.

The 10 drugs provided for under items 435.05 and 435.10 are of vegetable origin. The relatively more important ones are aloes, buchu leaves, ipecac, and digitalis (Lanata); the least important in the United States are aconite, asafetida, and cocculus indicus.

The other eight drugs provided for by name in the TSUS and covered by this summary are also all of vegetable origin. Three of these--cinchona bark, gentian, and henbane--have declined from their former importance as drugs; cinchona bark, however, is still important as a source of quinine, quinidine, and other alkaloids (item 437.08). Belladonna leaf and root, like the alkaloids derived from them (item 437.20), have a broad range of therapeutic applications in medicine, including use as a sedative, antiasthmatic, and mydriatic. The dried leaf of digitalis (Purpurea) is a heart stimulant and is a source of the important glycoside, digitoxin. (A similar glycoside, digoxin, is obtained from d. (Lanata). Ergot contains alkaloids which are used medicinally, principally as a parturient. An ergot derivative, lysergic acid diethylamide, is a hallucinogen for use in psychiatry. The dried ripe seed, nux vomica, is the source of the denaturant, brucine (item 437.00) and of strychnine (item 437.16); the latter is used as a cattle feed supplement. Stramonium, in the form of leaves and flowering or fruiting tops with branches, is used for treatment of bronchial asthma; its constituents are nearly the same as those found in belladonna.

1/ The meaning of the term "advanced" in this summary is defined in TSUSA (headnote 3(d), part 3, schedule 4) as any product advanced in value or improved in condition from its crude state by any mechanical or physical process beyond that which is essential to proper packing and the prevention of decay or deterioration pending manufacture. It does not include any product which had been artificially mixed with other substances, or the molecular structure of which as found in nature has been changed.

At least 70 different drugs not specially provided for in the TSUS are included in items 439.10 and 439.30; some are of vegetable and some are of animal origin. Drugs of vegetable origin included in these items are psyllium seed husks, kola nuts, rauwolfia root, rutin, senna leaves, quince seeds, and ginseng. Among the more important crude forms (botanicals) produced in the United States are: cascara bark, passionflower herb, witch-hazel leaves, bayberry root bark, cotton root bark, and ginseng. These many crude drugs are sources of various alkaloids, glycosides, and extracts for use in medicinals and in some cases also for cosmetic preparations. Ginseng has been a long-standing popular remedy in Chinese medicine. Among the plant-derived drugs advanced in value (item 439.30) are rose hips powder, ammoidin, and senna concentrate. Among the most important crude drugs of animal origin are the livers (in paste form), the pancreas, pituitary glands, and gall bladders of various animals; condensed estrogen-containing urine; and frozen human placentas. All of these crude drug products are the sources of various drugs and hormones used in medicine. The natural products are considered as advanced in value, for example, when converted to a powder or desiccated.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Aconite, aloes, asafetida, etc.:		
435.05	Crude	Free	Free 1/
435.10	Advanced	3% ad val.	1.5% ad val.
435.30	Barks, cinchona or other, from which quinine may be extracted	Free	Free 1/
435.35	Belladonna	Free	Free 1/
435.45	Digitalis (Purpurea)	13.5% ad val.	6.5% ad val.
435.50	Ergot	Free	Free 1/
435.55	Gentian	Free	Free 1/
435.60	Henbane	Free	Free 1/
435.65	Nux vomica	Free	Free 1/
435.75	Stramonium	Free	Free 1/
	Miscellaneous natural drugs:		
439.10	Crude	Free	Free 1/
439.30	Advanced	3% ad val.	1.5% ad val. 2/

1/ Rate not affected by the sixth round of trade negotiations under the General Agreement on Tariffs and Trade.

2/ Rate effective January 1, 1969.

The rates effective January 1, 1972, for items 435.10 and 435.45, represent the final stage of concessions granted by the United States in the sixth round of negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reductions became effective January 1, 1968. The rate effective January 1, 1969, for item 439.30 represents the second stage of a concession granted by the United States in the sixth round of trade negotiations under the GATT. Further reductions schedules for years subsequent to 1969 for this item have not become effective. Scheduled rates of duty for each of the individual stages are given in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The duty-free status for each of the other items was provided for in the Tariff Act of 1930, as originally enacted, and in the TSUS, and has been bound as concessions granted by the United States in the GATT, effective on the dates shown in the tabulation below.

TSUS item	Previous paragraph Nos.	Effective date
435.05	1,602	May 30, 1950
435.30	1,619	Jan. 1, 1948
435.35	1,728	May 30, 1950
435.50	"	Jan. 1, 1968
435.55	"	June 6, 1951
435.60	"	June 6, 1951
435.65	"	June 6, 1951
435.75	"	June 6, 1951
439.10	1,669	July 1, 1962

U.S. production, shipments, and consumption

The production of a natural drug derived from plants (botanicals) may be a simple process involving the collection of the plant or plant part followed only by drying, cleaning, or such other processing as is essential to proper packaging or the prevention of deterioration, or it may involve shredding, grinding, distillation, evaporation, or other operations. In the United States there is both the production of crude materials and the processing of domestic and imported crudes.

The plants which serve as source materials are generally grown and collected as a supplemental source of income by numerous persons who are engaged in other full-time occupations. The supply of labor for collecting the botanicals is affected by the availability of anti-poverty or other welfare funds, well-paying industrial employment, and weather conditions. It is estimated that about 15 or 20 small concerns throughout the United States receive these botanicals and process them;

most of them are in the states of North Carolina, Virginia, and Tennessee. These concerns may then, in turn, sell the processed drugs to larger concerns who extract the active principles.

The production of natural drugs derived from animals is more highly organized than the production of botanicals. Such drugs are commonly obtained from cattle, sheep, and hogs as byproducts by various large meat-packing companies; the number of firms which produce them is not known.

Official statistics on the production of natural drugs, either botanicals or animal-derived, are not available. In both 1963 and 1967, U.S. industry shipments, including interplant transfers, of botanical drugs and derivatives, in bulk, were valued at $21 million. It is estimated that about 40 percent of this amount consisted of the botanical drugs covered by this summary, which would amount to about $8.5 million. The value of shipments of drugs of animal origin, in bulk, amounted to $9 million in both 1963 and 1967. Thus a total value of U.S. shipments of the natural drugs here for 1963 and 1967 is estimated at about $17.5 million.

Apparent U.S. consumption can only be approximated from data on shipments, imports, and exports. Data on shipments are available for years not later than for the census year 1967 and it is estimated that apparent consumption of non-narcotic drugs amounted to $18 million in 1963 and $23 million in 1967. The increase in consumption in 1967 over 1963 was almost all supplied by a substantial increase in imports. In 1970 it is estimated that consumption amounted to $20 million.

U.S. exports

The value of U.S. exports of the natural drugs covered here increased from $8.6 million in 1965 to $11.6 in 1970; about three-fourths of the value in these years represented exports of drugs derived from plants.

U.S. exports during 1965-70 were valued as follows:

Year	Value (1,000 dollars)
1965	8,642
1966	9,940
1967	9,934
1968	10,102
1969	10,747
1970	11,605

The chief markets (measured in terms of value) for non-narcotic natural drugs were Hong Kong, Canada, Japan, Italy, the United Kingdom, France, Mexico, and West Germany. U.S. exports of these drugs in 1970 are shown in table 1 by export classes and principal markets. In 1970, about 43 percent ($5 million) of the total value was accounted for by exports of ginseng root, the bulk of which was imported into Hong Kong, probably for transshipment to other Asian countries. The classes for exports of natural drugs are not completely comparable to the TSUS items covered; the reported values for one of these, export class number 292.8030 (Schedule B), included exports of items not covered herein and exceed the value of exports of natural drugs by an estimated annual amount of $160,000.

U.S. imports

The annual value of imports of the natural drugs covered by this summary was in the range of $9.5 million to $15.5 million during 1965-70. In 1967 and 1968 the value of imports exceeded $15 million. In 1970 when they totaled $14.5 million, 86 percent of the value of imports was accounted for by miscellaneous crude drugs, (item 439.10) and about two-thirds of such value was accounted for by drugs of animal origin. U.S. imports of non-narcotic natural drugs by kind for the years 1965-70 are shown in table 2. On the basis of a sampling of documents of imports for 1965, the following items were found to be the most important ones in terms of value of imports: psyllium seed husks (mainly from India); preserved condensed urine, a source of hormones (from Canada); beef and liver paste, sources of vitamins (mainly from Argentina); and animal glands, including pancreas and pituitary glands (from Canada). Crude senna (from Sudan), kola nuts (from Nigeria), rutin (from Australia), and rauwolfia root (from India) are some of the other more important imports. In 1970 miscellaneous advanced natural drugs (item 439.30), and the group of 10 specified crude drugs (item 435.05), comprised about 9 and 4 percent, respectively, of the total value of imports of the drugs considered in this summary. On the basis of a sampling of the latter group (item 435.05) in 1967, the crude drugs buchu leaves, ipecac root, digitalis Lanata leaf, and aloes were the predominant items.

On an over-all basis, Canada was the chief source of imports from 1966 to 1970, in terms of value; India has been the second most important source in recent years (table 3). The bulk of the natural drugs from Canada were animal-derived, while the drugs from India were plant-derived. Argentina, New Zealand, Brazil, and Australia as well as numerous other countries, have been other sources of natural drugs imports.

The same kinds of drugs are not usually derived from plants grown in the United States and abroad because of differences in climatic and other growing conditions. The three hyoscyamine drugs (belladonna, henbane, and stramonium), as well as digitalis and ergot, are the chief exceptions. Imports of belladonna, henbane, and stramonium, however, supply most of the domestic consumption, while imports of digitalis supply about 10 percent of domestic consumption and those of ergot supply only a small but indeterminate part. Imports of natural drugs of animal origin are somewhat more competitive with the corresponding domestic products, but competition is limited since these drugs in crude form are, in general, byproducts of the meat-packing industry. The totals for imports do not include indeterminate but probably small amounts of such items as rose hips, digitalis, psyllium husks and kola nuts, which were included in error as vegetable substances, not specially provided for, (class 193.25). See Summary volume 1:14 of this series of Summaries of Trade and Tariff Information.

Table 1.--Natural drugs: U.S. exports of domestic merchandise, by specified types, and by principal markets, 1970

(Value in thousands of dollars)

Market	Ginseng	Other plants and plant parts 1/	Glycosides and their derivatives, bulk	Animal products used for medicinal preparations	Total
Hong Kong	4,583	-	-	-	4,583
Canada	-	598	69	344	1,011
Japan	-	68	-	730	798
Italy	-	330	-	267	597
United Kingdom	-	309	-	235	544
France	-	235	32	242	509
Mexico	-	163	14	305	482
W. Germany	-	339	-	143	482
Singapore	365	-	-	-	365
Spain	-	29	-	240	269
The Netherlands	-	38	-	180	218
Colombia	-	166	-	50	216
Denmark	-	-	-	201	201
Venezuela	-	83	13	102	198
Brazil	-	36	-	117	153
All other	69	482	77	351	979
Total	5,017	2,876	205	3,507	11,605

1/ Values in this column are overstated because an indeterminate but probably small part of this export class consists of plant materials for other than pharmaceutical uses.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Natural drugs: U.S. imports for consumption, by type, 1965-70

(Value in thousands of dollars)

Type	1965	1966	1967	1968	1969	1970
Specified plant drugs 1/						
Crude	398	346	539	410	746	612
Advanced	15	-	1	44	10	4
Cinchona and other quinine barks	4	-	108	2	5	2
Belladonna	50	54	13	20	17	4
Digitalis (Purpurea)	12	2	21	17	5	-
Ergot	13	11	13	11	13	9
Gentian	5	10	8	12	15	20
Henbane	5	1	-	-	-	-
Nux Vomica	2/	26	-	4	9	-
Stramonium	4	2	3	10	1	1
Miscellaneous natural drugs:						
Crude:						
of animal origin	3,322	5,478	10,549	10,464	8,340	8,457
of vegetable origin	4,928	5,593	3,702	3,478	3,421	4,017
other	84	14	5	40	76	51
Advanced:						
of animal origin	399	439	433	431	380	764
of vegetable origin	161	111	118	128	204	566
other	106	34	21	20	11	23
Total	9,506	12,121	15,534	15,091	13,253	14,530

1/ Aconite, aloes, asafetida, buchu leaves, cocculus indicus, digitalis (Lanata), ipecac, jalap, manna, and marshmallow or althea.
2/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Natural drugs: U.S. imports for consumption, by principal sources, 1965-70

(Value in thousands of dollars)

Source	1965	1966	1967	1968	1969	1970
Canada	2,868	4,947	10,152	10,328	8,072	8,462
India	3,570	3,321	2,496	2,155	2,001	2,457
Argentina	318	411	332	282	277	443
Nicaragua	16	63	67	66	105	199
Australia	248	520	515	75	203	191
New Zealand	138	201	220	247	240	174
All other	2,248	2,658	1,752	1,938	2,355	2,604
Total	9,506	12,121	15,534	15,091	13,253	14,530

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Coca leaves	435.40
Opium	435.70

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States imports all of its requirements for coca leaves and opium. In 1970, U.S. imports of these products amounted to $3.1 million. Such importations are strictly controlled in accordance with treaties, statutes, and regulations.

Description and uses

The two natural drugs covered in this summary--coca leaves and opium--are the basic raw materials for the manufacture of many narcotic drugs. International trade in these materials is closely governed by international treaty and their manufacture by various national statutes and regulations. In the United States these drugs are controlled by the Bureau of Narcotics and Dangerous Drugs. In recent years, the Bureau has been faced with a significant incidence of illegal imports of these drugs, particularly opium, into the United States.

Coca leaves are obtained from either of two species of shrub, Erythroxylon coca or E. truxillense. These shrubs are cultivated chiefly in Peru and Bolivia, and to a lesser extent in Columbia and Indonesia. Although the larger quantity of coca leaf is, and has been for centuries, chewed by the natives of the producing regions to produce a sense of euphoria, the principal commercial use of the leaves is for the production of the alkaloid, cocaine (in item 437.10). This alkaloid is present in commercial quantities in both Peruvian and Bolivian leaf. A Javanese leaf, however, contains chiefly the related alkaloid, ecgonine, which is readily converted to cocaine.

Some of the coca leaf from which the cocaine has been removed is used in the manufacture of a non-narcotic flavoring extract which is an ingredient in a well-known soft drink. The use of coca leaves for this purpose is allowed by an exception written into the treaties to which the United States is a party.

Opium is the coagulated and dried exudate or juice from the immature fruit or seed capsule of the opium poppy Papaver somniferum which is grown widely in Asia and Europe; in some regions it is grown primarily as a source of opium and in others for its edible and oil-containing seeds. The most favorable conditions for growing the opium poppy are found in those parts of the world where a sunny dry season follows a rainy season, and where plentiful labor is available for the harvest. The cultivation of the plant for opium is carried on principally in India, the U.S.S.R. and Turkey and to a lesser extent in Iran, Pakistan, and Yugoslavia. Opium is the source of several narcotic and non-narcotic alkaloids which may be divided into two classes--the so-called phenanthrene derivatives and the benzylisoquinoline derivatives. The first group includes the analgesic drugs used for severe pain--morphine, codeine, and thebaine (all in item 437.14). Morphine is the most physiologically active constituent of opium. In the second group are the non-narcotic drugs, papaverine, used in circulatory diseases, and narcotine and narceine used as stimulants. Preparations which are combinations of the opium alkaloids are marketed under various trade names; their actions are essentially that of the main constituent morphine.

Opium for smoking, prepared from the poppy by a simple process, is used in several Oriental countries despite official efforts to restrict its consumption.

U.S. tariff treatment, internal revenue tax, and other requirements

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
435.40	Coca leaves-----	1.46 per lb.	Free 1/
435.70	Opium----------	$7.20 per lb. of anhydrous morphine content	$3.60 per lb. of anhydrous morphine content

1/ Rate effective January 1, 1969.

The rate effective January 1, 1972, for opium represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. The duty-free status on coca leaves, however, became effective with the first stage of reductions on January 1, 1968. Rates of duty for the individual stages on opium are given in the TSUSA-1971, an excerpt from which is reproduced as

appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967. The ad valorem equivalent (A.V.E.) of the rate of duty on 1970 imports of opium, based on the rate effective January 1, 1970, is 8.3 percent.

In addition to the import duty imposed on opium, section 4701 of the Internal Revenue Code imposes an internal revenue tax of 1 cent per ounce, or fraction of an ounce in a package, for any narcotic drugs produced in, or imported into, the United States, and sold or removed for consumption or sale. The tax is paid either by the importer, manufacturer, or compounder. Section 4702 exempts from this tax decocainized coca leaves or preparations made therefrom. Insofar as the internal revenue tax applies to coca leaves and opium, it has much the effect of an import duty, since the entire U.S. supply of these products is obtained by importation.

The laws that govern the U.S. importation, exportation, and manufacture of narcotic drugs are administered by the Bureau of Narcotics and Dangerous Drugs and Bureau of Customs in cooperation with the International Criminal Police Organization (Interpol). The control by the Bureau of Narcotics and Dangerous Drugs has been extended to synthetic drugs that cause addiction, and to marihuana, a product of the hemp or cannabis plant.

U.S. consumption and imports

U.S. consumption of coca leaves and opium can be approximated by U S. imports of these materials inasmuch as imports are the sole sources. Crude opium and coca leaves except for emergencies may only be imported under formal permit for medical and legitimate uses. During 1965-70, the volume of U.S. imports of coca leaves fluctuated from year to year, averaging 631,000 pounds per year. Imports of opium during this period declined from 62,000 content pounds 1/ in 1965, to 28,000 content pounds in 1967, then increased to 46,000 pounds in 1970 (table 1); the generally smaller imports during this period compared with earlier years is attributed to increased utilization of synthetic alternates for morphine (e.g., meperidine hydrochloride).

U.S. imports of coca leaves came almost entirely from Peru during 1965-70; imports of opium came from Turkey or India. These materials are the only narcotic substances (aside from small quantities of other substances brought in by special permit for scientific purposes) which may be imported into the United States and they require import certificates.

Imports consist entirely of coca leaves and opium in crude form, except for small quantities of coca leaves that are advanced to the

1/ Morphine content.

state of having had the cocaine removed. Imports of the nonmedicinal coca leaves for the manufacture of non-narcotic flavoring extracts have been small in most years; in 1961, they amounted to 4,953 pounds, and in 1962, to 44,602 pounds. They have not been imported since 1962.

The international agreement or protocol for limiting and regulating the cultivation of the poppy plant, the production of, international and wholesale trade in, and use of opium to which the United States and some 50 other countries are parties, entered into force for the United States March 8, 1963. Among other control measures, it stipulates that the exporting countries shall be Bulgaria, Greece, India, Iran, Turkey, the U.S.S.R., and Yugoslavia, and restricts imports by participating countries to opium produced in such areas.

U.S. production

U.S. production of opium is, in effect, prohibited by the nonissuance of licenses. Licenses to produce opium poppy and to manufacture opium are to be issued only if the medical and scientific needs of the United States cannot be met by the importation of crude opium. Further, narcotic derivatives of coca leaves and opium as well as synthetic drugs found to have similar effects (all defined as "opiates") are excluded from importation except for scientific purposes in certain circumstances. Thus, all domestic requirements for the extracted derivatives of coca leaves and opium must be supplied by licensed domestic production from imported raw coca leaves and crude opium, respectively. (See summary on narcotic alkaloids-items 437.10, 437.14 and 437.74.) The quantities of these materials made available for manufacture in the United States are carefully adjusted to U.S. requirements for the manufacture of derivatives for both legitimate domestic consumption and licensed exportation.

A prohibitive tax is an effective deterrent to the production of smoking opium; imports of smoking opium are not permitted. Although certain areas in the Western States are climatically suited to the growing of poppies, the Opium Poppy Control Act of 1942 requires licenses for their domestic cultivation, even for the non-narcotic poppy seeds (item 175.36) used as a seasoning for bread and pastries. The applicable regulations state that no licenses shall be issued for the production of opium poppies solely for poppy seed (21 CFR 303.3).

U.S. exports

There is no legitimate domestic production of coca leaves or crude opium and there are no U.S. exports. Derivative narcotics can be exported in quantities determined by the Bureau of Narcotics and

Dangerous Drugs to be within the limits allowed by international arrangements.

World production and trade

The aggregate world production of coca leaves during the period 1966-69 fluctuated near an annual average of 30.5 million pounds. In 1969, 67 percent of the total amount produced was accounted for by Peru and 33 percent by Bolivia. Indonesia produced very small quantities in 1965-66 and none during 1967-69.

Although the principal use of coca leaf in the developed countries is for the production of cocaine, this use represents a small proportion of the amount of coca leaf used throughout the world. In 1969, in Peru, the only country for which such statistics are available, the use of coca leaf for cocaine amounted to only 3.6 percent. The bulk of the world crop of coca leaves is chewed by the indigenous population of South America.

In 1969, the bulk of Peru's exports of coca leaves went to the United States, while Bolivia's exports of coca leaves went mostly to Argentina and some to France. Total exports of coca leaves by these two producing countries, and minor amounts (probably exports of imported merchandise) from France totaled 821,000 pounds in that year (table 2).

World production of opium amounted to 2.7 million pounds in 1969 (table 2) having increased from 1.7 million pounds in 1967. India has been by far the largest producer; in 1969, Indian production represented 71 percent of the total, while the U.S.S.R. accounted for 18 percent and Turkey for 9.5 percent. Smaller amounts of opium were produced by Yugoslavia, Iran, Pakistan, Bulgaria and Japan.

In 1969, India had for its principal market the United Kingdom, while Turkey's largest export market was the United States. Total exports of raw opium by all producing countries in 1969 amounted to 1.6 million pounds (table 2).

Table 1.--Coca leaves and opium: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
	Coca leaves					
Peru	605	600	500	674	600	646
Uruguay	-	-	-	-	-	80
All other	-	-	2/ 83	-	-	-
Total	605	600	583	674	600	726
	Opium 1/					
India	16	7	8	17	31	36
Turkey	46	38	20	21	9	10
Total	62	45	28	38	40	46
	Value (1,000 dollars)					
	Coca leaves					
Peru	303	299	220	298	270	286
Uruguay	-	-	-	-	-	10
All other	-	-	2/ 24	-	-	-
Total	303	299	244	298	270	296
	Opium					
India	945	456	471	914	1,748	2,396
Turkey	1,902	1,404	776	877	429	426
Total	2,847	1,860	1,247	1,791	2,177	2,822

1/ Morphine content only.
2/ From Bolivia and Belgium.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Coca leaves and opium: World production and exports, by principal producing countries 1/, 1969

Drug and country	Quantity (1,000 pounds) 2/ Production	Exports	Principal export markets
Coca leaves:			
Peru	21,433	701	United States, Switzerland
Bolivia	10,692	120	Argentina, France
Total	32,157	3/ 821	
Opium:			
India	1,910	1,324	United Kingdom, United States, U.S.S.R., France, Italy
USSR	477	4/	5/
Turkey	257	260	United States, France, Spain, Japan
Iran	17	-	-
Pakistan	17	-	-
All other	3	-	-
Total	2,681	1,584	

1/ Includes only countries reporting to the United Nations.
2/ Quantities of opium represent whole opium. Data in table 1 is based on the morphine content of opium; morphine generally accounts for about 10-20 percent of the weight of opium.
3/ Total includes negligible amounts from France.
4/ Less than 500 pounds.
5/ Not available.

Source: Compiled from official statistics of the International Narcotics Control Board of the United Nations, Statistics on Narcotic Drugs for 1969.

	TSUS item
Caffeine and its compounds-----	437.02, -.04, -.06

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States, along with West Germany, is a principal world producer of caffeine. During 1965-70 annual U.S. consumption of caffeine is believed to have been several million pounds, at least half of which was supplied by domestic production. Annual imports amounted to 2 million pounds in 1968 and 1969, less in other years during this period. Exports are believed to have been small.

Description and uses

Caffeine is a white, crystalline, purine derivative which occurs as a natural component of coffee beans (item 160.10), tea leaves (item 160.50), and kola nuts (item 439.10). It is obtained commercially either by extraction from natural sources, or is produced synthetically. At present, the bulk of the extracted natural caffeine in the United States is a byproduct of decaffeinated coffee production. It may also be obtained by conversion of theobromine from tea waste, cocoa, or from crusts of coffee roasting ovens. Caffeine is synthesized from the intermediate chemicals dimethyl urea and malonic acid. Both the natural and synthetic forms are chemically identical, both satisfy the United States Pharmacopoeia requirements, and both are similarly priced. Caffeine is a cerebral stimulant and in both its natural and synthetic forms it is increasingly important as a basic material in the pharmaceutical and beverage industries.

About two-thirds of the caffeine consumed domestically is used in cola beverage production, in which there is a preference by one of the major producers for the natural type. The remaining one-third is used as a medicinal.

The compounds of caffeine covered by this summary are of the nonbenzenoid type. At present, the only compound included herein which is an item of commerce is citrated caffeine, which is a mixture containing approximately equal parts of anhydrous caffeine and anhydrous citric acid. Citrated caffeine is water-soluble and is used in formulations for relief of minor pain. The use of citrated caffeine is relatively limited.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
437.02	Caffeine	51¢ per lb.	25¢ per lb.
437.04	Citrated caffeine----	75¢ per lb.	37.5¢ per lb.
437.06	Other caffeine compounds----------	25% ad val.	12.5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reductions became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The ad valorem equivalent (A.V.E.) of the rate of duty effective January 1, 1970, for caffeine, based on imports in 1970, was 27.2 percent. There have been no imports of citrated caffeine since 1954; however, if the 1970 rate of duty were applied to imports in 1954, the A.V.E. on imports of citrated caffeine would be 17.5 percent.

U.S. consumption

The average annual consumption of caffeine in the United States during 1965-70 is estimated at several million pounds. During the early 1960's the use of caffeine had expanded because of the increased consumption of caffeine-containing drinks, principally cola drinks. Consumption for this use has continued stable in more recent years.

The consumption of caffeine citrate has been relatively small, estimated not to have exceeded several thousand pounds in the recent period covered.

U.S. producers

There are two domestic producers of caffeine. One of these located in New Jersey, produces the natural caffeine as a byproduct of its decaffeinated coffee output. The synthetic caffeine producer is located in Connecticut. Both companies are large and produce many other products; for neither of them is caffeine a major source of income. Two other companies, neither of which produces caffeine, produce very small amounts of caffeine citrate, and have plants located in Missouri and New Jersey.

U.S. production

In 1963 and 1964, U.S. production of caffeine amounted to 2,313,000 pounds and 2,791,000 pounds, respectively. For the period 1965-70 statistics on production have not been available; however, in 1965 U.S. sales of caffeine amounted to 2,741,000 pounds, valued at $5,036,000.

U.S. exports

Exports of caffeine are not separately classified in official statistics, but they are believed to be small. Caffeine produced in the United States is generally unable to compete on a price basis in European and South American markets with European-produced caffeine.

U.S. imports

During the period 1965-70 the volume of annual U.S. imports of caffeine increased from 1.2 million pounds in 1965 to 2.0 million pounds in 1968 and 1969, then decreased to 1.6 million pounds in 1970 (see accompanying table). The chief source of U.S. imports during this period was West Germany which supplied 80 percent of the imports in 1968, 95 percent in 1969, and virtually 100 percent in 1970. The Netherlands consistently supplied a smaller but substantial share of the U.S. import total during this period. The largest part of the imports from Germany was of the synthetic type; the remainder from West Germany and all of that from the Netherlands was caffeine derived from theobromine which was, in turn, derived from cocoa. This latter type of caffeine was used by those beverage producers who use only naturally derived material. Imports of caffeine compounds were limited and entered only in 1965 and 1966; about 3,800 pounds entered from the Netherlands in 1965 and about 1,000 pounds from West Germany in 1966.

Foreign production and trade

West Germany is the largest foreign producer of caffeine and is the leading supplier of imported caffeine to the United States, the United Kingdom, and Brazil. The largest part of West-German-produced caffeine is synthetic, but neither production nor trade statistics are available. The Netherlands, which is the second largest supplier of caffeine imports to the United States, produces all of its caffeine from theobromine. The United Kingdom, which exported about 80 percent of its output of caffeine to the United States prior to 1965, but has supplied none of these imports since that time, has produced both synthetic caffeine and theobromine-derived caffeine. Switzerland, India, and Japan are other countries that have produced, though not necessarily exported, caffeine.

Caffeine: U.S. imports for consumption by sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
West Germany	998	1,349	1,151	1,627	1,924	1,598
Netherlands	159	138	283	329	86	18
Spain	-	-	-	33	-	-
France	-	-	40	33	-	-
Total	1,157	1,487	1,474	2,022	2,010	1,616
	Value (1,000 dollars)					
West Germany	1,032	1,330	1,143	1,666	2,101	2,082
Netherlands	226	196	375	444	117	28
Spain	-	-	-	42	-	-
France	-	-	39	24	-	-
Total	1,258	1,526	1,557	2,176	2,218	2,110

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Cinchona bark alkaloids and their salts	437.08

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The domestic requirements, supplied principally by imports from Europe, greatly exceed domestic production. In 1970, imports exceeded 4.4 million ounces. The requirements of the U.S. Government, including the military, are obtained from the national stockpile of these materials.

Description and uses

The alkaloids considered in this summary are extracted from the bark of various species of the cinchona tree. These trees are cultivated chiefly in Indonesia, and, to a lesser extent, in the Congo, in Guatemala, and in Bolivia. The Indonesian bark, however, is of higher quality, since its quinine content is higher, and it is thus preferred for commercial use.

The most important alkaloids of this group are the two pairs of isomers, quinine and quinidine, and cinchonine and cinchonidine. Only the first pair, and some of their salts, have commercial significance in the United States. Quinine is readily converted to quinidine. This so-called synthetic quinidine is identical with quinidine obtained by direct extraction, and has been accepted by the United States Pharmacopoeia.

The major use of quinine and its sulfate salt is as an antipyretic and analgesic in cold remedies and other pharmaceutical preparations. Quinine is an effective anti-malarial agent. Synthetic anti-malarial agents, such as primaquine and chloroquine, had for a time largely supplanted quinine in the treatment of malaria; however, certain strains of the malaria organism developed resistance to the synthetic products, and recently there has been an increase in the use of quinine by our armed forces overseas. Quinine is also used in making quinine beverages. Industry sources estimate that 85 percent of the quinine used in the United States goes into medicinal preparations, while about 15 percent is used in tonic drinks.

Quinidine sulfate and quinidine gluconate are important drugs used

in the treatment of cardiac arrhythmias. Cinchonine, cinchonidine, and totaquinine are of relatively little importance in the United States, but are used in less-developed areas of the world as inexpensive substitutes for quinine for anti-malarial purposes. Quinoidine, another relatively unimportant derivative of cinchona bark, is used principally as a molding powder in metal casting, but it also has minor medical applications.

U.S. tariff treatment

The duty-free status of cinchona bark alkaloids and their salts was provided for in the Tariff Act of 1930, as originally enacted, and in the TSUS, effective August 31, 1963. This duty-free status was bound, effective February 1, 1936, as a concession granted by the United States to the Netherlands, and has been bound since January 1, 1948, as a concession granted in the General Agreement on Tariffs and Trade (GATT).

U.S. consumption

The U.S. consumption of cinchona bark alkaloids is supplied almost entirely by imports; exports are relatively small. Consumption appears to have risen from about 2.9 million ounces in 1965 to 4.4 million ounces in 1970. The increased consumption largely reflected the increased requirements for quinine both in medicinals and in beverages. The volume of quinidine used in the treatment of cardiac disease has been fairly stable in recent years. U.S. consumption declined in the latter part of 1965, however, when European processors curtailed production, with a consequent decrease of exports to the U.S. market. The decline in supply was accompanied by a sharp rise in the prices of these alkaloids.

U.S. production and exports

The only domestic production in recent years of cinchona bark derivatives is carried on by a small firm in New York State which produces small quantities of quinidine sulfate and quinidine gluconate. These quinidine salts are produced by converting quinine obtained, when available, from the U.S. Government stockpile. This firm also produces various other medicinal chemicals which it sells to pharmaceutical manufacturers, as well as some industrial chemicals and intermediates and some custom products.

Small quantities of cinchona tree bark, as indicated in a separate summary in this volume (in item 435.30), are imported annually. U.S. production of cinchona alkaloids from this imported raw material, which

was very small in volume, is believed to have been for experimental purposes. Exports of cinchona bark alkaloids and derivatives after 1964 have been negligible or nil, when sales of quinine from the National Stockpile of Strategic and Critical Materials were discontinued since the stockpile objective was increased.

U.S. imports

U.S. imports of cinchona bark alkaloids increased in volume from 2.9 million ounces in 1965 to 4.4 million ounces in 1970 (table 1), or by about 52 percent. These imports come mainly from West Germany and the Netherlands, and, to a lesser extent, from France, Israel, the United Kingdom, Indonesia and several other countries (tables 1 and 2). The imported materials, which are generally of high quality, are purchased by pharmaceutical manufacturers for use in medicinal formulations and preparations.

The average annual unit values of imports was much higher in 1966 than in more recent years. This resulted from the regulation of supply and prices by a cartel in the principal source countries.

World production and trade

The Netherlands and West Germany are the world's leading producers of refined cinchona bark alkaloids; together, they account for the bulk of world production. In each of these countries there are approximately 8 or 10 large concerns that are prime producers of quinine and quinidine and salts. These concerns also produce pharmaceuticals and various other alkaloids. Smaller quantities of quinine and quinidine and their salts are produced in Indonesia, the United Kingdom, Sweden, France, Japan, and India.

The raw materials for the refined alkaloids--crude alkaloids as well as the bark of the tree itself--are produced largely in Indonesia, the Congo, and India, and these countries are the source of supply for the production of refined alkaloids in other countries. Guatemala and Bolivia are also producing the bark in increasing quantities.

Statistics on production and sales of cinchona bark alkaloids and derivatives by producing countries are not available. Statistics on exports from the Netherlands are not published, but its exports are known to be vastly larger than its imports which amounted to 112,200 pounds, valued at $360,000, in 1964. Chief sources of the Netherlands imports in 1964 were India and the United States, which generally provided materials for further processing. The Netherlands' imports from the United States came from the National Stockpile of Strategic and Critical Materials before sales from this source were discontinued. Exports from Indonesia for 1969 were estimated at over $4 million.

Table 1.--Cinchona bark alkaloids and their salts: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 ounces)					
West Germany	887	1,461	809	1,286	1,241	1,491
Netherlands	1,342	1,480	1,106	1,960	1,833	1,658
France	72	20	218	380	291	454
Israel	-	70	21	95	74	273
United Kingdom	251	141	76	137	137	267
Indonesia	151	296	2	78	55	136
Bolivia	-	-	-	-	137	63
Switzerland	-	42	-	-	83	30
Japan	78	31	4	-	4	9
All other	115	253	105	91	9	57
Total	2,896	3,794	2,341	4,027	3,889	4,438
	Value (1,000 dollars)					
West Germany	1,821	5,244	1,662	1,315	1,970	2,280
Netherlands	1,722	4,145	1,762	1,668	2,292	2,068
France	167	72	132	444	505	835
Israel	-	147	28	116	139	563
United Kingdom	384	395	154	125	210	253
Indonesia	142	762	5	61	56	159
Bolivia	-	-	-	-	81	36
Switzerland	-	190	-	-	165	34
Japan	19	90	8	-	7	15
All other	232	762	182	105	60	27
Total	4,487	11,807	3,933	3,834	5,485	6,270

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Cinchona bark alkaloids and their salts: U.S. imports for consumption, by principal type and source, 1970

Source	Quinine and its salts	Quinidine and its salts	Other cinchona bark alkaloids and their salts	Total
	Quantity (1,000 ounces)			
West Germany	587	874	30	1,491
Netherlands	804	653	201	1,658
France	29	215	210	454
Israel	-	273	-	273
United Kingdom	102	145	20	267
Indonesia	131	5	-	136
Bolivia	28	35	-	63
Switzerland	30	-	-	30
Japan	-	9	-	9
All other	-	26	31	57
Total	1,711	2,235	492	4,438
	Value (1,000 dollars)			
West Germany	666	1,560	54	2,280
Netherlands	815	1,227	26	2,068
France	35	386	414	835
Israel	-	563	-	563
United Kingdom	122	99	32	253
Indonesia	153	6	-	159
Bolivia	16	20	-	36
Switzerland	34	-	-	34
Japan	-	15	-	15
All other	-	6	21	27
Total	1,841	3,882	547	6,270

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Brucine and its compounds	437.00
Ergotamine compounds	437.12
Nicotine and its compounds	437.13
Strychnine and its salts	437.16
Theobromine	437.18
Other alkaloids and their compounds, not elsewhere enumerated:	
Synthetic	437.20
Natural:	
Not artificially mixed	437.22
Other	437.24
Ethylhydrocupreine and its compounds	437.50

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The value of U.S. imports of the alkaloids covered herein exceeds that of domestic production. In 1970, imports were valued at $6.9 million and the value of domestic production is estimated at about $3.0 million. Exports are probably small.

Description and uses

This summary covers certain enumerated alkaloids and their compounds as well as synthetic and natural alkaloids and their compounds which have not been covered elsewhere in the TSUS. (See summaries in this volume on items 437.02 through 437.10 and on item 437.14 for other enumerated alkaloids). Alkaloids, derived from plants, are organic bases with one or more nitrogen atoms; they are physiologically active and thus of use in pharmaceutical or associated applications. Some of the alkaloids may also be produced by synthetic processes. Alkaloids may be classed according to the basic chemical structures from which they are derived, such as pyridine or piperidine, quinoline, isoquinoline, purine, tropane, and others. If produced by a synthetic process, however, alkaloids of benzenoid structures are classified in part 1 of schedule 4 of the TSUS, and are covered in summary volume 4:1.

Brucine (item 437.00) and strychnine (item 437.16) are alkaloids with both indole and quinoline groups as part of their structures. They are derived from nux vomica, the dried ripe seeds of the poisonous plant Strychnos Nux-Vomica, most of which is supplied to world markets by the southwest and northeast regions of India. Brucine and its most important salt, brucine sulfate, are used as important denaturants, although substitute denaturants such as quassin and "bitrex" (the latter a synthetic product) are used in alcohol, brucine is by far the predominant denaturant used in alcohol prepared for the cosmetics, perfumery, and toilet preparations industry. Strychnine and its salts are used mostly as poison for controlling predatory animals and rodents.

Ergotamine compounds (item 437.12), which contain an indole ring as part of their structure, are derivatives of ergot (item 435.50), a fungus growth occurring on rye plants. The most important compound is ergotamine tartrate which is used as a medicinal and marketed under various proprietary names. It is used mainly for the treatment of migraine headaches.

Nicotine is a poisonous pyridine-type alkaloid extracted from waste tobacco obtained in the manufacture of tobacco products. The main use for nicotine and nicotine sulfate, particularly a 40-percent solution of nicotine sulfate, is as an agricultural insecticide, effective against certain crop pests such as aphids. Superior synthetic products have replaced nicotine sulfate as an insecticide to a great extent.

Theobromine (item 437.18) is a member of the xanthine (based on purine) group of alkaloids. It occurs naturally in the seed of Theobroma Cacao. Commercially, it is extracted from cocoa press cake or cocoa residue, waste products of cocoa and chocolate manufacture, or it is synthesized. In its refined form, theobromine is used medicinally, as a diuretic, a myocardial stimulant, and as a dilator for the coronary or peripheral arteries. Theobromine is also used as an intermediate in the production of caffeine by methylation; however, this latter use is today far less significant than it was previously.

Ethylhydrocupreine and its compounds (item 437.50) are included in this summary although they are derivatives of an alkaloid cupreine, derived from the bark of certain trees of the genus Remijia. These drugs have limited use in low concentrations in topical ophthalmic preparations.

This summary covers, in addition, all alkaloids and their compounds, both natural and synthetic, not elsewhere enumerated in the TSUS (items 437.20-.24). Important among these miscellaneous alkaloids and alkaloid compounds are theophylline and aminophylline, pilocarpine, emetine, berberine, colchicine, and reserpine, including their salts. They are employed in medicine in ophthalmic uses, and for hypertension, arthritis,

and other therapy. Some are also employed in veterinary medicine.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Alkaloids and their esters, ethers, salts, and other compounds:		
437.00	Brucine and its compounds	10.5% ad val.	5% ad val.
437.12	Ergotamine compounds	10% ad val.	5% ad val.
437.13	Nicotine and its compounds	10.5% ad val.	5% ad. val
437.16	Strychnine and its salts	10¢ per oz.	5¢ per oz.
437.18	Theobromine	22¢ per lb.	11¢ per lb.
	Other alkaloids and their compounds:		
437.20	Synthetic	10.5% ad val.	5% ad val.
	Natural:		
437.22	Not artificially mixed	3% ad val.	2% ad val. 1/
437.24	Other	10.5% ad val.	5% ad val.
437.50	Ethylhydrocupreine and its compounds	20¢ per oz.	10¢ per oz.

1/ Rate effective January 1, 1969.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reductions became effective January 1, 1968. The rate effective January 1, 1969, for item 437.22 represents the second stage of a concession granted by the United States in the sixth round of trade negotiations under the GATT. Further reductions scheduled for years subsequent to 1969 for this item have not become effective. Scheduled rates of duty for the individual stages are given in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. Staged Rates and Historical Notes to part 3 of schedule 4 of the TSUSA-1971 are also shown in appendix A. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The average ad valorem equivalents (A.V.E.'s) for the rates of duty effective January 1, 1970 for strychnine and its salts, theobromine, and ethylhydrocupreine and its compounds, based on imports in 1970, was 16.7 percent, 2.9 percent, and 0.4 percent, respectively. For theobromine the range of A.V.E.'s based on country source of imports was from 2.5 percent to 6.3 percent. There was only one country source of imports in 1970 of ethylhydrocupreine.

U.S. consumption

Domestic consumption of all the alkaloids and compounds included in this summary probably amounted to about $10 million in 1970. The small U.S. consumption of brucine, ergotamine, nicotine, and strychnine and their compounds, and of theobromine, was supplied completely by imports. In 1970, the values of consumption of each of these five classes were less than $441,000, the value of imports of brucine in that year, and between 1965 and 1970 were generally small. The value of of consumption in 1970 of the other alkaloids, synthetic and natural, is believed to have approached $9 million. Estimated consumption is expressed in terms of value rather than quality, since both imports and domestic production comprise a heterogeneous group of products, ranging widely in unit value.

U.S. producers, production, and exports

Of the alkaloids included in this summary, there is domestic production of about 25 to 30 products, all of which fall in the classes of unenumerated alkaloids of synthetic or natural origin (items 437.20-.24). These alkaloids are produced domestically by about 20 companies located in the metropolitan New York-New Jersey area, Indiana, Illinois, Missouri, and California.

The value of the domestically produced alkaloids covered here is estimated to have amounted to $3.0 million in 1969 on the basis of statistics published by the U.S. Tariff Commission. The unit values of these alkaloids range very widely, from several dollars to several thousand dollars per pound. The largest item on the basis of quantity was aminophylline, of which 37,000 pounds were produced. Included also were the related theophylline and aminophylline compounds. The anti-neoplastic agents vinblastine sulfate and vincristine sulfate are examples of alkaloids having extremely high unit values (over several thousand dollars per pound); these drugs are probably used experimentally at present. Other alkaloids that are produced domestically (some by only one producer) are:

Deserpidine
Reserpine
Colchicine
Lobeline sulfate
Berberine hydrochloride
Hydrastine
Hydrastine hydrochloride

Statistics on U.S. exports of the non-narcotic alkaloids covered here are not separately classified, but exports of these products are believed to be small.

U.S. imports

In the years 1965-70, total annual imports of the alkaloids covered herein were valued at between $5 million and $7 million, except for 1967, when the value totaled $3 million. In 1970, as in the previous years, the predominant share of these imports was accounted for by imports of non-narcotic alkaloids, synthetic and natural, not elsewhere enumerated. Total annual imports of non-narcotic alkaloids and their compounds, by type, in 1965-70 are shown in the following tabulation:

Non-narcotic akaloids: U.S. imports for consumption, by type, 1965-70

Type	Value (1,000 dollars)					
	1965	1966	1967	1968	1969	1970
Brucine and its compounds	1,714	1,383	835	552	370	441
Ergotamine compounds	135	50	81	41	133	234
Nicotine and its compounds	341	273	96	70	60	107
Strychnine and its salts	124	117	130	86	113	101
Theobromine	131	126	31	167	148	320
Ethylhydrocupreine and its compounds	-	--	31	-	2	1/
Non-narcotic alkaloids and their compounds, not elsewhere enumerated	3,333	3,086	1,809	4,171	4,820	5,726
Total	5,778	5,035	3,013	5,087	5,646	6,929

1/ Less than $500.

For the first six items listed above, imports completely supply the small domestic market. Imports of brucine alkaloid and sulfate, which have come chiefly from India and Israel, have represented the only relatively substantial imports among these six items (tables 1-5). There were no imports of ethylhydrocupreine (not shown in the tables) in 1965 and 1966; in 1967, 90,000 pounds valued at $31,000 were imported mainly from West Germany and some from France. Negligible amounts, never valued at more than $1,800, were imported during 1968-70 from the United Kingdom and France.

For the period 1965-70, imports of alkaloids, not enumerated elsewhere, amounted to an annual average of 460,000 pounds; their average annual value was $4.3 million. In recent years, 25 to 30 different types of alkaloids were represented and were predominantly of the synthetic type. Based on data for 1968, the largest share of these imports, on a volume basis, consisted of theophylline and related compounds such as aminophylline, which originated mainly in West Germany. Theophylline itself has not been produced in the United States after 1961. Scopolamine compounds, also mostly from West Germany, contributed the most important share of the value of imports of this class. Other items of significance in this class were atropine alkaloid and compounds, pilocarpine, yohimbine and sparteine compounds, chiefly from West Germany. The average unit value of these items varied considerably from approximately $1.75 per pounds for theophylline to over $200 per pound for scopolamine compounds. (See table 6 for imports of alkaloids and their compounds, not elsewhere enumerated, by principal sources, during 1965-70.)

Various other alkaloids such as colchicine and eserine base which have not been chemically modified are included in the imports under the items 437.22 and 437.24, classed as natural alkaloids.

Foreign production and trade

Data on foreign production of non-narcotic alkaloids are only fragmentary, although it is believed that West Germany predominates generally in the production of alkaloids, particularly in theophylline and its compounds. Exports of alkaloids are not separately classified in West German official statistics. Other large producers of alkaloids are Switzerland, Italy, the United Kingdom, and Israel.

Switzerland in 1968 exported non-narcotic alkaloids amounting to $27,630,000. West Germany was her largest market absorbing over $2 million. The United States and France followed in market size.

In 1967 the value of Italy's exports of non-narcotic alkaloids totaled an estimated $2,145,000. The largest group represented was rauwolfia alkaloids (about $866,000), sent principally to France.

Another group consisted of eserine, veratrine, colchicine, and aconitine ($360,000). Yet another consisted of theophylline and ethylenediamine and its salts ($100,000). Other alkaloids such as ephedrine, nicotine, theobromine, and scopolamine, were less important export items.

Israel exported alkaloids in 1967 valued at $1,432,100. The United States, followed by France and West Germany, were its largest markets. Its other markets were mainly in Europe, although several South Amercian countries imported substantial quantities of alkaloids from Israel.

Table 1.--Brucine and its compounds: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
India	40	23	18	11	171	433
Israel	14	5	12	15	221	175
United Kingdom	4	3	3	2	30	-
All other	10	2	1/	1/	3	-
Total	68	33	33	28	425	608
	Value (1,000 dollars)					
India	643	939	424	140	138	289
Israel	650	242	294	364	200	152
United Kingdom	119	149	116	44	30	-
All other	302	53	1	4	2	-
Total	1,714	1,383	835	552	370	441

1/ Less than 500 pounds.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Nicotine and its compounds: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
United Kingdom	153	152	37	60	52	72
Japan	2	-	-	-	-	1
Switzerland	-	11	-	3	13	22
West Germany	4	-	-	4	1	4
Netherlands	61	29	4	-	-	-
Bulgaria	-	24	18	-	6	-
All other	6	17	19	10	-	-
Total	226	233	78	77	72	99
	Value (1,000 dollars)					
United Kingdom	233	189	54	55	46	49
Japan	2	-	-	-	-	45
Switzerland	-	9	-	3	7	10
West Germany	4	-	-	3	1	3
Netherlands	93	21	3	-	-	-
Bulgaria	-	30	22	-	6	-
All other	9	24	17	9	-	-
Total	341	273	96	70	60	107

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Ergotamine compounds: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (pounds)					
Switzerland	7	-	3	-	110	11
West Germany	25	25	31	23	202	272
United Kingdom	-	15	-	4	7	11
Canada	-	-	-	-	-	700
Yugoslavia	-	-	-	-	12	-
Finland	15	15	7	-	3	-
All other	20	1	26	1	-	-
Total	67	56	67	28	334	994
	Value (1,000 dollars)					
Switzerland	72	-	24	-	8	177
West Germany	31	33	41	26	110	40
United Kingdom	-	4	-	3	7	14
Canada	-	-	-	-	-	3
Yugoslavia	-	-	-	-	5	-
Finland	15	11	8	-	3	-
All other	17	2	8	5	-	-
Total	135	50	81	34	133	234

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 4.--Strychnine and its salts: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 ounces)					
Israel	45	54	92	51	125	139
India	106	90	144	135	83	92
United Kingdom	34	34	16	3	11	11
All other	5	4	-	-	-	-
Total	190	182	252	189	219	242
	Value (1,000 dollars)					
Israel	34	38	64	35	80	66
India	57	50	56	50	28	31
United Kingdom	29	26	10	1	5	4
All other	4	3	-	-	-	-
Total	124	117	130	86	113	101

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 5.--Theobromine: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
USSR	-	-	-	-	-	42
Netherlands	86	61	18	92	65	17
All other	1/	2/ 24	-	-	-	3
Total	86	85	18	92	65	62
	Value (1,000 dollars)					
USSR	-	-	-	-	-	224
Netherlands	131	90	31	167	148	85
All other	3/	2/ 36	-	-	-	11
Total	131	126	31	167	148	320

1/ Less than 500 pounds.

2/ Includes 22 thousand pounds, valued at 33 thousand dollars, from Denmark.

3/ Less than 500 dollars.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 6.--Alkaloids and their compounds, not elsewhere enumerated 1/: U.S. imports for consumption, by principal source, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Switzerland	2	3	4	12	1	19
West Germany	288	288	325	325	293	427
Israel	18	8	21	17	20	17
Italy	2/	1	112	111	1	60
Pakistan	-	-	9	11	15	18
France	7	18	9	23	2/	12
India	2	3	1	4	2	4
Netherlands	4	14	32	14	15	1
United Kingdom	4	2/	2	6	2/	1
All other	4	5	26	90	12	20
Total	329	340	541	613	359	579
	Value (1,000 dollars)					
Switzerland	2,100	1,689	67	2,382	3,178	3,342
West Germany	620	788	675	1,014	1,034	1,429
Israel	136	75	166	177	197	390
Italy	60	292	458	243	165	240
Pakistan	-	-	41	50	73	86
France	29	71	201	54	63	82
India	33	36	11	32	25	37
Netherlands	13	28	69	87	36	31
United Kingdom	318	61	70	93	39	30
All other	24	46	51	39	10	59
Total	3,333	3,086	1,809	4,171	4,820	5,726

1/ See text for discussion of specific alkaloids and compounds included here.

2/ Less than 500 pounds.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Cocaine and its compounds	437.10
Opium alkaloids and their compounds	437.14
Tinctures of opium such as laudanum and other liquid preparations of opium	437.74

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States produces all domestic requirements of the narcotic alkaloids covered by this summary; imports are prohibited by law. In 1966 (the latest year for which information is available), U.S. consumption of these commodities exceeded 50,000 kilograms. U.S. exports have been small compared to U.S. production and consumption.

Description and uses

Cocaine and its compounds and opium alkaloids and their compounds, all of which are narcotics, are obtained, respectively, from coca leaves (item 435.40) and from opium (item 435.70), the dried latex exuded from the unripe seed capsule of the opium poppy. These alkaloids and their compounds, however, are included here whether they are extracted from natural sources or produced synthetically. Preparations of opium are also covered in this summary and their production, sale, and importation are governed by the same laws which apply to the alkaloids and their compounds. All of the substances covered here are included among the 35 basic classes of narcotics which have been specifically allowed by law or regulation to be manufactured in the United States (21 U.S.C. 801-829; 21 CFR 307.51-307.151).

Cocaine, a tropane-derived alkaloid which occurs as colorless to white crystals, is obtained from the leaves of the evergreen shrubs of several species of the genus Erythroxylon (coca leaves) cultivated in the mountainous regions of Peru and Bolivia, in Indonesia (Java), and in Colombia. The average total yield of alkaloids obtained from the crude drug varies, depending upon the place of origin, from 0.3 to 2.5 percent. Of the alkaloids covered here, cocaine is the most important quantitatively. Those alkaloids

obtained from coca leaves but not covered here include cinnamylcocaine, alpha-truxilline (known also as cocamine), beta-truxilline (known also as isococamine), tropocaine, and others. They are not specially provided for by name in the tariff schedules, and are covered under the basket provisions for alkaloids (items 437.20-.24). Cocaine hydrochloride, either in the form of colorless crystals or a white crystalline powder, is the most important cocaine compound and is the only one listed in the National Formulary and the United States Pharmacopoeia. Commercially less-important are the salts, cocaine nitrate and cocaine sulfate. Cocaine and its hydrochlorides are used as local anesthetics. Cocaine is little used internally in medical practice because of its toxicity and tendency to produce addiction, but is used in ointments and oily solutions because of its solubility in fats; otherwise, one of the salts is used.

There are about 25 alkaloids which are the pharmacologically active constituents present in opium; four of these, morphine, codeine, papaverine, and thebaine are of importance in medical use. These constituents are divided into two distinct groups (relating to structure), a strongly narcotic group, which includes morphine, codeine, and thebaine, and a less narcotic group whose principal constituent is papaverine. The principal derivatives of morphine, which are used as analagesics, are morphine sulfate, morphine hydrochloride, hydromorphone, oxymorphone, and ethylmorphine. Derivatives of codeine, which are antitussive agents as well as analgesics, include the phosphate and sulfate salts, hydro- and dihydrocodeine, pholcodine, hydrocodone, and oxycodone. Thebaine, too toxic for medical use itself, is the raw material for other analgesics. The principal derivative of papaverine is papaverine hydrochloride, a muscle relaxant.

The bulk (in 1969, 97.6 percent) of the world supply of morphine extracted from opium is converted into other drugs. In 1969, 89.5 percent of the morphine produced in the world was converted into codeine, 5.8 percent into ethyl morphine, and 2 percent into pholcodine. Thus, the other opium alkaloids are obtained by conversion of morphine, rather than by extraction from the raw material opium. The bulk of the papaverine, a smooth-muscle antispasmodic, is produced synthetically.

Tinctures of opium are usually a 1-percent solution of opium in ethyl alcohol and water. They may also be combined with other medicinals in a solution of glycerine and water. These tinctures and combinations are used in treatment of diarrhea.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
437.10	Cocaine and its compounds---	$2.60 per oz.	$1.30 per oz.
437.14	Opium alkaloids and their compounds----------	$3 per oz.	$1.50 per oz.
437.74	Tinctures of opium such as laudanum and other liquid preparations of opium----	60% ad val.	30% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reductions became effective January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption

Official statistics for U.S. consumption of the products covered here have not been available since 1966 when recorded consumption amounted to 51,000 kilograms, having increased from 35,000 kilograms in 1963 (table 1). These annual totals do not include that consumption supplied by illegal imports, the volume of which is not known, but may have been substantial. In each of the years 1963-66, the largest portion (31,000 kilograms in 1966) of total reported consumption consisted of codeine. Papaverine and medicinal opium were also consumed in substantial quantities. It is to be noted, however, that the average therapeutic dosage for the various narcotic alkaloids and their derivatives varies in amount, reflecting their differing medicinal potencies or therapeutic effectiveness. (The amount for codeine is approximately twice by volume that for morphine, for example.)

U.S. producers

In 1967, ten companies of the thirteen manufacturers licensed to produce narcotics in the United States produced drugs included in the TSUS provisions covered by this summary. These ten producers are large chemical or pharmaceutical concerns, six of which are centered in the New York-New Jersey chemical producing region; three others are located in the midwest in Indianapolis, North Chicago, and St. Louis; the tenth is located in Philadelphia.

U.S. production

The requirements for domestic consumption of the narcotic alkaloids and derivatives included in this summary, other than that supplied by illegal imports, are supplied completely by domestic production. These items are included among the 35 classes of narcotics whose manufacture in the United States is controlled by the Bureau of Narcotics and Dangerous Drugs by law and regulation and is limited to licensed establishments. Except in the case of those intermediates used in the manufacture of the synthetic alkaloids as covered here, the regulations control the quantity of raw materials imported and the quantities of alkaloids and derivatives manufactured and their disposition. The regulations also require periodic reporting by manufacturers of all receipts and dispositions, and require periodic inspections of their factories. Production statistics for 1963-66 are shown in table 1.

U.S. exports

U.S. exports of narcotic alkaloids and compounds increased during 1963-66 from 436 kilograms to 1,230 kilograms (table 1). Separate U.S. export statistics showing markets for most of the alkaloids covered in this summary are not available. However, in accordance with statistics published by the International Narcotics Control Board of the United Nations, in 1969 South Vietnam and Indonesia were the principal markets by volume for U.S. exports of codeine. France, the United Kingdom, and West Germany were the principal markets for U.S. exports of cocaine in 1969, together absorbing the bulk exported that year. Export permits issued by the Director, Bureau of Narcotics and Dangerous Drugs, are required for exporting any of the specified narcotic substances.

World production, consumption and trade

International trade in narcotic alkaloids is regulated and controlled by an international universal control system utilizing import certificates and export authorizations in accordance with obligations undertaken by the various countries at the International Opium Convention signed at Geneva on February 19, 1925, and under the International Convention for Limiting the Manufacture and Regulating the Distribution of Narcotic Drugs, signed at Geneva July 13, 1931. These instruments were subsequently amended and incorporated, along with seven other multilateral treaties in a single convention on narcotic drugs of March 30, 1961. The United States has been a signatory to the single convention, by proclamation of the President, since July 12, 1967. This system of import certificates and export authorizations provides for a comprehensive and interlocking series of government documents covering all movements

of narcotic drugs; thus, no legitimate shipments can be sent from one country to another without an import or export authorization from the receiving or sending countries. Quantitative control of the legitimate shipments of narcotics and detection of any country's exceeding its import maximum are thus achieved. At present more than 100 countries are participants in the control system.

According to statistics published by the International Narcotics Control Board of the United Nations, total world consumption of narcotic alkaloids and their compounds covered by this summary in 1969 amounted to 169 metric tons, having increased from 137 metric tons in 1965. The greater part of consumption during 1965-69 was accounted for by codeine which increased somewhat irregularly from 115 metric tons to 143 metric tons. This alkaloid, used in antitussive preparations, not only represents the greatest volume of use of any of the alkaloids, but its derivatives are the most widely used of any opium alkaloid derivative. Of the other alkaloids, consumption during 1965-69 of ethylmorphine increased from 7.0 to 9.3 metric tons, that of morphine decreased from 3.6 to 2.4 metric tons, and that of cocaine decreased from 1.3 to 0.7 metric tons. Of the opium alkaloid compounds, consumption during the same period of dihydrocodeine increased from 5.7 to 8.1 metric tons, and that of pholcodeine increased from 2.3 to 4.2 metric tons; annual consumption in 1965-69 of hydrocodone (about 0.8 metric tons annually) and that of oxycodone (about 0.6 metric tons annually) did not vary appreciably from year to year (table 2).

Total world production during 1965-69 of the alkaloids and compounds covered here was from 141 metric tons to 190 metric tons (table 3). The trends in annual production of the various types of alkaloids and derivative compounds during 1965-69 were generally similar to those of consumption for the same period. World production of morphine in 1969 amounted to 163 metric tons, 97.6 percent of which was converted to other substances, according to the report of the International Narcotics Control Board. The quantity of morphine produced and not converted to other products in 1969 amounted to 4.0 metric tons.

According to United Nations statistics, the principal world suppliers in 1969 of the alkaloids listed are shown in the following tabulation:

Alkaloid	Principal suppliers
Cocaine	United States, United Kingdom, Peru
Morphine	Hungary, Czechoslovakia, the United Kingdom
Codeine	United Kingdom, U.S.S.R., Netherlands
Ethyl-morphine	United Kingdom, West Germany

Table 1.--Cocaine and opium alkaloids 1/ and their compounds, and medicinal opium, U.S. production, exports of domestic merchandise, and consumption, by principal types, 1963-66

(Quantity in kilograms)

Category and year	Total	Codeine	Papaverine	Medicinal opium	Morphine	Cocaine	Oxycodone	Hydrocodone	Ethylmorphine	All other
U.S. production:										
1963	37,181	26,637	3,935	3,850	540	736	794	472	80	137
1964	37,844	23,756	8,091	3,251	453	1,171	498	429	140	55
1965	49,374	29,524	13,419	3,416	534	1,081	596	524	173	107
1966	52,970	30,662	15,810	3,713	715	609	546	521	253	141
U.S. exports:										
1963	436	95	-	15	10	274	6	25	11	-
1964	1,069	154	-	3	15	795	10	22	68	2
1965	1,193	342	-	12	13	644	10	47	125	-
1966	1,230	755	-	3	37	155	9	72	198	1
U.S. consumption: 2/										
1963	34,679	24,515	3,997	3,886	641	431	601	415	77	116
1964	36,340	24,722	6,191	3,168	628	441	581	425	75	109
1965	44,882	26,849	12,485	3,421	491	429	563	459	57	128
1966	50,932	30,645	14,046	3,973	654	454	558	414	64	124

1/ Includes principal opium alkaloids.

2/ Difference between the total of U.S. production minus exports and total U.S. consumption as shown are accounted for by unused stocks or carry-over stocks from previous years.

Source: Compiled from official statistics of the U.S. Bureau of Narcotics, Traffic in Opium and Other Dangerous Drugs, 1967.

Table 2.--Cocaine and opium alkaloids, and their compounds: World consumption, by principal types, 1965-69

(Quantity in kilograms)

Type	1965	1966	1967	1968	1969
Codeine	114,877	124,204	117,127	142,603	142,903
Ethylmorphine	7,040	7,689	7,473	8,995	9,303
Morphine	3,596	3,223	2,432	2,562	2,356
Cocaine	1,271	1,108	1,119	1,061	714
Opium alkaloid compounds:					
Dihydrocodeine	5,747	5,760	5,031	7,432	8,140
Pholcodine	2,348	2,455	2,923	3,714	4,171
Hydrocodone	801	779	833	909	819
Oxycodone	553	552	580	607	649
All other	373	348	339	381	329
Total	136,606	146,118	137,857	168,264	169,384

Source: Compiled from official statistics of the International Narcotics Control Board of the United Nations, Statistics on Narcotic Drugs for 1969.

Table 3.--Cocaine and opium alkaloids, and their compounds: World production, by principal types, 1965-69

(Quantity in kilograms)

Type	1965	1966	1967	1968	1969
Codeine	121,153	135,843	136,197	144,946	154,693
Ethylmorphine	6,140	7,604	8,690	9,503	9,181
Thebaine	2,443	3,249	5,351	5,541	5,441
Morphine, not converted 1/	415	7,158	3,765	1,860	3,984
Cocaine	1,347	665	1,391	1,039	1,216
Opium alkaloid compounds:					
Dihydrocodeine	6,005	6,134	5,632	6,807	8,465
Pholcodine	1,882	3,154	2,444	4,231	4,127
Hydrocodone	871	862	1,001	875	1,381
Oxycodone	570	530	761	678	939
All other	360	636	279	381	359
Total	141,186	165,835	165,511	175,861	189,786

1/ Represents net manufacture of morphine (i.e., gross manufacture less amounts used for conversion to other drugs).

Source: Compiled from official statistics of the International Narcotics Control Board of the United Nations, Statistics on Narcotic Drugs for 1969.

Commodity	TSUS item
Antibiotics:	
Natural and not artificially mixed	437.30
Other	437.32

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States is a net exporter of antibiotics, exports exceeding imports by $70 million in 1969 and $93 million in 1970. U.S. production amounted to $280 million in 1969, 30 percent of which was exported.

Description and uses

This summary covers nonbenzenoid bulk antibiotics. Benzenoid antibiotics, though provided for in item 407.85 and included in the summary covering that item, are also discussed in this summary for the sake of completeness, since it is difficult to treat separately substances which are normally grouped together for medical and statistical purposes. Antibiotics in ampoules, capsules, jubes, lozenges, pills, tablets or similar forms, except for those provided for in item 407.85, are provided for in item 438.02 and are included in the summary in this volume covering that item.

Antibiotics are metabolic products of bacteria or fungi which kill or inhibit the growth of disease-causing organisms and are therefore useful in the treatment of infectious diseases. Originally, antibiotics were produced solely by cultures of micro-organisms; some of the newer antibiotics, however, the so-called "semi-synthetics", are chemical modifications of substances produced by the natural fermentation process; and a few antibiotics are made entirely by synthesis. Among the more important antibiotics are tetracycline and its derivatives, streptomycin and dihydrostreptomycin, chloramphenicol, erythromycin, and the various penicillins, including the newer semi-synthetic penicillins.

Antibiotics are used principally as drugs in the treatment of human or animal diseases. For this use the bulk drug must be further processed into finished pharmaceutical formulations or dosage-form products, either by the original producer or by a pharmaceutical manufacturer who purchases bulk antibiotics from the original producer.

Some antibiotics are effective against only one or two classes of pathogenic organisms; others, the "broad-spectrum" antibiotics, are effective against a wide range of organisms. In addition to their use in human and veterinary medicine, antibiotics have an important and growing use as animal feed supplements; of lesser importance are their uses as agricultural pesticides and as food preservatives.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Antibiotics:		
437.30	Natural and not artificially mixed----------	3% ad val.	2% ad val. 1/
437.32	Other----------	10.5% ad val.	5% ad val.

1/ Rate effective January 1, 1969.

The rate effective January 1, 1972 for item 437.32 represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reductions became effective January 1, 1968. The rate effective January 1, 1969, for item 437.30 represents the second stage of a concession granted by the United States in the sixth round of trade negotiations under the GATT. Further reductions scheduled for years subsequent to 1969 for this item have not become effective. Staged Rates and Historical Notes to part 3 of schedule 4 of the TSUSA-1971 are shown in appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption and production

U.S. consumption of bulk antibiotics,both benzenoid and nonbenzenoid, increased from $131 million in 1965 to $210 million in 1969, an average annual increase of 13 percent (table 1). This increase in consumption is due largely to the increasing use of antibiotics in animal feeds.

U.S. production of all bulk antibiotics for all uses increased irregularly from 7.5 million pounds, valued at an estimated $171 million, in 1965, to 13.2 million pounds, valued at an estimated $280 million in 1969 (tables 1 and 2). The penicillins and the tetracyclines together accounted for 70 percent of the total quantity produced in 1969. Production for medicinal use increased from 4.7 million pounds in 1965 to 7.4 million pounds in 1969, an average annual increase of 12 percent. Production for nonmedicinal uses increased from 2.8 million pounds in 1965 to 5.8 million pounds in 1969. This increase, amounting to 20 percent annually, reflects an increasing use of antibiotics as animal feed supplements. During 1965-69, the average unit value of all antibiotics sold for nonmedicinal uses by the primary producers declined 50 percent.

U.S. producers

Bulk antibiotics were produced in the United States in 1969 by 18 companies, all but one located in the Northeastern and North Central States. Most domestic producers are chemical or pharmaceutical companies; nearly all of them are fairly large concerns with a diversified line of products; and many of them have pharmaceutical production facilities abroad. Some producers--those who are not pharmaceutical manufacturers--sell their entire production of antibiotics in bulk for use in human or veterinary medical preparations or for use in animal feeds. Others sell little or no bulk antibiotics, preferring to use all or most of their production in the manufacture of the more profitable medicinal preparations, dosage-form products, and animal feed premixes.

If different salts of the same antibiotic base are counted as a single antibiotic, 50 different antibiotics were manufactured in the United States in 1969. Thirty-two antibiotics were made by only one producer each and 11 by two producers each; only ampicillin, bacitracin, chlorotetracycline, neomycin, penicillin G, penicillin V, and tetracycline had three or more producers each. This situation is due largely to the patent protection which still covers many of the antibiotics.

U.S. exports

Exports of antibiotics, including benzenoid as well as nonbenzenoid, increased from $45 million in 1965 to $107 million in 1970 (table 3). Forty-six percent of the value of exports in 1970 was accounted for by erythromycins, penicillins, and tetracyclines. Belgium, the leading market for U.S. exports of antibiotics, took 17 percent of the total in 1970. France, Panama, Japan, Hong Kong, Canada, the United Kingdom, Italy, Switzerland, and Mexico together took 52 percent, and the remainder was distributed to more than 30 other countries.

U.S. imports

U.S. imports of antibiotics increased from $5.3 million in 1965 to $13.6 million in 1970 (table 4), an average annual increase of 21 percent. These data, however, do not include benzenoid antibiotics, dutiable under item 407.85, imports of which are believed to be relatively small. During 1965-70, U.S. imports were supplied principally by Ireland, Italy, and the United Kingdom. Portugal, in 1970, emerged as a leading supplier of antibiotics. In recent years, the antibiotics which have been imported in significant amounts include colistin, griseofulvin, the tetracyclines, tyrothricin, and viomycin. Imports supplied 4.0 percent of consumption in 1965 and 6.8 percent in 1969.

Table 1.--Bulk Antibiotics: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1965-69

(In millions of dollars)

Year	Production 1/	Imports 2/	Exports	Apparent consumption	Ratio (percent) of imports to consumption
1965	170.8	5.3	45.0	131.1	4.0
1966	200.1	8.2	49.2	159.1	5.2
1967	192.7	12.6	56.0	149.3	8.4
1968	219.1	13.3	61.5	170.9	7.8
1969	280.0	14.3	84.0	210.3	6.8

1/ Value calculated based on unit value of sales.
2/ Does not include benzenoid antibiotics, imports of which are believed to be relatively small.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Bulk antibiotics: U.S. production and sales, 1965-69

Year	Production	Sales		
		Quantity	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
	Antibiotics for medicinal use (human or veterinary)			
1965	4,656	2,397	53,713	$22.41
1966	5,445	2,410	62,388	25.89
1967	5,223	2,390	65, 056	27.22
1968	5,981	2,417	70,846	29.31
1969	7,360	3,202	89,361	27.91
	Antibiotics for nonmedicinal use (animal feed supplements, food preparation, and crop spraying)			
1965	2,799	1,689	39,880	23.61
1966	4,207	2,378	36,875	15.51
1967	4,241	2,354	31,530	13.39
1968	4,281	1,996	22,743	11.57
1969	5,839	2,246	26,194	11.66
	Antibiotics, total			
1965	7,455	4,086	93,593	22.91
1966	9,652	4,788	99,263	20.73
1967	9,464	4,744	96,586	20.36
1968	10,262	4,383	93,589	21.35
1969	13,199	5,448	115,555	21.21

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 3.--Bulk antibiotics: U.S. exports of domestic merchandise, by principal markets, 1965-70

(In thousands of dollars)

Market	1965	1966	1967	1968	1969	1970
Belgium	4,927	7,154	8,626	7,372	9,545	18,458
France	1,883	3,119	5,079	6,234	9,016	8,830
Panama	2,815	3,140	3,964	2,997	8,189	8,427
Japan	2,463	3,457	2,816	3,698	4,850	6,934
Hong Kong	3,998	4,264	4,341	4,722	6,095	6,445
Canada	3,077	3,433	3,060	3,263	3,784	5,612
United Kingdom	2,916	1,999	2,272	2,183	3,843	5,356
Italy	876	713	1,067	2,401	2,561	5,066
Switzerland	196	494	742	509	1,847	4,480
Mexico	2,826	2,871	3,021	2,254	4,197	3,831
All other	19,038	18,569	20,995	25,890	30,034	33,229
Total	45,015	49,213	55,983	61,523	83,961	106,668

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 4.--Nonbenzenoid bulk antibiotics: U.S. imports for consumption, by principal sources, 1965-70

(In thousands of dollars)

Source	1965	1966	1967	1968	1969	1970
Ireland	1,122	3,748	4,731	5,399	7,711	4,301
Italy	1,440	1,662	3,309	3,193	2,427	3,518
United Kingdom	2,307	1,493	2,858	2,780	1,420	2,803
Portugal	-	4	76	374	486	1,188
Poland	153	699	661	912	1,298	1,172
Japan	40	76	380	385	562	366
West Germany	4	68	318	6	38	252
All other	214	458	299	213	358	758
Total	5,280	8,208	12,632	13,262	14,300	13,638

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Barbituric acid	437.36
Diethylbarbituric acid and its compounds	437.38
Other barbituric acid compounds (nonbenzenoid)	437.40

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

U.S. consumption of barbituric acid and its nonbenzenoid derivatives probably amounted to more than 1 million pounds, valued at less than $5 million, in 1969. The major share of consumption in 1969 was supplied by U.S. production, but a substantial portion was supplied by imports which amounted to about 400,000 pounds, valued at more than $900,000; imports are believed to have been several times larger than exports.

Description and uses

The compounds covered by this summary include barbituric acid and those of its derivatives that are nonbenzenoid. Derivatives of barbituric acid are generally termed barbiturates and are known mainly for their extensive use in medicine as sedatives. Barbituric acid is not a sedative but is used in the manufacture of derivatives and has some use as a polymerization catalyst in the manufacture of plastics. The principal derivatives of barbituric acid covered by this summary are diethylbarbituric acid (barbital), butylethylbarbituric acid (butabarbital), ethylmethylbutylbarbituric acid (pentobarbital), and allylmethylbutylbarbituric acid (secobarbital). Derivatives that are of a benzenoid structure, such as ethylphenylbarbituric acid (phenobarbital), are covered under item 407.85 (summary volume 4:1). Barbiturates are usually consumed in the form of the sodium, calcium, or magnesium salt of the respective acids because of the greater solubility of the salts. The most common type of reaction used to produce the various barbituric acids is the condensation of urea with the appropriate ester of malonic acid.

Barbiturates differ sufficiently so that some are more effective as antileptics, some as hypnotics, and others as sedatives or anesthetics despite the fact that all the barbiturates have somewhat the same general effect on the central nervous system. The barbiturates are further classed according to the length of reaction time ranging from long-acting to ultra-short-acting drugs.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Barbituric acid and its derivatives, nonbenzenoid:		
437.36	Barbituric acid	25% ad val.	12.5% ad val.
437.38	Diethylbarbituric acid and its compounds	$1.50 per lb.	75¢ per lb.
437.40	Other	10.5% ad val.	5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reductions became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS) through 1967. The ad valorem equivalent of the specific rate of duty in effect during 1970 for item 437.38, based on imports for that year, was 32.2 percent.

U.S. consumption and production

Domestic consumption of the materials covered by this summary is estimated to have amounted to more than a million pounds, valued at less than $5 million, in 1969.

Separate statistics for the production of nonbenzenoid barbiturates used as drugs were last published in 1964 when they amounted to 529,000 pounds, valued at about $4 million. Beginning with 1965, annual production statistics for barbiturate drugs included benzenoid as well as nonbenzenoid barbiturates; these statistics for the years 1965-69 are given in the following tabulation:

Barbiturate drugs: U.S. production, 1965-69

Year	Quantity 1,000 pounds	Value 1/ 1,000 dollars
1965	971	3,923
1966	977	4,162
1967	668	3,046
1968	802	3,954
1969	836	3,779

During 1965-69 U.S. production of the nonbenzenoid barbiturates is believed to have accounted for a substantial portion (perhaps half in some years) of the total production of barbiturate drugs as shown above. The average unit values for the nonbenzenoid barbiturate drugs, however, appear to be substantially higher than for the benzenoid. Production statistics are not available for barbituric acid and some of its non-drug derivatives; however, production of these is believed to be less than that of the nonbenzenoid barbiturates used as drugs.

Barbituric acid and its derivatives, both benzenoid and nonbenzenoid, are manufactured by a half dozen companies--most of which are rather large drug-manufacturing firms--situated primarily in the East and Midwest. Most of these companies produce a full line of drugs and pharmaceuticals, and for none of them are barbituric acid and its compounds a major source of income.

U.S. exports

There are no official statistics for exports of nonbenzenoid barbiturates. Annual exports are estimated, however, at about 100,000 pounds, with principal export markets in South America.

U.S. imports

Annual imports of barbituric acid and its nonbenzenoid derivatives averaged about 125,000 pounds, valued at $420,000, during 1965-68; imports rose substantially, however, in 1969-70, amounting to nearly 400,000 pounds, valued at more than $900,000, in 1969, and to nearly 900,000 pounds, valued at $850,000, in 1970. The rise in imports in 1969 was accounted for by a doubling of imports of barbituric acid derivatives from Denmark, a large expansion of imports of

1/ Value calculated based on unit value of bulk sales by producer.

barbituric acid from West Germany, and substantial increases in imports of both of these classes from Switzerland. In 1970, imports of barbituric acid from West Germany and Switzerland increased further, but imports from Denmark, all of which were derivatives of barbituric acid, decreased substantially. In 1970, however, a large quantity of low-priced derivatives of barbituric acid were received from the Netherlands. Imports of diethylbarbituric acid and its compounds (item 437.38) were small in 1969 and 1970 as in most recent years. The accompanying table shows total imports of barbituric acid and its nonbenzenoid derivatives by principal sources for the years 1965-70.

Barbituric acid and its derivatives, nonbenzenoid: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Denmark	53	68	59	62	130	73
Switzerland	8	15	15	18	99	186
West Germany	-	1	1	4	136	204
United Kingdom	22	28	38	45	28	23
All other	5	-	1/ 51	2	4	2/ 402
Total	88	112	164	131	397	888
	Value (1,000 dollars)					
Denmark	192	244	233	238	455	277
Switzerland	63	58	55	50	191	247
West Germany	-	3	1	4	141	220
United Kingdom	78	105	130	168	98	84
All other	24	-	1/ 31	7	32	2/ 22
Total	357	410	450	467	917	850

1/ Includes 12 thousand pounds, valued at 26 thousand dollars, from Mexico, and 39 thousand pounds, valued at 5 thousand dollars, from Canada.

2/ Includes 396 thousand pounds, valued at 9 thousand dollars, from the Netherlands.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Chloral hydrate	437.44

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The chemical compound chloral hydrate is a relatively insignificant article of both domestic and world trade. In recent years, the United States has imported from 40,000 to 90,000 pounds per year from Europe; these quantities are believed to have been substantially less than domestic production. Exports have probably been nil.

Description and uses

Chloral hydrate is produced by adding a calculated amount of water to chloral (trichloroacetaldehyde) which results in a colorless crystalline compound that has a peculiar odor and a slightly bitter taste. The principal use of the compound is as a hypnotic or sleep-producing drug in both human and veterinary medicine. Chloral hydrate was once widely used for these purposes but its use has greatly declined since the introduction of other chloral derivatives and of barbiturates.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
437.44	Chloral hydrate	14% ad val.	7¢ ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became operative January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. producers and production

Official statistics on domestic production of chloral hydrate are not available but industrial sources indicate that annual output has been declining for a number of years. Domestic production, however, is estimated to be considerably larger than imports. There are believed to be two domestic producers of chloral hydrate with plants located in New Jersey and Texas.

U.S. imports and exports

U.S. imports of chloral hydrate have fluctuated in recent years; during 1965-70 they ranged between 44,000 pounds, valued at $24,000, in 1966, and 88,000 pounds, valued at $50,000, in 1967. Imports in 1970 amounted to 45,000 pounds, valued at $25,000 (see accompanying table). The United Kingdom and Germany were the principal suppliers of chloral hydrate during 1965-70; Poland was a consistent supplier in the earlier part of the period.

Statistics on U.S. exports of chloral hydrate are not available; however, exports are believed to be very small or nil.

Chloral hydrate: U.S. imports for consumption, by sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (pounds)					
United Kingdom	33,736	32,240	55,699	53,931	35,000	29,400
West Germany	33,317	7,200	28,308	8,500	46,629	15,418
Poland	6,614	4,410	4,410	-	-	-
Total	73,667	43,850	88,417	62,431	81,629	44,818
	Value					
United Kingdom	$19,518	$17,944	$32,946	$29,020	$18,125	$15,683
West Germany	18,584	3,879	14,918	4,358	25,812	9,135
Poland	3,272	2,113	2,032	-	-	-
Total	41,374	23,936	49,896	33,378	43,937	24,818

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Enzymes and ferments:	
Rennet	437.46
Yeast (except dried brewers' yeast)	437.47
Brewers' yeast, dried, ficin, and papain, crude	437.48
Other	437.49

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

In 1970, U.S. consumption of enzymes and ferments is believed to have amounted to about $120 million; U.S. imports amounted to $13 million and exports to $16 million, or more. U.S. consumption of yeasts, which probably accounts for more than half of the total consumption of enzymes and ferments, is supplied almost entirely by domestic production while the consumption of rennet, an enzyme of domestic importance, is supplied largely by imports, and that of crude papain entirely by imports.

Description and uses

The materials covered by this summary include enzymes in both the crude and refined forms, including extracts, as well as certain enzyme-containing substances, such as yeast. The term "ferments" was formerly used to include individual enzymes as well.

Enzymes are protein substances that have the capability of catalyzing specific chemical reactions involving such processes as synthesis, hydrolysis, and oxidation. It has been estimated that there may be as many as 10,000 different enzymes involved in the chemical reactions of the human body. The number of known individual enzymes exceeds 1,000, of which more than 100 have been isolated.

Enzymes are classed according to the type of function they perform, thus the two principal classes are the carbohydrases (amylolytic enzymes), which catalyze reactions involving carbohydrates, and proteases (proteolytic enzymes), which affect reactions involving proteins. Other enzyme classes include: lipases (lipolytic enzymes), which catalyze reactions involving fats and fatty acid esters; pectic enzymes,

which affect fruit juice and wine manufacturing processes; and miscellaneous enzymes, which include several important enzymes with industrial or medicinal value.

Enzymes are obtained by one of three types of processes: (1) extraction from animal organs removed at slaughter; (2) extraction from vegetable material; and (3) cultivation of selected bacterial or fungal microorganisms. Examples of the first type of process are rennin and pepsin. Rennin, or rennet, as the enzyme-containing substance is known commercially, is used as a coagulating agent in the manufacture of cheese and has been obtained historically from the stomach lining of a young calf. Pepsin, an enzyme used as a digestive aid and food additive, is obtained from the stomach of a hog. Papain, an example of the second type of process, is derived from the papaya fruit and is used as a meat tenderizer. A second method for producing rennin, utilizing a fungal organism as an enzyme-producing agent, is an example of the third type of process. Yeasts, which are enzyme-producing unicellular organisms, are also representative of the third type of process; however, the enzymes in yeast are generally not extracted from the yeast before consumption.

Enzymes have uses in many industrial and pharmaceutical applications in addition to the normal physiological functions they perform in the bodies of humans and animals. Industrial applications are found in the brewing, baking, dairy, meat, wine, fruit juice, pharmaceutical, textile, paper, leather, detergent, adhesives, and photographic industries, to name the more important ones. The tabulation on the following page lists some of the more important enzymes, their sources, and important uses.

The amylase enzymes of the amylolytic class are produced in far larger quantities than any other sub-class of anzymes. Alpha-amylase is used in the manufacture of dextrins, starch glue, starchy syrups, and various food ingredients. A combination of alpha- and beta-amylase is used in the production of maltose, a sugar fermentable by yeast. Gluco-amylase, produced commercially from molds, is used by distillers in conjunction with malt in the conversion of grain starch to fermentable sugars. It is also used in the manufacture of glucose syrup and crystalline glucose from starch.

Proteases, or proteolytic enzymes, in commercial use include a number of specific enzymes such as rennin, pepsin, trypsin, chymotrypsin, papain, chymopapain, ficin, and bromelain. Certain of these proteases, or mixtures containing proteases, are used for various purposes, including prevention of haze formation in beer; tenderizing meats, meat casings, fish and poultry; reducing the viscosity of gelatin and other protein-type gels; and improving bread grain and texture.

Enzyme	Occurrence	Use
Amylase	Pancreas; saliva; plants; molds; bacteria	Hydrolyzes starch, glycogen, dextrins, and related polysaccharides
Bromelain	Pineapple plant	Tenderizes meat
Cellulase	Plants; microorganisms	Food and medicinals
Chymotrypsin	Pancreas juice of mammals	Medical anti-inflammatory agent
Fibrinolysin	Blood serum & plasma	Medical treatment of blood clots
Ficin	Tropical fig tree	Meat tenderizer
Glucose oxidase	Microorganisms	Food & fruit juice preservative
Hyaluronidase	Animal testes; bacterial cultures; snake venom	Medicinals
Invertase (sucrase)	Yeast; intestinal juices	Hydrolysis of sucrose into glucose and fructose
Lipase	Pancreatic juice of animals; oily seeds	Hydrolysis of fats into glycerin & fatty acids
Maltase	Yeast; intestinal juices	Converts maltose into glucose
Pancreatin	Hog pancreas	Digestive enzyme for foods
Papain	Papaya fruit	Meat tenderizer
Pectase	Plants; microorganisms	Hydrolyzes pectins in wines, juices
Pepsin	Hog stomach	Digestive aid
Rennin	Calf stomach	Coagulates milk for the manufacture of cheese
Trypsin	Pancreas gland of ox	Wound-cleansing agent
Zymase	Yeasts; bacteria	Ferments glucose & fructose

Enzymes have been used in spot removal by the dry-cleaning industry for many years, but the use of enzymes in laundering came about only recently. Enzyme-active presoak and detergent products were introduced in Europe in 1963 and soon attained widespread popularity; they were introduced in the United States early in 1968. The enzymes used in these products are principally of the proteolytic, or protein-degrading type, although mostly in combination with amylolytic enzymes that catalyze reactions involving starchy substances.

Yeast has been used as an enzyme-producing substance for thousands of years in baking and in the production of fermented beverages, and now finds many additional uses as a nutritional supplement and as a raw material for the extraction of biochemicals. Bakers' yeast, used principally in commercial and home baking, and brewers' yeast, used in the fermentation of beer, ale and malt liquors, although of the same strain of organisms, are sources of different enzymes and, thus, are each best suited for their respective uses. Substantial quantities of brewers' yeast are recovered from brewing operations and dried and processed for use as human and animal nutritional supplements.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Enzymes and ferments:		
437.46	Rennet----------	Free	Free 1/
437.47	Yeast (except dried brewers' yeast)----	10% ad val.	10% ad val. 1/
437.48	Brewers' yeast, dried, ficin, and papain, all the foregoing, if crude----------	Free	Free
437.49	Other----------	10.5% ad val.	5% ad val.

1/ Rate not affected by the sixth round of trade negotiations under the General Agreement on Tariffs and Trade.

The duty-free status of rennet (item 437.46) and of the products in item 437.48 was provided for in the Tariff Act of 1930, as originally enacted. The duty-free status of rennet was bound effective May 28, 1950, and that of crude dried brewers' yeast, ficin, and

papain is considered bound under the General Agreement on Tariffs and Trade (GATT) as a result of negotiations between the United States and the United Kingdom and Ceylon, completed on April 5, 1966, and March 20, 1964, respectively.

The rate effective January 1, 1972, on unenumerated enzymes and ferments (item 437.49) represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the GATT. The first of five annual stages of the reductions became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rates shown above for items 437.47 and 437.49 as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967. The rate of duty for yeast (item 437.47) was not affected by the sixth round of trade negotiations under the GATT.

U.S. consumption

Although official statistics on U.S. consumption of the enzymes and ferments covered by this summary are not available, consumption of enzymes and ferments, including yeast, for 1970, based on trade information, is estimated to have been valued at about $120 million. Of the total amount consumed, about $60 million is believed to have been accounted for by yeasts, $20 million or more by food and beverage uses, about $30 million by enzymes used in the new pre-soak and detergent formulations, $5 million or less, by pharmaceutical uses, and about $5 million by other industrial uses.

U.S. producers and production

Rennet is produced by the conventional process from calves' stomachs by one Midwestern pharmaceutical and chemical company. A commercially competitive enzyme derived from microorganisms is produced by the Midwestern subsidiary of a second pharmaceutical and chemical company. Yeasts are produced by about 10, and other enzymes by about 25, establishments of various sizes dispersed throughout the United States. Enzymes for use in presoak and detergent formulations are produced by two domestic producers. One producer, a very large U.S. chemical company, operates a plant for this purpose in the Southwest, while the other producer, which is also the manufacturer of the enzyme product competitive with rennet, makes an enzyme product for detergent purposes at plants in New England and the Midwest under a license granted by the original foreign producer. In 1969, a second foreign producer of enzymes for detergent purposes announced plans to produce his enzyme products in the United States in a plant under construction in late 1970.

Based on trade estimates, the value of annual U.S. production of the materials covered by this summary is believed to exceed $120 million. According to the 1967 Census of Manufactures, total shipments of yeast products by producers amounted to $59 million in that year. There is also known to be substantial production of rennet and other enzymes and ferments. There is no production, however, of crude papain, the total domestic supply of which is imported.

U.S. exports

Official U.S. statistics on exports of enzymes and ferments in 1965-70 were published on a basis not completely comparable with U.S. imports and on a still less comparable basis before 1965. Since 1965, export statistics on these materials have been covered by two classes--(1) enzymes and (2) natural yeast and prepared baking powder. During 1965-70 annual exports of enzymes and ferments, including yeast, are estimated at between $10 million and $12 million in 1965 and between $16 million and $18 million in 1970. Exports classified as enzymes accounted for the greater part of the estimated totals for these years. The value of U.S. exports of enzymes, which does not include yeasts, by total and principal markets for 1965-70 are shown in table 1.

U.S. imports

During 1965-70 annual U.S. imports of rennet ranged from slightly more than 400,000 pounds in 1965-66 to nearly 800,000 pounds in 1970. A wide variation in the average unit value from year to year resulted in a range in the annual value of imports from less than $400,000 in 1965 to $2.2 million on 1968. Canada, New Zealand, and Italy were consistently the principal suppliers during the period. France was a principal source during the latter part of the period (table 2). During the same period annual U.S. imports of yeast, excluding dried brewers' yeast, did not exceed 36,000 pounds (in 1968) or $30,000 (in 1970). Imports were derived from several sources which included Switzerland, West Germany, the United Kingdom, and Canada (table 3). The quantity of imports in the tariff class which includes crude dried brewers' yeast, ficin, and papain increased in each year during 1965-69 from 1.6 million pounds in 1965 to 2.3 million pounds in 1969, but declined to 2.0 million pounds in 1970. The value of these imports fluctuated from year to year in the range $1.0 million to $2.0 million annually (table 4). Africa, mainly the countries of Uganda and the Congo (Kinshasa), has been the principal source of imports in the class, most of which are believed to have been crude papain. The quantity of imports of unenumerated (other) enzymes and ferments increased in each year during 1965-70 from less than 500 thousand pounds to nearly 6 million pounds; the value of imports increased in each year from less than $1 million to more than $16 million in 1969, but decreased to less than $10 million in 1970. Denmark was the principal source of imports in this class during 1966-70; West Germany,

Japan, the United Kingdom, Canada, and the Netherlands were other important sources during the period 1965-70 (table 5). Imports in this class included a variety of enzymes with a wide range of unit values, but the greater part of the increase in shipments from Denmark in 1968-70 was due to the increasing U.S. market for detergent-type enzymes.

Foreign production and trade

The principal sources of U.S. imports of rennet--New Zealand, Canada, Italy, and France--are important cattle- and sheep-raising countries. Rennet obtained from some of these countries is used to manufacture the distinctive types of cheese associated with the countries.

Papaya--the source of papain--is now grown in most tropical countries; however, only Africa is an important source in international trade.

Yeasts are produced in every country in the world; however, the distribution has been somewhat localized until recently when improvements were made in the keeping quality of yeast, allowing greater international shipment of the product.

Of the other enzymes and ferments, those of greatest commercial importance are probably the ones used in pre-soak detergent formulations and produced mainly in Denmark, the Netherlands, and West Germany.

Table 1.--Enzymes 1/: U.S. exports of domestic merchandise, by principal markets, 1965-70

Market	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Canada	1,128	679	858	1,100	1,493	1,803
West Germany	74	132	178	207	168	307
Japan	257	58	42	40	40	68
Mexico	129	143	121	381	313	181
Italy	42	68	116	82	108	103
Venezuela	24	78	39	63	41	50
Brazil	14	14	24	31	32	31
United Kingdom	209	221	192	212	139	86
Spain	37	20	38	63	31	46
France	16	23	57	107	125	104
Argentina	28	32	40	23	90	70
Colombia	20	56	15	46	45	46
All other	1,245	1,251	826	949	771	1,004
Total	3,223	2,775	2,546	3,304	3,396	3,899
	Value (1,000 dollars)					
Canada	1,297	1,375	1,315	1,513	2,230	2,459
West Germany	342	759	911	1,142	883	1,408
Japan	980	1,542	1,093	770	981	1,327
Mexico	1,168	1,521	1,458	1,483	1,358	907
Italy	383	399	352	462	395	832
Venezuela	641	663	602	474	434	736
Brazil	105	99	226	358	469	703
United Kingdom	497	444	383	595	546	557
Spain	170	168	271	584	437	557
France	87	295	330	705	1,138	553
Argentina	199	155	230	230	643	507
Colombia	144	465	302	586	540	455
All other	3,590	3,366	3,649	3,741	4,317	3,772
Total	9,603	11,251	11,122	12,643	14,371	14,773

1/ Exports included in the export classification for "enzymes" are believed to account for the greater part of export materials covered by this summary. Exports in a class for "ferments" are relatively small; exports of yeasts are included in a third class with baking powder and cannot be readily estimated.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Rennet: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Canada	257	270	287	431	455	381
New Zealand	92	30	26	89	101	56
France	-	-	27	90	60	153
Italy	68	62	86	52	75	86
Japan	-	1/	-	1/	5	11
Mexico	-	1	6	4	7	11
All other	1	2/ 44	3/ 64	4/ 98	14	5/ 71
Total	418	407	496	764	717	769
	Value (1,000 dollars)					
Canada	116	232	465	581	755	539
New Zealand	168	205	286	479	777	394
France	-	-	233	463	113	361
Italy	102	94	137	76	126	177
Japan	-	2	-	3	59	147
Mexico	-	8	29	38	51	62
All other	3	2/ 358	3/ 283	4/ 610	37	5/ 192
Total	389	899	1,433	2,250	1,918	1,872

1/ Less than 500 pounds.

2/ Includes 20 thousand pounds, valued at 265 thousand dollars, from Denmark.

3/ Includes 37 thousand pounds, valued at 247 thousand dollars, from the Netherlands.

4/ Includes 37 thousand pounds, valued at 363 thousand dollars, from Switzerland.

5/ Includes 34 thousand pounds, valued at 110 thousand dollars, from West Germany.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Yeast (except dried brewers' yeast): U.S. imports for consumption, by prinicpal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Switzerland	-	1	1/	1	-	15
West Germany	-	-	1	1	1/	8
United Kingdom	4	2	1	-	2	1
Canada	-	5	-	10	19	-
Venezuela	10	-	-	-	10	-
Netherlands	-	1	3	16	-	-
All other	1/	1/	-	8	-	1/
Total	14	9	5	36	31	24
	Value (1,000 dollars)					
Switzerland	-	1	1/	2	-	18
West Germany	-	-	1	3	2	9
United Kingdom	3	2	1	-	4	2
Canada	-	1	-	3	8	-
Venezuela	2	-	-	-	3	-
Netherlands	-	1/	1	7	-	-
All other	1	1/	-	4	-	1
Total	6	4	3	19	17	30

1/ Less than 500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 4.--Brewers' yeast, dried, ficin, and papain, all of the foregoing if crude; U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Congo (Kinshasa)	103	108	113	132	130	154
Uganda	361	96	161	203	287	128
Denmark	-	-	-	-	25	67
Canada	899	1,278	1,272	1,321	1,289	1,269
Kenya	38	41	28	59	94	50
Western Africa	10	-	4	96	166	48
All other	171	149	112	133	300	235
Total	1/1,582	1,672	1,690	1,944	2,291	1,951
	Value (1,000 dollars)					
Congo (Kinshasa)	321	248	323	443	318	282
Uganda	1,000	199	581	745	641	237
Denmark	-	-	-	-	179	155
Canada	76	122	128	123	136	104
Kenya	110	65	60	192	193	86
Western Africa	26	-	9	303	299	79
All other	562	379	263	297	382	209
Total	1/2,095	1,013	1,364	2,103	2,148	1,152

1/ In 1965, U.S. imports of crude papain amounted to 678 thousand pounds, valued at 2,007 thousand dollars.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 5.--Enzymes and ferments, other: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Denmark	208	686	998	3,266	4,551	5,034
West Germany	43	49	84	72	72	64
Japan	4	8	3	21	40	147
United Kingdom	76	98	72	54	45	60
Canada	75	72	90	55	95	55
Netherlands	12	13	19	241	46	40
All other	41	115	49	55	1/ 292	2/ 537
Total	459	991	1,315	3,764	5,141	5,937
	Value (1,000 dollars)					
Denmark	59	590	1,455	9,587	13,387	7,310
West Germany	372	518	643	726	1,182	844
Japan	21	35	29	128	236	494
United Kingdom	121	133	101	123	182	198
Canada	115	74	65	120	128	106
Netherlands	46	63	50	694	181	104
All other	46	101	188	226	1/ 805	2/ 601
Total	780	1,514	2,531	11,604	16,101	9,657

1/ Includes 153 thousand pounds, valued at 511 thousand dollars, from Belgium.

2/ Includes 414 thousand pounds, valued at 284 thousand dollars, from Brazil.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Gluconic acid and its compounds:	
Acid	437.51
Other	437.52

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

During 1965-69, U.S. consumption of gluconic acid and sodium gluconate, the basic materials from which other gluconic acid derivatives are made, were probably equivalent in quantity to domestic production. In 1969, production of these materials amounted to 18.2 million pounds, valued at $4.8 million; imports of gluconic acid and its compounds amounted to 929,000 pounds, valued at $426,000. Exports of these materials are believed to have been small in recent years.

Description and uses

Gluconic acid is a sugar acid produced by oxidation of glucose (also known as dextrose or corn sugar) either by a fermentation process or by conventional chemical methods. Because of the difficulty of crystallizing the acid in its pure form, it is usually marketed as a 50-percent aqueous solution. Glucono-δ-lactone and the various salts of gluconic acid, chiefly the calcium and sodium salts, are produced from gluconic acid; both the lactone and the salts are crystalline solids.

Gluconic acid, glucono-δ-lactone, and sodium gluconate are sequestering agents. Their uses are based on the ability of the gluconate ion in solution to tie up, or sequester, metallic ions and thereby prevent these ions from being precipitated from solution in the form of insoluble salts. The gluconates are the preferred sequestering agents for use in strongly alkaline solutions. No competing material is equally as satisfactory.

The major use of these products, at least until recently, has been in caustic bottle-washing compounds used in breweries, dairies, and soft-drink bottling plants. Because of the increased use of cardboard cartons and throw-away bottles and cans, however, this use is not as important as it was several years ago. Gluconic acid compounds are also used as components of alkaline metal-cleaning and rust-removal compounds, paint strippers, aluminum-etching compounds,

electroplating solutions, cement additives, and water-treatment products. In addition to the foregoing uses, the lactone has some use as a leavening agent in cake mixes and has been suggested as a substitute for yeast in bread. Ammonium gluconate is used as a latent acid catalyst in textile printing.

The salts of gluconic acid, except the ammonium and sodium salts, are used as drugs for the treatment of mineral deficiencies. In this use, the gluconate ion functions as a soluble and non-toxic carrier of a needed mineral element. Each medicinal salt of gluconic acid is somewhat competitive with other salts of the same mineral element. Calcium gluconate is by far the most important of these medicinal salts and is widely used as an animal feed additive. Next in importance is the iron (ferrous) salt. Of less importance are the cobalt, copper, magnesium, manganese, potassium, and zinc salts.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS ITEM	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Gluconic acid and its compounds:		
437.51	Acid	12.5% ad val.	6% ad val.
437.52	Other	10% ad val.	5% ad val.

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reductions became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Sodium gluconate was the subject of an investigation by the U.S. Tariff Commission under section 301(f)(1) of the Trade Expansion Act of 1962 (adjustment assistance to a firm). The Commission found that sodium gluconate, technical, was not being imported in such increased quantities as a result in major part of trade agreement concessions as to cause or threaten to cause, serious injury to the applicant. 1/

1/ U.S. Tariff Commission, Tariff Commission Report to the President on Petition for Adjustment Assistance by Industrial Biochemicals, Inc., T.C. Publication 101, 1963 [processed].

U.S. producers

There are five basic U.S. producers of sodium gluconate, only one of which was in production before 1955. All of them are located in the Northeastern and Midwestern states, and all but one produce gluconic acid as well. One of them produces the lactone and the ammonium salt, as well as the calcium, ferrous, and other medicinal salts. In addition to the five basic producers, there are two secondary producers who make either the calcium or ferrous salt, presumably from purchased acid or sodium salt. All but one of the primary and secondary producers are large or medium-sized companies with a diversified line of products. The remaining producer is a relatively new company specializing in fermentation products and originally manufacturing only gluconic acid and sodium gluconate.

U.S. consumption and production

Apparent U.S. consumption of gluconic acid and its compounds is believed to be approximately equal to domestic production, as imports and exports are relatively small.

U.S. production of gluconic acid and sodium gluconate, the two basic products from which all the other compounds are made, has increased substantially in recent years. Production of the acid and the sodium salt amounted to 11.9 million pounds in 1965, of which 8.0 million pounds consisted of sodium salt; by 1969, total production had risen to 18.1 million pounds, 14.8 million pounds of which consisted of the sodium salt (table 1). Since production and consumption of the calcium, iron, and other medicinal salts have been stable or declining, the large increase in production of gluconic acid and its compounds is due almost entirely to their increased use as sequestering agents.

The quantity of gluconic acid and sodium gluconate sold by the five primary producers, except for the relatively small amounts which may be purchased by the secondary producers and converted to the calcium or ferrous salts, is purchased primarily by chemical specialty manufacturers who formulate caustic bottle-washing compounds, paint strippers, and other specialty products. The quantity of sales, therefore, should be roughly equal to the quantity consumed as sequestering agents. Sales of these two products increased from 11.1 million pounds, vaulued at $3.4 million in 1965, to 18.2 million pounds, valued at $4.8 million, in 1969, representing an increase for the period of 64 percent, based on quantity.

Of the medicinal salts of gluconic acid, statistics are available only for calcium gluconate. The production of calcium gluconate amounted to 656,000 pounds in 1965, and to 371,000 pounds in 1968;

data for 1966, 1967 and 1969 were not publishable. Production of the other salts is relatively small.

U.S. exports and imports

Official statistics on exports of gluconic acid and its compounds are not available. It is believed that exports are small relative to domestic production.

U.S. imports of gluconic acid and its compounds exhibited no apparent trend during 1965-70. It is believed that the quantity of imports amounted to less than 1 million pounds, and the value of imports to less than $500,000, in each year during the period. Imports of these chemicals in 1970 amounted to 929,000 pounds, valued at $426,000 (table 2). Although official statistics show imports in 1969 amounting to 2,456,000 pounds, valued at $477,000, it is believed that these totals include imports that were misclassified.

These imports consisted chiefly of the sodium salt and to a lesser extent of the calcium and iron salts; imports of the other salts, of the lactone, and of gluconic acid itself have been negligible. A major part of these imports has originated in the Netherlands, where it is made from potato starch by a potato growers' cooperative; Switzerland had accounted for a substantial part of the remainder.

Table 1.--Gluconic acid and its sodium and calcium salts: U.S. production and sales, 1965-69

(Quantity in thousands of pounds; value in thousands of dollars)

Year	Production	Sales		
	(Quantity)	Quantity	Value	Unit value per pound
	Gluconic acid			
1965	3,891	3,501	1,135	$0.32
1966	3,828	3,677	1,233	.34
1967	4,123	3,607	1,214	.34
1968	3,950	3,884	1,188	.31
1969	3,325	3,655	1,086	.30
	Sodium gluconate			
1965	8,014	7,559	2,270	.30
1966	11,618	10,014	2,870	.29
1967	12,603	13,249	3,488	.26
1968	14,660	13,687	3,444	.25
1969	14,814	14,496	3,730	.26
	Calcium gluconate			
1965	656	524	345	.66
1966	1/	554	350	.63
1967	1/	332	211	.64
1968	371	519	335	.65
1969	1/	1/	1/	1/

1/ Not available.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 2.--Gluconic acid and its compounds: U.S. imports for consumption by principal sources, 1965-70

Year	Total	Netherlands	Switzerland	All other
	Quantity (1,000 pounds)			
1965	881	853	6	22
1966	797	755	22	20
1967	668	608	23	37
1968	714	593	52	69
1969	1/ 2,456	624	26	1/ 1,806
1970	929	761	32	136
	Value (1,000 dollars)			
1965	219	194	11	14
1966	252	199	38	15
1967	235	168	40	27
1968	322	213	83	26
1969	1/ 477	204	47	1/ 226
1970	426	259	64	103

1/ Includes 1,793 thousand pounds, valued at 216 thousand dollars, from the Dominican Republic; these imports are apparently misclassified.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Glycerophosphoric acid and its compounds----------	437.54

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

U.S. consumption of glycerophosphoric acid and its compounds is supplied entirely by imports. In recent years annual U.S. imports of these compounds have averaged about 41,000 pounds, valued at $47,000. Exports are believed to be negligible.

Comment

Glycerophosphoric acid and its derivatives, which consist principally of the calcium, iron, magnesium, manganese, potassium, and sodium salts, are produced as crystalline solids or as aqueous solutions of a syrupy consistency. The acid is made from glycerine and phosphoric acid and is used to produce the various glycerophosphate salts and to improve the taste of glycerophosphate solutions. The salts are used as dietary supplements and as ingredients in proprietary tonics; they supply phosphorus and calcium, iron, or other minerals in a soluble and non-toxic form. These products are of declining importance in domestic and international trade because of a decline in the use of proprietary tonics, which have been largely replaced by vitamin and mineral preparations.

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
437.54	Glycerophosphoric acid and its compounds------	17.5% ad val.	8.5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are shown in

the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Until 1967 small quantities of sodium glycerophosphate were made domestically, but production was discontinued in that year. Hence, domestic needs for glycerophosphoric acid and its compounds are now supplied entirely by imports. During 1965-70, annual U.S. imports of these chemicals averaged 41,000 pounds, valued at $47,000, and came almost entirely from France and the United Kingdom (see accompanying table). Exports are believed to be negligible.

Glycerophosphoric acid and its compounds: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
France	28	35	11	22	18	25
United Kingdom	15	15	8	14	12	12
All other	5	9	13	1/	3	2
Total	48	59	32	36	33	39
	Value (1,000 dollars)					
France	28	34	13	23	20	24
United Kingdom	16	14	7	15	13	14
All other	4	11	27	7	7	4
Total	48	59	47	45	40	42

1/ Less than 500 pounds.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Haarlem oil	437.55

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

U.S. consumption of Haarlem oil is small, amounting to only a few thousand dollars annually; the bulk of U.S. consumption is probably supplied by imports, all of which come from the Netherlands. There are no known U.S. exports of Haarlem oil.

Comment

Haarlem oil, sometimes called "Dutch Drops", is a medicinal consisting essentially of a solution of one part of sulfurated linseed oil in three parts of spirits of turpentine. This summary covers only Haarlem oil in bulk; imports in dosage form are provided for in item 438.02. Haarlem oil is used as a diuretic, but in recent years has been replaced to a great extent by synthetic chemicals.

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1969
437.55	Haarlem oil	7.5% ad val.	6% ad val.

The rate effective January 1, 1969, represents the second stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of the five annual stages provided for in the reduction became effective January 1, 1968; the second became effective January 1, 1969. Further reductions scheduled for years subsequent to 1969 for this item have not become effective. Staged Rates and Historical Notes to part 3 of schedule 4 of the TSUSA-1971 are shown in appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption amounted to about $25,000 annually 15 years ago, but probably amounts to less than $2,000 a year now. It is believed that there is one domestic producer of Haarlem oil, situated on the East Coast, but his output is believed to be small.

There are probably no exports of Haarlem oil.

U.S. imports of Haarlem oil fluctuate considerably from year to year; however, in recent years imports have generally declined, decreasing from 4,395 pounds, valued at $8,042, in 1965 to none in 1970. Imports, all from the Netherlands, are shown in the following tabulation, which has been compiled from official statistics of the U.S. Department of Commerce.

Year	Quantity (pounds)	Value
1965----------	4,395	$8,042
1966----------	3,707	5,894
1967----------	133	678
1968----------	1,004	1,820
1969----------	138	824
1970----------	-	-

Commodity	TSUS item
Hormones:	
Synthetic:	
Adrenocortical hormones-----	437.56
Other----------	437.57
Natural:	
Not artificially mixed------	437.58
Other----------	437.60

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

Hormones are important both as therapeutic agents and as articles of commerce. U.S. consumption of bulk hormones in 1969 amounted to about $160 million, four-fifths of which was supplied by domestic production and the remainder by imports. In each of the years 1965-70, the value of imports exceeded the value of exports.

Description and uses

This summary covers nonbenzenoid bulk hormones which are made or modified synthetically (items 437.56 and 437.57), and benzenoid and nonbenzenoid bulk hormones which are obtained from natural sources (items 437.58 and 437.60). The summary also contains information on benzenoid bulk hormones which are made or modified synthetically; for tariff purposes, such hormones are included in item 407.85. The distinction between benzenoid and nonbenzenoid hormones is one that is not normally made in medical practice and, thus, a discussion that did not include both would be incomplete. Moreover, it is not feasible to separate data on production or exports of the benzenoid types from the corresponding data on the nonbenzenoid.

Hormones are substances which are secreted by the endocrine glands and which stimulate and control the growth and functioning of other parts of the body. Like the vitamins, they are essential in minute quantities to normal animal metabolism; unlike the vitamins, they are ordinarily produced in sufficient quantity by the healthy animal organism. Hormones include steroids, such as hydrocortisone and other corticosteroids produced by the adrenal cortex, and the various androgenic, estrogenic, and progestational hormones produced by the ovaries and testes; they also include nonsteroids, such as insulin, produced by the pancreas; corticotropin (ACTH), produced by the pituitary gland, and thyroxin, produced by the thyroid gland. Also included are synthetic chemicals which produce physiological effects substantially the same as those of the natural hormones.

Hormones are produced commercially either by extraction from animal tissues or by chemical synthesis from materials obtained from several sources, including benzenoid intermediates and plant and animal tissues. The chief chemical raw materials for steroid hormone synthesis are diosgenin, hecogenin, cholesterol, stigmasterol, cholic acid, and desoxycholic acid. Diosgenin and hecogenin are extracted from various plants which grow abundantly in Mexico and Central America. Cholesterol is extracted from beef brains, spinal cords, fish oils, and wool grease. Stigmasterol comes from soybean and other vegetable oils. Cholic and desoxycholic acids are bile acids obtained from beef bile.

Hormones are used in the treatment of a wide variety of metabolic disorders, e.g., insulin in the treatment of diabetes, thyroxin in the treatment of hypothyroidism, and the hormones of the adrenal cortex in the treatment of rheumatoid arthritis and other inflammatory conditions. Some of the progestational hormones are widely used as anovulants, i.e., drugs which suppress ovulation and can therefore be used to prevent conception. Some hormones are also used to a small extent in cosmetics.

Before they can be sold to the consumer, bulk hormones must first be processed into finished pharmaceutical products, put up in dosage forms, and packaged for retail sale either by the primary producers or by pharmaceutical manufacturers who purchase bulk hormones from the primary producers. Except for the benzenoid hormones provided for in item 407.85, hormones in ampoules, capsules, jubes, lozenges, pills, tablets, or similar forms are provided for under item 438.02 and are included in the summary in this volume covering that item.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Hormones:		
	Synthetic:		
437.56	Adrenocortical hormones--------	10.5% ad val.	10.5% ad val. 1/
437.57	Other-------------	10.5% ad val.	5% ad val.
	Natural:		
437.58	Not artificially mixed----------	3% ad val.	2% ad val. 2/
437.60	Other-------------	10.5% ad val.	5% ad val.

1/ Rate not affected by the sixth round of trade negotiations under the General Agreement on Tariffs and Trade.

2/ Rate effective Jan. 1, 1969.

The rate shown for item 437.56 represents the final stage of a concession granted by the United States in the fifth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT), and became effective July 1, 1963. The rates effective January 1, 1972, for items 437.57 and 437.60 represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the GATT. The first of five annual stages of the reductions became effective January 1, 1968. The rate effective January 1, 1969, for item 437.58 represents the second stage of a concession granted by the United States in the sixth round of trade negotiations under the GATT. Further reductions scheduled for years subsequent to 1969 for this item have not become effective. Staged Rates and Historical Notes to part 3 of schedule 4 of the TSUSA-1971 are shown in appendix A. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption

The estimated value of all bulk hormones consumed in the United States in the manufacture of hormone preparations increased steadily from $113 million in 1965 to $160 million in 1969 (table 1). This amounts to an average annual increase of 9 percent. The quantity of consumption presumably increased to a somewhat greater extent during these years because of the progressive lowering of prices of many steroid hormones, made possible by the ready availability of low priced steroids from abroad and by the economics of large scale production.

Much of the increased consumption of hormones appears to be due to the increasing use of progestational hormones as oral contraceptives. Shipments of oral contraceptive preparations increased from $74 million in 1965 to $111 million in 1969. The value of oral contraceptives accounted for almost one-quarter of the value of all U.S. shipments of hormone preparations in 1969.

U.S. producers

Fifteen manufacturers, all located in the Northeastern and North Central States, reported production of 36 different hormones to the U.S. Tariff Commission in 1969. Only three hormones--cortisone acetate, dexamethasone, and hydrocortisone--were made by three producers each; 6 had two producers each and the remainder had only one producer each.

Most of the producers are large pharmaceutical or meat-packing companies with a diversified line of products and an extensive research program. Many U.S. producers have manufacturing affiliates or subsidiaries in foreign countries, and they are importers as well as producers of bulk hormones. At least two major U.S. producers of oral contraceptives import all of the bulk hormones which go into their products. There is extensive cross-licensing of patents and processes among steroid producers in the United States, Mexico, and Europe. Much of the domestic output of bulk hormones is put up in dosage forms by the primary producers. The remainder is sold to domestic pharmaceutical manufacturers or is exported, largely to foreign subsidiaries or affiliates of the producers.

U.S. production

The estimated value of U.S. production of bulk hormones increased steadily from $103 million in 1965 to $146 million in 1969 (table 1). This amounts to an average annual increase of 9 percent during the 4-year period. The quantity of production probably increased to a greater extent than the value because of the long-term trend toward lower prices for steroids. As an example of this trend, the price of hydrocortisone alcohol and acetate, as reported to the Tariff Commission by the primary producers, declined from $2,388 per pound in 1956 to $210.90 per pound in 1965, the most recent year for which data were published.

U.S. exports

U.S. exports of bulk hormones increased irregularly from $15.9 million in 1965 to $19.8 million in 1970 (table 2). Exports of prednisolone accounted for more than half of the value of the exports in each of these years. U.S, bulk hormones are exported to numerous countries. Belgium, Italy, and West Germany were the leading customers in 1970, accounting for one-third of the total (table 3).

The United States enjoyed a favorable balance of trade in bulk hormones until 1965, when the balance became a deficit, which increased steadily to $15.8 million in 1968 and then declined to $2.9 million in 1970.

U.S. imports

U.S. imports of nonbenzenoid bulk hormones increased irregularly from $26.4 million in 1965 to $32.3 million in 1969, but then declined to $22.7 million in 1970 (table 4). The share of consumption supplied by imports has declined slightly, from 23 percent in 1965 to 20 percent in 1969 (table 1).

In the years 1965-68, Mexico supplied about half of U.S. imports of bulk hormones. The Bahamas supplanted Mexico as the principal supplier in 1969 and accounted for half of U.S. imports in the years 1969-70. The sharp decline in U.S. imports in 1970 consists largely of a decline in shipments from the Bahamas, which nevertheless remained the largest supplier in that year. Other important sources of supply during the years 1965-70 were Netherlands, West Germany, and Panama.

The important position of Mexico and Panama as suppliers of steroid hormones is due largely to a natural abundance of steroid-producing plants of the genus Dioscorea (barbasco, Mexican yams). The availability of steroids from these plant sources has undoubtedly been a major factor in the progressive lowering of prices of steroid hormones in recent years.

Table 1.--Bulk hormones: U.S. production, exports of domestic merchandise, imports for consumption, and shipments of preparations, 1965-70

(In millions of dollars)

Item	1965	1966	1967	1968	1969	1970
Production 1/	103	115	126	135	146	2/
Exports	16	18	17	15	18	20
Imports 3/	26	29	31	31	32	23
Consumption 4/	113	126	140	151	160	2/
Ratio (percent) of imports to consumption	23	23	22	20	20	2/
Shipments of hormone preparations	338	378	421	454	479	2/

1/ Calculated from data shown for imports, exports, and consumption.
2/ Not available.
3/ Does not include benzenoid hormones which are known to be small.
4/ Estimated as one-third of the reported value of shipments of hormone preparations.

Source: Compiled from official statistics of the U.S. Department of Commerce, except as noted.

Table 2.--Bulk hormones: U.S. exports of domestic merchandise, by principal kinds, 1965-70

(In thousands of dollars)

Year	Total	Prednisolone	Hydrocortisone	Cortisone and ACTH	Other
1965	15,864	8,405	3,439	297	3,723
1966	17,671	10,045	3,929	174	3,523
1967	16,716	8,907	2,298	680	4,831
1968	15,136	9,525	1,491	504	3,616
1969	18,388	10,256	2,121	400	5,611
1970	19,782	11,618	1,100	525	6,539

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Bulk hormones: U.S. exports of domestic merchandise, by principal markets, 1965-70

(In thousands of dollars)

Market	1965	1966	1967	1968	1969	1970
Belgium	852	1,204	1,841	2,184	1,891	2,834
Italy	941	657	464	1,184	928	2,251
West Germany	2,454	2,451	2,492	2,085	1,552	1,582
Canada	470	1,039	1,186	959	1,218	1,479
Mexico	711	845	1,392	1,241	1,476	1,360
Bermuda	927	722	992	729	884	1,321
Japan	290	741	627	534	1,454	1,103
United Kingdom	1,134	890	315	599	715	1,087
All other	8,085	9,122	7,407	5,621	8,270	6,765
Total	15,864	17,671	16,716	15,136	18,388	19,782

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 4.--Nonbenzenoid bulk hormones: U.S. imports for consumption, by principal sources, 1965-70

(In thousands of dollars)

Source	1965	1966	1967	1968	1969	1970
Bahamas	-	-	-	4,622	17,041	10,780
Mexico	10,196	15,728	19,422	15,249	5,400	4,569
Netherlands	1,282	2,041	1,609	4,561	4,797	2,404
West Germany	2,658	1,181	1,136	1,543	1,311	761
Panama	9,386	6,274	5,056	1,556	237	619
All other	2,892	4,157	4,135	3,386	3,537	3,592
Total	26,414	29,381	31,358	30,917	32,323	22,725

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Menthol	437.64

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States is the world's largest consumer of menthol; in 1969, U.S. consumption was estimated at 2.2 million pounds, 80 percent of which was supplied by imports. Exports are negligible or nil.

Description and uses

The product covered by TSUS item 437.64 is natural menthol, a terpene alcohol. This summary, however, includes information (except for imports) as to both natural menthol and synthetic menthol derived from metacresol or from any other product obtained, derived or manufactured from the benzenoid products described in subparts 1A and 1B of schedule 4 of the TSUS. Any imports of menthol derived from such benzenoid products are included in the summary covering item 407.85 in summary volume 4:1.

Menthol occurs in nature as the optically active isomer, levo-menthol, and is produced synthetically both as levo-menthol and as racemic (optically inactive) menthol. The levo and racemic forms are chemically identical and are similar in odor and flavor. The United States Pharmacopoeia (U.S.P.) recognizes both natural and synthetic menthol, and both the levo and racemic isomers. Most menthol is of U.S.P. grade but small amounts of technical grades of synthetic menthol, both levo-rotatory and racemic, are also sold in the United States. The technical grade is less pure than the U.S.P. grade, but conforms to certain technical specifications.

Natural menthol is derived from oil of Mentha arvensis, or cornmint oil (item 452.22). Synthetic levo-menthol is produced from alpha-pinene, a constituent of spirits of turpentine (item 188.50). Synthetic racemic menthol is produced from synthetic thymol (in item 407.85) which is obtained by converting metacresol (in item 403.44).

There is no technical differentiation between naturally derived and synthetic menthol derived from a benzenoid product; however, there may be a preference for the natural menthol by some users.

Menthol is used as a flavoring agent in liqueurs, confectionery, cigarettes, and cough drops, and in nasal inhalers and cigarettes; it is also used as a mild anesthetic.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
437.64	Menthol----------	35¢ per lb.	17¢ per lb.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The ad valorem equivalent (A.V.E.) of the rate of duty effective January 1, 1970, for menthol, based on imports in 1970, was 7.3 percent. The range of A.V.E.'s, based on country source of imports, was from 5.6 percent to 13.6 percent.

U.S. consumption

During the years 1965-69 annual U.S. consumption of menthol ranged from 1.6 million pounds, valued at $4.8 million in 1965, to 2.6 million pounds, valued at $10.0 million, in 1967; consumption decreased somewhat in 1968-69, amounting to 2.2 million pounds, valued at $7.6 million (table 1). Imported menthol supplied about 80 percent of U.S. consumption during this period. Although users generally prefer natural menthol, the domestically produced synthetic menthol supplies a significant part of U.S. requirements, and a greater part during times when output of the natural product is low and prices are high.

U.S. producers and production

In 1969, synthetic menthol was produced by four firms, three of which are in the New York City-New Jersey area, and one in Florida.

Each of the plants also produced various other products and menthol accounted for only a small part of their total sales. Annual U.S. production, all of which is synthetic, rose from 381,000 pounds in 1965, to a peak of 652,000 pounds in 1967, before dropping to 450,000 pounds in 1969 (table 1). In 1969, the predominant part of the domestically produced menthol was of the U.S.P. grade and competed with the natural product from Brazil.

U.S. imports

During 1965-70, annual imports of menthol increased from 1.2 million pounds in 1965 to 2.0 million pounds in 1967, decreasing to 1.8 million pounds in 1969 and 1970; the annual value of imports reached a peak in 1966, when they were $8 million, then decreased to less than $6 million in 1969 and 1970 (table 1). During this period, Brazil supplied from 82 to 95 percent of total imports of menthol, all of which consisted of natural menthol derived from cornmint oil. Japan, Australia, Argentina, Taiwan, and Spain were other sources of U.S. imports of natural menthol (table 2).

Foreign production and trade

Brazil is the world's largest producer of menthol and the United States is the largest foreign market for Brazil's exports of menthol. In 1967, Brazil exported 2.8 million pounds of menthol, valued at $10.3 million, of which 1.8 million pounds, valued at $6.5 million, entered the United States. Other important markets for Brazil were the United Kingdom, Hong Kong, and the Netherlands.

France and Japan rank next to Brazil in the value of menthol exported. Exports from France which were of the synthetic type amounted in 1967 to $960,000; India was the largest market for menthol from France, other important markets being the United States and Thailand. In 1967, Japan exported menthol valued at about $552,000, a significant part of which entered the U.S. market. Mainland China is believed to produce and export substantial quantities of menthol; the exports go mainly to Europe.

Table 1.--Menthol: U.S. production, imports for consumption, and apparent consumption, 1965-70

Year	Production 1/	Imports 2/	Apparent consumption 3/	Ratio (percent) of imports to consumption
	Quantity (1,000 pounds)			
1965	381	1,231	1,600	77
1966	574	1,903	2,400	80
1967	652	2,023	2,600	78
1968	473	1,907	2,400	79
1969	450	1,769	2,200	80
1970	4/	1,806	4/	4/
	Value (1,000 dollars)			
1965	1,345	3,435	4,800	72
1966	2,145	7,984	10,100	79
1967	2,510	7,507	10,000	75
1968	1,717	7,007	8,700	80
1969	1,750	5,823	7,600	77
1970	4/	5,954	4/	4/

1/ Value of production estimated from unit value of sales. Domestic production is entirely synthetic menthol.

2/ Imports are all natural menthol.

3/ Consumption is approximately equal to production plus imports, since U.S. exports are very small or nil.

4/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports, compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Menthol (nonbenzenoid): U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Brazil	1,071	1,557	1,818	1,742	1,676	1,723
Japan	39	113	89	87	69	38
Australia	7	16	19	20	10	22
Argentina	-	4	4	-	-	10
Taiwan	51	97	41	22	9	4
Spain	19	41	24	23	4	2
All other	44	75	28	13	1	7
Total	1,231	1,903	2,023	1,907	1,769	1,806
	Value (1,000 dollars)					
Brazil	2,880	6,090	6,532	6,405	5,561	5,750
Japan	175	861	494	322	185	66
Australia	14	40	51	55	27	58
Argentina	-	15	16	-	-	35
Taiwan	182	483	214	86	32	17
Spain	52	179	104	86	10	10
All other	132	316	96	53	8	18
Total	3,435	7,984	7,507	7,007	5,823	5,954

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Meso-inositol hexanicotinate	437.65

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

This chemical is a relatively new product which has not achieved prominence.

Comment

Meso-inositol hexanicotinate, also known as inositol niacinate, is an ester made from meso-inositol and nicotinic acid (niacin). It was formerly used in the treatment of acne and was considered for use as a peripheral vasodilator. At the present time, however, it is not available commercially.

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
437.65	Meso-inositol hexanicotinate	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of this reduction became effective January 1, 1968. Rates of duty for each of the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

So far as is known, there has been no domestic production of this drug. Consumption has been supplied entirely by imports, which have been quite small. An analysis of entry papers revealed that, in 1970, total U.S. imports of this chemical amounted to 661 pounds, valued at $405, from West Germany. 1/

1/ Most imports shown in official statistics are believed to be misclassified.

Commodity	TSUS item
Santonin and its salts	437.66

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

U.S. consumption of santonin, all of which is supplied by imports, has diminished greatly in recent years because of displacement by other drugs. In 1969 there were no imports, and in 1970 imports amounted to 45 pounds, valued at $1,500.

Description and uses

Santonin is primarily a veterinary drug which appears in commerce in the form of a crystalline powder. It is extracted from Levant Wormseed, which is a plant of the Artemisia family. This plant has, in the past, been cultivated in the U.S.S.R., England, the United States, and Pakistan; at present the chief source of supply is the Kurram Valley of northern West Pakistan, although some is probably also produced in the U.S.S.R.

Santonin and its salts are used as an antihelminthic in the treatment of round worm infection of hogs. There has been a generally declining trend in the market for santonin and its salts in recent years. Other drugs, such as oil of chenopodium, which are more effective, less toxic, and less expensive, have been used in place of santonin.

U.S. tariff treatment

Imports of santonin and its salts are entered free of duty under item 437.66 of the TSUS. The duty-free status was provided for in the Tariff Act of 1930, as originally enacted, (paragraph 1754), and in the TSUS, effective August 31, 1963, and has been bound since September 10, 1955, as a concession granted by the United States in the General Agreement on Tariffs and Trade (GATT).

U.S. consumption and production

U.S. consumption of santonin has declined sharply in recent years. Present consumption is estimated by industry sources (and substantiated by the small imports) to be less than 300 pounds annually.

The sole U.S. producer of santonin, a division of a medium-sized New York concern, discontinued production of this drug from domestically grown plant sources in the latter 1950's. Its present activities in the santonin market are limited to some refining of the imported crude concentrates and preparation of santonin tablets for use as a medicinal.

U.S. imports and exports

During the period 1965-70, the volume of U.S. imports of santonin declined irregularly from 300 pounds, valued at $6,000, in 1965 to none in 1969; imports in 1970 amounted to 45 pounds, valued at $1,500 (see accompanying table). West Germany, India, the Netherlands, and Pakistan have been intermittant suppliers of these imports in recent years. It is believed that the European countries which are sources of U.S. imports no longer cultivate the plant raw material, but import from Pakistan both the raw material and crude concentrate for further processing. Although statistics on exports of santonin from the United States are not available, it is known that a substantial portion, probably more than half of the imports, are refined or formulated in the United States into medicinals which are exported to Asian countries.

Foreign trade

Artemisia, the raw material from which santonin is produced, is grown chiefly in the isolated Kurram Valley of northern West Pakistan. According to trade sources, artemisia production is an important source of livelihood of the tribesmen of this small Pakistan valley and a regular source of valuable foreign exchange to the country. Extraction of the santonin is carried out in a factory near Rawalpindi. Data are not available on production of either the plant raw material or the extract, although according to trade sources, the capacity of the factory is approximately 15,000 pounds per year. The production and marketing functions of this Pakistani industry are now controlled by a government agency whose aim is to support the industry because of its local importance and its capacity to earn foreign exchange. Pakistani exports of santonin face competition in world markets from other products and from santonin which has been produced elsewhere from Pakistani raw material.

Santonin and its salts: U.S. imports for consumption, by sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (pounds)					
West Germany	-	-	26	-	-	22
India	-	-	-	-	-	12
Netherlands	-	-	-	-	-	11
Pakistan	330	-	-	11	-	-
Total	330	-	26	11	-	45
	Value					
West Germany	-	-	$595	-	-	$619
India	-	-	-	-	-	573
Netherlands	-	-	-	-	-	344
Pakistan	$6,416	-	-	$267	-	-
Total	6,416	-	595	267	-	1,536

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Tannic acid containing by weight 50% or more of tannic acid:	
National Formulary specifications---	437.68
Other----------	437.69

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

Annual U.S. imports of tannic acid were variable during 1965-70 but are believed to have supplied a substantial share of domestic consumption, the value of which in recent years has probably amounted to $1 million or more. Imports of tannic acid in 1970 were valued at $622,000. Exports, if any, are negligible.

Description and uses

Tannic acid is the purest form of tannin, the astringent or tanning principle occurring in the woods, barks, fruits, leaves, and roots of a large number of trees. In recent years tannic acid has been prepared commercially in the United States almost entirely by solvent extraction from Aleppo gall nuts (item 470.30), a product of the Eastern Mediterranean, and from tara pods (in item 470.20), a product of South America. Restrictions on the use of Asian gall nuts, largely a product of mainland China, existed under U.S. Foreign Assets Control Regulations and excluded for U.S. producers this kind of gall nut as a less expensive raw material. It is expected with the liberalization of trade between China and the United States that mainland China will again be a source for gall nuts.

Commercial tannic acid is a yellow or light brown powder with an astringent taste and is marketed in three grades: Reagent grade; N.F. (conforming to National Formulary specifications); and, technical grade. Reagent-grade tannic acid is of high purity and is used essentially for analytical work. N.F. grade is of relatively high purity and is used industrially in the manufacture of writing and printing inks; in fur tanning and dyeing; in the tanning of hides; in paper and textile sizing; as a coagulant in rubber manufacture; in photography; and in electroplating. It also has various food, medicinal, and cosmetic applications such as in the stabilization of beer, wine, and ale; for treatment of throat and skin disorders; and as an ingredient in anti-perspirant

preparations. Technical-grade tannic acid is used in many related industrial applications, except for food and medicinals, but where high purity is not a consideration. Formulations of technical grade tannic acid containing less than 50 percent tannic acid are also available but are not included in the tariff classes covered by this summary.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
437.68	Tannic acid, N.F.----	9¢ per lb.	4.5¢ per lb.
437.69	Tannic acid, other---	5.5¢ per lb.	4¢ per lb. 1/

1/ Rate effective January 1, 1969.

The rate effective January 1, 1972, for tannic acid, N.F., represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. The rate effective January 1, 1969, for tannic acid, other, represents the second stage of a concession granted by the United States in the sixth round of trade negotiations under the GATT. Further reductions scheduled for years subsequent to 1969 for this item have not become effective. Staged Rates and Historical Notes to part 3 of schedule 4 of the TSUSA-1971 are shown in appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption and production

Official statistics are not available on U.S. consumption or production of tannic acid; the value of U.S. consumption, however, probably amounts to $1 million, or more. The trend in domestic production of tannic acid in recent years is believed to have been downward.

Tannic acid is produced in the United States by one fairly large, midwestern chemical company for whom tannic-acid production and sales represent only a small portion of income.

U.S. exports and imports

Data on exports of tannic acid are not available, but exports, if any, are negligible.

During 1965-70, annual U.S. imports of tannic acid have ranged between 610,000 pounds (in 1965) and 872,000 pounds (in 1966); the value of annual imports ranged between $459,000 (in 1969) and $947,000 (in 1966). Imports of N.F. grade tannic acid accounted for the greater part of total imports of tannic acid during these years. The United Kingdom was the principal source of imports of tannic acid in both imports classes; France and Belgium were other sources of importance for N.F. grade tannic acid; Italy, Belgium, and France were sources of other grades of tannic acid (tables 1 and 2).

Table 1.--Tannic acid conforming to National Formulary specifications, containing 50 percent or more tannic acid: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
United Kingdom	392	602	320	471	365	526
France	-	6	11	28	100	85
Belgium	21	32	18	21	69	54
All other	7	-	-	-	-	-
Total	420	640	349	520	534	665
	Value (1,000 dollars)					
United Kingdom	419	686	349	307	223	388
France	-	6	11	29	111	87
Belgium	25	42	24	27	51	64
All other	8	-	-	-	-	-
Total	452	734	384	363	385	539

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Tannic acid, containing 50 percent or more tannic acid, not elsewhere enumerated: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
United Kingdom	156	204	88	109	67	62
Italy	34	26	28	24	16	16
Belgium	-	1/	-	-	-	11
France	1/	2	13	19	10	9
Total	190	232	129	152	93	98
	Value (1,000 dollars)					
United Kingdom	146	184	69	79	51	48
Italy	34	27	30	22	15	15
Belgium	-	1	-	-	-	13
France	2/	1	10	14	8	7
Total	180	213	109	115	74	83

1/ Less than 500 pounds.
2/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Terpin hydrate--------	437.70

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

U.S. consumption of terpin hydrate exceeds 1 million pounds annually and is supplied mainly by domestic production, much of which is consumed in the manufacture of terpineol, a perfume material. U.S. imports of terpin hydrate in 1970 amounted to 354,000 pounds, valued at $73,000. Exports, if any, are believed to be smaller than imports.

Comment

Terpin is the chemical, p-menthane-1,8-diol. The hydrate contains one molecule of water of crystallization, and occurs either as lustrous, colorless crystals or as a white crystalline powder. It is usually prepared synthetically by the action of nitric acid, sulfuric acid, and alcohol on spirits of turpentine; however, it can be isolated from pinewood crude oils, after distilling off the more volatile fractions.

Terpin hydrate is manufactured and sold in two grades, the medicinal grade and the technical grade. The former is used as an expectorant while the latter is used as a raw material for the manufacture of terpineol, which is used as a solvent and also to furnish a pleasant lilac-like odor to perfume formulations.

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
437.70	Terpin hydrate-------	28% ad val.	14% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as

appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption of terpin hydrate is supplied mainly by domestic production and is believed to have exceeded 1 million pounds annually in recent years. The major portion of production is not sold but is used by the producer as a raw material in the manufacture of terpineol.

Terpin hydrate is manufactured in the United States by three firms; two produce the medicinal grade and the other produces the technical grade. The firm producing the technical grade and one of the firms producing the medicinal grade are large integrated chemical concerns; manufacturing terpin hydrate is not a major source of income for either. The other firm producing the medicinal grade is a medium-sized chemical company producing a variety of mostly pharmaceutical chemicals.

During 1965-70, U.S. imports of terpin hydrate ranged widely from year to year between 47,000 pounds, valued at $11,000, in 1967 to 432,000 pounds, valued at $82,000, in 1969. Imports in 1970 amounted to 354,000 pounds, valued at $73,000 (see accompanying table). Imports are of both medicinal and technical grades with the technical grade predominating. The medicinal grade is consumed by pharmaceutical-compounding firms and the technical grade is almost exclusively used as a raw material for the manufacture of terpineol, a solvent and a perfume material.

During the period 1965-70, France was most consistently the principal source of U.S. imports of terpin hydrate, although Japan and Canada were the principal sources in 1966 and 1967, respectively. West Germany and Spain were sources in some years.

Statistics on exports of terpin hydrate are not available but exports, if any, are smaller than imports.

Terpin hydrate is a relatively unimportant item in international trade.

Terpin hydrate: U.S. imports for consumption, by sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
France	117	28	17	142	432	266
Japan	-	220	-	-	-	66
Spain	-	-	-	33	-	22
West Germany	67	-	-	30	-	-
Canada	-	-	30	-	-	-
Total	184	248	47	205	432	354
	Value (1,000 dollars)					
France	27	8	5	28	82	57
Japan	-	35	-	-	-	10
Spain	-	-	-	6	-	6
West Germany	13	-	-	6	-	-
Canada	-	-	6	-	-	-
Total	40	43	11	40	82	73

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Thymol	437.72

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

There has been no known U.S. consumption, production, imports, or exports of natural thymol in recent years.

Description and uses

The thymol covered by TSUS item 437.72 has been administratively determined to be that derived from natural sources. (See "U.S. tariff treatment" and "U.S. imports" sections). It may be obtained from the volatile oils of several plants including thyme and ajowan. The thymol most commonly found in commerce, however, is produced synthetically by a process starting with metacresol, a benzenoid chemical; such thymol is provided for under item 407.85, covered in summary volume 4:1.

There is no essential difference between thymol derived from natural sources and that produced synthetically, and both may be used interchangeably. Thymol is a white crystalline substance having a pungent and aromatic odor, and has been used principally as an intermediate in the production of synthetic menthol (see summary for item 437.64 in this volume), although this use has declined recently in favor of alternate methods of producing synthetic menthol. Thymol is also used in medicine and allied areas as a disinfectant, fungicide, and anthelmintic agent (chiefly against hookworm). It serves frequently as the antiseptic and germicidal ingredient in dental preparations, soap, and creams. It is also used as a stabilizer in various cosmetic products.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
437.72	Thymol	12% ad val.	6% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

In a decision of the Bureau of Customs on October 9, 1969 (T.D. 69.234) it was held that synthetically produced thymol was classifiable under TSUS item 407.85.

U.S. consumption, production, and exports

Statistics on U.S. consumption of thymol are not available. All U.S.-produced thymol, however, is believed to be synthetic, and since all U.S. imports of thymol are probably of the synthetic type, there is probably little or no domestic consumption of natural thymol. There are no known exports of natural thymol.

U.S. imports

The official statistics on imports of thymol reported under item 437.72 include imports of both the natural product, if any, and the synthetic. It is believed, however, that virtually all, if not all, of the imports were of synthetic thymol. The amounts of thymol imported during 1965-70 under item 437.72 (according to official statistics of the U.S. Department of Commerce) and those amounts (all synthetic) imported under item 407.85 (according to the Tariff Commission's report, Imports of Benzenoid Chemicals and Products) are shown in the following tabulation:

Year	Imports under item 437.72		Imports under item 407.85 1/	Total
	Quantity (pounds)	Sources	Quantity (pounds)	Quantity (pounds)
1965	119,152	W. Germany, France, and Japan	-	119,152
1966	148,453	W. Germany, France, and Japan	56,205	204,658
1967	22,045	France	207,578	229,623
1968	9,156	France and Japan	86,647	95,803
1969	42,320	W. Germany, Japan, and France	2/	2/
1970	10,741	W. Germany and France	113,035	123,776

1/ Imports reported under item 407.85 were probably from the same sources, in general, as those reported under item 437.72.
2/ Not available.

Commodity	TSUS item
Biological products------	437.76
Fibrin-------------------	493.35

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States is the world's largest producer and consumer of biological products. In 1967, U.S. shipments of these materials by producers were valued at $216 million. Exports in that year amounted to more than $22 million but had increased to $37 million in 1970. U.S. imports ranged between $1.3 million and $3.5 million during the same period.

Description and uses

The biological products covered by this summary and included in item 437.76 are: viruses, therapeutic serums, vaccines, toxins, toxoids, antitoxins, and analagous products (such as allergenic extracts); human blood, plasmas, and other fractions of blood; and anatomical parts of the human body prepared for diagnostic or therapeutic purposes. Also covered by this summary is the protein fibrin. Not included are diagnostic (as contrasted with therapeutic) serums derived from the blood of rabbits, which are provided for under item 799.00 pursuant to Treasury Decision 67-113(2).

The products included here are used in medicine and surgery for such purposes as immunization, diagnosis, and therapeutic treatment of animals and humans. Immunizing agents, imported as well as those produced domestically, are important aids in controlling infectious disease in the United States.

Fibrin is a protein derived from human blood, obtained through the interaction of fibrinogen and thrombin, both of which are derived from human blood plasma. Fibrin had been commercially available in two forms as a film or thin transparent sheet of uniform thickness used in neurosurgery, and as a foam resembling a honeycomb for use as a hemostatic agent which was absorbed into the living tissue in which it was embedded. Available information indicates that these latter products are no longer produced or used in the United States.

The biological products included herein if in dosage form, are provided for in TSUS item 438.02, discussed in a separate summary in this volume.

U.S. tariff treatment

Imports of the biological products included under TSUS item 437.76 and of fibrin (item 493.35) enter the United States free of duty. The duty-free status for most of the biological products under item 437.76 was provided for in the Tariff Act of 1930, as originally enacted, and in the Tariff Schedules of the United States (TSUS).The duty-free status of most of these products has been bound under the General Agreement on Tariffs and Trade (GATT) since June 6, 1951. The duty-free status of fibrin was also provided for in the Tariff Act of 1930, as originally enacted, and in the TSUS, and has been bound under the GATT since January 1, 1968.

U.S. consumption and production

Domestic consumption of the products discussed herein can only be evaluated in terms of apparent consumption (production plus imports minus exports) for certain years. Based on Bureau of the Census data for U.S. shipments of these products by manufacturers, apparent consumption in 1967 was valued at about $195 million; in 1963 it exceeded $140 million, an increase of nearly 50 percent over that in 1958. Shipments of biological products in 1958 amounted to $119 million, in 1963 to $167 million and in 1967 to $216 million. U.S. imports and exports of biological products have been small compared with domestic shipments which are generally comparable to U.S. production; exports, however, have been several times greater than imports.

Approximately 75 percent of the value of domestic shipments in 1967 consisted of biological products for human use, the remainder for veterinary use. Production of fibrin was discontinued in 1959 when the sole U.S. producer of the foam requested that his license to manufacture this product be discontinued.

In 1970 there were more than 250 domestic establishments licensed for the production of biological products; 216 of the establishments were licensed by the National Institutes of Health for the manufacture and distribution of these products for human use; the remaining establishments were licensed by the Department of Agriculture for the manufacture and distribution of biological products for use in the treatment of animals. The establishments are widely dispersed throughout the United States and include pharmaceutical and chemical concerns and blood banks of hospitals; together they produce under license about 480 different types of biologicals.

U.S. exports

The value of U.S. exports of all the biological products covered in this summary increased by 147 percent between 1965 and 1970. Total exports of these products rose from nearly $15 million in 1965 to nearly $37 million in 1970. The bulk of the increase was accounted for by biological products for human use (other than poliomyelitis vaccine) which increased from $11 million in 1965 to $32 million in 1970. Exports of poliomyelitis vaccine which amounted to $339,000 in 1965 decreased irregularly to $166,000 in 1970; a trend to declining markets for polio vaccine had continued from previous years. Exports of the biological products for veterinary use covered here accounted for about $4 million in each year during 1965-70 (table 1).

The principal markets in 1970 for exports of the various forms of biological products were as follows:

Product	Principal Markets	Value ($1,000)
Vaccines (except poliomyelitis vaccine) for human use	Canada	2,790
	Mexico	571
	Nigeria	545
	Western Africa	477
	West Germany	440
Serums, antitoxins and toxoids, for human use	Canada	1,795
	West Germany	1,567
	Argentina	867
	Italy	861
	Switzerland	621
	Spain	576
Blood derivatives (except antiserums) for human use	Canada	3,418
	West Germany	1,830
	Belgium	1,236
Biological products for veterinary use	Canada	949
	Mexico	311
	Japan	304
Poliomyelitis vaccine	Philippines	63

U.S. imports

The value of U.S. imports of biological products increased from $407,000 in 1965 to $3.5 million in 1970; imports had decreased from a higher ($1.6 million) 1963 level to the 1965 value before a gradual rise to the 1970 level (table 2). The largest annual value for imports in recent years occurred in 1962 when it exceeded $4 million.

In 1970, there were 18 foreign establishments which held licenses granted by the National Institutes of Health, to export biological products for human use to the United States. U.S. imports of biological products for veterinary use are regulated by permits issued by the U.S. Department of Agriculture. In 1970, the principal suppliers of U.S. imports of biological products, in terms of value, were Belgium, the United Kingdom, El Salvador, Canada, and Costa Rica.

Statistics on imports according to basic use are not available, but it is believed that the value of imports of products for human use exceeds that of imports for veterinary use. The imported products--which include various vaccines, serums, human plasma, and anatomical specimens--are comparable in quality and use to those produced domestically.

There have been no U.S. imports of fibrin in recent years.

Foreign production and trade

Statistics on world production of the biological products considered herein are not available. It is believed that the United States and the United Kingdom are among the world's largest producers of these serums, vaccines, and related biological products. There is significant production of these products also in the European Economic Community (EEC) countries, Switzerland, and Eastern Europe, including Yugoslavia.

As of January 1971, of 18 foreign establishments licensed by the National Institutes of Health to export biological products (for human use) to the United States, six were located in England, three in the Netherlands, and one each in France, Norway, Sweden, Belgium, West Germany, Canada, Italy, Austria, and Switzerland.

Statistics compiled by the Statistical Office of the United Nations, which did not include data for the countries of Eastern Europe, show that the United States was the largest exporter of biological products in 1968 ($18.1 million); exports of such products by France were valued at $6.7 million, by the United Kingdom at $6.5 million, those of Canada, at $6.4 million, and those of West Germany at $4.5 million.

Table 1.--Biological products: U.S. exports of domestic merchandise, by principal type, 1965-70

(Value in thousands of dollars)

Year	Total	Biological products for veterinary use	Poliomyelitis vaccine	Vaccines, except poliomyelitis, serums, antitoxins and toxins, blood derivatives, for human use
1965	14,893	3,685	339	10,869
1966	17,376	3,368	837	13,171
1967	22,373	3,827	167	18,379
1968	23,908	4,137	186	19,585
1969	22,975	3,821	286	18,868
1970	36,863	4,400	166	32,297

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Biological products: U.S. imports for consumption, by principal sources, 1965-70

(Value in thousands of dollars)

Source	1965	1966	1967	1968	1969	1970
Belgium	-	1	1/	88	72	1,529
United Kingdom	147	349	585	454	444	444
El Salvador	-	-	72	287	289	432
Canada	86	79	140	272	519	400
Costa Rica	-	26	177	208	224	168
Dominican Republic	-	-	-	-	85	125
France	-	60	42	93	141	108
Columbia	109	119	95	82	63	89
Philippine Republic	-	-	23	21	48	35
West Germany	26	46	17	18	137	11
All other	39	36	117	124	41	121
Total	407	716	1,268	1,647	2,063	3,462

1/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Vitamins:	
Synthetic	437.82
Natural:	
Not artificially mixed	437.84
Other	437.86

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

Vitamins are an important item in domestic and international trade. In 1969, annual U.S. consumption, which approximated production in that year, amounted to $85 million; 33 percent of the quantity and 13 percent of the value of consumption in 1969 was supplied by imports. The U.S. has a favorable but declining balance of trade in bulk vitamins, which amounted to $4.1 million in 1968 and $767,000 in 1969, as compared with $8.5 million in 1965.

Description and uses

This summary covers nonbenzenoid bulk vitamins. Benzenoid vitamins, though provided for in item 407.85 and included in the summary covering that item, are also discussed in this summary for the sake of completeness. Except for the benzenoid vitamins provided for in item 407.85, vitamins in ampoules, capsules, jubes, lozenges, jels, tablets or similar forms are provided for in item 438.01 and are included in the summary in this volume covering that item.

Vitamins, like hormones, are organic substances, other than carbohydrates, fats, or proteins, which in minute quantities are essential to normal animal metabolism. Unlike hormones, which are normally produced in sufficient quantity by the healthy animal organism, vitamins or their precursors are ingested with the diet. The absence of any vitamin from an otherwise adequate diet produces the symptoms of a characteristic deficiency disease. Thus the absence from the diet of vitamin A causes night blindness and xerophthalmia; the absence of vitamin C (ascorbic acid) causes scurvy; the absence of vitamin D causes rickets; the absence of vitamin K causes hypoprothrombinemia; the absence of thiamine causes beriberi; and the absence of niacin and niacinamide causes pellagra.

Vitamins are among the leading products of the pharmaceutical industry. They are used in medicine for the prevention and treatment of deficiency diseases and for the treatment of certain specific pathological conditions. They are also widely used for the enrichment of food products such as bread and milk, in proprietary multi-vitamin preparations sold as general dietary supplements, and in animal feed additives. In addition, vitamin C is used as an antioxidant in certain canned and frozen foods.

Vitamins may be produced synthetically or extracted from naturally occurring substances such as fish liver oils, which are rich in vitamins. Currently, most vitamins are made at least partially by synthesis. Bulk vitamins are used in the existing form by the food processing and animal feed industries or are further processed into tablets, capsules, formulated preparations, food additives, or animal feed premixes either by the primary producers or by pharmaceutical or other manufacturers who purchase bulk vitamins from primary producers.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Vitamins:		
437.82	Synthetic-------	8.5% ad val.	4% ad val.
	Natural:		
437.84	Not artificially mixed--	3% ad val.	2% ad val. 1/
437.86	Other---------	8.5% ad val.	4% ad val.

1/ Rate effective January 1, 1969.

The rates effective January 1, 1972, for items 437.82 and 437.86 represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reductions became effective January 1, 1968. The rate effective January 1, 1969, for item 437.84 represents the second stage of concessions granted by the United States in the sixth round of trade negotiations under the GATT. Further reductions scheduled for years subsequent to 1969 for this item have not become effective. Schedule 5 rates of duty for the individual stages are given in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. Staged Rates and Historical Notes to part 3 of schedule 4 of the

TSUSA-1971, are shown in appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption

U.S. consumption of all bulk vitamins shows a generally rising trend, from 14.9 million pounds, valued at $80.0 million, in 1965, to 22.0 million pounds, valued at $84.6 million, in 1969 (table 1). These figures represent an average annual increase of 10 percent in quantity and 1 percent in value. The average annual increase in consumption has been larger in terms of quantity than in terms of value because of a generally downward trend in vitamin prices. The average value of all vitamins consumed in the United States increased from $5.37 per pound in 1965 to $5.80 per pound in 1966, but then declined steadily to $3.84 per pound in 1967. It is estimated that about 50 percent of the bulk vitamins consumed in the United States is used in the manufacture of ethical and proprietary vitamin preparations, 40 percent in animal feeds, and 10 percent in enriched foods.

U.S. consumption of vitamin C which is the vitamin produced domestically in the greatest quantity, shows a similar upward trend, from 7.5 million pounds, value at $15.0 million, in 1965 to 11.6 million pounds, valued at 17.6 million, in 1969 (table 1). This represents an average annual increase of 12 percent in quantity and 4 percent in value. Likewise the average value of vitamins consumed in the United States increased from $2.01 per pound in 1965 to $2.20 per pound in 1967 and then declined to $1.53 per pound in 1969.

U.S. producers

There were 24 companies which reported production of bulk vitamins to the U.S. Tariff Commission in 1969. The producers are located mostly in the Northeastern and North Central States, and they range in size from small, highly specialized companies to large, diversified concerns. Most of the manufacturers are chemical or pharmaceutical companies; some of them have manufacturing operations abroad; and one domestic producer is the U.S. subsidiary of a large Swiss-owned company. Some manufacturers sell their entire production of vitamins in bulk; others sell a large proportion of their production in the form of vitamin preparations and other finished products.

Excluding different grades and different racemic forms of the same chemical entity, 35 different vitamins were produced in the United States in 1969; 19 were manufactured by one or two producers each, and were made by three or more producers.

U.S. production

The quantity of vitamins produced in the United States increased irregularly from 16.3 million pounds in 1965 to 17.6 million pounds in 1969. The value, however, increased from $88.5 million in 1965 to $104.2 million in 1967 and then declined to $85.4 million in 1969--a net decrease of 3.5 percent over the 4-year period (table 1). Vitamin C shows a similar trend, increasing slightly from 8.6 million pounds in 1965 to 8.9 million pounds in 1969 but decreasing in value from $17.0 million to $14.8 million during the same years (table 2).

In terms of quantity, vitamin C is the leading vitamin produced in the United States, accounting for 50 percent of the total quantity and 17 percent of the value in 1969. In terms of value, however, vitamin A is the leader, accounting for 8 percent of the quantity and 35 percent of the value. Other important vitamins are niacin and niacinamide, pantothenic acid and its derivatives, riboflavin, and vitamin E; which together accounted for 34 percent of the quantity and and 33 percent of the value of all vitamins produced in the United States in 1969.

U.S. imports

U.S. imports of nonbenzenoid bulk vitamins increased from 2.3 million pounds, valued at $6.3 million, in 1965 to 7.5 million pounds, valued at $13.8 million, in 1970 (table 3). The average annual increase in imports during this period was 27 percent in terms of quantity and 17 percent in terms of value. During 1965-69, the proportion of U.S. consumption supplied by imports increased from 15 percent in 1965 to 33 percent in 1969 in terms of quantity, and from 8 percent in 1965 to 13 percent in 1969 in terms of value. Japan has been the most important source of these imports accounting for at least one-third of the value in each of the years 1965-70. Other important suppliers were Denmark, Switzerland, Netherlands, and France. Imports have consisted principally of synthetic vitamins classifiable under item 437.82. The following tabulation shows U.S. imports of synthetic vitamins by kinds, and principal sources in 1970.

Kind of vitamin (synthetic)	Quantity (1,000 pounds)	Value (1,000 dollars)	Principal sources
Niacin and niacinamide	1,996	2,049	Switzerland, Italy, and Denmark
Pyridoxine	49	421	Japan and Denmark
Thiamine hydrochloride and mononitrate	148	871	Japan and United Kingdom
Vitamin A	1,063	3,417	Denmark, France, and Switzerland
Vitamin C (ascorbic acid and its salts)	2,700	3,027	Japan, Denmark, and West Germany
Vitamins D_2 and D_3	186	778	Netherlands, France, and United Kingdom
All other	1,015	2,360	Japan and the Netherlands
Total	7,157	12,923	

U.S. exports

U.S. exports of bulk vitamins decreased irregularly, from $14.8 million in 1965, to $13.0 million in 1970, a decrease of about 12 percent during that period (table 4). Canada was the principal export market for vitamins; other important markets included Bermuda, Japan, and Switzerland.

The following tabulation shows U.S. exports of bulk vitamins, by kinds, in 1970.

Kind of vitamin	Quantity (1,000 pounds)	Value (1,000 dollars)	Principal markets
Vitamin A----------	348	1,570	Switzerland, Canada, and Japan
Vitamin B (thiamine hydrochloride and mononitrate----------	192	1,533	West Germany, Denmark, India, Switzerland, and Brazil
Vitamin B_{12} (cyanocobalamin)----------	192	2,359	Bermuda, Canada, and the Philippine Republic
Other B vitamins---------	1,191	4,372	Japan, India, Canada, United Kingdom, and Switzerland
Vitamin C (ascorbic acid and its salts)----	380	595	Canada, Pakistan, and Mexico
Other vitamins----------	625	2,546	Canada, United Kingdom, Australia, the Netherlands, and Laos
Total----------	2,928	12,975	

Table 1.--Vitamins: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1965-69

Year	Production	Imports 1/	Exports	Apparent consumption	Ratio (percent) of imports to consumption
	Quantity (1,000 pounds)				
1965	16,279	2,274	3,659	14,912	15.2
1966	17,582	3,312	3,993	16,901	19.6
1967	17,568	4,907	4,468	18,007	27.3
1968	16,982	5,175	4,007	18,510	28.0
1969	17,647	7,221	2,874	21,994	32.8
	Value (1,000 dollars)				
1965	2/ 88,493	6,332	14,806	80,019	7.9
1966	2/103,382	7,960	13,311	98,031	8.1
1967	2/104,178	9,762	13,590	100,350	9.7
1968	2/ 93,571	9,352	13,448	89,475	10.4
1969	2/ 85,411	11,186	11,953	84,644	13.2

1/ Does not include benzenoid vitamins, imports of which have been small.

2/ Estimated by multiplying the total quantity of production by the average unit value of all sales of bulk vitamins by the primary producers.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Vitamin C: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1965-69

Year	Production 1/	Imports	Exports	Apparent consumption	Ratio (percent) of imports to consumption
	Quantity (1,000 pounds)				
1965	8,629	427	1,589	7,467	5.7
1966	9,600	772	1,840	8,532	9.0
1967	9,160	1,329	1,975	8,514	15.6
1968	8,560	2,051	1,321	9,290	22.1
1969	8,866	3,246	561	11,551	28.1
	Value (1,000 dollars)				
1965	16,999	813	2,817	14,995	5.4
1966	19,968	1,479	3,092	18,355	8.1
1967	19,694	2,237	3,170	18,761	11.9
1968	14,466	2,953	1,975	15,444	19.1
1969	14,806	3,636	795	17,647	20.6

1/ Value estimated by multiplying the total quantity of production by the average unit value of all bulk sales by the primary producers.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Vitamins: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Japan	648	1,080	1,391	1,927	2,419	2,466
Denmark	162	303	640	802	1,072	959
Switzerland	738	935	1,356	1,038	1,660	1,631
Netherlands	201	317	299	298	382	471
France	68	52	118	71	80	212
Italy	78	242	400	437	516	747
West Germany	38	102	286	240	696	454
United Kingdom	117	57	56	95	64	64
All other	224	224	361	267	332	491
Total	2,274	3,312	4,907	5,175	7,221	7,495
	Value (1,000 dollars)					
Japan	2,544	3,345	3,451	3,626	3,742	4,531
Denmark	703	1,124	1,585	1,634	2,047	2,057
Switzerland	743	861	1,201	966	1,509	1,708
Netherlands	608	932	954	878	1,058	1,373
France	804	624	774	729	886	1,120
Italy	90	245	372	508	477	901
West Germany	197	204	492	324	781	577
United Kingdom	371	408	343	290	318	403
All other	272	217	590	397	368	1,096
Total	6,332	7,960	9,762	9,352	11,186	13,766

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 4.--Vitamins: U.S. exports of domestic merchandise, by principal markets, 1965-70

(In thousands of dollars)

Market	1965	1966	1967	1968	1969	1970
Canada	1,573	1,906	2,004	1,408	2,260	2,102
Bermuda	499	432	624	491	1,150	1,407
Japan	778	446	494	836	1,326	1,292
Switzerland	1,155	599	867	2,983	2,056	1,101
India	257	657	1,026	334	416	723
Mexico	939	801	619	694	348	412
Brazil	990	1,156	641	665	352	389
Argentina	1,295	769	777	694	442	223
Netherlands	1,348	535	310	351	247	207
France	846	330	241	115	54	205
All other	5,126	5,680	5,987	4,877	3,302	4,914
Total	14,806	13,311	13,590	13,448	11,953	12,975

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Miscellaneous nonbenzenoid drugs--------	439.50

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

U.S. consumption of the heterogeneous group of bulk medicinal chemicals and finished pharmaceutical products covered by this summary is supplied mostly by domestic production. In recent years, U.S. imports have ranged from $6 to $9 million annually; it is believed that the value of exports is at least twice as large, and the value of domestic production at least 10 times as large, as the value of imports.

Description and uses

This summary covers nonbenzenoid drugs and mixtures of drugs which are not elsewhere enumerated in the TSUS; it does not include crude and advanced natural drugs. The products covered here consist of a large number of organic and inorganic compounds and mixtures, including synthetic, semisynthetic, and artificially mixed natural products, having therapeutic properties; they are used chiefly as medicines or as ingredients in medicines. Included herein are bulk medicinal chemicals and mixtures, as well as finished pharmaceutical products (except those put up in ampoules, capsules, tablets, or similar measured doses, which are discussed in the summary covering item 440.00).

The following drugs, all of which have been imported, are indicative of the kinds of drugs included in this summary.

acetylcysteine	erythrityl tetranitrate	pantolinium tartrate
allantoin	furazolidone	propylthiouracil
barium sulfate	herb tea	senna concentrate
calcium lactate	hesperidin	sodium heparin
choline bitartrate	iron-dextran complex	sodium iodide
cyclophosphamide	meprobamate	undecylenic acid
digitoxin	milk of magnesia	
digoxin	orange peel extract	

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Drugs not provided for in subpart A or B of part 3:		
439.50	Other, including synthetic drugs------	10.5% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption, production, and exports

In view of the heterogeneous composition of this group, no comparable data are available for consumption, production, or export of the drugs covered here. It is estimated, however, that the value of U.S. consumption and production is at least 10 times as large, and that of exports is at least twice as large, as the value of imports. The number of U.S. producers of these drugs is at least several hundred but less than a thousand.

U.S. imports

U.S. imports of these miscellaneous nonbenzenoid drugs increased irregularly from $6.1 million in 1965, to $8.8 million in 1968, then decreased to $6.9 million in 1970 (see accompanying table). The Netherlands, Canada, the United Kingdom, West Germany, and Sweden were the source of more than half of the imports during 1965-70.

Miscellaneous nonbenzenoid drugs: U.S. imports for consumption, by principal sources, 1965-70

(In thousands of dollars)

Source	1965	1966	1967	1968	1969	1970
Netherlands	1,042	1,663	1,729	2,613	1,388	1,564
Canada	365	673	999	1,129	784	1,444
United Kingdom	764	952	973	1,226	1,281	1,439
West Germany	578	639	784	987	1,064	1,167
Sweden	419	538	857	875	582	812
France	385	704	446	490	785	658
Bahamas	-	-	-	-	1	675
Switzerland	470	407	287	367	540	527
Italy	542	464	190	384	340	292
Japan	469	660	200	225	397	261
All other	1/ 1,085	431	225	455	572	1,898
Total	6,119	7,131	6,690	8,751	7,733	6,941

1/ Includes imports valued at 524 thousand dollars from Mexico and 371 thousand dollars from Poland.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Nonbenzenoid drugs in dosage forms	436.00, 438.01-.02, 440.00

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

U.S. production and consumption of nonbenzenoid drugs in dosage forms is estimated to have ranged from $1.2 to $1.7 billion annually in recent years. Imports supply less than 1 percent of U.S. consumption, while exports account for about 3 percent of U.S. production.

Description and uses

This summary covers all nonbenzenoid drugs packaged "in ampoules, capsules, jubes, lozenges, pills, tablets, troches, or similar forms, including powders put up in medicinal doses". Thus it covers the dosage forms of all natural and synthetic drugs listed in subparts 3A and 3B of schedule 4 of the TSUS as well as those provided for under the miscellaneous provisions of subpart 3C. Nonbenzenoid alkaloids, antibiotics, hormones, and vitamins are among the most important groups of drugs whose dosage forms are included in this summary.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
436.00	Any of the products provided for in subpart 3A of schedule 4 when imported in dosage forms--	The product rate in subpart 3A, but not less than 10.5 percent ad val.	The product rate in subpart 3A, but not less than 5 percent ad val.
	Any of the products provided for in subpart 3B of schedule 4 when imported in dosage forms:		
438.01	Vitamins----------	8.5 percent ad val.	4 percent ad val.
438.02	Other----------	The product rate in subpart 3B, but not less than 10.5 percent ad val.	The product rate in subpart 3B, but not less than 5 percent ad val.
440.00	Any of the products provided for in subpart 3C of schedule 4 when imported in dosage forms--	The product rate in subpart 3C, but not less than 10.5 percent ad val.	The product rate in subpart 3C, but not less than 5 percent ad val.

The rates effective January 1, 1972, reflect the final stage of the concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of these reductions became effective January 1, 1968. Rates of duty for each of the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The ad valorem equivalent for items 436.00 and 438.02 could not be ascertained as the actual amounts of collectible duties were not available. Since the minimum rate provided for item 440.00 is the maximum rate included in subpart 3C, the minimum rate always applies. In 1970, the minimum statutory rate of duty for item 440.00 was 7 percent.

U.S. producers

According to the 1967 Census of Manufactures, there were 875 establishments producing pharmaceutical preparations, 318 of which had 20 or more employees. These establishments are located in all sections of the country but are heavily concentrated in the Northeastern and North Central states. Most establishments presumably produce at least some nonbenzenoid drugs in dosage forms. Most producers are formulators who purchase medicinal chemicals in bulk from the primary manufacturers here or abroad; a relatively small number of producers, mostly larger ones, manufacture and sell both bulk drugs and finished pharmaceutical products, including those put up in dosage forms.

U.S. consumption and production

There are no statistics on domestic consumption and production of nonbenzenoid drugs in dosage forms. According to Bureau of the Census statistics, however, the value of shipments of both benzenoid and nonbenzenoid drugs in dosage forms and of pharmaceutical products not in dosage forms increased from $3.6 billion in 1965, to $5.0 billion in 1969. If nonbenzenoid drugs in dosage forms account for one-third of this total, U.S. production of the drugs covered by this summary increased from $1.2 billion in 1965 to $1.7 billion in 1969, an average annual increase of 9 percent. Consumption is nearly equal to production, since exports and imports are small compared with production.

U.S. exports and imports

Statistics from the Bureau of the Census on export shipments of pharmaceutical preparations indicate that exports of both benzenoid and nonbenzenoid drugs in dosage forms and of finished pharmaceutical preparations not in dosage forms increased from $115 million in 1965 to $140 million in 1969. Nonbenzenoid drugs in dosage forms probably accounted for one-third of this total, ranging from $38 million in 1965 to $47 million in 1969..

U.S. imports of nonbenzenoid drugs in dosage forms increased steadily from $2.7 million in 1965, to $10.5 million in 1970 (see table). Most of the increase occurred in 1970, when imports more than doubled in value over the preceeding year. The United Kingdom has been the principal supplier and has accounted for most of the imports during 1965-70. Federal laws and regulations regarding plant inspection, labeling, and the efficacy and safety of new drugs apply to imported drugs as well as to the domestic product.

Nonbenzenoid drugs in dosage forms: U.S. imports for consumption, by principal sources, 1965-70

(In thousands of dollars)

Source	1965	1966	1967	1968	1969	1970
United Kingdom	1,956	2,126	2,248	2,929	3,923	5,851
Belgium	-	1/	-	-	11	2,983
Sweden	139	47	575	443	446	652
Canada	84	72	205	260	240	364
West Germany	99	133	78	96	158	191
Italy	176	543	147	206	56	126
Japan	42	23	55	49	37	102
Denmark	116	117	4	1/	17	2
All other	134	51	79	131	80	210
Total	2,746	3,112	3,391	4,114	4,968	10,481

1/ Less than $500.

Source: Compiled from official statistics of the U.S. Department of Commerce.

CELLULOSIC PLASTICS

Commodity	TSUS item
Cellulosic plastics materials:	
Cellulose acetate-----	445.20
Other----------	445.25

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

During 1965-70, U.S. production of cellulosic plastics materials covered in this summary was approximately 100 million pounds per year. In the same period, U.S. exports were from 25 million to 35 million pounds per year; imports, which were negligible prior to 1967 and again in 1970, were substantial in 1967-69, amounting to as much as 5.5 million pounds in 1968.

Description and uses

This summary covers cellulosic plastics materials, usually in unfinished forms, and liquid solutions of pyroxylin and other cellulose ethers and esters. The materials may be in solid, semisolid, or liquid state, such as flakes, powders, pellets, granules, solutions, and emulsions, and other basic forms. Cellulosic plastics in the form of film, sheet, strips, blocks, rods, and other solid forms are not included in this summary but are provided for under items 771.20 - .35 of the TSUS, and are discussed in a volume of summaries covering schedule 7 of the TSUS. Thus, none of the statistics in this summary include regenerated cellulose because it is produced directly as film; i.e., cellophane.

Cellulosic plastics materials are made by plasticizing esters and other derivatives of cellulose, a natural polymer abundant in vegetation. The cellulose derivatives used in the manufacture of plastic materials are obtained by chemical treatment of cotton linters or wood pulp. The principal derivatives used for plastics are cellulose acetate, cellulose acetate butyrate, cellulose acetate propionate, ethyl cellulose, and nitrocellulose; the plastics materials are obtained by the addition of plasticizers, stabilizers, and colors to the cellulose derivatives.

Plastics made from the cellulose acetate esters--the acetate, and the mixed esters, cellulose acetate butyrate and cellulose acetate

propionate--are the most important of the cellulose plastics. The acetate type has the greatest utility and is produced in the greatest quantity of any of the cellulose derivatives; the acetate butyrate type is one of the strongest and toughest of the cellulose plastics, and the acetate propionate type yields tough, shock-resistant materials. The three acetate ester plastics materials are used widely in the production of molded and extruded articles such as films and sheet for signs and packaging; toys, buttons, and closures; automobile steering wheels, arm rests, and knobs; household appliance and business machine housings and parts; and kitchen utensils, tooth brushes, and eye-glass frames.

The ethyl cellulose type of plastics is derived from the ethyl ether of cellulose. Its products are tough and shock-resistant and include films, containers, housings, tool handles, helmets, bowling pin bases, and flashlight cases. Nitrocellulose plastic, once the preeminent cellulosic, is now of small importance because of its flammability and difficulty of processing.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Cellulosic plastics materials:		
445.20	Cellulose acetate	7.5¢ per lb.	6¢ per lb. 1/
445.25	Other	19.5¢ per lb.	9.7¢ per lb.

1/ Rate effective January 1, 1969.

The rate effective January 1, 1969, for cellulose acetate plastics materials represents the second stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). Further reductions scheduled for years subsequent to 1969 for this item have not become effective. The rate effective January 1, 1972, for other cellulosic plastics materials represents the fifth and final stage of a concession granted by the United States in the sixth round of trade negotiations under the GATT. The first stage for both items became effective January 1, 1968. Staged Rates and Historical Notes to part 4 of schedule 4 of the TSUSA-1971 are shown in appendix A. The rates shown above as existing prior to January 1, 1968, remained

unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The ad valorem equivalents (A.V.E.) of the rates of duty on 1970 imports, based on the rates in effect in 1970, are as follows:

TSUS item	Commodity	A.V.E. (percent)	Range (percent)
445.20	Cellulose acetate plastics-----	8.4	3.4 - 16.0
445.25	Other cellulosic plastics------	19.4	5.8 - 46.6

U.S. consumption and production

U.S. consumption of the cellulosic plastics materials covered in this summary has been estimated, though somewhat understated, by adjusting domestic production of cellulosic plastics for molding and extrusion materials, the use to which most of the material is put, by imports and exports. Based on estimates thus obtained, annual consumption during 1965-67 was in the range of 75 million to 85 million pounds, increasing to 90 million pounds in 1968; consumption decreased somewhat in 1969, and still further in 1970 to about 65 million pounds. (Estimates are based on data shown in accompanying table). Consumption which cannot be readily estimated includes relatively small amounts of material such as nitrocellulose plastics which are consumed in the manufacture of sheeting and film.

In 1970, cellulosic plastics molding and extrusion materials were produced by four companies, three of which are large chemical and plastics manufacturers; one of these producers, however, discontinued production of molding and extrusion materials early in 1971. For none of the four large producers were the sales of cellulosic plastics a major source of income.

Domestic output of cellulosic plastics materials for use as molding and extrusion materials amounted to 99 million pounds in 1965, ranged between 106 million and 116 million pounds annually during 1966-69, and decreased to 94 million pounds in 1970. The value of annual production during 1965-69 (1970 value data not available) ranged between $65 million and $75 million (see accompanying table).

U.S. exports

Official U.S. export data most closely approximating the import classes covered by this summary are those which include exports of cellulose ether (and derivative) plastics in unfinished, semifinished, and finished shapes, and cellulose ester molding and extrusion compositions. During 1965-70, U.S. exports of these materials increased in each year from 25 million pounds, valued at $14 million, to 34 million pounds, valued at $19 million (see table).

During 1968-70, the Netherlands was the destination for 55 percent, or more, of the quantity, and 49 percent, or more, of the value, of U.S. exports of the cellulose ether plastics; smaller amounts of these exports were marketed in about 30 other countries during these years. In the same period, exports of cellulose ester molding and extrusion materials were marketed in 35 or more countries, of which Canada, Mexico, the United Kingdom, Switzerland, India, Japan, and Italy were the more important markets. Canada, the principal market for these cellulose ester exports in 1968-70, accounted for no more than about 20 percent of the total quantity in any of the years.

U.S. imports

Imports of cellulosic plastics materials were negligible before 1967 and again in 1970, amounting to less than 200,000 pounds, valued at no more than about $100,000, in any of these years. However, the expanded importation of cellulose acetate plastics from Canada during 1967-69 caused total imports of cellulosic plastics to rise to 2.2 million pounds, valued at $500,000, in 1967, to 5.6 million pounds, valued at $1.2 million in 1968, then decrease to 3.7 million pounds, valued at $800,000, in 1969 (see table). Other sources of imports in recent years have included mainly the EEC countries, the United Kingdom, and Japan.

The ratio of imports to consumption, based on the estimated quantity, did not exceed 5 percent in 1968, the peak year for imports; the ratio for those years when imports were negligible was considerably below 1 percent. The ratios of imports to consumption, based on value, for 1967-69, were substantially smaller than those based on quantity because the unit value of the large quantities of cellulose acetate plastics imported from Canada in those years was below 25 cents per pound while the average unit value of consumption in those years was about 65 cents per pound.

Cellulosic plastics materials: U.S. production, imports for consumption, and exports of domestic merchandise, 1965-70

Year	Production 1/	Imports	Exports 2/
	Quantity (1,000 pounds)		
1965	98,714	197	25,324
1966	110,811	73	27,935
1967	106,497	2,203	29,761
1968	116,498	5,551	32,138
1969	112,210	3,694	32,975
1970	94,347	150	34,150
	Value (1,000 dollars)		
1965	65,151	53	13,996
1966	74,243	66	15,113
1967	69,223	507	16,641
1968	73,324	1,164	17,369
1969	74,059	803	18,419
1970	3/	105	18,834

1/ Production is for cellulosic molding and extrusion materials only. Value of production calculated using the unit value of sales of all cellulosic plastics materials.

2/ Includes exports of cellulose ether and derivative plastics in unfinished, semifinished, and finished shapes, and cellulose ester molding and extrusion compositions.

3/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Polyethylene resins----------	445.30

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States is the world's largest producer of polyethylene resins which are of considerable importance in international trade. In 1970, U.S. production of these resins amounted to 5,872 million pounds, the value of which probably exceeded $700 million; exports in 1970 amounted to 598 million pounds, valued at $80 million. U.S. annual imports in recent years have accounted for less than 1 percent of consumption; in 1970, imports amounted to 20 million pounds, valued at less than $3 million.

Description and uses

Polyethylene resins are produced in a wide range of varieties depending on intended use and on method of manufacture. The two major types are low-density (including medium-density), or conventional polyethylene resins, made principally by the high-pressure process; and high-density, or linear polyethylene resins, made principally by the low-pressure process.

The low- and medium-density materials are in the specific gravity range of 0.916 to 0.940, and are usually produced by the polymerization of ethylene by a high-pressure process. Small amounts of oxygen, nitrogen oxides, or organic peroxides, and chemical modifiers to control the specific gravity, are mixed with the ethylene feed stock and the resulting molten polymer is extruded into rods or strips which are cut into small pellets or spheres for captive use or shipment. The low- and medium-density polyethylenes are used principally in the manufacture of films and sheeting, extrusion coatings on paper and other substrates, injection molding, and wire and cable coating.

High-density, or linear polyethylene, has specific gravities in excess of 0.940, and is produced in a process using considerably lower pressure than is used in producing the low-density material. In this process, ethylene is polymerized in the presence of catalysts such as aluminum alkyl, chromium oxide, or molybdenum, depending on which of the three major processes is used. The largest use for high-density polyethylene is in blow-molded products, followed by injection molded products, and films and sheeting.

U.S. tariff treatment

The column 1 rates of duty applicable to imports of polyethylene resins (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
445.30	Polyethylene resins	2.75¢ per lb. + 20% ad val.	1.3¢ per lb. + 10% ad val.

The rate effective January 1, 1972 represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are given in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The average ad valorem equivalent (A.V.E.) of the rate of duty effective January 1, 1970, for polyethylene resins, based on imports in 1970, was 27.3 percent. The range of A.V.E's, based on country source of imports, was from 17.7 percent to 28.3 percent.

U.S. consumption

Total U.S. consumption of polyethylene of all density grades more than doubled between 1965 and 1970. Consumption of polyethylene in 1965 is estimated to have been 2,622 million pounds, increasing in each year from 1965 to 1970, when it amounted to 5,294 million pounds (table 1).

U.S. consumption of low- and medium-density polyethylene (density 0.940 and below), as reported by the U.S. Tariff Commission (sales plus intracompany use), increased from 1,979 million pounds in 1965 to 3,689 million pounds in 1970 (table 2). According to Tariff Commission data, in 1970, the largest single use for low-density polyethylene was in the manufacture of film and sheet for which purpose 2,049 million pounds was reported. The second largest market was reported to be for the manufacture of injection-molded products (491 million pounds), followed by extrusion coating on paper and other substrates, and wire and cable coating (381 million pounds and 404 million pounds, respectively).

U.S. consumption of high-density polyethylene (density over 0.940) was reported by the Tariff Commission to be 652 million pounds in 1965 and 1,417 million pounds in 1970. In 1970, the largest

markets for high-density polyethylene, as reported by the Tariff Commission, was in the manufacture of blow-molded articles (593 million pounds), injection-molded articles (326 million pounds), film and sheet (63 million pounds), and pipe and conduit (60 million pounds).

The estimated data given in table 1 for U.S. apparent consumption of all polyethylene are higher than the total of low- and high-density polyethylene reported by the Tariff Commission in table 2 because the former includes materials added to inventory whereas the Tariff data do not. The upward trend in consumption of both low- and high-density polyethylene is expected to continue in the 1970's.

U.S. producers

Low-density polyethylene production was reported to the Tariff Commission in 1969 by 13 companies which operate 21 plants. Of these plants, 13 are located in Texas, 3 in Louisiana, 2 in Illinois, and 1 each in California, Indiana, and West Virginia. High-density polyethylene production was reported by 11 companies, operating 13 plants of which 8 are in Texas, 2 each in Louisiana and New Jersey, and 1 in Illinois. Of the producers of polyethylene, 7 are among the largest chemical companies; 5 are associated with major oil companies; 1 produces only plastics materials; and 2 major producers are in fields other than chemicals or petroleum. The plants of all the producers are large in size and their polyethylene business represents an important source of income. The producing plants are located for the most part near the source of supply of the raw material, ethylene.

U.S. production

U.S. production of polyethylene of all density grades in 1965 was 3,047 million pounds. Production increased rapidly each year thereafter and in 1970 amounted to 5,872 million pounds, an increase of more than 90 percent (table 1). The value of production in 1970 probably exceeded $700 million.

Data on polyethylene published annually by the U.S. Tariff Commission shows that production of low-density polyethylene in 1965 amounted to 2,263 million pounds; sales amounted to 2,046 million pounds, valued at $344 million. By 1970 U.S. output of low-density polyethylene has risen to 4,168 million pounds; sales data for 1970 are not yet available, but sales in 1970 are believed to have exceeded 1969 sales which amounted to 3,503 million pounds, valued at $424 million (table 3). Production data on low-density polyethylene in recent years has included production of ethylene copolymers.

Production and sales figures for high-density polyethylene, as

reported by the Tariff Commission, show that in 1965 production of high-density polyethylene amounted to 784 million pounds, and sales to 649 million pounds, valued at $120 million; in 1970 production amounted to 1,704 million pounds, while sales are believed to exceed 1969 sales of 1,242 million pounds, valued at $189 million (table 3). Trade sources indicate that the installed production capacity for low-density polyethylene plants by the end of 1970 would be 4.5 billion pounds and for high-density polyethylene plants, 2.0 billion pounds.

U.S. exports

U.S. exports of low-density and high-density polyethylene in 1970 amounted to about 10 percent (598 million pounds) of domestic production. During 1965-70 total annual exports were substantially lower during the first half of the period, when they amounted on the average to 380 million pounds, valued at $70 million, than in the second half when they amounted on the average to more than 600 million pounds, valued at $85 million (table 4). In 1970, the principal markets for U.S. exports of polyethylene, in order of value, were Canada ($11.4 million), the Republic of Korea ($9.5 million), Mexico ($8.2 million), Brazil ($5.5 million), the Netherlands ($4.4 million) and South Viet Nam ($4.3 million). Other countries to which substantial exports were made were Belgium, Columbia, Hong Kong, Venezuela, and Spain.

In 1965, exports of low-density and high-density polyethylene were shown separately in the official statistics of the Department of Commerce for the first time. Exports for each type for the years 1965-70 are given in the following tabulation:

	Low-density		High-density	
	Quantity	Value	Quantity	Value
Year	1,000 pounds	1,000 dollars	1,000 pounds	1,000 dollars
1965	301,455	54,515	128,422	26,692
1966	260,032	47,091	94,940	17,800
1967	265,083	43,794	92,303	15,717
1968	393,008	55,143	177,840	26,869
1969	461,926	61,970	196,187	26,889
1970	409,289	55,076	188,664	25,359

The five leading markets for low-density polyethylene, in terms of value, in 1970 were Canada ($8.6 million), the Republic of Korea ($6.8 million) Brazil ($4.9 million), Mexico ($4.8 million), and South Viet Nam ($3.5 million). The largest importers of U.S. high-density polyethylene in 1970 were the Netherlands ($4.1 million), Mexico ($3.4 million), Canada ($2.9 million), and the Korean Republic ($2.7 million).

U.S. imports

During 1965-70, imports of polyethylene resins were negligible compared to domestic consumption and exports. In 1970, when imports of polyethylene resins were several times higher than in other recent years, the ratio of imports to consumption was no greater than 0.5 percent; exports in 1970 were about 30 times greater than imports. Annual imports during 1965-67 decreased from 1,863,000 pounds, valued at $305,000 to 355,000 pounds, valued at $96,000; imports then increased in each year during 1968-70, amounting to 2,558,000 pounds, valued at $778,000, in 1968; 5,571,000 pounds, valued at $953,000, in 1969; and 20,091,000 pounds, valued at $2,878,000, in 1970 (table 1). Japan accounted for the greater part of the total imports in 1968-70 and for more than 90 percent of the quantity of imports (84 percent of the value) in 1970. West Germany, Canada, and the United Kingdom were other consistent suppliers of U.S. imports of polyethylene during 1965-70 (table 5).

Foreign production and trade

Foreign production of polyethylene for 1968, as reported by trade sources, in millions of pounds, is shown in the following tabulation:

Country or area	Low-density polyethylene	High-density polyethylene	Total polyethylene
European Economic Community-----	2,240	818	3,058
United Kingdom-----------	538	123	661
Other Western Europe----------	336	11	347
Japan----------	1,389	459	1,848
Other world----------	1,344	314	1,658
Total----------	5,847	1,725	7,572

Table 1.--Polyethylene: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1965-70

Year	Production 1/	Imports	Exports	Apparent consumption
	Quantity (1,000 pounds)			
1965	3,047,363	1,863	426,877	2,622,349
1966	3,557,958	688	354,972	3,203,674
1967	3,798,556	355	357,386	3,441,525
1968	4,567,722	2,558	570,848	3,999,432
1969	5,489,886	5,571	658,113	4,837,344
1970	2/ 5,872,298	20,091	597,953	5,294,436
	Value (1,000 dollars)			
1965	518,052	305	81,207	437,150
1966	604,853	158	64,891	540,120
1967	569,783	96	59,511	510,368
1968	593,804	778	82,012	512,570
1969	713,685	953	88,859	625,779
1970	3/	2,878	80,435	3/

1/ Value of production estimated using unit values of sales.
2/ Preliminary.
3/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Polyethylene: U.S. producers' sales and use, totals, and by end-use, 1965-70

(In thousands of pounds)

Type and end-use	1965	1966	1967	1968	1969	1970 1/
Density 0.940 and below:						
Sales and use, total	1,979,297	2,183,905	2,315,614	2,822,909	3,288,600	3,689,119
Injection molding	291,091	323,464	352,669	412,349	496,470	491,320
Blow molding	40,468	42,503	44,689	52,026	50,393	42,011
Film and sheet	938,193	1,100,493	1,094,354	1,418,928	1,631,071	2,049,335
Extrusion coating	282,610	313,164	307,430	348,404	398,091	381,322
Wire and cable	215,946	275,768	264,950	284,581	358,333	403,722
Other extruded products	31,663	40,023	37,258	25,074	51,317	22,787
All other uses	179,326	188,490	214,264	281,547	302,925	298,622
Density over 0.940:						
Sales and use, total	652,334	808,506	888,484	1,070,974	1,247,591	1,416,859
Injection molding	130,111	178,800	217,172	236,444	289,056	326,128
Blow molding	272,769	346,864	402,619	488,749	539,355	592,503
Film and sheet	37,539	45,423	38,485	49,373	55,362	62,870
Extrusion coating	2/	6,715	6,506	15,422	13,493	21,382
Wire and cable	22,600	30,193	34,561	39,152	33,473	31,034
Pipe and conduit	29,759	39,059	38,236	43,898	46,382	60,452
Other extruded products	26,302	22,384	20,685	16,577	18,269	20,943
All other uses	133,254	139,068	130,220	181,359	252,201	301,547

1/ Preliminary.
2/ Included with other extruded products.

Source: U.S. Tariff Commission: Synthetic Organic Chemicals, United States Production and Sales.

Table 3.--Polyethylene resins: U.S. production and sales, total and by type, 1965-70

Year and type	Production	Sales	Value	Unit value
	1,000 pounds	1,000 pounds	1,000 dollars	Per pound
1965:				
Total	3,047,363	2,695,090	464,292	$0.17
Density 0.940 and below	2,262,922	2,046,006	344,431	.17
Density over 0.940	784,441	649,084	119,861	.18
1966:				
Total	3,557,958	3,151,380	547,057	.17
Density 0.940 and below	1/2,647,615	2,320,740	401,090	.17
Density over 0.940	2/ 910,343	830,640	145,967	.18
1967:				
Total	3,798,556	3,458,648	529,362	.15
Density 0.940 and below	1/2,716,380	2,538,688	373,897	.15
Density over 0.940	2/1,082,176	919,960	155,465	.17
1968:				
Total	4,567,722	4,228,402	550,978	.13
Density 0.940 and below	1/3,306,455	3,110,794	377,503	.12
Density over 0.940	2/1,261,267	1,117,608	173,475	.16
1969:				
Total	5,489,886	4,744,681	613,041	.13
Density 0.940 and below	1/3,880,256	3,502,663	424,051	.12
Density over 0.940	2/1,609,630	1,242,018	188,990	.15
1970:				
Total	5,872,298	4/	4/	4/
Density 0.940 and below	1/4,168,219	4/	4/	4/
Density over 0.940	2/1,704,079	4/	4/	4/

1/ High pressure process and ethylene copolymers.
2/ Low pressure process.
3/ Preliminary.
4/ Not available.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 4.--Polyethylene: U.S. exports of domestic merchandise, by principal markets, 1965-70

Market	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Canada	21,670	24,318	32,604	55,010	80,073	74,674
Republic of Korea	11,784	6,844	13,735	62,228	55,003	74,679
Mexico	54,155	46,960	14,651	33,825	47,886	71,211
Brazil	2,649	4,851	11,796	178,862	25,317	41,826
Netherlands	23,288	23,207	24,698	59,501	56,569	37,564
South Vietnam	15,174	11,234	15,174	24,815	50,490	35,785
Belgium	13,562	10,390	14,444	19,113	26,597	19,395
Colombia	6,081	12,743	6,489	23,428	17,729	25,042
Hong Kong	28,103	13,515	26,679	20,415	32,484	23,360
Venezuela	7,805	6,098	6,823	13,829	17,314	17,131
Spain	43,203	25,069	12,230	18,414	28,911	6,066
All other	199,403	169,743	178,063	61,408	219,740	171,220
Total	426,877	354,972	357,386	570,848	658,113	597,953
	Value (1,000 dollars)					
Canada	4,832	4,880	6,518	8,905	12,281	11,436
Republic of Korea	1,947	1,243	2,272	8,352	6,525	9,541
Mexico	10,340	8,947	2,969	4,052	5,481	8,217
Brazil	425	837	1,527	1,879	2,958	5,478
Netherlands	4,519	3,674	3,563	7,948	6,522	4,461
South Vietnam	7,384	2,108	2,431	3,034	5,754	4,337
Belgium	2,608	1,783	2,077	3,422	4,132	3,554
Colombia	1,014	2,244	1,010	2,753	2,041	3,282
Hong Kong	4,592	2,134	3,365	2,264	3,387	2,520
Venezuela	1,391	1,156	1,016	1,747	2,368	2,382
Spain	6,482	3,814	1,932	2,596	3,740	896
All other	35,673	32,071	30,831	35,060	33,670	24,331
Total	81,207	64,891	59,511	82,012	88,859	80,435

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 5.--Polyethylene: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (pounds)					
Japan	-	4,044	44,973	1,478,927	3,634,665	18,239,225
West Germany	58,040	66,496	68,994	365,538	790,089	1,217,870
Canada	1,565,836	487,306	222,033	175,508	1,039,324	557,046
United Kingdom	146,663	33,001	11,440	35,661	74,540	56,486
Switzerland	86,140	85,755	-	-	-	13,397
All other	6,096	11,135	7,709	1/ 501,964	32,653	6,636
Total	1,862,775	687,737	355,149	2,557,598	5,571,271	20,090,660
	Value					
Japan	-	$3,492	$5,486	$559,523	$521,871	$2,421,633
West Germany	$32,062	29,764	46,205	108,730	235,136	338,031
Canada	199,028	69,479	38,277	29,700	154,729	94,682
United Kingdom	35,984	9,575	5,057	37,953	19,568	19,081
Switzerland	36,707	42,187	-	-	-	3,347
All other	1,207	3,897	1,318	1/ 42,467	21,590	1,473
Total	304,988	158,394	96,343	778,373	952,894	2,878,247

1/ Includes 497,578 pounds, valued at $41,090, from Italy.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Urea and amino (including melamine) resins----------	445.35

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

Amino resins, consisting essentially of urea and melamine resins, are an important class of plastics materials. In 1970, U.S. production of these resins amounted to 624 million pounds, while exports exceeded 13 million pounds; imports, which accounted for less than one percent of consumption, were less than 1 million pounds.

Description and uses

The term, amino resin, designates a group of organic resins made by the reaction of an amine with an aldehyde, usually formaldehyde (item 427.48). The nitrogen in these resins is characteristically present in amino form. The two most important amino resins are urea-formaldehyde and melamine formaldehyde, being generally referred to simply as urea resins and melamine resins. They account for virtually all of the annual output of amino resins with urea resins accounting for more than two-thirds of the total annual production. Benzenoid amino resins are covered in a separate summary in volume 4:1 under item 405.25.

The first step in producing urea or melamine resins, the formation of a polymerizable compound, is achieved by reacting either urea or melamine with formaldehyde. The product--or monomer--formed by this reaction is converted by condensation polymerization (the splitting-out of water from the molecule) into the polymeric urea or melamine resin. Amino resins--part of the broad class of thermosetting resins--, when consumed in the manufacture of end-products, are heated, with or without a catalyst, to form hard, insoluble, infusible materials.

The major end-uses for urea and melamine resins are in bonding and adhesive application, laminates, textile and paper treatment and coating, protective coating, and molded products. The urea resins in recent years have been used principally as adhesives for plywood, while the primary use for melamine resins has been in molded products (about 90 percent of melamine's molding volume goes into dinnerware).

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
445.35	Urea and amino (including melamine) resins	2.75¢ per lb. +20% ad val.	1.3¢ per lb. +10% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

Based on imports entered in 1970, the average ad valorem equivalent (A.V.E.) of the rate of duty in effect for that year on urea and amino (including melamine) resins was 24.5 percent. The A.V.E.'s, by country source of imports, ranged between 14.7 percent and 30.2 percent.

U.S. consumption

Official statistics on U.S. consumption of urea and other amino (including melamine) resins are not available; nor is it possible to make an accurate calculation of apparent consumption because official export statistics beginning with the year 1965 have excluded exports of resins for use as protective coatings or adhesives. Estimates of consumption for the period 1965-70, however, indicate that annual consumption of urea and other amino resins probably amounted to about 600 million pounds in 1965, rising to about 800 million pounds in 1968-69, then declining to about 600 million pounds in 1970. The decline in consumption in 1970 was probably the result of general economic conditions rather than problems specifically related to the amino resins industry.

The following tabluation on market patterns for urea and melamine resins is estimated by trade sources to be representative of their consumption by end use:

Use	Resin type: Urea (percent)	Resin type: Melamine (percent)
Bonding and adhesives, total----	58	32
Plywood----------	29	Negligible
Fibrous and granulated wood---	27	3
Laminating----------	2	29
Textile treating and coating----	10	13
Paper treating and coating-----	9	7
Protective coatings----------	7	15
Molding and miscellaneous-------	16	33
Total----------	100	100

The prices of both urea resins and melamine resins cover a wide range because of the many areas of application. Each major market requires a variation in the resin formulation, usually a modification of the basic resin.

U.S. producers

In 1969, there were more than 60 companies producing urea and melamine resins at about 150 plants throughout the continental United States. Only 17 of these companies may be classed as large, basic chemical manufacturers. About half of the producers of urea and melamine resins in 1969 were not basic chemical producers, but were primarily in the paint and coating industry, lumber and paper industry, or the textile industry. Nearly all of the remaining urea and melamine resins producers were small-sized specialty chemical producers--only a few of the producers could be considered as medium-sized chemical firms.

Those companies described as large chemical producers account for the bulk of the annual production of urea and melamine resins. Eight of these firms are reported to account for more than 64 percent of the annual capacity of these resins. Urea and melamine resins consumed by the producers in the manufacture of advanced products (captive production) has amounted to about 15 percent of the total production of these resins in recent years. This part of the consumption has been accounted for principally by the smaller manufacturers and those companies that produce the resins for special uses; there is little captive consumption by the large chemical company producers.

U.S. production

Annual production of urea and melamine resins increased irregularly from 621 million pounds in 1965 to about 816 million pounds in both 1968 and 1969, then declined to 624 million pounds in 1970 (table 1).

In 1965, production of urea resins amounted to 449 million pounds--72 percent of total production; production of melamine resins amounted to 172 million pounds--28 percent of the total. Separate statistics on production of these resins have not been available after 1965; however, it is believed that urea resins have continued to represent about 70 percent of total production.

U.S. exports

Official export statistics for urea and melamine resins exclude those exports for use as protective coatings or adhesives; thus, export data for the resins covered by this summary are substantially understated. Annual exports of the resins reported in official statistics generally declined during 1965-69, amounting on the average to about 16 million pounds in 1965-66, 13 million pounds in 1967-68, and 11 million pounds in 1969. Exports increased to more than 13 million pounds in 1970 (table 1).

The pattern of the export market changed somewhat during 1965-70. Canada was the principal market for U.S. amino resins during 1965-69, although the share of the total market held by Canada declined gradually from 37 percent to 30 percent during the period; Canada's share in 1970 was less than 15 percent. The United Kingdom, which accounted for 35 percent of the quantity (but only 20 percent of the value) of U.S. exports of amino resins in 1970, was the principal market in that year. The Netherlands was an important market in each year during 1965-70, while Italy, Surinam, and Iran were important only in the early part of the period. (Table 2 shows exports by principal markets in 1965-70).

During 1965-70, annual exports of urea and melamine resins were either evenly divided between both types, or exports of melamine resins exceeded those of urea resins by a small margin. Of the principal markets referred to, Canada was a market for both types of resins, generally in equal amounts; the Netherlands, Italy, and Iran were predominantly purchasers of melamine resins, while the United Kingdom and Surinam were purchasers only of urea resins.

U.S. imports

Imports of amino resins have been small in relation to domestic consumption in recent years, accounting at most for about 0.2 percent of consumption during 1965-70. The pattern of annual imports during this period was irregular and ranged between 880,000 pounds (in 1966) and 1,872,000 pounds (in 1968); imports in 1970 amounted to 893,000 pounds (table 1). West Germany, Sweden, Italy, Canada, and France were the principal sources of imports of amino resins during 1965-70

(table 3), the first three being consistently important suppliers during the period. Although data are not available showing the content of annual imports, it has probably varied considerably from year to year as indicated in 1965-70 by the average unit values which were 45¢ per pound or more in 1965 and 1968, and 25¢ per pound or less in the other years.

Table 1.--Urea and amino (including melamine) resins: U.S. production, imports for consumption, and exports of domestic merchandise, 1965-70

Year	Production 1/	Imports	Exports 2/
	Quantity (1,000 pounds)		
1965	621,179	1,096	15,001
1966	718,322	880	16,806
1967	690,062	1,272	13,018
1968	816,077	1,872	12,519
1969	816,521	1,509	10,530
1970	623,545	893	13,440
	Value (1,000 dollars)		
1965	155,295	528	4,141
1966	172,397	220	4,065
1967	158,714	231	3,281
1968	155,055	834	2,919
1969	155,139	319	2,537
1970	3/	162	2,867

1/ Value of production calculated using the unit value of sales.

2/ Does not include resins for use as protective coatings or adhesives.

3/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Urea and amino (including melamine) resins: U.S. exports of domestic merchandise 1/, by principal market, 1965-70

Market	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
United Kingdom	582	518	726	718	1,503	4,709
Canada	5,558	5,958	4,675	4,123	3,161	1,722
Netherlands	615	1,137	1,290	2,264	1,286	1,046
Italy	1,277	1,255	1,116	620	306	119
All other	2/ 6,969	3/ 7,938	4/ 5,211	4,794	4,274	5,844
Total	15,001	16,806	13,018	12,519	10,530	13,440
	Value (1,000 dollars)					
United Kingdom	127	158	204	168	295	567
Canada	1,597	1,391	1,340	956	741	435
Netherlands	117	227	257	380	297	228
Italy	419	383	347	173	88	42
All other	2/ 1,881	3/ 1,906	4/ 1,133	1,242	1,116	1,595
Total	4,141	4,065	3,281	2,919	2,537	2,867

1/ Does not include resins for use as protective coatings or adhesives.

2/ Includes 1,583 thousand pounds, valued at 490 thousand dollars, to Iran.

3/ Includes 1,443 thousand pounds, valued at 440 thousand dollars, to Iran, and 2,056 thousand pounds, valued at 170 thousand dollars, to Surinam.

4/ Includes 1,393 thousand pounds, valued at 114 thousand dollars, to Surinam.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.-- Urea and amino (including melamine) resins: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
West Germany	138	303	307	342	354	419
Sweden	365	147	118	208	159	255
Italy	39	180	767	324	447	135
Canada	58	152	13	424	501	5
France	272	61	-	491	2	-
All other	1/ 224	37	67	83	46	79
Total	1,096	880	1,272	1,872	1,509	893
	Value (1,000 dollars)					
West Germany	32	54	55	50	65	63
Sweden	98	40	21	37	27	43
Italy	6	29	118	50	72	27
Canada	16	37	3	94	142	2
France	272	44	-	564	2	-
All other	1/ 104	16	34	39	11	27
Total	528	220	231	834	319	162

1/ Includes 114 thousand pounds, valued at 72 thousand dollars, from Switzerland.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Polyvinyl acetate and derivatives	445.40
Other vinyl resins, except polyvinyl chlorides	445.45 (pt.)

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

In 1970, U.S. production of the vinyl resins covered by this summary exceeded 500 million pounds, valued at $100 million; exports amounted to about 100 million pounds; and imports totaled 35 million pounds. Polyvinyl acetate is the most important item included here with production of 400 million pounds in 1970.

Description and uses

This summary covers polyvinyl acetate and its commercial derivatives--polyvinyl alcohol, polyvinyl butyral, polyvinyl formal and polyvinyl acetal--as well as other vinyl resins including polyvinyl fluoride and the polyvinyl ethers. Not included here is the most important vinyl resins--polyvinyl chloride (item 445.4520)--which is discussed separately in another summary in this volume.

Polyvinyl acetate, by far the most important item covered here, is a clear nontoxic thermoplastic resin polymerized from vinyl acetate monomer (item 428.68). Most of the polyvinyl acetate produced is used in aqueous dispersions for such applications as emulsion paints, adhesives, and fabric finishes; some, however, is used as the basic raw material for other resins, being converted by hydrolysis to polyvinyl alcohol. Part of the polyvinyl alcohol produced is used in textile sizing, adhesives, and paper coatings; some is further used as a raw material for other vinyl resins, being reacted with aldehydes to form polyvinyl butyral, formal and acetal. Polyvinyl butyral is the most important of these derived resins and is used principally as an interlayer in the manufacture of safety glass, primarily for automobile windshields and windows. Other uses of polyvinyl butyral include fabric coatings and prime coatings for marine use, pipelines, oil-storage tanks, and air conditioning equipment. Polyvinyl formal is used mostly in coatings for electrical insulation which are highly resistant to heat, abrasion, and solvents. Polyvinyl acetal is used as a photographic film base and as an injection molding material.

The other vinyl resins covered here (in item 445.45) include polyvinyl fluoride and the polyvinyl ethers. Polyvinyl fluoride is made by

polymerizing vinyl fluoride monomer (item 429.48). It forms tough, flexible films, but is used only in small volume at present. Polyvinyl ethers are polymerized from monomers such as ethyl vinyl ether and methyl vinyl ether. They are mostly viscous liquids, used in small quantities in plasticizers, adhesives, and surface coatings.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
445.40	Polyvinyl acetate and derivatives--	1.25¢ per lb. + 6.25% ad val.	0.6¢ per lb. + 3% ad val.
445.45 (pt.)	Other vinyl resins-------	2.5¢ per lb. + 12.5% ad val.	1.25¢ per lb. + 6% ad val.

The rate effective January 1, 1972, represent the final stages of concessions granted by the United States in the sixth round of negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The ad valorem equivalents (A.V.E.) of the rates of duty on 1970 imports of the items covered in this summary, based on the rates effective January 1, 1970, are as follows:

TSUSA item	Commodity	A.V.E. (percent)	Range (percent)
445.4020	Polyvinyl alcohol resins	7.3	5.5-8.3
445.4040	Polyvinyl acetate and derivatives other than polyvinyl alcohol	7.2	4.8-11.2
445.4540	Other vinyl resins, except polyvinyl chloride	15.3	10.0-40.3

U.S. consumption

Official statistics on which to calculate consumption of the vinyl resins covered here are not available inasmuch as production data reported for the vinyl resins, other than polyvinyl chloride, include data for polyvinylidene chloride (in item 445.50), covered in another summary. Thus, the apparent consumption shown in table 1 (about 550 million pounds in 1970) is substantially overstated.

During 1965-69, consumption of vinyl resins other than polyvinyl chloride, but including polyvinylidene chloride, increased in each year of the period and increased overall by about one-third; domestic consumption in 1965 amounted to about 440 million pounds. During 1965-70 polyvinyl acetate accounted for about two-thirds of the total reported consumption of vinyl resins other than polyvinyl chloride resins; polyvinyl alcohol, polyvinyl butyral, and polyvinylidene chloride accounted for a substantital part of the remainder. U.S. sales, including consumption by the producers, of polyvinyl acetate in 1970 amounted to 379 million pounds, down from 395 million pounds in 1969. Sales of polyvinyl alcohol in 1970 reported on a similar basis, amounted to to 39 million pounds down from 51 million pounds in 1969. Separate consumption or sales data for the other vinyl resins covered here are not available. Decreases in sales in 1970 for polyvinyl acetate and polyvinyl alcohol are believed to be the results of general economic conditions rather than indicative of a trend in the demand for these materials. The trend in sales for these products in the period preceding 1970 was upward.

The principal markets for sales of polyvinyl acetate, the principal vinyl resin considered here, have been emulsion paints and adhesives; U.S. sales for these markets in 1970 amounted to 135 million pounds and 124 million pounds, respectively. Sales for bonding and sizing in the paper and textile industries in 1970 amounted to 40 million pounds; sales for other uses amounted to 80 million pounds (table 3).

U.S. producers

In 1969, the latest year for the which data are available, polyvinyl acetate was produced by 45 firms; most of them are large and located in the East and Midwest. Six firms produced polyvinyl alcohol, greater part of which was made by four companies; the plants are situated in Kentucky, Massachusetts, New York, and Ohio. The other vinyl resins were made by five firms--most of which also made polyvinyl acetate and a few, polyvinyl alcohol--in plants located mainly in the East and Midwest.

U.S. production

Domestic production of vinyl resins other than polyvinyl chloride (including substantial quantities of polyvinylidene chloride, in item 445.50) increased in each year during 1965-69 from at least 475 million pounds to 654 million, or more, pounds (table 1); production of these resins in 1970 was about 5 percent smaller than in 1969. During 1965-70, annual production of polyvinyl acetate, the resin of greatest economic importance covered here, ranged between 313 million pounds, valued at $97 million, in 1965 and 426 million pounds, valued at $111 million, in 1969; production in 1970 declined to 403 million pounds (table 2). About a third of the production of polyvinyl acetate is believed to be consumed by the producers in the manufacture of derivatives and advanced products.

During 1965-70 the production of polyvinyl alcohol increased from 37 million pounds, valued at an estimated $16 million, in 1965 to 57 million pounds, valued at $19 million, in 1969; production decreased to 49 million pounds in 1970. The data, however, do not include the quantities which are converted by producers to polyvinyl butyral. For the same period, the combined output of other resins covered by this summary, and for which combined data are available, increased in each year from 124 million pounds in 1965 to 171 million pounds in 1969; production of these resins decreased to 168 million pounds in 1970 (table 2). The aggregate production of vinyl resins covered by this summary, but not included in the above statistics, is small; it is more than offset, however, by the production of polyvinylidene chloride included here.

U.S. exports

During 1965-70 exports of vinyl resins other than polyvinyl chloride increased overall from 45 million pounds, valued at $19 million in 1965, to 105 million pounds, valued at $39 million in 1970. The greater part of the annual exports was accounted for by vinyl resins containing no additives (i.e., uncompounded). In 1970, U.S. exports of uncompounded vinyl resins amounted to 81 million pounds, valued at $30 million; exports of vinyl resins containing additives (i.e., compounded) amounted to 24 million pounds, valued at $9 million.

Canada was the principal market for the vinyl resins covered by this summary in each year during 1965-70; in 1970 exports to Canada amounted to 24 million pounds, valued at nearly $8 million. Belgium, the Netherlands, West Germany, the United Kingdom, and Japan have been other important markets in recent years (table 4).

U.S. imports

During 1965-70, imports of the vinyl resins covered by this summary increased from 10 million pounds in 1965 to 26 million pounds in 1967, declined to 24 million pounds in 1969, then increased to nearly 35 million pounds in 1970 (table 1). Imports of polyvinyl acetate and its derivatives (item 445.40) accounted for by far the greater part of the total imports covered here--more than 90 percent in 1967-70; imports of polyvinyl alcohol accounted for more than 85 percent of item 445.40 in 1970, when they were first reported separately. Japan was the principal supplier of imports of polyvinyl acetate and derivatives during 1965-70; West Germany and Canada were suppliers of less importance (table 5).

U.S. imports of the other vinyl resins included here have been small, amounting to about 2 million pounds annually during 1965-70. West Germany was the principal supplier of the other vinyl resins in these years; an invoice analysis for 1967 showed that most imports from West Germany at that time consisted of polyvinyl ethers.

World production and trade

The vinyl resins of this summary are usually produced in volume, and only in those countries with well developed organic chemical industries. Next to Japan, the United States is the world's leading producer of polyvinyl acetate, polyvinyl alcohol, and the other vinyl resins. Other important producing countries are West Germany, France, the United Kingdom, the Netherlands, Belgium, Italy, Switzerland, and Canada.

International trade in these vinyl resins is less than the trade in articles fabricated and formulated from them. Principal exporting countries are Japan, the United States, West Germany, and Canada.

Table 1.--Polyvinyl resins, except polyvinyl chloride: U.S. production 1/, imports for consumption, exports of domestic merchandise, and apparent consumption, 1965-70

(In thousands of pounds)

Year	Production	Imports	Exports	Apparent Consumption
1965	474,819	10,077	45,218	439,678
1966	506,396	15,767	59,239	462,924
1967	539,489	26,140	64,462	491,167
1968	579,721	25,424	93,403	511,742
1969	654,139	23,705	86,227	591,617
1970	2/ 620,503	34,575	104,511	550,567

1/ Data are reported on resin-content basis and include polyvinyl alcohol (item 445.4020), polyvinyl acetate, polyvinyl butyral and other polyvinyl acetate derivatives (item 445.4040), and other vinyl resins, except polyvinyl chloride (item 445.4540), which are covered by this summary. Also included is polyvinylidene chloride (in item 445.5040), which is covered by another summary in this volume.

2/ Preliminary.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Polyvinyl resins, except polyvinyl chloride 1/: U.S. production, by type, 1965-70

Year	Total	Polyvinyl acetate	Polyvinyl alcohol	Other vinyl resins
	Quantity (1,000 pounds)			
1965	474,819	313,160	37,373	124,286
1966	506,396	335,961	38,337	132,098
1967	529,489	342,370	43,484	143,635
1968	579,721	383,569	45,168	150,984
1969	654,139	426,342	57,003	170,794
1970 2/	620,503	403,173	49,037	168,293
	Value (1,000 dollars) 3/			
1965	179,526	97,080	4/	5/ 82,446
1966	182,605	97,429	16,485	68,691
1967	184,492	99,287	19,133	66,072
1968	175,257	95,892	18,971	60,394
1969	195,132	110,849	19,381	64,902
1970	6/	6/	6/	6/

1/ Data are reported on resin-content basis and include polyvinyl alcohol (item 445.4020), polyvinyl acetate, polyvinyl butyral and other polyvinyl acetate derivatives (item 445.4040), and other vinyl resins, except polyvinyl chloride (item 445.4540), which are covered by this summary. Also included is polyvinylidene chloride (in item 445.5040), which is covered by another summary in this volume.

2/ Preliminary.

3/ Value of production estimated from unit value of sales.

4/ Included with Other vinyl resins.

5/ Includes value of polyvinyl alcohol.

6/ Not available.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 3.--Polyvinyl acetate U.S. sales by producers 1/ by principal use, 1965-70

(In thousands of pounds)

Use	1965	1966	1967	1968	1969	1970 2/
Emulsion paints	104,641	110,090	95,461	120,625	136,923	134,848
Adhesives	111,064	105,444	116,971	133,562	124,722	123,973
Bonding and sizing	19,856	35,907	32,356	40,403	43,245	39,969
All other uses	45,074	51,719	63,270	60,809	83,567	79,934
Total	280,635	303,160	308,058	355,399	388,457	378,724

1/ Resin-content basis; includes data on intracompany consumption, but does not include export sales by producers.

2/ Preliminary.

Source: U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales.

Table 4.--Polyvinyl resins, except polyvinyl chloride: U.S. exports of domestic merchandise, by principal markets, 1965-70

Market	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Canada	13,304	15,029	13,823	18,523	25,050	23,947
Belgium	4,010	5,421	5,686	9,362	8,567	9,749
Netherlands	5,552	7,092	6,362	9,754	10,896	9,955
West Germany	2,387	3,668	3,841	5,109	7,904	16,158
United Kingdom	4,924	5,374	9,128	10,772	5,965	7,755
Japan	2,199	3,898	4,849	7,822	4,782	6,079
All other	12,842	18,757	20,773	32,061	23,063	30,867
Total	45,218	59,239	64,462	93,403	86,227	104,510
	Value (1,000 dollars)					
Canada	4,487	5,124	4,905	6,053	7,997	7,541
Belgium	2,391	3,155	3,123	5,636	4,701	5,551
Netherlands	2,397	3,087	2,749	4,505	3,253	5,175
West Germany	963	1,379	1,622	1,897	2,363	4,200
United Kingdom	2,577	2,684	4,395	4,342	2,695	2,985
Japan	815	1,605	1,781	2,586	1,681	2,577
All other	5,295	8,111	8,904	11,970	9,120	11,320
Total	18,925	25,145	27,479	36,989	31,810	39,349

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 5.--Polyvinyl acetate and derivatives: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Japan	3,923	10,325	21,715	21,176	19,262	31,362
West Germany	1,065	1,066	1,289	1,343	1,532	1,120
Canada	2,695	2,302	528	459	546	210
All other	295	390	629	686	-	1/ 555
Total	7,978	14,083	24,161	23,664	21,950	2/ 33,247
	Value (1,000 dollars)					
Japan	1,199	2,888	5,914	5,578	5,011	7,965
West Germany	319	247	443	400	420	351
Canada	929	519	133	89	94	61
All other	60	72	232	204	-	1/ 241
Total	2,507	3,726	6,722	6,271	5,746	2/ 8,618

1/ Includes 253 thousand pounds, valued at 148 thousand dollars, from France.

2/ Includes imports of polyvinyl alcohol amounting to 29,861 thousand pounds, valued at 7,721 thousand dollars.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Polyvinyl chloride resins----------	445.45 (pt.)

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

U.S. consumption of polyvinyl chloride resins is supplied almost entirely by domestic production, which in both 1969 and 1970 exceeded 3 billion pounds. In terms of quantity, U.S. exports of polyvinyl chloride resins (167 million pounds in 1970) amounted to 5 percent of domestic production. In the same year, imports amounted to 6 million pounds.

Description and uses

Polyvinyl chloride resins (commonly called PVC) are widely used because they are low in cost, easy to fabricate, adaptable to many uses and resistant to weathering, electricity, water, and chemicals. PVC homopolymers are produced by polymerization of vinyl chloride monomer (item 429.44). Most are blended with plasticizers to make them flexible and rubbery. Copolymers are produced by the simultaneous polymerization of vinyl chloride with another monomer. The most important copolymer is the vinyl chloride-vinyl acetate copolymer which usually contains 85 to 97 percent of the chloride and is more flexible than the homopolymer; i.e., the vinyl acetate portion of the molecule acts as a self-contained plasticizer.

By varying the conditions and components of the polymerization reaction and additives which are blended in subsequently, a variety of polymers may be obtained tailored for intended use. They range from soft rubbery materials to hard rigid products.

The major markets of PVC are film and sheet (for flooring, shower curtains, seat covers, etc.); electrical insulation on wire; phonograph records; and a host of other applications including coatings, hose and pipe, bottles, and gutters.

The traditional polymerization processes employ suspensions or emulsions of small droplets of monomer in an aqueous medium to facilitate close control of temperature, promote contact with water-soluble catalysts, and avoid buildup of a solid layer of resin on the walls of the stirred kettle or other reactor. An important recent development

has been the bulk or mass polymerization process in which no water or solvent is present. Except for some emulsions (latexes) which are used as such, or others in which the fine polymer particles are dispersed in plasticizer (i.e., plastisols), most of the polyvinyl chloride is separated and dried for use as pellets or powder. In these forms the PVC is later blended with stabilizers, colors, plasticizers, fillers, and other additives; then in the fabrication process, the PVC resins as covered by this summary are softened by heat and pressed into shape by machines such as extruders, injection molding machines, calenders, and blow molding equipment.

Whatever the physical form, PVC is made in a variety of grades depending not only on additives but also on comonomers (of any), molecular weight, and other chemical factors.

Some of the important categories or grades of PVC resins and copolymers are the following:

(1) General-purpose homopolymers.
(2) General-purpose copolymers.
(3) Rigid grades--usually copolymers without plasticizer for uses such as piping, gutters, and phonograph records.
(4) Dispersion resins--small particle size, for dispersion in plasticizer--i.e., plastisol.
(5) Latexes--i.e., emulsions in water for coating paper or textiles.
(6) Solution-type resins, of low molecular weight, which are dissolved in organic solvents and used for surface coatings.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
445.45 (pt.)	Polyvinyl chloride resins	2.5¢ per lb. + 12.5% ad val.	1.25¢ per lb. + 6% ad val.

The rate effective January 1, 1972, represents a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became effective January 1, 1968.

Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The average ad valorem equivalent (A.V.E.) of the rate of duty effective January 1, 1970, for polyvinyl chloride resins, based on imports in 1970, was 15.5 percent. The range of A.V.E.'s based on country source of imports, was from 12.8 percent to 40.6 percent.

U.S. consumption and production

During 1965-70 the apparent consumption of polyvinyl chloride resins increased rather regularly from 1.8 billion pounds in 1965 to nearly 3.0 billion pounds in 1970 (table 1). The value of consumption increased by about $100 million during this period.

In the same period, U.S. production of polyvinyl chloride resins followed a pattern of increase similar to that of domestic consumption, except that in 1968-70 production increased at a greater rate than consumption, the difference being absorbed by the export market. Production increased over-all in 1965-70 from 1.8 billion pounds to 3.1 billion pounds (table 1), an increase for the period of about 70 percent.

In 1969, when domestic sales and intracompany (captive) consumption of polyvinyl chloride resins, as reported by the U.S. Tariff Commission, amounted to 2,753.5 million pounds, sales and intracompany consumption, by use categories, were as follows:

(In millions of pounds)

Sales and use, total	2,753.5
Calendering, except flooring	522.5
Flooring:	
Calendered	269.8
Coated	66.1
Paper and textile coating, and other paper and textile uses	101.3
Protective coatings and adhesives	84.2
Wire and cable	376.5
Extruded film and sheet	161.4
Other extruded products	463.0
Sound records	138.0
Injection and blow molding	109.6
Plastisol formulating and molding	111.6
All other domestic uses	349.5

U.S. producers

In 1969, there were 23 companies producing polyvinyl chloride and copolymer resins. Eleven of the producers were very large, diversified chemical producers to whom polyvinyl chloride and copolymer resins were an important but not a predominant part of operations. Five other producers were major manufacturers of tires and other rubber goods. Four producers were relatively small concerns and polyvinyl chloride and copolymer resins constituted a major part of their business. For two other producers, not classified in a particular industry, polyvinyl chloride and copolymer resins are a minor part of the operations. The remaining producer is an affiliate of a major oil company.

Polyvinyl chloride and copolymer resins were produced in 1969 in 36 plants located in 15 States, distributed as follows: California, 3; Delaware, 3; Florida, 1; Illinois, 3; Kentucky, 2; Louisiana, 1; Maryland, 1; Massachusetts, 4; Mississippi, 1; New Jersey, 5; New York, 3; Ohio, 4; Pennsylvania, 1; Texas, 2; and West Virginia, 2.

U.S. exports

During 1965-70, exports of polyvinyl chloride resins and copolymer resins increased in quantity by more than 100 percent and in value by more than 60 percent. Exports increased from 79 million pounds, valued at $20 million, in 1965 to 167 million pounds, valued at $32 million, in 1970; exports in 1969 amounted to 167 million pounds, valued at $34 million (table 1). Canada was the principal market for U.S.-produced polyvinyl chloride resins in each year during the period accounting for from 15 million to 25 million pounds, valued at from $4 million to $6 million, in each year. The United Kingdom, Belgium, Brazil, Venezuela, and Australia were other important markets in most of these years (table 2).

Official export statistics are divided into two categories: (1) Uncompounded polyvinyl chloride and copolymer resins (not containing additives); and (2) compounded polyvinyl chloride and copolymer resins (containing additives). From 1965 through 1970, the uncompounded material accounted annually for from 55 to 79 percent of the total annual exports. In 1970, the United Kingdom, Canada, Belgium, Brazil, Venezuela, Japan, and Australia were the principal markets for exports of uncompounded polyvinyl chloride and copolymer resins. These countries accounted for about 66 percent of the exports in 1970. During 1970, the principal export markets for compounded polyvinyl chloride and copolymer resins were Canada, the Dominican Republic, Australia, Ecuador, and the Philippine Republic. These countries represented about 60 percent of the total exports of compounded resin in 1970; Canada accounted for about one-third of the total value.

U.S. imports

Imports increased in each year during 1965-68 from 6.7 million pounds to 16.6 million pounds, then decreased to 6.2 million pounds in 1970 (table 1). At no time during these years did imports account for as much as 1 percent of apparent consumption.

In recent years, Japan, West Germany, Italy, Canada, the United Kingdom, France, and Belgium have accounted for nearly all the U.S. imports of polyvinyl chloride resins. During 1965-69, West Germany and Italy, together, accounted for from 60 to 90 percent of imports; in 1970, however, Japan accounted for more than 70 percent of imports. (Table 3 shows imports of polyvinyl chloride resins, by principal sources, during 1965-70.)

Foreign production and trade

Polyvinyl chloride and copolymer resins are produced in all of the principal countries of the world. Production, imports, and exports of polyvinyl chloride and copolymer resins for the major producing countries are given in the following tabulation for the year 1968:

Country	Production 1,000 short tons	Imports 1,000 short tons	Exports 1,000 short tons
Japan	942	3	87
Germany	615	1/	1/
Italy	465	1/	1/
Great Britain	2/313	57	30
France	279	45	67
The Netherlands	3/	89	23

1/ Not available.
2/ Consumption plus exports.
3/ Production of all thermoplastic resins in 1968 was 285,000 short tons.

Table 1.--Polyvinyl chloride resins 1/: U.S. production, imports for consumption, exports of domestic merchandise, and apparent consumption, 1965-70

Year	Production 2/	Imports	Exports	Apparent consumption	Ratio (percent) of imports to apparent consumption
	Quantity (1,000 pounds)				
1965	1,837,477	6,686	79,256	1,764,897	0.4
1966	2,163,561	9,290	86,538	2,086,313	.4
1967	2,142,438	14,012	75,546	2,080,904	.7
1968	2,635,314	16,639	112,212	2,299,541	.7
1969	3,032,063	6,480	166,924	2,871,619	.2
1970	3/ 3,133,908	6,194	167,407	2,972,695	.2
	Value (1,000 dollars)				
1965	312,369	1,054	20,141	293,282	0.4
1966	367,805	1,204	10,911	349,098	.3
1967	364,214	2,132	19,369	346,977	.6
1968	368,935	2,453	26,034	345,354	.7
1969	424,572	1,021	34,241	391,352	.2
1970	4/	1,527	32,496	4/	4/

1/ The statistics also include data for copolymer resins which contain 50 percent, or more, polyvinyl chloride.
2/ Value of production calculated using the unit value of sales.
3/ Based on preliminary data.
4/ Not available.

Source: Production, U.S. Tariff Commission, Synthetic Organic Chemicals, United States Production and Sales; imports and exports, compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Polyvinyl chloride resins 1/: U.S. exports of domestic merchandise, by principal markets, 1965-70

Market	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Canada	20,150	22,896	15,790	19,803	24,884	25,483
United Kingdom	4,276	4,488	4,591	11,969	23,404	21,185
Belgium	3,561	5,510	6,881	7,115	10,084	6,819
Brazil	305	534	1,032	8,441	13,745	16,885
Venezuela	5,181	5,613	6,491	7,112	9,211	15,012
Australia	2,795	1,447	1,848	2,420	5,048	9,864
All other	42,988	46,050	38,913	55,352	80,548	72,159
Total	79,256	86,538	75,546	112,212	166,924	167,407
	Value (1,000 dollars)					
Canada	5,529	4,824	4,164	4,691	6,134	5,838
United Kingdom	1,537	1,388	1,440	3,237	4,502	3,815
Belgium	1,203	1,824	2,612	2,612	3,809	2,787
Brazil	85	132	173	1,189	1,952	2,238
Venezuela	956	1,031	1,225	1,236	1,473	2,085
Australia	624	495	587	727	960	1,716
All other	10,207	10,218	9,168	12,342	15,411	14,017
Total	20,141	19,912	19,369	26,034	34,241	32,496

1/ The statistics also include data for copolymer resins which contain 50 percent, or more, polyvinyl chloride.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Polyvinyl chloride resins 1/: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
Japan	935	556	348	23	274	4,547
West Germany	1,705	2,511	2,991	5,638	3,042	510
Italy	3,454	5,565	8,758	6,705	1,952	364
Canada	505	152	570	499	327	231
United Kingdom	39	89	101	316	156	224
France	44	411	1,088	2,653	174	8
Belgium	-	-	85	65	10	2
All other	4	6	71	740	545	308
Total	6,686	9,290	14,012	16,639	6,480	6,194
	Value (1,000 dollars)					
Japan	153	86	123	8	41	1,237
West Germany	262	223	471	872	507	88
Italy	507	790	1,227	935	279	47
Canada	117	34	131	185	60	58
United Kingdom	8	19	23	81	40	46
France	7	49	127	269	16	3
Belgium	-	-	15	8	2	1
All other	-	3	15	95	76	47
Total	1,054	1,204	2,132	2,453	1,021	1,527

1/ The statistics also include data for copolymer resins which contain 50 percent, or more, polyvinyl chloride.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Polypropylene resins----	445.50 (pt.)

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States is the world's largest producer of polypropylene resins. U.S. production of polypropylene resins in 1970 amounted to 1,038 million pounds. Exports of polypropylene resins in 1970 amounted to more than 100 million pounds; imports are believed to have been negligible.

Description and uses

Polypropylene resins are thermoplastic resins produced by the heterogenous polymerization of high-purity propylene dissolved in hydrocarbons. Several catalytic systems are used in the production process, including titanium chloride and aluminum alkyl, using normal paraffins, isoparaffins, and naphthenes as diluents. The resulting solid polymer--which is mostly isotactic polypropylene--and the solvent phase, which contains atactic and low-molecular weight polypropylene, are separated. The isotactic material is further purified, after which it is washed, dried, and stored for shipment or for consumption by the producer.

Polypropylene is one of the most versatile and fastest growing of the family of plastics materials because of its unusual combination of properties which make it suitable for tailoring to specific end-use requirements. Propylene is also copolymerized with other monomers, usually a smaller amount of ethylene, to provide additional families of resins with varied groups of characteristics. Polypropylene and propylene copolymer resins are produced in many grades and formulations, including molding and extrusion grades with various melt flows. Resins for the manufacture of films and fibers are also produced in many grades. Polypropylene has the lowest density of the commercially available thermoplastic resins, and possesses high yield strength and rigidity, good flex life, and good surface hardness. It is essentially unaffected by most chemicals, and is resistant to cracking. Its dielectric properties are excellent, and it has good resistance to scratching and abrasion. Polypropylene is used for making twine and rope and is being developed as a foam. Polypropylene resins are used to make blow-molded and injection-molded articles, film and sheet, monofilaments and multifilaments, pipe and pipe fittings, and in wire

and cable coating and in a number of other minor uses. Polypropylene is the only polymer for which there is a large market in fibers and filaments as well as plastics materials.

U.S. tariff treatment

The column 1 rates of duty applicable to imports of polypropylene resins (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
445.50 (pt.)	Synthetic plastics materials:		
	Other--------	2.75¢ per lb. +20% ad val.	1.3¢ per lb. +10% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade. The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The average ad valorem equivalent (A.V.E.) for imports of polypropylene resins in 1970, based on the rate of duty effective January 1, 1970, and on the estimated unit value of imports, is about 21 percent. Imports of polypropylene resins are not reported separately, but are included in a group of miscellaneous plastics under TSUS item 445.50; the other materials included under this item are discussed in the summary on miscellaneous plastic materials.

U.S. consumption

Domestic consumption of polypropylene resins is estimated, based on reported sales and intracompany consumption by the producer, or by trade sources, for selected recent years, as follows:

Year	Quantity (million pounds)
1963	152
1966	500
1968	800
1969	925
1970	864

The largest markets for polypropylene resins are in the manufacture of molded articles, filaments and fibers, and film and sheeting. Trade estimates for domestic consumption of polypropylene resins by major markets for 1968 and 1969 are given in the following tabulation:

Market	1968 (million pounds)	1969 (million pounds)
Injection and blow molding	427	512
Fibers and filaments	225	270
Film and sheeting	80	90
Pipe and profiles	14	14
Miscellaneous	54	39
Total	800	925

There is some overlap between polypropylene used for fibers and that used for sheeting and film because textile fibers may be made from slit film and could be considered in either category. Polypropylene fibers and filaments offer the best possibilities for growth. Fibers from slit film also have good growth possibilities, especially for outdoor carpeting and in garments such as slacks and sweaters. These fibers are likely to offer considerable competition to nylon, acrylic, and polyester fibers.

U.S. producers

Polypropylene is produced in the United States by 8 companies in 9 producing plants, 4 of which are in Texas, 2 in New Jersey, and 1 each in Delaware, West Virginia, and Louisiana.

Three of the producers of polypropylene are affiliated with major oil companies. Three are large, diversified producers of chemicals. One is affiliated with a drug and chemical producer; and one produces

only plastics materials. One large chemical company operated a 30-million-pound-per-year plant for polypropylene, but ceased production early in 1968.

U.S. production

Production of propylene polymer and copolymer resins increased nearly tenfold between 1960, when it amounted to 41 million pounds, and 1965, when it amounted to 374 million pounds. During 1965-69, production increased in each year, amounting to nearly 1,100 million pounds in 1969; production decreased in 1970 to 1,038 million pounds. U.S. production of propylene polymer and copolymer resins in 1965-70, as reported by the U.S. Tariff Commission, is shown in the following tabulation:

Year	Quantity (1,000 pounds)
1965	374,067
1966	553,533
1967	662,328
1968	876,179
1969	1,089,890
1970 1/	1,037,977

U.S. exports and imports

Data on exports of polypropylene resins were not reported separately in the official Government statistics before 1968, but according to data reported to the Tariff Commission, manufacturers' exports of polypropylene resins prior to 1968 was from 50 million to 75 million pounds per year. Official data for 1968-70 give exports of polypropylene resins in 1968 as 129 million pounds, valued at $29 million, in 1969 as 75 million pounds, valued at $16 million, and in 1970 as 102 million pounds, valued at $22 million. Principal markets in 1970 were Canada, Mexico, the United Kingdom, Sweden, Italy, West Germany, and the Netherlands (see accompanying table).

Data on imports of polypropylene resins are not separately reported; however, it is not likely, in view of the large and growing production of polypropylene resins in the United States, that they are imported in appreciable quantities.

1/ Preliminary

Polypropylene resins 1/: U.S. exports of domestic merchandise, by principal markets, 1968-70

Market	1968	1969	1970
	Quantity (1,000 pounds)		
Canada	41,373	31,440	37,783
Mexico	8,673	4,006	11,155
United Kingdom	6,824	3,912	9,810
Sweden	4,727	1,594	5,663
Italy	595	703	4,147
West Germany	9,156	5,051	4,068
Netherlands	9,678	2,176	3,180
All other	48,181	25,956	25,805
Total	129,207	74,838	101,611
	Value (1,000 dollars)		
Canada	9,339	6,819	8,199
Mexico	1,719	889	2,557
United Kingdom	1,495	780	1,958
Sweden	1,033	347	1,248
Italy	155	136	909
West Germany	1,890	1,108	867
Netherlands	2,431	531	781
All other	11,028	5,673	5,717
Total	29,090	16,283	22,236

1/ Does not include resins for protective coatings and adhesives.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Synthetic plastics materials:	
Acrylic and methacrylic acid resins---	445.05
Acrylonitrile resins----------	445.10
Allyl resins----------	445.15
Other, not elsewhere enumerated-------	445.50(pt.)
Artificial mixtures of two or more nonbenzenoid synthetic plastics materials----------	445.75

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

U.S. annual consumption of the synthetic plastics materials covered in this summary amounted to 600 million, or more, pounds in 1969 and 1970. U.S. imports in 1970 of the plastics materials included in this summary amounted to about 18 million pounds, valued at $9 million; exports were several times greater than imports.

Description and uses

This summary covers nonbenzenoid synthetic plastics materials not included in other summaries. (See summaries in this volume for other nonbenzenoid plastics materials as covered by TSUS items 445.20, -.25, -.30, -.35 -.40, and -.45; polypropylene resins which are provided for in TSUS item 445.50, are treated in a separate summary in this volume because of their importance) More than a score of plastics materials covered by this summary are produced commercially but many are specialty products made in small volume.

By far the most important materials covered here are resins derived from esters of acrylic and methacrylic acids (e.g. ethyl acrylate, item 428.62 and methylmethacrylate in item 428.72) which are polymerized with a catalyst and heat. Though similar in chemical composition, the acrylates and methacrylates are made by different technologies and have widely different end-use patterns.

By far the most important methacrylate is the methyl ester, made by the two- or three-step combination of acetone and hydrogen cyanide plus methanol. Polymethylmethacrylate cast into sheets is as transparent and weather resistant as glass but lighter in weight and less easily broken. Glazing, illuminated outdoor advertising signs, and similar sheet products are the most important methacrylate markets; followed by molded and extruded products such as stoplight lenses,

nameplates, dials, and knobs; and protective coatings--mainly industrial finishes.

Acrylate esters are made mainly by the reaction of acetylene with carbon monoxide and ethyl or another alcohol. One of the competitive processes is oxidation of propylene first to acrolein and then to acrylic acid, followed by the esterification step. Polyacrylate ester monomers are generally copolymerized with vinyl acetate or methyl methacrylate and/or other chemicals in emulsions which are used in that form as paint latexes, textile finishing resins, etc. Minor uses of acrylates are in specialty rubbers and solid copolymers.

Next in importance on a value basis are the fluorocarbon resins (also known as fluoroplastics). These resins are polymerized from monomers such as chlorotrifluoroethylene, fluorinated ethylene propylene, tetrafluoroethylene, and vinylidene fluoride. They have outstanding resistance to chemicals, heat, and electricity. Their main use is in heat-resistant wire and cable in the defense and aerospace industries. Other uses include high-performance glass-reinforced pipes and plastic-lined valves for equipment exposed to corrosive chemicals, in textile finishes to impart stain resistance, in coatings to prevent food from sticking to cooking utensils, as high-temperature lubricants, and for long-life external protective coatings for metal.

Acetal resins are produced from formaldehyde--as such or as the trimer (trioxane). They have excellent strength and dimensional stability which makes them useful as replacements for metal in engineered parts for automobiles, appliances, industrial machines, and other hardware components.

Polyamide resins (non-nylon type) are made by condensation of lactams or polycarboxylic acids and polyamines, and used in surface-coatings, hot-melt adhesives, and printing inks.

Polyvinylidene chloride is polymerized from vinylidene chloride monomer and used in self-adhesive films; coatings which are resistant to moisture, grease, and gases; and bristles and other monofilament products.

Silicones are prepared by reacting methyl chloride with powdered silicon to form chloromethylsilane monomers. The monomers are further hydrolyzed and polymerized to form various resins which are chemically inert, water repellent, and stable at high temperatures. Major uses for silicone resins are protective coatings, electrical insulation, and high-temperature laminates for many uses including electrical. There is considerable usage of silicones as release coatings (easy peel-off), water-repellant coatings for paper and textiles and lubricants; here there is some disagreement in the industry as to whether these products are fluids or resins.

MISCELLANEOUS PLASTICS MATERIALS

Acrylonitrile polymers are produced as an intermediate stage in the manufacture of acrylic fibers but acrylonitrile resins are seldom isolated or traded for use in plastics.

Allyl resins produced from monomers such as allyl diglycol carbonate are clear casting resins with excellent abrasion resistance.

Polyterpene resins are made by catalytic polymerization of terpene hydrocarbons derived from turpentine and used mainly in pressure-sensitive adhesives and hot-melt adhesives and coatings.

As far as can be determined, there are few products produced in the United States which would be considered artifical mixtures, as provided for under item 445.75; materials of this mature, however, would probably be specialties such as adhesives, or other bonding compounds.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Synthetic plastics materials:		
445.05	Acrylic and methacrylic acid resins	2.75¢ per lb. + 20% ad val.	1.3¢ per lb. + 10% ad val.
445.10	Acrylonitrile resins	2.75¢ per lb. + 20% ad val.	1.3¢ per lb. + 10% ad val.
445.15	Allyl resins	2.75¢ per lb. + 20% ad val.	1.3¢ per lb. + 10% ad val.
445.50(pt.)	Other, not elsewhere enumerated	2.75¢ per lb. + 20% ad val.	1.3¢ per lb. + 10% ad val.
445.75	Artificial mixtures of two or more nonbenzenoid synthetic plastics materials	The highest rate applicable to any component material	The highest rate applicable to any component material

The rates effective January 1, 1972, represent the final stage of concessions granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. The rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rates shown as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

The ad valorem equivalent (A.V.E.) of the rates of duty on 1970 imports of the items covered in this summary, based on the rates effective January 1, 1970, are as follows:

TSUSA item	Commodity	A.V.E. (Percent)	Range (Percent)
445.0500	Acrylic resins----------	20.3	14.1-21.4
445.1000	Acrylonitrile resins------	16.6	14.1-20.8
445.1500	Allyl resins----------	18.9	14.6-22.8
445.5020	Polytetrafluoroethylene---	14.7	14.4-15.0
445.5040(pt.) 1/	Other plastics materials--	17.1	14.2-19.4

1/ The A.V.E. shown for this item is based on data for the entire TSUS class which includes polypropylene resins, discussed in a separate summary.

U.S. consumption and production and producers

U.S. production of the plastics materials covered here is estimated at over 800 million pounds, valued at $400 million, in 1970. Consumption is somewhat less than production in view of substantial exports which are estimated to be several times greater than imports. Separate data are not available on production, consumption, or sales of the individual plastics and resin materials considered here.

The plastics materials covered in this summary are produced by over 100 companies, ranging in size from the largest chemical companies to very small, specialized operations. Some of the producers consume all or most of their resin production to make more advanced products. Acrylic resins are produced in the United States by about 20 companies, but over 90 percent of the production of acrylic resins is accounted for by a half-dozen companies. Of these, the major ones are very large producers of chemicals, making a large variety of products. Another is a producer of household specialties while one is a major producer of petroleum products. Acetal resins are produced in the United States by two large chemical concerns. Polyvinylidene chloride is made in the United States by eight companies; fluorocarbon resins by four companies, and the polyamide resins (non-nylon type) by six companies, both large and small. The other plastics and resins covered in this summary are made by numerous paint, chemical, and specialty manufacturers, varying in size from small to very large, most of which produce other products in conjunction with plastics materials.

U.S. exports

Total U.S. export data for the plastics materials covered in this summary are not available since many of the export classes involved are not entirely comparable with import classes. In some instances export classes combine benzenoid and nonbenzenoid materials where import classes do not; in other instances export classes do not include resins for use as protective coatings and adhesives. Statistics for exports in 1970 for some of the materials included in this summary are shown in the following tabulation:

Description	Quantity	Value	Principal markets
	1,000 pounds	1,000 dollars	
Silicone resins in unfinished forms.	23,013	26,501	Belgium, Netherlands, Japan, Canada, U.K., and West Germany.
Acrylic resins in unfinished forms except for protective coatings and adhesives.	20,829	12,134	Canada, Colombia, Netherlands, U.K., and France.

Exports of other plastics materials covered here probably amounted to several million pounds more than those tabulated.

U.S. imports

Total imports in 1970 for the plastics materials covered here, including those for polypropylene resins discussed in another summary, amounted to 17.8 million pounds, valued at $9.2 million, a decrease from total imports in 1969--23.1 million pounds, valued at $9.3 million--the highest in recent years. Of imports in 1970, the miscellaneous class, including polypropylene resins, accounted for 9.7 million pounds, valued at $4.6 million; imports of polytetrafluoroethylene, reported separately from the miscellaneous class for the first time in 1970, amounted to 1.2 million pounds, valued at $2.4 million. Imports of acrylic resins in 1970 accounted for most of the remaining imports covered here, amounting to 6.4 million pounds, valued at $1.9 million; imports of acrylonitrile and alkyl resins, and artificial mixtures of two or more plastics materials, were small in 1970 as in other recent years (see accompanying table).

Miscellaneous plastics materials: U.S. imports for consumption, by type, 1965-70

Year	Acrylic resins	Acrylonitrile resins	Allyl resins	Poly-tetra-fluoro-ethylene	Other plastics and resins 1/	Artificial mixtures
	Quantity (1,000 pounds)					
1965	232	1,273	85	2/	1,869	11
1966	436	421	91	2/	4,794	7
1967	454	12	179	2/	3,073	8
1968	6,496	115	139	2/	5,117	18
1969	8,669	114	204	2/	14,064	18
1970	6,432	151	266	1,205	9,655	74
	Value (1,000 dollars)					
1965	127	318	22	2/	1,827	4
1966	166	110	17	2/	4,056	2
1967	223	3	51	2/	4,612	7
1968	1,860	37	40	2/	4,837	13
1969	2,386	10	56	2/	6,878	26
1970	1,927	115	103	2,446	4,613	24

1/ Includes imports of polypropylene, covered in a separate summary.
2/ Included with "Other plastics and resins."

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Natural rubber:	
Not containing fillers, extenders, pigments, or rubber-processing chemicals	446.05
Containing fillers, extenders, pigments, or rubber-processing chemicals	446.10

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

Crude natural rubber is not produced in the United States; domestic consumption, which in 1970 amounted to 566,000 long tons, was supplied either by imports (556,000 long tons) or by shipments from the U.S. stockpile (26,000 long tons). U.S. exports of crude natural rubber (16,000 long tons) were small in 1970. Most of the crude natural rubber is converted to natural rubber containing fillers, extenders, pigments, or rubber-processing chemicals; imports and exports of the converted product are small.

Description and uses

Hevea rubber is the product most commonly known world-wide as natural rubber, being the product obtained from rubber trees. This summary, however, also includes as natural rubber the related natural gums, balata, jelutong, gutta percha, and other guttas, as provided for in the Tariff Schedules of the United States (TSUS) which defines rubber in headnote 2 to part 4B of schedule 4. The definition, in addition to specifying certain physical performance requirements, states that rubber "means a substance, whether natural or synthetic, in bale, crumb, powder, latex, or other crude form, which can be vulcanized or otherwise cross-linked. . . . and includes such substance whether or not containing fillers, extenders, pigments, or rubber-processing chemicals".

Natural rubber without additives is called crude rubber, whereas natural rubber containing additives is oftentimes (and hereafter) called compounded rubber. The latter material is derived, or compounded, from crude rubber, an important article of world commerce and, until the development of the synthetic rubber industry, a highly strategic material for the world powers. Other kinds of rubber--chlorinated natural rubber (item 446.12), synthetic rubber

(item 446.15), reclaimed rubber (item 446.20), and rubber mixtures (item 446.30)--are covered in separate summaries in this volume.

The trees from which hevea rubber is derived are cultivated in tropical areas of the world, principally in Southeast Asia and Africa, and to some extent in South America. The crude rubber is obtained from the trees in the form of a milky fluid called latex which is harvested by a process called "tapping", a periodic draining of latex from tree sections from which the bark has been removed.

Crude hevea rubber is generally marketed either as a dry rubber which has been coagulated from diluted latex and rolled into sheets, or as a concentrated latex of 60-70 percent rubber content. Most crude hevea rubber is smoke-dried to form "ribbed smoked sheets" although a large amount is specially milled and dried into a spongy "crepe" rubber which is usually lighter in color than the smoke-dried rubber. Dry rubber is generally shipped as bales of rubber sheets although some is shipped as bales of compressed rubber crumbs. Latex rubber is transported in tank ships; facilities for storing the latex rubber are available at many domestic seaports.

When consumed in the manufacture of various rubber products, practically all crude rubber is first converted to a compounded rubber containing one or more chemical agents. In the manufacturing process, most of the compounded rubber is in turn subjected to a curing process called vulcanization which improves the rubber's elasticity, strength, and other properties.

Early in the 20th century, about a hundred years after natural rubber was first used in commercial manufacturing, rubber produced synthetically was made available first in Europe and later in the United States. Since World War II, these chemically produced rubbers, collectively termed "synthetic rubber", have replaced natural rubber in many uses. Natural rubber is still used, however, as a raw material in producing tires for automotive vehicles and in the manufacture of tens of thousands of other industrial and consumer articles. It is preferred for truck and airplane tires, whereas synthetic rubber is consumed in greater quantities for passenger car tires and tire-related products.

Balata and gutta percha are the principal guttas covered here. Guttas are gums that are closely related to hevea rubber in chemical structure and have somewhat similar uses. Both balata and gutta percha are used in the manufacture of golf balls, belting, and underwater cable insulation. Balata is native to the northeastern part of South America while gutta percha is obtained mainly from Malaysia and Indonesia.

Jelutong (or pontianak) is a highly resinous rubber and is used as a chewing gum base in the same manner that chicle (items 188.32-.34) is used. Jelutong is produced mainly in Malaysia.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
	Natural rubber:		
446.05	Not compounded	Free	Free 1/
446.10	Compounded	10% ad val.	5% ad val.

1/ Rate not affected by the sixth round of trade negotiations under the General Agreement on Tariffs and Trade.

The duty-free status for uncompounded (crude) rubber was provided for in the original Tariff Act of 1930 and in the TSUS, effective August 31, 1963, and has been bound under the General Agreement on Tariffs and Trade (GATT) since January 1, 1948 (specifically for india rubber latex, since May 20, 1950), as a concession granted by the United States.

The rate effective January 1, 1972, on compounded natural rubber represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the GATT. The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rates shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption

The United States is the world's largest consumer of natural rubber, accounting for about one-fifth of all the natural rubber consumed. During 1965-70, U.S. consumption of hevea rubber increased irregularly from 515,000 long tons in 1965 to 598,000 long tons in 1969, decreasing to 559,000 long tons in 1970 (table 1). Only in a very few years during the post-World War II period has U.S. consumption of natural rubber been as high as in 1969. In general, the trend for U.S. consumption in recent years has been upward; consumption decreased in 1967 because of labor strikes in the rubber

products manufacturing industry, and in 1970 probably due to the general slowing of the U.S. economy. In recent years about 70 percent of the crude hevea rubber consumed in the United States has been used in the manufacture of tires or tire-related products.

Statistics on the consumption of balata, gutta percha and other guttas, and jelutong are not available; however, based on imports, it is estimated that the U.S. consumption of these gums in recent years has accounted for no more than about 1 percent of the total consumption of materials covered by this summary, which are estimated to have been 566,000 long tons in 1970 (table 1).

U.S. producers and production

Crude natural rubber is not produced commercially in the United States. Although there have been attempts to cultivate "wild rubber", such as guayule rubber, on a large scale in the Southwestern part of the United States, these ventures have met with little economic success. However, a few of the large U.S. tire and rubber companies own and operate hevea rubber plantations in countries better suited to the cultivation of natural rubber than the United States. Plantations of substantial size are operated by one or more of these companies in Indonesia, Malaysia, Liberia, and Nigeria. Smaller plantations are operated by one or more of these same companies in the Philippines, Brazil, and Guatemala. U.S.-owned plantations, however, produce only a very small part of the total world output of crude natural rubber.

Compounded natural rubber is produced as an intermediate product by hundreds of domestic rubber-fabricating companies. Statistics are not available on U.S. production of compounded natural rubber but it is assumed that most of the crude rubber used in this country is converted to compounded rubber.

The same U.S. rubber companies that operate plantations abroad and produce compounded natural rubber domestically are among the largest U.S. producers of synthetic rubber and fabricators of rubber products. More than 1,500 U.S. companies manufacture articles made from natural or synthetic rubbers, or both.

U.S. Government stockpile

Between 1959 and 1970, a source of supply of natural rubber was that quantity made available from the U.S. Government stockpile of natural rubber. The stockpile was created as a security measure at the end of World War II in order to guarantee that adequate supplies of rubber would be available in emergency situations; supplies had

been curtailed during the war because of the inaccessibility of rubber from Asia. The purpose for the stockpile was largely nullified, however, by the successful development of the domestic synthetic-rubber industry in the postwar era. Thus, between 1959 and 1970, the United States disposed of more than 850,000 long tons of natural rubber, or about three-fourths of the stockpile. During 1965-70 the annual quantity released ranged from 26,000 long tons in 1970 to 155,000 long tons in 1966 (table 1). Substantial portions of the rubber sold was for foreign aid, defense, and other Government uses, although much was sold to industry.

U.S. imports

Imports, including imports for stockpiling, have supplied all of the U.S. consumption of crude natural rubber and allied gums covered by this summary. During the period 1965-70 total annual imports of these materials ranged between 435,000 long tons in 1966 and 590,000 long tons in 1969. Of the amount imported in 1970 (556,000 long tons), hevea rubber accounted for 550,000 tons, of which 69,000 long tons was in the form of latex; imports of gutta percha and miscellaneous guttas amounted to nearly 4,000 long tons, those of balata to nearly 600 long tons, and those of jelutong to nearly 2,000 long tons (table 2).

Malaysia and Indonesia are the principal sources of U.S. imports of crude natural rubber although lesser but substantial quantities are supplied by the African countries, Liberia, Nigeria, and the Congo (Kinshasa), and by Singapore and the other Asian countries, Thailand, Ceylon, and Cambodia (table 3). Singapore is an important rubber-processing area and the trade center for rubber in Southeast Asia.

During 1965-70 Malaysia and Indonesia alternated as the principal source of U.S. imports of crude natural rubber, together supplying from 70 to 80 percent of annual U.S. imports. In 1970 imports from Malaysia amounted to 246,000 long tons, valued at $110 million, and imports from Indonesia amounted to 140,000 long tons, valued at $54 million. U.S. imports from these countries in 1970 were smaller than those in 1969. In general, imports of crude rubber from Indonesia have been of lower grade than those from other sources.

In recent years U.S. imports of balata have been from South or Central America, mainly Brazil; imports of gutta percha and other guttas have been principally from Indonesia and Malaysia; imports of jelutong have been from Singapore, Malaysia, and Indonesia.

U.S. imports of compounded natural rubber have been small in comparison with crude rubber and in 1967, the peak year (based on quantity) for these imports, they amounted only to 675 long tons, valued at $384,000, about two-thirds of which was supplied by Malaysia. Imports of the compounded rubber were substantially greater in 1966 and 1967 than in other years during 1965-70 as shown in the following tabulation compiled from U.S. Department of Commerce figures; statistics for this class of imports were not available before 1964.

Year	Total	Malaysia	All other
	Quantity (long tons)		
1965	368	277	91
1966	662	592	70
1967	675	448	227
1968	396	350	46
1969	356	336	20
1970	342	289	53
	Value (1,000 dollars)		
1965	297	253	44
1966	622	534	88
1967	384	254	130
1968	218	167	51
1969	211	185	26
1970	205	148	57

U.S. exports

Exports of crude natural rubber, including the allied gums, consist of shipments of imported merchandise. During 1965-70, these exports increased from 37,000 long tons in 1965 to 50,000 long tons in 1966, then decreased in each succeeding year to 16,000 long tons in 1970 (table 1). The higher annual exports in the early part of the period were principally accounted for by relatively large shipments to the Korean Republic and Turkey, the principal destinations during these years, and to India in the peak year, 1966 (table 4). Canada was also a consistently important market during the period. During 1966-68, exports were equivalent to from 6 to 9 percent of the supply of natural rubber (imports plus rubber from stockpile).

Separate statistics on exports of balata, gutta percha, and other allied gums are available only for years prior to 1965; during

1962-64 annual exports of these gums amounted to less than 70 long tons. Separate official statistics on exports of compounded rubber are not available, but it is believed that exports of this material have been very small.

World production, consumption, and trade

In 1970 the world output of natural rubber amounted to nearly 2.9 million long tons, almost all of which was produced in the tropical zones of Asia, Africa, and Latin America (table 5). In recent years, Malaysia has produced 43 percent of the world's supply of natural rubber; Indonesia, 27 percent; Thailand, 10 percent; and African countries, 7 percent. The remainder has been produced by other countries of southern Asia and Latin America. Countries of Latin America have accounted for less than 2 percent of the world production.

World consumption of natural rubber in 1970 amounted to nearly 2.9 million long tons, almost all of which was consumed in countries other than where it was produced (table 6). The principal consuming countries and the shares of the world consumption accounted for by each in 1970 are: the United States, 19 percent; Japan, 10 percent; the U.S.S.R., 9 percent; West Germany, 7 percent; China (Mainland), 6 percent; the United Kingdom, 6 percent; and France, 5 percent. Eastern European countries, not including the U.S.S.R., accounted for about 7 percent of the world's consumption of natural rubber.

During the period 1965-70, the annual world consumption of natural rubber increased at a smaller rate than the consumption of synthetic rubber and in 1970 accounted for less than 40 percent of the total consumption of rubber. In the principal consuming countries other than the United States, natural rubber accounted for a larger share of the consumption of rubber than in the United States, although the proportion of natural rubber to total rubber used in these countries also decreased.

For most of the producing countries, natural rubber has been an important source of income and economic conditions in these countries are affected by the fluctuations of world prices for natural rubber. The rubber industry in most of the producing countries consists not only of large planting enterprises (estates), usually thousands of acres in size, but also of many small-scale growers (small holders) whose holdings may each average only a few acres.

Malaysia is the world's principal producer of natural rubber which accounts for a substantial part of the value of the country's exports. Malaysia's production of rubber in 1970 amounted to 1,255,000 long tons compared with 934,000 long tons in 1965.

New high-yield rubber trees have accounted for much of the increase in the country's rubber output and Malaysian producers have initiated a number of new processing, grading, and packing methods to make their product more attractive to consumers.

Indonesia, the other large producer of natural rubber, was beset in the early 1960's with political problems which had adverse effects on the quantity and quality of rubber produced. Production decreased from 670,000 long tons in 1962 to 573,000 tons in 1963, then increased generally over the next several years to nearly 782,000 long tons in 1970.

Table 1.--Natural rubber (crude) 1/: U.S. imports for consumption, deliveries from stockpile, exports of foreign merchandise, and consumption, 1965-70

(In long tons)

Year	Imports 2/	Deliveries from stockpile	Total new supply 3/	Exports 4/	Consumption 5/	
					Total 6/	Hevea
1965--	452,951	119,660	572,611	36,519	522,340	514,706
1966--	435,037	154,686	589,723	49,832	549,057	545,678
1967--	458,008	96,884	554,892	41,221	494,007	488,848
1968--	545,800	78,615	624,415	40,922	587,489	581,864
1969--	589,649	34,762	624,411	23,070	602,645	598,272
1970--	556,309	25,528	581,837	15,988	565,699	559,315

1/ There is no U.S. production of crude natural rubber.

2/ Includes balata, guttas, and jelutong in addition to hevea rubber, but does not include compounded natural rubber.

3/ Imports plus deliveries from stockpile.

4/ Includes balata, guttas, jelutong, and other allied gums, in addition to hevea rubber.

5/ Includes small amounts of imported compounded rubber.

6/ Consumption of hevea rubber plus imports of balata, guttas, and jelutong.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Natural rubber (crude): U.S. imports for consumption, by type, 1965-70

Type	1965	1966	1967	1968	1969	1970
	Quantity (long tons)					
Rubber (Hevea), dry------	391,301	383,084	401,108	477,198	518,155	480,560
Rubber (Hevea), latex----	54,016	48,574	51,741	62,977	67,121	69,365
Balata-----	1,874	1,117	818	904	750	572
Gutta percha and other guttas---	4,122	1,235	3,127	2,673	1,645	3,915
Jelutong---	1,638	1,027	1,214	2,048	1,978	1,897
Total--	452,951	435,037	458,008	545,800	589,649	556,309
	Value (1,000 dollars)					
Rubber (Hevea), dry------	152,277	151,820	145,278	161,213	244,879	203,916
Rubber (Hevea), latex----	30,054	25,099	24,321	26,362	30,548	27,383
Balata-----	1,815	1,745	1,226	972	925	691
Gutta percha and other guttas---	1,979	1,006	2,378	1,289	1,198	2,271
Jelutong---	1,970	1,276	1,324	1,920	1,989	2,237
Total--	188,095	180,946	174,527	191,756	279,539	236,498

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Natural rubber (crude) 1/: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (long tons)					
Malaysia	126,103	109,263	158,692	205,602	271,746	245,470
Indonesia	243,084	240,280	192,663	179,135	155,923	139,935
Liberia	42,944	42,983	50,336	56,191	57,138	69,962
Singapore	-	4,328	11,550	28,203	34,691	30,179
Thailand	5,614	5,805	8,313	33,525	27,846	27,361
Nigeria	9,303	10,448	10,999	9,203	15,721	19,363
Congo (Kinshasa)	7,706	7,642	7,880	16,632	11,159	12,667
Ceylon	8,885	9,104	9,150	9,934	7,915	8,264
Cambodia	4,318	2,348	4,296	4,179	4,768	1,853
All other	4,994	2,836	4,129	3,196	2,742	1,255
Total	452,951	435,037	458,008	545,800	589,649	556,309
	Value (1,000 dollars)					
Malaysia	66,939	56,028	67,328	77,118	136,460	109,745
Indonesia	77,867	82,306	61,734	53,054	63,565	53,858
Liberia	22,282	20,957	21,458	21,701	27,204	26,741
Singapore	-	2,263	5,003	11,726	17,868	14,431
Thailand	2,581	2,582	3,023	11,242	13,133	11,883
Nigeria	4,332	4,672	4,443	3,116	7,438	7,810
Congo (Kinshasa)	3,959	3,719	3,453	6,374	5,346	5,806
Ceylon	4,550	4,645	3,943	4,059	4,292	4,166
Cambodia	2,032	1,062	1,710	1,455	2,283	861
All other	3,553	2,712	2,432	1,911	1,950	1,197
Total	188,095	180,946	174,527	191,756	279,539	236,498

1/ In addition to hevea rubber, includes guttas, balata, and jelutong.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 4.--Natural rubber (crude) 1/: U.S. exports of foreign merchandise, by principal markets, 1965-70

Market	1965	1966	1967	1968	1969	1970
	Quantity (long tons)					
Canada	4,976	6,815	5,579	5,183	5,858	5,614
United Kingdom	458	848	690	770	686	902
Venezuela	1,343	1,397	1,647	1,825	567	1,083
France	474	646	844	699	364	553
Denmark	321	309	379	631	556	844
Korean Republic	10,181	12,175	12,801	16,865	4,941	-
India	35	7,952	1,478	-	1,869	-
Turkey	9,615	8,176	7,987	7,526	2,506	-
All other	9,590	12,160	10,660	8,122	6,087	7,545
Total	36,519	49,832	41,221	40,922	23,070	15,988
	Value (1,000 dollars)					
Canada	3,364	4,324	3,682	3,476	3,845	3,447
United Kingdom	465	776	720	746	696	883
Venezuela	773	844	997	1,103	409	735
France	461	587	840	760	340	691
Denmark	228	209	268	478	424	639
Korean Republic	5,251	6,051	5,413	6,562	2,166	-
India	16	4,040	696	-	863	-
Turkey	5,334	4,565	3,928	1,919	831	-
All other	6,187	8,029	6,851	5,701	4,351	5,625
Total	21,618	28,838	22,555	19,985	13,585	11,329

1/ Includes balata, guttas, jelutong, and other allied gums, in addition to hevea rubber.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 5.--Natural rubber (crude) 1/: World production, by country, 1965-70

(In long tons)

Country	1965	1966	1967	1968	1969	1970
Malaysia	934,251	982,515	982,290	1,082,905	1,247,964	2/1,255,000
Indonesia	705,323	704,390	2/750,000	2/740,000	777,945	2/ 782,500
Thailand	213,065	203,824	210,793	254,704	277,390	287,163
Ceylon	116,442	128,946	140,942	146,370	148,452	156,644
India	48,607	52,355	61,515	67,757	78,688	88,485
Cambodia	48,144	50,519	52,815	50,521	51,016	3/
Vietnam	60,000	48,070	39,902	29,226	25,737	28,009
Brazil	28,827	23,962	20,833	22,595	23,571	24,582
Africa 2/	157,000	174,000	161,150	167,050	178,600	198,800
All other 4/	30,800	30,400	27,800	29,900	30,100	45,300
Total 4/	2,342,500	2,399,000	2,448,000	2,591,000	2,839,500	2,866,500

1/ Does not include balata, guttas, or jelutong.
2/ Estimated.
3/ Not available.
4/ Partly estimated and rounded.

Source: Compiled from statistics published in the Rubber Statistical Bulletin by the Secretariat of the International Rubber Study Group.

Table 6.--Natural rubber (crude) 1/: World consumption, by country, 1965-70

(In long tons)

Country	1965	1966	1967	1968	1969	1970
United States	514,706	545,678	488,848	581,864	598,272	559,315
China (Mainland) 2/	137,500	169,750	157,250	208,500	270,750	178,500
U.S.S.R. 2/	256,200	289,650	258,250	320,750	290,350	268,500
Japan	198,300	212,600	239,150	250,950	263,750	278,550
United Kingdom	183,800	181,000	175,700	191,000	188,400	185,400
West Germany	155,367	155,114	139,105	167,315	188,220	197,555
France	120,579	123,996	125,801	126,775	145,243	153,823
Italy	85,600	90,000	98,400	98,400	100,400	111,200
India	63,653	65,639	71,370	82,876	85,323	85,103
Canada	42,793	46,521	45,385	44,758	48,880	49,817
Australia	36,295	33,874	36,281	37,809	39,225	38,726
Brazil	26,134	30,374	31,625	37,553	34,518	36,159
All other 3/	563,100	604,800	593,300	654,000	682,200	726,400
Total 3/	2,384,000	2,549,000	2,460,500	2,802,500	2,935,500	2,869,000

1/ Does not include balata, guttas, or jelutong.
2/ Estimated imports.
3/ Partly estimated and rounded.

Source: Compiled from statistics published in the Rubber Statistical Bulletin by the Secretariat of the International Rubber Study Group.

Commodity	TSUS item
Chlorinated natural rubber----------	446.12

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States in recent years has produced most of the chlorinated rubber it has consumed. U.S. consumption in 1970 is believed to have been about 10 million pounds. U.S. exports are estimated to have been equivalent to at least 12 percent of domestic production. U.S. imports have been near 1 million pounds annually in recent years.

Description and uses

Chlorinated natural rubber, or chlorinated rubber as it is known industrially, is generally marketed as a white, granular powder of high bulk density. It is prepared by chlorinating pale crepe rubber dissolved in an organic solvent from which the product is precipitated, then dried. The process requires expensive corrosion-resistant equipment and a high degree of maintenance. In recent years, natural rubber has been replaced to some extent by synthetic polyisoprene rubber as the principal raw material in the manufacture of chlorinated rubber. Polyisoprene, the synthetic duplicate of natural rubber, yields an almost identical chlorinated product; however, imports of such a product would be classifiable under the provision for synthetic rubber (446.15) rather than under the item covered here.

Chlorinated rubber, including that produced from either natural or synthetic rubber, has its greatest application in those end-products where resistance to moisture, weather, or the corrosive effects of chemicals are prime considerations. Thus most of the chlorinated rubber consumed in the United States is used in the manufacture of paints for industrial, marine, and public applications, including those for metal and concrete surfaces. Other important uses of chlorinated rubber are for printing inks, such as inks for printing solvent-and-chemical-resistant labels, and adhesives. Chlorinated rubber is competitive with many of the plastic resins, including alkyds, vinyls, and epoxies, in many of the above uses.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

CHLORINATED NATURAL RUBBER

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
446.12	Chlorinated natural rubber	10% ad val.	5% ad val.

The rate effective January 1, 1972, reflects the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are shown in the TSUSA-1971, an excerpt from which is reproduced in appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption, production, and exports

Official statistics are not available on U.S. consumption and production of chlorinated rubber although the U.S. market for this material has been estimated to be 10 million pounds or more annually. Although part of the demand for chlorinated rubber is supplied by the chlorinated synthetic rubber--polyisoprene, the greatest part is believed to be supplied by chlorinated natural rubber. Of the total domestic market for chlorinated rubber (including that derived from synthetic rubber), 50 percent is accounted for by protective coatings, 20 percent by printing inks, 15 percent by traffic paints, 10 percent by adhesives, and 5 percent by concrete curing compounds.

There was only one U.S. producer of chlorinated rubber before 1966, at which time a second producer commenced operations. The second producer is a subsidiary of a large British chemicals firm which is the world's largest producer of chlorinated rubber. The plants of both U.S. producers are located in New Jersey.

U.S. exports of chlorinated rubber are estimated at 12 percent or more of U.S. production. There are no official export statistics available on chlorinated rubber.

U.S. imports

Annual U.S. imports of chlorinated natural rubber exhibited no apparent trend during 1965-70, fluctuating within the range of 774,000 pounds, valued at $363,000, and 1,439,000 pounds, valued at $651,000 (see accompanying table); annual imports during the period amounted on the average to slightly more than 1 million pounds,

valued at about $500,000. In the early part of the period (1965-67) the United Kingdom accounted for 70 percent, or more, of imports of chlorinated natural rubber; however, following the establishment of a British subsidiary as the second U.S. producer, the share of total imports of chlorinated rubber supplied by the United Kingdom decreased, accounting for only about 20 percent in 1970. Italy, generally the second most important source of these imports during 1965-70, was the principal supplier in 1970. Japan became an important supplier in 1969 and 1970; West Germany and Canada were other sources of supply in 1965-70 (see table).

Foreign production and trade

The world market for chlorinated rubber in 1970 is reported to be near 36 million pounds, the greatest part of which is supplied by producers in Western Europe, principally in the United Kingdom, West Germany, and Italy. Most of the chlorinated rubber produced by these countries was probably consumed in Europe. Japan is a fourth foreign producer of importance.

Chlorinated rubber: U.S. imports for consumption, by sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (1,000 pounds)					
United Kingdom	978	1,251	751	452	865	150
Italy	106	141	258	333	233	392
West Germany	33	47	24	7	8	12
Japan	50	-	-	2	245	220
Canada	21	-	41	-	2	1/
Total	1,188	1,439	1,074	794	1,353	774
	Value (1,000 dollars)					
United Kingdom	440	558	338	204	365	67
Italy	48	70	131	166	118	203
West Germany	16	23	12	3	3	5
Japan	20	-	-	1	94	87
Canada	5	-	10	-	6	1
Total	529	651	491	374	586	363

1/ Less than 500 pounds.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Synthetic rubber	446.15

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

The United States produces nearly half of the world supply of synthetic rubber and consumes 85 percent, or more, of its own output. U.S. production of synthetic rubber in 1970 amounted to 2.2 million long tons, of which 13 percent was exported. In 1970 U.S. imports supplied nearly 5 percent of domestic consumption, which amounted to 1.9 million long tons.

Description and uses

Synthetic rubber is any of a class of chemical polymers which exhibit characteristics generally similar to those of natural rubber. In this sense, most synthetic rubbers are actually chemical substitutes for natural rubber. Most, however, are not duplicates of natural rubber either in chemical structure or functional characteristics. One relatively new synthetic rubber (polyisoprene), though, is structurally identical to natural rubber and closely emulates its physical characteristics. For U.S. tariff purposes, the term "rubber" is defined in headnote 2 to part 4B of schedule 4 of the Tariff Schedules of the United States (TSUS). The definition, in addition to specifying certain physical performance requirements, states that rubber "means a substance, whether natural or synthetic, in bale, crumb, powder, latex, or other crude form, which can be vulcanized or otherwise cross-linked;...and includes such substances whether or not containing fillers, extenders, pigments, or rubber-processing chemicals". Rubber other than synthetic rubber is discussed in other summaries which include those on natural rubber (items 446.05 to 446.10), reclaimed rubber (item 446.20), chlorinated natural rubber (item 446.12), and rubber mixtures (item 446.30).

The various types of synthetic rubber polymers are composed of large (long chain) molecules having structures of varying complexity. Each type possesses characteristics which combine, among others, different degrees of tensile strength, elasticity, hardness, and abrasion resistance. The characteristics of a particular rubber may, however, be changed somewhat by adding to it one or more chemical compounding agents, including fillers, pigments, extenders, and plasticizers, or by curing the rubber by a process known as vulcanization. Compounding

ingredients such as carbon black considerably alter the color of the rubber which is usually cream or light amber in the crude form. In addition to its normal dry form, synthetic rubber is produced as a latex, a milky dispersion of minute rubber particles in water. The principal types of synthetic rubber, together with standard abbreviations and alternate names, are listed below:

Type	Abbreviation in common use	Other names and abbreviations
Butyl----------	IIR	Isobutylene-isoprene; GR-I
Ethylene-propylene-----	EPR	E-P copolymer
	EPT;EPDM	E-P terpolymer
Neoprene----------	CR	Polychloroprene
Nitrile-butadiene------	NBR	Nitrile rubber; acrylonitrile-butadiene; N-type; AB; GR-A; Buna-N
Polybutadiene----------	BR or PB	cis-(or trans-)1,4-polybutadiene
Polyisoprene----------	IR or PI	cis-(or trans-)1,4-polyisoprene
Styrene-butadiene------	SBR	S-type; GR-S; Buna-S

The various types of synthetic rubber can be broadly grouped as general-purpose or special-purpose synthetic rubber, depending upon use. A prerequisite for general-purpose synthetic rubbers, which account for the bulk of the rubber consumed in the United States, is that it be suitable for extensive use in tires for motor vehicles as well as in tens of thousands of other products. Special-purpose synthetic rubber includes many types with combinations of characteristics which make them particularly useful in the manufacture of insulating and protective materials and in equipment requiring high resistance to chemical and petroleum products.

Styrene-butadiene rubber (SBR), a general-purpose rubber, is commercially the most important synthetic rubber. In recent years, several new types of general-purpose rubber have been marketed but none have reached the stature of SBR. Polybutadiene rubber, one of a newer group known as stereo-regular rubbers (class based on molecular arrangement), has shown the greatest growth. Polyisoprene, another stereo-regular rubber, and ethylene-propylene rubber have gained in importance but are still in earlier stages of market development. General-purpose synthetic rubbers are used extensively in automobile tire treads, whereas natural rubber is often favored for other tire parts and for truck, bus, and airplane tires. Natural rubber is more effective in larger tires because of its ability to withstand the greater buildup of heat in these tires. Some automobile tires, however, are produced almost entirely from synthetic rubber and synthetic rubber is finding increased use in larger tires.

Neoprene and nitrile rubbers are the principal examples of special-purpose rubbers. Neoprene is particularly suitable for the manufacture of chemical equipment because of its high resistance to chemical action. Nitrile rubber is highly resistant to deterioration by petroleum products and is used extensively in fuel hoses, oil-well parts, and the like. Other special-purpose synthetic rubbers (including polysulfide, polyacrylate, and silicone rubber) are used for insulating, sealing, and molding applications, particularly in aircraft, where resistance to water, oil, and extreme temperatures is needed. Butyl rubber, which has characteristics of both general- and special-purpose rubbers, is particularly suited to the manufacture of tire inner-tubes for cars and trucks and is also used in a variety of other automotive and miscellaneous applications.

Synthetic rubber in the form latex is used mainly in the manufacture of foam rubber, although lesser quantities go into the manufacture of clothing, carpet backing, paints, paper coatings, and textile finishes. Latex foam rubber is used primarily in mattresses, cushions, pillows, and automotive padding.

Raw materials for the various synthetic rubbers come mainly from the petroleum industry, which provides the materials in large quantities and at fairly low cost. Butadiene, the chemical used in the greatest quantity, is a petroleum derivative. Ethylene, propylene, isobutylene, and isoprene also are obtained directly or indirectly from petroleum. Styrene is produced from ethylene and benzene, the latter derived from petroleum or coal. Acetylene, the raw material for neoprene, is derived either from calcium carbide produced by the electric-furnace reaction of coal and limestone, or from petroleum. Acetylene is also a starting material in some processes for the production of acrylonitrile, a monomer used in making nitrile-butadiene rubber.

U.S. tariff treatment

The column 1 rates of duty applicable to imports (see general headnote 3 of the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
446.15	Synthetic rubber-----	6.5% ad val.	3% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages

are shown in the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

U.S. consumption

During 1965-70, consumption of synthetic rubber in the United States increased irregularly from 1,540,000 long tons in 1965 to 2,024,000 long tons in 1969, then decreased to 1,918,000 long tons in 1970 (table 1).

During 1965-70, SBR was the synthetic rubber consumed in the United States in the greatest amounts; however, its share of total consumption of synthetic rubber decreased from 71 percent in 1965 to 63 percent in 1970. At the same time, the share of consumption for stereo-regular rubbers increased from 12 to 21 percent. Throughout the period, butyl rubber accounted for 5 percent of the total, nitrile rubber for 3 percent, and all other rubber, including neoprene, for 8 or 9 percent. In 1969, the peak year for consumption of most principal types of synthetic rubber, U.S. consumption of SBR amounted to 1,310,000 long tons, polybutadiene rubber to 263,000 long tons, polyisoprene rubber to 86,000 long tons, ethylene-propylene rubber to 45,000 long tons, butyl rubber to 94,000 long tons, nitrile rubber to 68,000 long tons, and all other rubbers to 158,000 long tons (table 2). U.S. consumption of neoprene rubber was last reported separately in 1964 when it amounted to 103,000 long tons.

In recent years from 8 to 10 percent of the synthetic rubber consumed in the United States has been in the form of latexes, principally those of SBR, neoprene, and nitrile rubber. Consumption of these latexes in 1964 amounted to 137,000 long tons, of which SBR accounted for 110,000 long tons, neoprene for 15,000 long tons, and nitrile rubber for 12,000 long tons. In 1970, U.S. consumption of SBR latex amounted to 122,000 long tons and nitrile latex to 12,000 long tons; statistics for U.S. consumption of neoprene latex were not reported after 1964.

In recent years tires and tire products have accounted for more than 60 percent of the synthetic rubber consumed in the United States. Table 3 shows the quantity and percent of consumption by type of synthetic rubber for tire and non-tire use in 1966, 1968, and 1969. The quantity of consumption increased in most categories in these years; however, the share of consumption for some types (e.g., SBR and stereo) shifted. The principal uses of SBR, butyl, and stereo rubber were for tires and tire products, while non-tire uses predominated for neoprene, nitrile, and the miscellaneous types.

U.S. producers

Synthetic rubber was produced in the United States in 1969 by at least 30 companies at 50 or more plant locations by about 10,000 employees. About 16 of the companies could be considered principal producers. In 1969 three companies held nearly 40 percent of the plant capacity for making synthetic rubber and 12 companies held 80 percent. The plants were situated principally in Texas, Louisiana, Ohio, and Kentucky. The remaining plants were distributed along the eastern seaboard and in Michigan and California. Nearly two-thirds of the total plant capacity was located in the Texas-Louisiana gulf coast area.

Some of the largest U.S. producers of synthetic rubber are corporations that also manufacture a wide range of rubber products, including tires, which utilize a large portion of their output of synthetic rubber. A few large synthetic-rubber operations are divisions of large oil or chemical companies or joint venture operations of rubber and oil companies. Several of the larger companies operate foreign plants which are wholly owned subsidiaries or jointly owned with foreign or other U.S. firms. In many instances, overseas operations are licensed by U.S. rubber firms. Synthetic rubber accounts for a substantial, if not major, share of the output of most of the manufacturing corporations.

U.S. production

From 1965 to 1970, U.S. production of synthetic rubber increased over all by more than 20 percent, from 1,813,000 long tons in 1965 to 2,197,000 long tons in 1970 (table 1). Styrene-butadiene rubber, which accounted for about 70 percent of all synthetic rubber produced in the United States in 1965, accounted for less than 61 percent of that produced in 1970, although production of SBR increased by at least 5 percent during the period. Production of SBR during 1965-70 ranged between 1,244,000 long tons in 1967 and 1,403,000 long tons in 1969. The stereo rubbers, mainly polybutadiene, accounted for most of the increase in production during this period when the share of production supplied by them rose from 12 to 21 percent. Production of the stereo rubbers in 1970 amounted to 463,000 long tons, of which 280,000 long tons was polybutadiene; 120,000 long tons, polyisoprene; and 63,000 long tons, ethylene-propylene. The peak year for the production of butyl rubber was 1969, when it amounted to 130,000 long tons, and for nitrile rubber, 1968, when it amounted to 71,000 long tons (table 2). The production of neoprene rubber amounted to 141,000 long tons in 1964, the last year for which production statistics are available.

U.S. exports

During 1965-70 annual exports of synthetic rubber ranged between 226,000 long tons in 1969 and 308,000 long tons in 1966 (table 1). Exports during the period averaged about 280,000 long tons annually and amounted to 289,000 long tons in 1970. Inasmuch as the size of exports fluctuated only narrowly and U.S. production increased generally during 1963-68, the ratio of exports to production declined from about 16 to 13 percent.

In recent years synthetic rubber has been exported by the United States to more than 75 countries. During 1965-70, Canada, Japan, the United Kingdom, and the EEC countries were the leading markets for U.S. synthetic rubber. Australia, Brazil, Mexico, and Sweden were other consistently large consumers of U.S. exports of synthetic rubber during these years (table 4). In 1965 exports of SBR amounted to 172,000 long tons and represented about 61 percent of total exports of synthetic rubber; by 1970, exports of SBR had decreased to less than 100,000 long tons and represented less than 35 percent ot total exports. In the same interval, the share of exports, represented by neoprene, the stereo rubber, and miscellaneous rubbers, rose from 26 to 51 percent. Export data for these rubbers were reported together until 1970 when export statistics for the 3 classes of stereo rubbers were reported separately, polyisoprene rubber accounting for 9 percent of exports, polybutadiene for 3 percent, and ethylene-propylene for 1 percent. In 1970, exports of butyl rubber accounted for 11 percent of the total, and those of nitrile rubber for 4 percent.

Not included in the export totals given above, and in tables 1 and 4, are relatively small amounts of silicone rubber and synthetic rubber in the form of carbon black masterbatches (carbon-containing rubber mixtures). Export data for silicone rubber was first reported separately in official statistics in 1970 when exports amounted to 1,304 long tons, valued at $6 million; the Netherlands, Canada, Japan, Belgium, and Mexico were the principal markets. Exports of carbon black masterbatches were reported for 1967-70, and in 1970 amounted to 7,048 long tons, valued at $2,648,000. The principal markets for U.S.-exported masterbatches during 1967-70 were France, Sweden, Israel, Iran, Canada, and New Zealand.

U.S. imports

In the 1965-70 period, U.S. imports of synthetic rubber, which have been considerably smaller than exports, increased by more than 130 percent from 40,000 long tons in 1965 to 92,000 long tons in 1970 (table 5). The ratio of imports to consumption rose from about 2.6 percent in 1965 to 4.8 percent in 1970. The decrease in imports in

1967 is probably attributable to the smaller quantity of rubber products manufactured in that year due to labor problems.

In 1965 Canada supplied more than 80 percent of U.S. imports of synthetic rubber; however, by 1970 the share supplied by Canada dropped to less than 60 percent as Japan and certain EEC countries became more important suppliers. U.S. import statistics on synthetic rubber by principal types were first published in 1971; these data and the principal sources for the imports for the first four months of 1971 are shown in the following tabulation:

Type	Quantity (long tons)	Value (1,000 dollars)	Principal Sources
Butyl	4,761	2,650	Canada; France
Nitrile	559	591	Canada
Polybutadiene	11,285	3,660	Japan; Canada
Neoprene	1,467	1,246	Japan; France
Styrene-butadiene	8,434	3,041	Canada
All other 1/	15,407	7,599	Canada; Japan; France
Total	41,913	18,787	

1/ This category probably contains some shipments properly included in the above classes but included here due to incomplete identification which sometimes occurs when reporting new classes.

World consumption, production, and trade

Free world consumption and production of synthetic rubber increased by 49 and 56 percent, respectively, between 1965 and 1970. Consumption in 1970 was about 4.5 million long tons and production nearly 4.8 million long tons (table 6).

For many years synthetic rubber has been acquiring a larger share of the growing market for new rubber, which includes both synthetic and natural but excludes reclaimed rubber. Although the consumption of natural rubber has been increasing, synthetic rubber has captured most of the market growth. This has resulted generally from the availability at competitive prices of diversified types of synthetic rubber, each with characteristics specially suited to certain areas of application. At the same time the growth in consumption of natural rubber has possibly been limited by its availability. In the 10-year period, 1960-70, the share of free-world consumption of new rubber supplied by synthetic rubber increased by 14 percentage points and in 1970 was about 66 percent. Led by the United States, whose share of rubber consumption supplied by synthetic

in 1970 was nearly 78 percent, many of the large rubber-consuming countries have substantially increased the share of consumption supplied by synthetic rubber between 1960 and 1970, as shown in the following tabulation:

Country	1960 Percent	1970 Percent
United States	69.3	77.8
Canada	61.4	72.8
Italy	43.6	63.6
West Germany	41.8	64.1
France	41.6	61.8
Japan	26.8	63.7
United Kingdom	39.2	59.1

The countries that are the principal free world producers of synthetic rubber, in addition to the United States, are Japan, France, the United Kingdom, West Germany, the Netherlands, Canada, and Italy. Table 6 gives world consumption and production, respectively, by country, for selected years. The production of synthetic rubber in free world countries other than the United States is predominantly styrene-butadiene supplemented by smaller amounts of other rubbers, principally stereo, butyl, neoprene, and nitrile. Many of these operations are wholly or partly owned subsidiaries of U.S. producers of synthetic rubber or are licensed by U.S. producers. A number of large foreign producers, however, operate independently of U.S. firms.

The leading exporters of synthetic rubber, after the United States, are Japan, the Netherlands, France, and Canada, followed by the United Kingdom, West Germany, and Italy. In 1970, each of the aforementioned countries, except Italy, exported more than 100,000 long tons of synthetic rubber (table 7). The United States, China, Italy, West Germany, and Belgium were the principal markets in 1970 for exports of synthetic rubber produced in Japan; Canada, the United Kingdom, and the EEC countries were principal markets for the Netherlands; other EEC countries and the United Kingdom were principal markets for France, and the United States and the United Kingdom were the principal markets for synthetic rubber exported by Canada.

In 1970, seven of the eight leading exporting countries were also among the leading importing countries. This occurrence is largely caused by the variety of types and grades of synthetic rubber produced in individual countries and the resultant cross-marketing. In 1970, West Germany imported 153,000 long tons of synthetic rubber, France 126,000 long tons, and Italy 118,000 long tons; the United Kingdom, the United States, Canada, Sweden, the Netherlands, Spain, and Japan each imported between 30,000 and 100,000 long tons (table 7).

Table 1.--Synthetic rubber: U.S. production, imports for consumption, exports of domestic merchandise, and consumption, 1965-70

(In long tons)

Year	Production	Imports	Exports 1/	Consumption 2/
1965	1,813,232	39,994	281,777	1,540,114
1966	1,969,973	44,510	308,436	1,666,057
1967	1,911,873	40,507	300,183	1,628,258
1968	2,131,105	60,808	287,196	1,894,378
1969	2,250,192	79,348	226,493	2,024,061
1970	2,197,049	92,261	290,055	1,917,852

1/ Do not include exports of silicone rubber or of carbon black masterbatches (see section on Exports).

2/ Actual consumption as reported by the U.S. Department of Commerce.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Synthetic rubber: U.S. consumption and production, by type, 1965-70

(In thousands of long tons)

Type	1965	1966	1967	1968	1969	1970
	Consumption					
Synthetic rubber, total	1,540	1,666	1,628	1,894	2,024	1,918
Styrene-butadiene 1/	1,096	1,153	1,106	1,281	1,310	1,216
Butyl	75	82	81	90	94	92
Nitrile	49	58	55	60	68	60
Polybutadiene 1/	133	169	170	218	263	277
Other stereo 1/	55	64	79	96	2/ 131	3/ 126
All other 1/ 4/	132	140	137	149	158	147
	Production					
Synthetic rubber, total	1,813	1,970	1,912	2,131	2,250	2,197
Styrene-butadiene 1/	1,262	1,336	1,244	1,389	1,403	1,331
Butyl	101	103	114	113	130	118
Nitrile	58	70	62	71	69	67
Polybutadiene 1/	154	186	202	217	264	280
Other stereo 1/	65	86	105	140	5/ 184	6/ 183
All other 1/ 4/	173	189	185	201	200	218

1/ Includes oil content.

2/ Includes polyisoprene rubber amounting to 86,000 long tons, and ethylene-propylene rubber amounting to 45,000 long tons.

3/ Includes polyisoprene rubber amounting to 80,000 long tons, and ethylene-propylene rubber amounting to 46,000 long tons.

4/ Includes neoprene rubber.

5/ Includes polyisoprene rubber amounting to 109,000 long tons, and ethylene-propylene rubber amounting to 75,000 long tons.

6/ Includes polyisoprene rubber amounting to 120,000 long tons, and ethylene-propylene rubber amounting to 63,000 long tons.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Synthetic rubber: Quantity and percent used in the United States in tire and tire products and in other products, by principal types, specified years, 1966 to 1969

Synthetic rubber type	1966		1968		1969	
	Tires and tire products	Nontire products	Tires and tire products	Nontire products	Tires and tire products	Nontire products
	Quantity (long tons)					
Styrene-butadiene 1/	774,001	378,547	875,550	405,291	893,235	416,833
Butyl	59,671	22,155	66,383	23,220	69,172	25,250
Nitrile	801	57,198	393	59,730	158	67,776
Stereo 1/	182,727	49,796	261,247	53,387	324,600	69,162
All other 1/	7,608	133,553	6,502	142,675	5,590	152,285
Total	1,024,808	641,249	1,210,075	684,303	1,292,755	731,306
	Percent of annual total					
Styrene-butadiene 1/	46.4	22.8	46.3	21.4	44.2	20.7
Butyl	3.6	1.3	3.5	1.2	3.4	1.2
Nitrile	2/	3.4	2/	3.2	2/	3.3
Stereo 1/	11.0	3.0	13.8	2.8	16.0	3.4
All other 1/	.5	8.0	.3	7.5	.3	7.5
Total	61.5	38.5	63.9	36.1	63.9	36.1

1/ Includes oil content
2/ Less than 0.05 percent.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 4.--Synthetic rubber: U.S. exports of domestic merchandise, by principal markets, 1965-70

Market	1965	1966	1967	1968	1969	1970
	Quantity (long tons)					
Canada	27,478	36,989	40,374	35,047	42,801	64,467
West Germany	29,862	32,818	26,502	21,780	18,232	28,806
Japan	28,497	31,742	34,095	39,045	21,335	19,151
France	30,076	36,647	35,058	31,973	21,078	27,242
Italy	10,847	16,369	20,951	16,986	14,646	19,035
United Kingdom	10,162	8,674	12,413	11,848	9,783	14,815
Netherlands	12,797	13,839	17,548	18,544	10,061	17,153
Brazil	4,767	8,216	5,481	9,882	7,034	9,963
Belgium	14,646	12,883	10,436	9,671	7,428	8,942
Mexico	17,814	19,456	11,088	8,099	5,828	6,541
Sweden	9,804	8,480	11,238	5,195	4,935	6,206
Australia	7,546	7,923	8,748	11,076	6,618	10,378
All other	77,481	1/ 74,400	2/ 66,251	3/ 68,050	56,714	57,356
Total	281,777	308,436	300,183	287,196	226,493	290,055
	Value (1,000 dollars)					
Canada	16,898	21,202	22,870	20,472	25,123	32,223
West Germany	18,457	19,892	16,574	17,757	14,076	21,794
Japan	15,783	18,857	21,466	24,979	14,267	15,596
France	15,987	18,917	17,413	18,466	11,683	15,527
Italy	7,362	8,688	11,164	11,451	8,167	11,212
United Kingdom	6,489	7,269	9,084	11,281	7,030	10,079
Netherlands	6,858	7,161	8,079	10,380	7,886	9,009
Brazil	2,874	5,313	3,525	6,370	4,871	6,599
Belgium	11,662	9,552	8,064	6,294	4,355	5,418
Mexico	8,982	9,576	6,382	5,199	4,215	4,616
Sweden	4,996	4,294	5,032	3,236	2,556	3,678
Australia	5,598	5,931	6,366	7,916	5,228	3,173
All other	39,240	1/ 38,443	2/ 34,010	3/ 36,459	30,126	37,101
Total	161,186	175,095	170,029	180,260	139,583	176,025

1/ Includes 9,450 long tons, valued at $4,554 thousand, exported to Spain.
2/ Includes 10,970 long tons, valued at $4,843 thousand, exported to Turkey.
3/ Includes 9,467 long tons, valued at $4,189 thousand, exported to Turkey.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 5.--Synthetic rubber: U.S. imports for consumption, by principal sources, 1965-70

Source	1965	1966	1967	1968	1969	1970
	Quantity (long tons)					
Canada	32,814	35,930	34,538	44,327	53,986	53,624
Japan	191	3,475	2,271	8,143	13,088	28,851
France	2,375	1,453	1,187	2,153	2,633	3,204
West Germany	981	1,579	983	2,197	4,485	3,559
Belgium	2,387	700	1,085	1,557	1,165	813
All other	1/ 1,246	2/ 1,373	443	2,431	3,991	3/ 2,210
Total	39,994	44,510	40,507	60,808	79,348	92,261
	Value (1,000 dollars)					
Canada	15,384	17,643	17,096	21,115	25,888	25,227
Japan	137	2,840	1,695	4,206	6,057	12,176
France	1,048	1,057	805	1,430	1,997	1,982
West Germany	547	1,087	663	1,078	1,695	1,632
Belgium	1,188	275	452	678	465	319
All other	1/ 735	2/ 747	86	816	1,486	3/ 914
Total	19,039	23,649	20,797	29,323	37,588	42,250

1/ Includes 1,079 long tons, valued at 691 thousand dollars, from the United Kingdom.

2/ Includes 1,006 long tons, valued at 649 thousand dollars, from the United Kingdom.

3/ Includes 847 long tons, valued at 474 thousand dollars from Australia.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 6.--Synthetic rubber: World consumption and production, by countries, specified years, 1965 to 1970 1/

Country	1965	1967	1969	1970
	Consumption			
United States	1,540,114	1,628,258	2,024,061	1,917,852
Japan	172,750	268,700	419,300	488,166
West Germany	205,228	197,430	322,788	352,431
United Kingdom	179,800	202,200	252,000	267,700
France	152,008	185,325	222,594	248,903
Italy	111,200	152,600	175,200	193,900
Canada	96,142	108,607	127,049	133,326
Brazil	37,261	56,122	69,997	84,006
Australia	36,936	38,945	42,037	45,843
All other 2/	492,550	554,800	729,450	772,850
Total 2/	3,024,000	3,393,000	4,384,500	4,505,000
	Production			
United States	1,813,232	1,911,873	2,250,192	2,197,049
Japan	158,771	276,157	518,164	685,784
France	145,946	186,267	270,620	310,921
United Kingdom	171,745	200,446	268,681	301,109
West Germany	161,373	187,175	287,070	297,144
Netherlands	100,000	125,000	210,161	202,373
Canada	202,982	197,081	195,671	202,120
Italy	118,000	116,000	133,000	157,000
All other 3/	176,450	259,500	368,950	420,000
Total 3/	3,048,500	3,459,500	4,502,500	4,773,500

1/ Quantities include oil content of oil-extended rubbers and total solids content of latexes; value data are not available.

2/ Partly estimated and rounded. Includes only imports for Eastern Europe and China and production for Czechoslovakia.

3/ Partly estimated and rounded. Does not include Communist countries, except Czechoslovakia.

Source: Compiled from statistics published in the Rubber Statistical Bulletin by the Secretariat of the International Rubber Study Group and from official statistics of the U.S. Department of Commerce.

Table 7.--Synthetic rubber: Exports of principal producing countries (free world), and imports of principal consuming countries (free world), specified years, 1965 to 1970

(In long tons)

Country	1965	1967	1969	1970
	Exports			
United States	281,777	300,183	226,493	290,055
Japan	30,829	57,535	117,885	189,421
Netherlands	100,032	118,526	190,736	174,073
France	73,422	94,751	161,864	162,604
Canada	128,576	114,421	1/125,750	1/131,500
United Kingdom	50,874	54,783	97,239	116,461
West Germany	53,176	60,351	109,700	104,305
Italy	59,946	45,774	59,513	44,787
	Imports			
West Germany	97,416	89,936	141,049	152,877
France	79,782	100,911	115,213	126,162
Italy	54,560	83,791	106,884	118,034
United Kingdom	54,263	69,381	88,499	92,671
United States	39,994	40,507	79,348	92,261
Canada	29,590	42,881	58,708	75,057
Sweden	32,020	36,197	52,051	50,230
Netherlands	17,043	20,932	30,427	40,330
Spain	31,907	32,808	34,359	29,081
Belgium-Luxembourg	26,858	26,903	38,009	2/

1/ Estimated.
2/ Not available.

Source: Compiled from statistics published in the Rubber Statistical Bulletin by the Secretariat of the International Rubber Study Group and from official statistics of the U.S. Department of Commerce.

Commodity	TSUS item
Reclaimed rubber of all kinds----	446.20

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUS-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

U.S. consumption of reclaimed rubber, which amounted to 200,000 long tons in 1970, is supplied almost entirely by domestic production. During 1965-70 about 4 percent of production was exported each year; the small annual imports consisted mainly of special grades.

Description and uses

Reclaimed rubber (reclaim) is made in general from used (scrap) natural and synthetic rubber (item 771.10) that has been reprocessed for use in new rubber products, largely tires. The process may be described basically as a depolymerization process which includes grinding of the scrap rubber, removal of fabric fibers by chemical digestion or mechanical separation, and refinement of the rubber by the addition of chemicals and by milling. The reclaimed rubber yielded by the process takes the form of thin sheets which may be built into slabs or reformed into pellets.

Reclaimed rubber may be further processed, compounded, or vulcanized, and may be blended with new natural or synthetic rubber. Producers of reclaimed rubber market the product in several grades based on its origin, type, or blend. These include: grades of reclaimed rubber made from whole tires, tire treads, or inner tubes; those containing specific amounts of carbon black; or those made from natural or one of the several types of synthetic rubber.

Scrap rubber, the raw material for reclaimed rubber, is a market commodity, usually supplied by scrap dealers from stocks accumulated within a radius of a few hundred miles of the consuming plant; stockpiles are usually maintained by such plants to offset periods of high prices and short supply. Over 90 percent of the scrap rubber so utilized is derived from tires. Sales of scrap rubber are based on grade specifications which are published by the Rubber Reclaimers Association, a U.S. and Canadian organization representing North American producers.

The manufacture of automobile tires and inner tubes constitutes an important use for reclaimed rubber; little is used, however, for truck and airplane tires. Other automotive uses for reclaim include steering

wheels, battery boxes, radiator hose, weather stripping, and mats; non-automotive uses include garden hose, adhesives, belting, shoe heels and soles, and household items. Reclaimed rubber, which was once considered to be primarily a substitute for other rubbers, now satisfies specific market requirements and consequently is not affected as much by the price fluctuations of other rubbers. Although most reclaim sells at a price somewhat below crude natural and synthetic rubber, it has certain quality advantages regardless of cost, such as uniformity of product, suitability for extruding processes, high rate of cure, and good tack.

U.S. tariff treatment

The duty-free status of reclaimed natural (India) rubber was provided for in paragraph 1697 of the Tariff Act of 1930, as originally enacted, and was bound January 1, 1948, as a concession granted by the United States in the General Agreement on Tariffs and Trade. Imports of reclaimed synthetic rubber became free of duty, as provided for by Public Law 415, amending paragraph 1697, effective February 25, 1948. The duty-free status of reclaimed rubber of all kinds was provided for in the TSUS, effective August 31, 1963.

U.S. consumption

During the period 1965-70, U.S. average annual consumption of reclaimed rubber was about 240,000 long tons. Annual consumption generally decreased from 270,000 long tons in 1965 to 200,000 long tons in 1970 (table 1). The ratio of reclaim to total rubber consumed annually in the United States decreased from more than 13 percent in 1965 to 8 percent in 1970.

In 1965-70, about 60 percent of U.S. annual consumption of reclaimed rubber was accounted for by the manufacture of tires and tire-related products (e.g., inner tubes). Nearly all of the reclaimed rubber consumed in the United States is supplied by domestic production.

U.S. producers and production

There are about 10 domestic producers of reclaimed rubber, operating some 15 reclaiming plants in the United States and 4 plants overseas. Plants in the United States are located from coast to coast, with the greatest concentrations in the Midwest-Great Lakes area and in the Northeastern States. Two U.S. producers have plants in Canada; one of these producers also has a plant in the United Kingdom; a third producer has a plant in Belgium. Additional U.S. producers are believed to be engaged in joint foreign ventures.

About half of the domestic producers carry on sizable reclaiming operations; among such producers are most of the large U.S. tire and rubber companies which reclaim rubber primarily for internal use. Some of the small reclaimers produce special types of reclaim related to their other rubber-producing activities. Therefore, the reclaiming of rubber is an operation of secondary importance to some large and small producers alike. Some companies, whose principal source of income is derived from rubber reclamation, have attempted in recent years to introduce new operations such as custom mixing, remilling, and other similar processing of rubbers to obtain additional sources of income as compensation for the lack of expansion in the reclaiming of rubber. The reclaiming operation itself requires a substantial initial investment in heavy equipment and large operating expenditures for steam, electric power, and cooling water.

In 1965-70, domestic production of reclaimed rubber averaged about 250,000 long tons annually. Annual production generally decreased from 280,000 long tons in 1965 to 200,000 long tons in 1970 (table 1). Nearly all of U.S. production in these years was consumed domestically.

U.S. exports

U.S. exports of reclaimed rubber decreased from about 11,000 long tons in 1965-66 to 9,000 long tons in 1969-70 (table 1). During this period, from 65 to 75 percent of exports went to Canada; among the other markets those generally of greater importance were Mexico, Venezuela, Turkey, the Philippines, Australia, and New Zealand (table 2). In recent years, U.S. reclaimed rubber has been exported to about 30 countries.

U.S. imports

U.S. imports of reclaimed rubber increased from 1,100 long tons in 1965 to more than 4,200 long tons in 1968, but decreased in each succeeding year to 1,600 long tons in 1970 (table 1). Although imports in 1968 were the largest in many years, they supplied less than 2 percent of U.S. consumption in that year; in 1970 they supplied less than 1 percent. The sources of imports during this period were mainly Canada and the United Kingdom. The imports are believed to have consisted of intracompany shipments and special grades of reclaim.

Foreign production, consumption and trade

Principal foreign producers of reclaimed rubber are the United Kingdom, West Germany, and France; other producers of significance

are Brazil, Canada, and Australia. During 1965-70, the United Kingdom and West Germany each produced annual quantities of reclaimed rubber in the range 20,000 to 40,000 long tons. West Germany increased its reliance on imports during the period, while the United Kingdom continued to export about 25 percent of its production. Production statistics for France are not available and consumption data are only available for 1967 and earlier; annual consumption, most of which is believed to have been supplied from domestic production, exceeded 30,000 long tons in each year from 1962 to 1967. The totals both of production and consumption of reclaimed rubber for all the above-mentioned countries amounted to less than 70 percent of those for the United States in recent years. Statistics for the consumption and production of reclaimed rubber by the principal foreign producing countries for 1965-70 are shown in table 3.

International trade in reclaimed rubber is relatively small in relation to world production. The United Kingdom is the next largest exporter of reclaim after the United States. During 1965-70, exports of reclaimed rubber from the United Kingdom ranged between 10,029 long tons in 1965 and 5,855 long tons in 1967; exports in 1970 amounted to 7,436 long tons. West German exports of reclaimed rubber amounted to between 3,000 and 3,600 long tons annually during the same period and in 1970 represented about 15 percent of production which had declined by nearly 50 percent since 1965. The amount of reclaimed rubber exported by other producing countries is believed to be negligible. (U.S. exports are equivalent to less than 5 percent of U.S. production). The largest importer of reclaimed rubber in 1965 was Canada which imported nearly 8,000 long tons in that year. During the period 1965-70 Canadian annual imports declined to between 5,500 and 6,000 long tons in 1969-70. At the same time West German imports rose from between 4,000 and 4,600 long tons in 1965-67 to nearly 12,000 long tons in 1970. Annual imports of reclaimed rubber by other countries were generally less than those of West Germany and Canada.

Table 1.--Reclaimed rubber: U.S. production, exports of domestic merchandise, imports for consumption, and consumption, 1965-70

(Quantity in long tons)

Year	Production	Exports	Imports	Consumption
1965	280,289	10,965	1,084	269,542
1966	277,363	11,559	1,265	264,506
1967	243,650	9,877	1,868	239,271
1968	257,218	9,750	4,204	250,426
1969	238,923	9,188	1,970	231,770
1970	200,555	9,240	1,586	199,571

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 2.--Reclaimed rubber: U.S. exports of domestic merchandise, by principal markets, 1965-70

Market	1965	1966	1967	1968	1969	1970
	Quantity (long tons)					
Canada	7,947	7,947	6,295	6,355	6,850	6,760
Mexico	762	1,214	1,030	1,401	978	877
Venezuela	46	37	162	294	198	406
Turkey	98	233	306	373	9	134
Philippine Rep.	212	222	255	160	152	116
All other	1,900	1/ 1,906	2/ 1,829	1,167	3/ 1,001	947
Total	10,965	11,559	9,877	9,750	9,188	9,240
	Value (1,000 dollars)					
Canada	2,049	2,055	1,717	1,728	1,970	1,976
Mexico	202	336	295	382	287	259
Venezuela	16	13	44	84	59	114
Turkey	32	72	94	113	3	45
Philippine Rep.	59	62	62	38	36	32
All other	518	1/ 514	2/ 446	338	3/ 278	251
Total	2,876	3,052	2,658	2,683	2,633	2,677

1/ Includes 364 long tons, valued at 91 thousand dollars, to New Zealand, and 339 long tons, valued at 88 thousand dollars, to Colombia.

2/ Includes 788 long tons, valued at 173 thousand dollars, to Australia, and 222 long tons, valued at 50 thousand dollars, to New Zealand.

3/ Includes 267 long tons, valued at 80 thousand dollars, to Sweden.

Source: Compiled from official statistics of the U.S. Department of Commerce.

Table 3.--Reclaimed rubber: Foreign consumption and production for selected countries, 1965-70

(In long tons)

Year	West Germany	United Kingdom	France	Canada	Australia	Brazil
	Consumption					
1965	41,694	34,400	30,310	18,200	10,960	9,598
1966	37,137	31,600	32,360	18,682	9,813	12,128
1967	31,656	29,700	32,014	17,996	9,903	14,245
1968	35,690	29,100	1/	16,580	8,720	17,845
1969	34,686	26,600	1/	17,093	8,622	17,839
1970	31,809	23,400	1/	16,001	2/ 8,800	20,278
	Production					
1965	41,314	40,600	1/	6,792	11,185	9,807
1966	36,231	35,200	1/	8,666	9,803	11,749
1967	29,649	32,900	1/	14,764	9,357	14,264
1968	32,998	34,700	1/	15,561	9,435	18,570
1969	28,204	33,500	1/	14,808	7,817	18,349
1970	21,675	29,200	1/	12,016	2/ 8,660	20,590

1/ Not available.
2/ Estimated.

Source: Compiled from the Rubber Statistical Bulletin, published by the Secretariat of the International Rubber Study Group, except as noted.

Commodity	TSUS item
Rubber mixtures----------	446.30

Note.--For the statutory description, see the Tariff Schedules of the United States Annotated (TSUSA-1971); pertinent sections thereof are reproduced in appendix A to this volume.

U.S. trade position

Rubber mixtures are of minor importance as articles of domestic and international trade and are produced and consumed principally as in-process intermediates which may account for hundreds of thousands of tons annually. Exports are believed to be negligible and the value of imports did not exceed $75,000 annually during 1965-70.

Comment

The materials provided for here are mixtures of two or more of the kinds of rubber described in subpart 4B of schedule 4 of the tariff schedules (items 446.05 - 446.20), which includes natural, chlorinated natural, and synthetic rubbers as well as reclaimed forms of these rubbers. The mixtures consist mostly of specialty products used in the manufacture of more complex products, and formulations which are process intermediates subsequently converted into finished goods. A rubber mixture specialty product may, for example, be a rubberized shoe finish or other kind of protective coating. A rubber mixture that is a process intermediate may be a basic formulation for tires or other products; it may be in the form of mixed latexes as well as of mixed dry rubbers.

The rubber mixtures covered in this summary are not articles of domestic or international commerce to any appreciable extent and, when they do appear as such, are often experimental in nature.

The column 1 rates of duty applicable to imports (see general headnote 3 in the TSUSA-1971) are as follows:

TSUS item	Commodity	Rate prior to Jan. 1, 1968	Rate effective Jan. 1, 1972
446.30	Rubber mixtures---------	10% ad val.	5% ad val.

The rate effective January 1, 1972, represents the final stage of a concession granted by the United States in the sixth round of trade negotiations under the General Agreement on Tariffs and Trade (GATT). The first of five annual stages of the reduction became effective January 1, 1968. Rates of duty for the individual stages are shown in

the TSUSA-1971, an excerpt from which is reproduced as appendix A to this volume. The rate shown above as existing prior to January 1, 1968, remained unchanged from August 31, 1963 (the effective date of the TSUS), through 1967.

In view of the varying nature of materials classed as rubber mixtures, it is virtually impossible to estimate the U.S. consumption or production of these mixtures. If in-process intermediates of manufacturers of tires and other rubber products were included in such estimates, production and consumption would both probably amount to hundreds of thousands of tons annually.

U.S. exports of rubber mixtures are believed to be negligible and limited to small amounts of special formulations and possibly some intracompany transfers of semi-processed materials. Statistics on such exports are not reported separately in official statistics.

U.S. imports of rubber mixtures have been small with an annual value of less than $75,000 during 1965-70, and less than $25,000 during 1967-70. Malaysia, Japan, West Germany, and Canada were the principal countries of origin for the import shipments reported during 1965-70.

A P P E N D I X A

Tariff Schedules of the United States Annotated (1971): General headnotes and rules of interpretation, and excerpts relating to the items included in this volume.

NOTE: The shaded areas in this appendix cover headnotes and TSUS items not pertaining to summaries in this volume.

1. Tariff Treatment of Imported Articles. All articles imported into the customs territory of the United States from outside thereof are subject to duty or exempt therefrom as prescribed in general headnote 3.

2. Customs Territory of the United States. The term "customs territory of the United States", as used in the schedules, includes only the States, the District of Columbia, and Puerto Rico.

3. Rates of Duty. The rates of duty in the "Rates of Duty" columns numbered 1 and 2 of the schedules apply to articles imported into the customs territory of the United States as hereinafter provided in this headnote:

(a) Products of Insular Possessions.

(i) Except as provided in headnote 6 of schedule 7, part 2, subpart E, [and] except as provided in headnote 4 of schedule 7, part 7, subpart A, articles imported from insular possessions of the United States which are outside the customs territory of the United States are subject to the rates of duty set forth in column numbered 1 of the schedules, except that all such articles the growth or product of any such possession, or manufactured or produced in any such possession from materials the growth, product, or manufacture of any such possession or of the customs territory of the United States, or of both, which do not contain foreign materials to the value of more than 50 percent of their total value, coming to the customs territory of the United States directly from any such possession, and all articles previously imported into the customs territory of the United States with payment of all applicable duties and taxes imposed upon or by reason of importation which were shipped from the United States, without remission, refund, or drawback of such duties or taxes, directly to the possession from which they are being returned by direct shipment, are exempt from duty.

(ii) In determining whether an article produced or manufactured in any such insular possession contains foreign materials to the value of more than 50 percent, no material shall be considered foreign which, at the time such article is entered, may be imported into the customs territory from a foreign country, other than Cuba or the Philippine Republic, and entered free of duty.

(b) Products of Cuba. Products of Cuba imported into the customs territory of the United States, whether imported directly or indirectly, are subject to the rates of duty set forth in column numbered 1 of the schedules. Preferential rates of duty for such products apply only as shown in the said column 1. 1/

(c) Products of the Philippine Republic.

(i) Products of the Philippine Republic imported into the customs territory of the United States, whether imported directly or indirectly, are subject to the rates of duty which are set forth in column numbered 1 of the schedules or to fractional parts of the rates in the said column 1, as hereinafter prescribed in subdivisions (c)(ii) and (c)(iii) of this headnote.

(ii) Except as otherwise prescribed in the schedules, a Philippine article, as defined in subdivision (c)(iv) of this headnote, imported into the customs territory of the United States and entered on or before July 3, 1974, is subject to that rate which results from the application of the following percentages to the most favorable rate of duty (i.e., including a preferential rate prescribed for any product of Cuba) set forth in column numbered 1 of the schedules:

(A) 20 percent, during calendar years 1963 through 1964,

(B) 40 percent, during calendar years 1965 through 1967,

(C) 60 percent, during calendar years 1968 through 1970,

(D) 80 percent, during calendar years 1971 through 1973,

(E) 100 percent, during the period from January 1, 1974, through July 3, 1974.

(iii) Except as otherwise prescribed in the schedules, products of the Philippine Republic, other than Philippine articles, are subject to the rates of duty (except any preferential rates prescribed for products of Cuba) set forth in column numbered 1 of the schedules.

(iv) The term "Philippine article", as used in the schedules, means an article which is the product of the Philippines, but does not include any article produced with the use of materials imported into the Philippines which are products of any foreign country (except materials produced within the customs territory of the United States) if the aggregate value of such imported materials when landed at the Philippine port of entry, exclusive of any landing cost and Philippine duty, was more than 20 percent of the appraised customs value of the article imported into the customs territory of the United States.

(d) Products of Canada.

(i) Products of Canada imported into the customs territory of the United States, whether imported directly or indirectly, are subject to the rates of duty set forth in column numbered 1 of the schedules. The rates of duty for a Canadian article, as defined in subdivision (d)(ii) of this headnote, apply only as shown in the said column numbered 1.

(ii) The term "Canadian article", as used in the schedules, means an article which is the product of Canada, but does not include any article produced with the use of materials imported into Canada which are products of any foreign country (except materials produced within the customs territory of the United States), if the aggregate value of such imported materials when landed at the Canadian port of entry (that is, the actual purchase price, or if not purchased, the export value, of such materials, plus, if not included therein, the cost of transporting such materials to Canada but exclusive of any landing cost and Canadian duty) was --

(A) with regard to any motor vehicle or automobile truck tractor entered on or before December 31, 1967, more than 60 percent of the appraised value of the article imported into the customs territory of the United States; and

(B) with regard to any other article (including any motor vehicle or automobile truck tractor entered after December 31, 1967), more than 50 percent of the appraised value of the article imported into the customs territory of the United States.

(e) Products of Communist Countries. Notwithstanding any of the foregoing provisions of this headnote, the rates of duty shown in column numbered 2 shall apply to products, whether imported directly or indirectly, of the following countries and areas pursuant to section 401 of the Tariff Classification Act of 1962, to section 231 or 257(e)(2) of the Trade Expansion Act of 1962, or to

1/ By virtue of section 401 of the Tariff Classification Act of 1962, the application to products of Cuba of either a preferential or other reduced rate of duty in column 1 is suspended. See general headnote 3(e), infra. The provisions for preferential Cuban rates continue to be reflected in the schedules because, under section 401, the rates therefor in column 1 still form the bases for determining the rates of duty applicable to certain products, including "Philippine articles".

action taken by the President thereunder:

Albania
Bulgaria
China (any part of which may be under Communist domination or control)
Cuba 1/
Czechoslovakia
Estonia
Germany (the Soviet zone and the Soviet sector of Berlin)
Hungary
Indochina (any part of Cambodia, Laos, or Vietnam which may be under Communist domination or control)
Korea (any part of which may be under Communist domination or control)
Kurile Islands
Latvia
Lithuania
Outer Mongolia
Rumania
Southern Sakhalin
Tanna Tuva
Tibet
Union of Soviet Socialist Republics and the area in East Prussia under the provisional administration of the Union of Soviet Socialist Republics.

(f) Products of All Other Countries. Products of all countries not previously mentioned in this headnote imported into the customs territory of the United States are subject to the rates of duty set forth in column numbered 1 of the schedules.

(g) Effective Date; Exceptions - Staged Rates of Duty. 2/ Except as specified below or as may be specified elsewhere, pursuant to section 501(a) of the Tariff Classification Act of 1962 (P.L. 87-456, approved May 24, 1962), the rates of duty in columns numbered 1 and 2 become effective with respect to articles entered on or after the 10th day following the date of the President's proclamation provided for in section 102 of the said Act. If, in column numbered 1, any rate of duty or part thereof is set forth in parenthesis, the effective date shall be governed as follows:

(i) If the rate in column numbered 1 has only one part (i.e., 8¢ (10¢) per lb.), the parenthetical rate (viz., 10¢ per lb.) shall be effective as to articles entered before July 1, 1964, and the other rate (viz., 8¢ per lb.) shall be effective as to articles entered on or after July 1, 1964.

(ii) If the rate in column numbered 1 has two or more parts (i.e., 5¢ per lb. + 50% ad val.) and has a parenthetical rate for either or both parts, each part of the rate shall be governed as if it were a one-part rate. For example, if a rate is expressed as "4¢ (4.5¢) per lb. + 8% (9%) ad val.", the rate applicable to articles entered before July 1, 1964, would be "4.5¢ per lb. + 9% ad val."; the rate applicable to articles entered on or after July 1, 1964, would be "4¢ per lb. + 8% ad val.".

(iii) If the rate in column numbered 1 is marked with an asterisk (*), the foregoing provisions of (i) and (ii) shall apply except that "January 1, 1964" shall be substituted for "July 1, 1964", wherever this latter date appears.

4. Modification or Amendment of Rates of Duty. Except as otherwise provided in the Appendix to the Tariff Schedules --

(a) a statutory rate of duty supersedes and terminates the existing rates of duty in both column numbered 1 and column numbered 2 unless otherwise specified in the amending statute;

(b) a rate of duty proclaimed pursuant to a concession granted in a trade agreement shall be reflected in column numbered 1 and, if higher than the then existing rate in column numbered 2, also in the latter column, and shall supersede but not terminate the then existing rate (or rates) in such column (or columns);

(c) a rate of duty proclaimed pursuant to section 336 of the Tariff Act of 1930 shall be reflected in both column numbered 1 and column numbered 2 and shall supersede but not terminate the then existing rates in such columns; and

(d) whenever a proclaimed rate is terminated or suspended, the rate shall revert, unless otherwise provided, to the next intervening proclaimed rate previously superseded but not terminated or, if none, to the statutory rate.

5. Intangibles. For the purposes of headnote 1 --

(a) corpses, together with their coffins and accompanying flowers,
(b) currency (metal or paper) in current circulation in any country and imported for monetary purposes,
(c) electricity,
(d) securities and similar evidences of value, and
(e) vessels which are not "yachts or pleasure boats" within the purview of subpart D, part 6, of schedule 6,

are not articles subject to the provisions of these schedules.

6. Containers or Holders for Imported Merchandise. For the purposes of the tariff schedules, containers or holders are subject to tariff treatment as follows:

(a) Imported Empty: Containers or holders if imported empty are subject to tariff treatment as imported articles and as such are subject to duty unless they are within the purview of a provision which specifically exempts them from duty.

(b) Not Imported Empty: Containers or holders if imported containing or holding articles are subject to tariff treatment as follows:

(i) The usual or ordinary types of shipping or transportation containers or holders, if not designed for, or capable of, reuse, and containers of usual types ordinarily sold at retail with their contents, are not subject to treatment as imported articles. Their cost, however, is, under section 402 or section 402a of the tariff act, a part of the value of their contents and if their contents are subject to an ad valorem rate of duty such containers or holders are, in effect, dutiable at the same rate as their contents, except that their cost is deductible from dutiable value upon submission of satisfactory proof that they are products of the United States which are being returned without having been advanced in value or improved in condition by any means while abroad.

(ii) The usual or ordinary types of shipping or transportation containers or holders, if designed for, or capable of, reuse, are subject to treatment as imported articles separate and distinct from their contents. Such holders or containers are not part of the dutiable value of their contents and are separately subject to duty upon each and every importation into the customs territory of the United States unless within the scope of a provision specifically exempting them from duty.

(iii) In the absence of context which requires otherwise, all other containers or holders are subject to the same treatment as specified in (ii) above for usual or ordinary types of shipping or transportation containers or holders designed for, or capable of, reuse.

1/ In Proclamation 3447, dated February 3, 1962, the President, acting under authority of section 620(a) of the Foreign Assistance Act of 1961 (75 Stat. 445), as amended, prohibited the importation into the United States of all goods of Cuban origin and all goods imported from or through Cuba, subject to such exceptions as the Secretary of the Treasury determines to be consistent with the effective operation of the embargo.

2/ The purpose of headnote 3(g) was to provide for an effective date for the rates of duty initially contained in the Tariff Schedules of the United States. By Presidential Proclamation 3548 of August 21, 1963, these rates of duty, except as noted in subparagraphs (i), (ii), and (iii) of headnote 3(g), became effective on August 31, 1963.

7. Commingling of Articles. (a) Whenever articles subject to different rates of duty are so packed together or mingled that the quantity or value of each class of articles cannot be readily ascertained by customs officers (without physical segregation of the shipment or the contents of any entire package thereof), by one or more of the following means:

(i) sampling,

(ii) verification of packing lists or other documents filed at the time of entry, or

(iii) evidence showing performance of commercial settlement tests generally accepted in the trade and filed in such time and manner as may be prescribed by regulations of the Secretary of the Treasury,

the commingled articles shall be subject to the highest rate of duty applicable to any part thereof unless the consignee or his agent segregates the articles pursuant to subdivision (b) hereof.

(b) Every segregation of articles made pursuant to this headnote shall be accomplished by the consignee or his agent at the risk and expense of the consignee within 30 days (unless the Secretary authorizes in writing a longer time) after the date of personal delivery or mailing, by such employee as the Secretary of the Treasury shall designate, of written notice to the consignee that the articles are commingled and that the quantity or value of each class of articles cannot be readily ascertained by customs officers. Every such segregation shall be accomplished under customs supervision, and the compensation and expenses of the supervising customs officers shall be reimbursed to the Government by the consignee under such regulations as the Secretary of the Treasury may prescribe.

(c) The foregoing provisions of this headnote do not apply with respect to any part of a shipment if the consignee or his agent furnishes, in such time and manner as may be prescribed by regulations of the Secretary of the Treasury, satisfactory proof --

(i) that such part (A) is commercially negligible, (B) is not capable of segregation without excessive cost, and (C) will not be segregated prior to its use in a manufacturing process or otherwise, and

(ii) that the commingling was not intended to avoid the payment of lawful duties.

Any article with respect to which such proof is furnished shall be considered for all customs purposes as a part of the article, subject to the next lower rate of duty, with which it is commingled.

(d) The foregoing provisions of this headnote do not apply with respect to any shipment if the consignee or his agent shall furnish, in such time and manner as may be prescribed by regulations of the Secretary of the Treasury, satisfactory proof --

(i) that the value of the commingled articles is less than the aggregate value would be if the shipment were segregated;

(ii) that the shipment is not capable of segregation without excessive cost and will not be segregated prior to its use in a manufacturing process or otherwise; and

(iii) that the commingling was not intended to avoid the payment of lawful duties.

Any merchandise with respect to which such proof is furnished shall be considered for all customs purposes to be dutiable at the rate applicable to the material present in greater quantity than any other material.

(e) The provisions of this headnote shall apply only in cases where the schedules do not expressly provide a particular tariff treatment for commingled articles.

8. Abbreviations. In the schedules the following symbols and abbreviations are used with the meanings respectively indicated below:

$	-	dollars
¢	-	cents
%	-	percent
+	-	plus
ad val.	-	ad valorem
bu.	-	bushel
cu.	-	cubic
doz.	-	dozen
ft.	-	feet
gal.	-	gallon
in.	-	inches
lb.	-	pounds
oz.	-	ounces
sq.	-	square
wt.	-	weight
yd.	-	yard
pcs.	-	pieces
prs.	-	pairs
lin.	-	linear
I.R.C.	-	Internal Revenue Code

9. Definitions. For the purposes of the schedules, unless the context otherwise requires --

(a) the term "entered" means entered, or withdrawn from warehouse, for consumption in the customs territory of the United States;

(b) the term "entered for consumption" does not include withdrawals from warehouse for consumption;

(c) the term "withdrawn for consumption" means withdrawn from warehouse for consumption and does not include articles entered for consumption;

(d) the term "rate of duty" includes a free rate of duty; rates of duty proclaimed by the President shall be referred to as "proclaimed" rates of duty; rates of duty enacted by the Congress shall be referred to as "statutory" rates of duty; and the rates of duty in column numbered 2 at the time the schedules become effective shall be referred to as "original statutory" rates of duty;

(e) the term "ton" means 2,240 pounds, and the term "short ton" means 2,000 pounds;

(f) the terms "of", "wholly of", "almost wholly of", "in part of" and "containing", when used between the description of an article and a material (e.g., "furniture of wood", "woven fabrics, wholly of cotton", etc.), have the following meanings:

(i) "of" means that the article is wholly or in chief value of the named material;

(ii) "wholly of" means that the article is, except for negligible or insignificant quantities of some other material or materials, composed completely of the named material;

(iii) "almost wholly of" means that the essential character of the article is imparted by the named material, notwithstanding the fact that significant quantities of some other material or materials may be present; and

(iv) "in part of" or "containing" mean that the article contains a significant quantity of the named material.

With regard to the application of the quantitative concepts specified in subparagraphs (ii) and (iv) above, it is intended that the de minimis rule apply.

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

General Headnotes and Rules of Interpretation

10. General Interpretative Rules. For the purposes of these schedules --

(a) the general, schedule, part, and subpart headnotes, and the provisions describing the classes of imported articles and specifying the rates of duty or other import restrictions to be imposed thereon are subject to the rules of interpretation set forth herein and to such other rules of statutory interpretation, not inconsistent therewith, as have been or may be developed under administrative or judicial rulings;

(b) the titles of the various schedules, parts, and subparts and the footnotes therein are intended for convenience in reference only and have no legal or interpretative significance;

(c) an imported article which is described in two or more provisions of the schedules is classifiable in the provision which most specifically describes it; but, in applying this rule of interpretation, the following considerations shall govern:

(i) a superior heading cannot be enlarged by inferior headings indented under it but can be limited thereby;

(ii) comparisons are to be made only between provisions of coordinate or equal status, i.e., between the primary or main superior headings of the schedules or between coordinate inferior headings which are subordinate to the same superior heading;

(d) if two or more tariff descriptions are equally applicable to an article, such article shall be subject to duty under the description for which the original statutory rate is highest, and, should the highest original statutory rate be applicable to two or more of such descriptions, the article shall be subject to duty under that one of such descriptions which first appears in the schedules;

(e) in the absence of special language or context which otherwise requires --

(i) a tariff classification controlled by use (other than actual use) is to be determined in accordance with the use in the United States at, or immediately prior to, the date of importation, of articles of that class or kind to which the imported articles belong, and the controlling use is the chief use, i.e., the use which exceeds all other uses (if any) combined;

(ii) a tariff classification controlled by the actual use to which an imported article is put in the United States is satisfied only if such use is intended at the time of importation, the article is so used, and proof thereof is furnished within 3 years after the date the article is entered;

(f) an article is in chief value of a material if such material exceeds in value each other single component material of the article;

(g) a headnote provision which enumerates articles not included in a schedule, part, or subpart is not necessarily exhaustive, and the absence of a particular article from such headnote provision shall not be given weight in determining the relative specificity of competing provisions which describe such article;

(h) unless the context requires otherwise, a tariff description for an article covers such article, whether assembled or not assembled, and whether finished or not finished;

(ij) a provision for "parts" of an article covers a product solely or chiefly used as a part of such article, but does not prevail over a specific provision for such part.

11. Issuance of Rules and Regulations. The Secretary of the Treasury is hereby authorized to issue rules and regulations governing the admission of articles under the provisions of the schedules. The allowance of an importer's claim for classification, under any of the provisions of the schedules which provide for total or partial relief from duty or other import restrictions on the basis of facts which are not determinable from an examination of the article itself in its condition as imported, is dependent upon his complying with any rules or regulations which may be issued pursuant to this headnote.

12. The Secretary of the Treasury is authorized to prescribe methods of analyzing, testing, sampling, weighing, gauging, measuring, or other methods of ascertainment whenever he finds that such methods are necessary to determine the physical, chemical, or other properties or characteristics of articles for purposes of any law administered by the Customs Service.

General statistical headnotes:

1. Statistical Requirements for Imported Articles. Persons making customs entry or withdrawal of articles imported into the customs territory of the United States shall complete the entry or withdrawal forms, as provided herein and in regulations issued pursuant to law, to provide for statistical purposes information as follows:

(a) the number of the Customs district and of the port where the articles are being entered for consumption or warehouse, as shown in Statistical Annex A of these schedules;

(b) the name of the carrier or the means of transportation by which the articles were transported to the first port of unloading in the United States;

(c) the foreign port of lading;

(d) the United States port of unlading;

(e) the date of importation;

(f) the country of origin of the articles expressed in terms of the designation therefor in Statistical Annex B of these schedules;

(g) a description of the articles in sufficient detail to permit the classification thereof under the proper statistical reporting number in these schedules;

(h) the statistical reporting number under which the articles are classifiable;

(ij) gross weight in pounds for the articles covered by each reporting number when imported in vessels or aircraft;

(k) the net quantity in the units specified herein for the classification involved;

(l) the U.S. dollar value in accordance with the definition in Section 402 or 402a of the Tariff Act of 1930, as amended, for all merchandise including that free of duty or dutiable at specific rates; and

(m) such other information with respect to the imported articles as is provided for elsewhere in these schedules.

2. Statistical Annotations. (a) The statistical annotations to the Tariff Schedules of the United States consist of --

(i) the 2-digit statistical suffixes,
(ii) the indicated units of quantity,
(iii) the statistical headnotes and annexes, and
(iv) the italicized article descriptions.

(b) The legal text of the Tariff Schedules of the United States consists of the remaining text as more specifically identified in headnote 10(a) of the general headnotes and rules of interpretation.

(c) The statistical annotations are subordinate to the provisions of the legal text and cannot change their scope.

3. Statistical Reporting Number. (a) General Rule: Except as provided in paragraph (b) of this headnote, and in the absence of specific instructions to the contrary elsewhere, the statistical reporting number for an article consists of the 7-digit number formed by combining the 5-digit item number with the appropriate 2-digit statistical suffix. Thus, the statistical reporting number for live monkeys dutiable under item 100.95 is "100.9520".

(b) Wherever in the tariff schedules an article is classifiable under a provision which derives its rate of duty from a different provision, the statistical reporting number is, in the absence of specific instructions to the contrary elsewhere, the 7-digit number for the basic provision followed by the item number of the provision from which the rate is derived. Thus, the statistical reporting number of mixed apple and grape juices, not containing over 1.0 percent of ethyl alcohol by volume, is "165.6500-165.40".

4. Abbreviations. (a) The following symbols and abbreviations are used with the meanings respectively indicated below:

s. ton	-	short ton
C.	-	one hundred
Cwt.	-	100 lbs.
mg.	-	milligram
M.	-	1,000
bd. ft.	-	board feet
M. bd. ft.	-	1,000 board feet
mc.	-	millicurie
cord	-	128 cubic feet
square	-	amount to cover 100 square feet of surface
sup. ft.	-	superficial foot
oz.	-	ounces avoirdupois
fl. oz.	-	fluid ounce
oz. troy	-	troy ounce
pf. gal.	-	proof gallon

(b) An "X" appearing in the column for units of quantity means that no quantity (other than gross weight) is to be reported.

(c) Whenever two separate units of quantity are shown for the same article, the "v" following one of such units means that the value of the article is to be reported with that quantity.

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

HISTORICAL NOTES

Amendments and Modifications

PROVISIONS	
Gen Hdnte--3(a)(i)	Language "Except as provided in headnote 6 of schedule 7, part 2, subpart E," added; language "except that all articles" deleted and language "except that all such articles" inserted in lieu thereof. Pub. L. 89-805, Secs. 1(a), (c), Nov. 10, 1966, 80 Stat. 1521, 1522, effective date Jan. 1, 1967. Language "Except as provided in headnote 4 of schedule 7, part 7, subpart A," added. Pub. L. 89-806, Secs. 2(b), (c), Nov. 10, 1966, 80 Stat. 1523, effective date March 11, 1967.
Gen Hdnte--3(d), (e), (f) and (g)	Headnotes 3(d), (e), and (f) redesignated as headnotes 3(e), (f), and (g), respectively, and new headnote 3(d) added. Pub. L. 89-283, Secs. 401(a), 403, Oct. 21, 1965, 79 Stat. 1021, 1022; entered into force Oct. 22, 1965, by Pres. Proc. 3682, Oct. 21, 1965, 3 CFR, 1965 Supp., p. 68.
Gen Hdnte--6(b)(i)	Language "and containers of usual types ordinarily sold at retail with their contents," added. Pub. L. 89-241, Secs. 2(a), 4, Oct. 7, 1965, 79 Stat. 933, 934, effective date Dec. 7, 1965.

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS

APPENDIX A

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS

Schedule 4 headnotes:

1. This schedule does not include --
   (i) any of the mineral products provided for in schedule 5;
   (ii) metal-bearing ores and other metal-bearing materials, provided for in part 1 of schedule 6; or
   (iii) metals provided for in part 2 of schedule 6.

2. (a) The term "compounds", as used in this schedule, means substances occurring naturally or produced artificially by the reaction of two or more ingredients, each compound --
   (i) consisting of two or more elements,
   (ii) having its own characteristic properties different from those of its elements and from those of other compounds, and
   (iii) always consisting of the same elements united in the same proportions by weight with the same internal arrangement.

The presence of impurities which occur naturally or as an incident to production does not in itself affect the classification of a product as a compound.

(b) The term "compounds", as used in this schedule, includes a solution of a single compound in water, and, in determining the amount of duty on any such compound subject to duty in this schedule at a specific rate, an allowance in weight or volume, as the case may be, shall be made for the water in excess of any water of crystallization which may have been in the compound.

3. (a) The term "mixtures", as used in this schedule, means substances consisting of two or more ingredients (i.e., elements or compounds), whether occurring as such in nature, or whether artificially produced (i.e., brought about by mechanical, physical, or chemical means), which do not bear a fixed ratio to one another and which, however thoroughly commingled, retain their individual chemical properties and are not chemically united. The fact that the ingredients of a product are incapable of separation or have been commingled in definite proportions does not in itself affect the classification of such product as a mixture.

(b) The term "mixtures", as used in this schedule, includes solutions, except solutions defined as compounds in headnote 2(b) of this schedule.

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty	
				1	2
		PART 3. - DRUGS AND RELATED PRODUCTS			
		Part 3 headnotes:			
		1. Any product described in this part which is a mixture containing as an ingredient any product described in part 1 of this schedule remains classifiable in part 3 unless the part 1 ingredient, as used in the mixture, imparts therapeutic or medicinal properties thereto. Notwithstanding the provisions of part 1 of this schedule, niacin, niacinamide, meso-inositol hexanicotinate, and pyridoxine (vitamin B_6), regardless of source, are classifiable in part 3 of this schedule.			
		2. For the purposes of the tariff schedules, the term "drugs" means those substances, whether natural or synthetic, having therapeutic or medicinal properties and chiefly used as medicines or as ingredients in medicines.			
		3. For the purposes of this part -- (a) "natural substances" are those substances found in nature which comprise whole plants and herbs, anatomical parts thereof, vegetable saps, extracts, secretions and other constituents thereof; whole animals, anatomical parts thereof, glands or other animal organs, extracts, secretions and other constituents thereof, and which have not had changes made in their molecular structure as found in nature; (b) a "synthetic substance" is a chemical compound made by the artificial combination of elements or radicals by any physical or chemical process; (c) the term "crude", as used in relation to natural products, means any product which has not been advanced in value or improved in condition by shredding, grinding, chipping, crushing, distilling, evaporating, extracting, by artificial mixing with other substances or by any other process or treatment beyond that which is essential to its proper packing and the prevention of decay or deterioration pending manufacture; and (d) the term "advanced", as used in relation to natural products, means any product which has been advanced in value or improved in condition from its crude state by any mechanical or physical process whatever beyond that which is essential to its proper packing and the prevention of decay or deterioration pending manufacture, but does not include any product which has been artificially mixed with other substances or the molecular structure of which as found in nature has been changed.			
		Subpart A. - Natural Drugs, Crude or Advanced			
		Subpart A headnote:			
		1. This subpart covers only products which are natural drugs, crude or advanced.			

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

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SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 3. - Drugs and Related Products

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		Aconite, aloes, asafetida, buchu leaves, cocculus indicus, digitalis (Lanata), ipecac, jalap, manna, and marshmallow or althea:			
435.05	00	Crude	Lb.	Free	Free
435.10	00	Advanced	Lb.	1.5% ad val.	10% ad val.
435.30	00	Barks, cinchona or other, from which quinine may be extracted	Lb.	Free	Free
435.35	00	Belladonna	Lb.	Free	Free
435.40	00	Coca leaves	Lb.	Free	10¢ per lb.
435.45	00	Digitalis (Purpurea)	Lb.	8% ad val.	20% ad val.
435.50	00	Ergot	Lb.	Free	Free
435.55	00	Gentian	Lb.	Free	Free
435.60	00	Henbane	Lb.	Free	Free
435.65	00	Nux vomica	Lb.	Free	Free
435.70	00	Opium		$4.32 per lb. of anhydrous morphine content	$18 per lb. of anhydrous morphine content
		anhydrous morphine content	*Lb.*		
435.75	00	Stramonium	Lb.	Free	Free
436.00	00	Any of the products provided for in this subpart when imported in ampoules, capsules, jubes, lozenges, pills, tablets, troches, or similar forms, including powders put up in medicinal doses	X	The rate provided for such product in this subpart, but not less than 6% ad val.	The rate provided for such product in this subpart, but not less than 25% ad val.
		Subpart B. - Alkaloids, Antibiotics, Barbiturates, Hormones, Vitamins, and Other Drugs and Related Products			
		Subpart B headnote:			
		1. The articles described in this subpart are classifiable hereunder whether or not they are drugs.			
		Alkaloids and their esters, ethers, salts, and other compounds:			
437.00	00	Brucine and its compounds	Oz.	6% ad val.	25% ad val.
		Caffeine and its compounds:			
437.02	00	Caffeine	Lb.	30.5¢ per lb.	$1.25 per lb.
437.04	00	Caffeine, citrated	Lb.	45¢ per lb.	75¢ per lb.
437.06	00	Other	Lb.	15% ad val.	25% ad val.
437.08		Cinchona bark alkaloids and their salts		Free	Free
	20	*Quinine and its salts*	*Oz.*		
	40	*Quinidine and its salts*	*Oz.*		
	60	*Other*	*Oz.*		
437.10	00	Cocaine and its compounds	Oz.	$1.56 per oz.	$2.60 per oz.
437.12	00	Ergotamine compounds	Lb.	6% ad val.	25% ad val.
437.13	00	Nicotine and its compounds	Lb.	6% ad val.	25% ad val.
437.14	00	Opium alkaloids and their compounds	Oz.	$1.80 per oz.	$3 per oz.
437.16	00	Strychnine and its salts	Oz.	6¢ per oz.	20¢ per oz.
437.18	00	Theobromine	Lb.	13¢ per lb.	75¢ per lb.
		Other alkaloids and their compounds:			
437.20	00	Synthetic	Lb.	6% ad val.	25% ad val.
		Natural:			
437.22	00	Not artificially mixed	Lb.	2% ad val.	10% ad val.
437.24	00	Other	Lb.	6% ad val.	25% ad val.
		Antibiotics:			
437.30	00	Natural and not artificially mixed	Gram	2% ad val.	10% ad val.
437.32	00	Other	Gram	6% ad val.	25% ad val.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 3. - Drugs and Related Products

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		Barbituric acid and its compounds:			
437.36	00	Barbituric acid	Lb.	15% ad val.	25% ad val.
437.38	00	Diethylbarbituric acid and its compounds	Lb.	90¢ per lb.	$2.50 per lb.
437.40	00	Other	Lb.	6% ad val.	25% ad val.
437.44	00	Chloral hydrate	Lb.	8% ad val.	35% ad val.
		Enzymes and ferments:			
437.46	00	Rennet	Lb.	Free	Free
437.47	00	Yeast (except dried brewers' yeast)	Lb.	10% ad val.	20% ad val.
437.48	00	Brewers' yeast, dried, ficin, and papain, all the foregoing, if crude	Lb.	Free	Free
437.49	00	Other	Lb.	6% ad val.	25% ad val.
437.50	00	Ethylhydrocupreine and its compounds	Oz.	12¢ per oz.	20¢ per oz.
		Gluconic acid and its compounds:			
437.51	00	Acid	Lb.	7% ad val.	25% ad val.
437.52	00	Other	Lb.	6% ad val.	25% ad val.
437.54	00	Glycerophosphoric acid and its compounds	Lb.	10% ad val.	35% ad val.
437.55	00	Haarlem oil	Lb.	6% ad val.	25% ad val.
		Hormones:			
		Synthetic:			
437.56	00	Adrenocortical hormones	Gram	10.5% ad val.	25% ad val.
437.57	00	Other	Gram	6% ad val.	25% ad val.
		Natural:			
437.58	00	Not artificially mixed	Gram	2% ad val.	10% ad val.
437.60	00	Other	Gram	6% ad val.	25% ad val.
437.64	00	Menthol	Lb.	21¢ per lb.	50¢ per lb.
437.65	00	Meso-inositol hexanicotinate, whether or not regarded as a vitamin	Lb.	6% ad val.	25% ad val.
437.66	00	Santonin and its salts	Lb.	Free	Free
		Tannic acid containing by weight 50% or more of tannic acid:			
437.68	00	Conforming to the specifications for tannic acid contained in the National Formulary, XI	Lb.	5¢ per lb.	18¢ per lb.
437.69	00	Other	Lb.	4¢ per lb.	11¢ per lb.
437.70	00	Terpin hydrate	Lb.	16.5% ad val.	35% ad val.
437.72	00	Thymol	Lb.	7% ad val.	35% ad val.
437.74	00	Tinctures of opium such as laudanum and other liquid preparations of opium	Fl. oz.	36% ad val.	60% ad val.
437.76	00	Viruses, therapeutic serums, vaccines, toxins, antitoxins, and analogous biological products; human blood and fractions thereof; human skin and bone grafts, and other anatomical parts of the human body prepared for diagnostic or therapeutic purposes	X	Free	Free
		Vitamins:			
437.82		Synthetic		5% ad val.	25% ad val.
	10	*Niacin and niacinamide*	*Lb.*		
	20	*Pyridoxine (vitamin B_6)*	*Lb.*		
	30	*Vitamin B_1 (thiamine hydrochloride or thiamine mononitrate)*	*Lb.*		
	35	*Vitamin A (alcohol and esters) and provitamin A*	*Lb.*		
	40	*Vitamin C (ascorbic acid and its salts)*	*Lb.*		
	45	*Vitamin D (ergocalciferol and cholecalciferol)*	*Lb.*		
	60	*Other*	*Lb.*		
		Natural:			
437.84	00	Not artificially mixed	Lb.	2% ad val.	10% ad val.
437.86	00	Other	Lb.	5% ad val.	25% ad val.

Item	Stat. Suffix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		Any of the products provided for in this subpart when imported in ampoules, capsules, jubes, lozenges, pills, tablets, troches, or similar forms, including powders put up in medicinal doses:			
438.01	00	Vitamins	X.....	5% ad val.	25% ad val.
438.02	00	Other	X.....	The rate provided for such product in this subpart, but not less than 6% ad val.	The rate provided for such product in this subpart, but not less than 25% ad val.
		Subpart C. - Other Drugs			
		Drugs, not provided for in subpart A or B of this part:			
		Natural drugs, crude or advanced:			
439.10		Crude	.....	Free	Free
	20	*Of animal origin*	Lb.		
	40	*Of vegetable origin*	Lb.		
	60	*Other*	Lb.		
439.30		Advanced	.....	1.5% ad val.	10% ad val.
	20	*Of animal origin*	Lb.		
	40	*Of vegetable origin*	Lb.		
	60	*Other*	Lb.		
439.50		Other, including synthetic drugs	.....	6% ad val. 1/	25% ad val.
	20	*Chemically defined compounds*	Lb.		
		Other:			
	40	*Of animal origin*	Lb.		
	60	*Of vegetable origin*	Lb.		
	80	*Other*	Lb.		
440.00	00	Any of the products provided for in this subpart when imported in ampoules, capsules, jubes, lozenges, pills, tablets, troches, or similar forms, including powders put up in medicinal doses	X.....	The rate provided for such product in this subpart, but not less than 6% ad val.	The rate provided for such product in this subpart, but not less than 25% ad val.

1/ L-Dopa is temporarily free of duty. See item 907.45 in part 1B, Appendix to Tariff Schedules.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

STAGED RATES AND HISTORICAL NOTES

Notes p. 1
Schedule 4,
Part 3

Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002:

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 --				
		1968	1969	1970	1971	1972
435.10	3% ad val.	2.5% ad val.	2% ad val.	2% ad val.	1.5% ad val.	1.5% ad val.
435.40	1.4¢ per lb.	Free	Free	Free	Free	Free
435.45	13.5% ad val.	12% ad val.	10.5% ad val.	9% ad val.	8% ad val.	6.5% ad val.
435.70	$7.20 per lb. of anhydrous morphine content	$6.48 per lb. of anhydrous morphine content	$5.76 per lb. of anhydrous morphine content	$5.04 per lb. of anhydrous morphine content	$4.32 per lb. of anhydrous morphine content	$3.60 per lb. of anhydrous morphine content
436.00	The rate provided for such product in this subpart, but not less than 10.5% ad val.	The rate provided for such product in this subpart, but not less than 9% ad val.	The rate provided for such product in this subpart, but not less than 8% ad val.	The rate provided for such product in this subpart, but not less than 7% ad val.	The rate provided for such product in this subpart, but not less than 6% ad val.	The rate provided for such product in this subpart, but not less than 5% ad val.
437.00	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.02	51¢ per lb.	45.5¢ per lb.	40.5¢ per lb.	35.5¢ per lb.	30.5¢ per lb.	25¢ per lb.
437.04	75¢ per lb.	67.5¢ per lb.	60¢ per lb.	52.5¢ per lb.	45¢ per lb.	37.5¢ per lb.
437.06	25% ad val.	22% ad val.	20% ad val.	17% ad val.	15% ad val.	12.5% ad val.
437.10	$2.60 per oz.	$2.34 per oz.	$2.08 per oz.	$1.82 per oz.	$1.56 per oz.	$1.30 per oz.
437.12	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.13	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.14	$3 per oz.	$2.70 per oz.	$2.40 per oz.	$2.10 per oz.	$1.80 per oz.	$1.50 per oz.
437.16	10¢ per oz.	9¢ per oz.	8¢ per oz.	7¢ per oz.	6¢ per oz.	5¢ per oz.
437.18	22¢ per lb.	19.5¢ per lb.	17¢ per lb.	15¢ per lb.	13¢ per lb.	11¢ per lb.
437.20	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.22 1/	3% ad val.	2.5% ad val.	2% ad val.	2% ad val.	1.5% ad val.	1.5% ad val.
437.24	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.30 1/	3% ad val.	2.5% ad val.	2% ad val.	2% ad val.	1.5% ad val.	1.5% ad val.
437.32	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.36	25% ad val.	22% ad val.	20% ad val.	17% ad val.	15% ad val.	12.5% ad val.
437.38	$1.50 per lb.	$1.35 per lb.	$1.20 per lb.	$1.05 per lb.	90¢ per lb.	75¢ per lb.
437.40	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.44	14% ad val.	12.5% ad val.	11% ad val.	9.5% ad val.	8% ad val.	7% ad val.
437.49	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.50	20¢ per oz.	18¢ per oz.	16¢ per oz.	14¢ per oz.	12¢ per oz.	10¢ per oz.
437.51	12.5% ad val.	11% ad val.	10% ad val.	8.5% ad val.	7% ad val.	6% ad val.
437.52	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.54	17.5% ad val.	15.5% ad val.	14% ad val.	12% ad val.	10% ad val.	8.5% ad val.
437.55 1/	7.5% ad val.	6.5% ad val.	6% ad val.	5% ad val.	4% ad val.	3.5% ad val.
437.57	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.58 1/	3% ad val.	2.5% ad val.	2% ad val.	2% ad val.	1.5% ad val.	1.5% ad val.
437.60	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.64	35¢ per lb.	31¢ per lb.	28¢ per lb.	24¢ per lb.	21¢ per lb.	17¢ per lb.
437.65	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
437.68	9¢ per lb.	8¢ per lb.	7¢ per lb.	6¢ per lb.	5¢ per lb.	4.5¢ per lb.
437.69 1/	5.5¢ per lb.	4.5¢ per lb.	4¢ per lb.	3.5¢ per lb.	3¢ per lb.	2.7¢ per lb.
437.70	28% ad val.	25% ad val.	22% ad val.	19.5% ad val.	16.5% ad val.	14% ad val.
437.72	12% ad val.	10.5% ad val.	9.5% ad val.	8% ad val.	7% ad val.	6% ad val.
437.74	60% ad val.	54% ad val.	48% ad val.	42% ad val.	36% ad val.	30% ad val.
437.82	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
437.84 1/	3% ad val.	2.5% ad val.	2% ad val.	2% ad val.	1.5% ad val.	1.5% ad val.
437.86	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
438.01	8.5% ad val.	7.5% ad val.	6.5% ad val.	5.5% ad val.	5% ad val.	4% ad val.
438.02	The rate provided for such product in this subpart, but not less than 10.5% ad val.	The rate provided for such product in this subpart, but not less than 9% ad val.	The rate provided for such product in this subpart, but not less than 8% ad val.	The rate provided for such product in this subpart, but not less than 7% ad val.	The rate provided for such product in this subpart, but not less than 6% ad val.	The rate provided for such product in this subpart, but not less than 5% ad val.
439.30 1/	3% ad val.	2% ad val.	1.5% ad val.	1% ad val.	0.5% ad val.	Free
439.50	10.5% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
440.00	The rate provided for such product in this subpart, but not less than 10.5% ad val.	The rate provided for such product in this subpart, but not less than 9% ad val.	The rate provided for such product in this subpart, but not less than 8% ad val.	The rate provided for such product in this subpart, but not less than 7% ad val.	The rate provided for such product in this subpart, but not less than 6% ad val.	The rate provided for such product in this subpart, but not less than 5% ad val.

See footnote 1/ on the following page.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

Notes p. 2
Schedule 4,
Part 3

STAGED RATES AND HISTORICAL NOTES

1/ In accordance with general note 3(f) to Schedule XX (Geneva - 1967), the rates of duty for this item in the columns headed 1970, 1971, 1972 were to become effective unless the European Economic Community and the United Kingdom had not proceeded with certain reductions provided for in their respective schedules annexed to the Geneva (1967) Protocol to the GATT. These two participants have not so proceeded, and the President has so proclaimed (Pres. Proc. 3950, Dec. 24, 1969, 34 F.R. 20299, effective date January 1, 1970), with the result that the rate of duty in the column headed 1969 will continue in effect unless or until the President proclaims that they have agreed so to proceed. See related footnote 1 to Kennedy Round Staged Rates at the end of schedule 4, parts 3, 4, 5, 7, 8, 9, and 13; schedule 5, part 1; schedule 6, part 2; and schedule 7, parts 2, 9, 12, and 13.

Other Amendments and Modifications

PROVISION	
437.56-- 437.57	Item 437.56 (column 1 rate--10.5% ad val.; column 2 rate--25% ad val.) deleted and new items 437.56 and 437.57 and heading immediately preceding item 437.56 added in lieu thereof. Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002, effective date Jan. 1, 1968.

Statistical Notes

PROVISION	Effective date
437.00--	
00--Unit of quantity changed from "Lb." to "Oz."	*Jan. 1, 1968*
437.08--	
00--Disc. (transferred to 437.0820, 40 & 60)	*Jan. 1, 1966*
20--Estab. (transferred from 437.0800pt)	*do*
40--Estab.	*do*
60--Estab.	*do*
437.48--	
00--Estab. (transferred from 437.4820 & 40)	*Jan. 1, 1966*
20--Disc. (transferred to 437.4800)	*do*
40--Disc.	*do*
437.56--See Other Amendments and Modifications	
00--Synthetic hormones other than adrenocortical hormones transferred to 437.5700	*Jan. 1, 1968*
437.57--See Other Amendments and Modifications	
00--Estab. (transferred from 437.5600pt)	*Jan. 1, 1968*
437.82--	
35--Estab. (transferred from 437.8250pt)	*Jan. 1, 1969*
45--Estab.	*do*
50--Disc. (transferred to 437.8235, 45 & 60)	*do*
60--Estab. (transferred from 437.8250pt)	*do*
439.50--See Amendments and Modifications (item 907.45)	
20--L-Dopa temporarily transferred to 907.4500	*July 8, 1970*

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 4. - Synthetic Resins and Plastics Materials; Rubber

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		PART 4. - SYNTHETIC RESINS AND PLASTICS MATERIALS; RUBBER			
		Subpart A. - Synthetic Resins and Plastics Materials			
		Subpart A headnotes:			
		1. This subpart does not cover synthetic plastics materials provided for in part 1C of this schedule, but the addition of any product described in part 1 of this schedule to a synthetic plastics material described in this subpart as an antioxidant, color, dispersing agent, emulsifier, extender, filler, pesticide, plasticizer, or stabilizer does not affect the classification of such synthetic plastics material in this subpart.			
		2. The term "synthetic plastics materials", in this subpart, embraces products formed by the condensation, polymerization, or copolymerization of organic chemicals and to which an antioxidant, color, dispersing agent, emulsifier, extender, filler, pesticide, plasticizer, or stabilizer may have been added. These products contain as an essential ingredient an organic substance of high molecular weight; are capable, at some stage during processing into finished articles, of being molded or shaped by flow; and are solid in the finished article. The term includes, but is not limited to, such products derived from esters of acrylic or methacrylic acid; vinyl acetate, vinyl chloride resins, polyvinyl alcohol, acetals, butyral, formal resins, polyvinyl ether and ester resins, and polyvinylidene chloride resins; urea and amino resins; polyethylene, polypropylene, and other polyalkene resins; siloxanes, silicones, and other organo-silicon resins; alkyd, acrylonitrile, allyl, and formaldehyde resins; and cellulosic plastics materials. These synthetic plastics materials may be in solid, semi-solid, or liquid condition such as flakes, powders, pellets, granules, solutions, emulsions, and other basic crude forms not further processed.			
		Synthetic plastics materials:			
445.05	00	Acrylic and methacrylic acid resins	Lb.	1.5¢ per lb. + 12% ad val.	4¢ per lb. + 30% ad val.
445.10	00	Acrylonitrile resins	Lb.	1.6¢ per lb. + 12% ad val.	4¢ per lb. + 30% ad val.
445.15	00	Allyl resins	Lb.	1.6¢ per lb. + 12% ad val.	4¢ per lb. + 30% ad val.
		Cellulosic plastics materials:			
445.20	00	Cellulose acetate	Lb.	6¢ per lb.	50¢ per lb.
445.25	00	Other	Lb.	11.5¢ per lb.	40¢ per lb.
445.30	00	Polyethylene resins	Lb.	1.6¢ per lb. + 12% ad val.	4¢ per lb. + 30% ad val.
445.35	00	Urea and amino (including melamine) resins	Lb.	1.5¢ per lb + 12% ad val.	4¢ per lb. + 30% ad val.
		Vinyl resins:			
445.40		Polyvinyl acetate and vinyl resins containing by weight 50 percent or more of derivatives of vinyl acetate		0.7¢ per lb. + 3.5% ad val.	4¢ per lb. + 30% ad val.
	20	*Polyvinyl alcohol resins*	*Lb.*		
	40	*Other*	*Lb.*		
445.45		Other		1.5¢ per lb. + 7% ad val.	4¢ per lb. + 30% ad val.
	20	*Polyvinyl chloride resins*	*Lb.*		
	40	*Other vinyl resins*	*Lb.*		
445.50		Other		1.3¢ per lb. + 12% ad val.	4¢ per lb. + 30% ad val.
	20	*Polytetrafluoroethylene (PTFE)*	*Lb.*		
	40	*Other*	*Lb.*		

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

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4 - 4 - B
445.75 - 446.30

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 4. - Synthetic Resins and Plastics Materials; Rubber

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty	
				1	2
445.75	00	Artificial mixtures of two or more of the foregoing plastics materials	Lb.....	The highest rate applicable to any component material	The highest rate applicable to any component material
		Subpart B. - Rubber			
		Subpart B headnotes: 1. This subpart covers all rubber whether or not obtained, derived, or manufactured in whole or in part from any product described in part 1 of this schedule. 2. For the purposes of the tariff schedules, the term "rubber" means a substance, whether natural or synthetic, in bale, crumb, powder, latex, or other crude form, which can be vulcanized or otherwise cross-linked, and which after cross-linking can be stretched at 68°F. to at least three times its original length and which, after having been stretched to twice its original length and the stress removed, returns within 5 minutes to less than 150 percent of its original length, and includes such substance whether or not containing fillers, extenders, pigments, or rubber-processing chemicals.			
		Natural rubber:			
446.05		Not containing fillers, extenders, pigments, or rubber-processing chemicals	.....	Free	Free
	10	*Gutta balata*	*Lb.*		
	20	*Gutta-percha and guttas, n.e.s.*	*Lb.*		
	30	*Jelutong or pontianak*	*Lb.*		
		Other:			
	40	*Latex*	*Lb. 1/*		
	50	*Dry form*	*Lb.*		
446.10	00	Containing fillers, extenders, pigments, or rubber-processing chemicals	Lb.....	6% ad val.	20% ad val.
446.12	00	Chlorinated natural rubber	Lb.....	6% ad val.	20% ad val.
446.15		Synthetic rubber	.....	3.5% ad val.	20% ad val.
	10	*Butyl*	*Lb.*		
	20	*Nitrile*	*Lb.*		
	30	*Polybutadiene*	*Lb.*		
	40	*Polychloroprene (neoprene)*	*Lb.*		
	50	*Styrene-butadiene*	*Lb.*		
	60	*Other*	*Lb.*		
446.20	00	Reclaimed rubber of all kinds	Lb.....	Free	Free
446.30	00	Mixtures of any of the foregoing	Lb.....	6% ad val.	20% ad val.

1/ Pounds dry rubber content.

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

STAGED RATES AND HISTORICAL NOTES

Notes p. 1
Schedule 4,
Part 4

Staged Rates

Modifications of column 1 rates of duty by Pres. Proc. 3822 (Kennedy Round), Dec. 16, 1967, 32 F.R. 19002:

TSUS item	Prior rate	Rate of duty, effective with respect to articles entered on and after January 1 --				
		1968	1969	1970	1971	1972
445.05	2.75¢ per lb. + 20% ad val.	2.4¢ per lb. + 18% ad val.	2¢ per lb. + 16% ad val.	1.9¢ per lb. + 14% ad val.	1.5¢ per lb. + 12% ad val.	1.3¢ per lb. + 10% ad val.
445.10	2.75¢ per lb. + 20% ad val.	2.4¢ per lb. + 18% ad val.	2.2¢ per lb. + 16% ad val.	1.9¢ per lb. + 14% ad val.	1.6¢ per lb. + 12% ad val.	1.3¢ per lb. + 10% ad val.
445.15	2.75¢ per lb. + 20% ad val.	2.4¢ per lb. + 18% ad val.	2.2¢ per lb. + 16% ad val.	1.9¢ per lb. + 14% ad val.	1.6¢ per lb. + 12% ad val.	1.3¢ per lb. + 10% ad val.
445.20 1/	7.5¢ per lb.	6.7¢ per lb.	6¢ per lb.	5.2¢ per lb.	4.5¢ per lb.	3.7¢ per lb.
445.25	19.5¢ per lb.	17¢ per lb.	15¢ per lb.	13¢ per lb.	11.5¢ per lb.	9.7¢ per lb.
445.30	2.75¢ per lb. + 20% ad val.	2.4¢ per lb. + 18% ad val.	2.2¢ per lb. + 16% ad val.	1.9¢ per lb. + 14% ad val.	1.6¢ per lb. + 12% ad val.	1.3¢ per lb. + 10% ad val.
445.35	2.75¢ per lb. + 20% ad val.	2.4¢ per lb. + 18% ad val.	2¢ per lb. + 16% ad val.	1.9¢ per lb. + 14% ad val.	1.5¢ per lb. + 12% ad val.	1.3¢ per lb. + 10% ad val.
445.40	1.25¢ per lb. + 6.25% ad val.	1.1¢ per lb. + 5.5% ad val.	1¢ per lb. + 5% ad val.	0.85¢ per lb. + 4% ad val.	0.7¢ per lb. + 3.5% ad val.	0.6¢ per lb. + 3% ad val.
445.45	2.5¢ per lb. + 12.5% ad val.	2.2¢ per lb. + 11% ad val.	2¢ per lb. + 10% ad val.	1.7¢ per lb. + 8.5% ad val.	1.5¢ per lb. + 7% ad val.	1.25¢ per lb. + 6% ad val.
445.50	2.75¢ per lb. + 20% ad val.	2¢ per lb. + 18% ad val.	2¢ per lb. + 16% ad val.	1.5¢ per lb. + 14% ad val.	1.3¢ per lb. + 12% ad val.	1.3¢ per lb. + 10% ad val.
446.10	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
446.12	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.
446.15	6.5% ad val.	5.5% ad val.	5% ad val.	4.5% ad val.	3.5% ad val.	3% ad val.
446.30	10% ad val.	9% ad val.	8% ad val.	7% ad val.	6% ad val.	5% ad val.

1/ In accordance with general note 3(f) to Schedule XX (Geneva - 1967), the rates of duty for this item in the columns headed 1970, 1971, 1972 were to become effective unless the European Economic Community and the United Kingdom had not proceeded with certain reductions provided for in their respective schedules annexed to the Geneva (1967) Protocol to the GATT. These two participants have not so proceeded, and the President has so proclaimed (Pres. Proc. 3950, Dec. 24, 1969, 34 F.R. 20299, effective date January 1, 1970), with the result that the rate of duty in the column headed 1969 will continue in effect unless or until the President proclaims that they have agreed so to proceed. See related footnote 1 to Kennedy Round Staged Rates at the end of schedule 4, parts 3, 4, 5, 7, 8, 9, and 13; schedule 5, part 1; schedule 6, part 2; and schedule 7, parts 2, 9, 12, and 13.

Other Amendments and Modifications

PROVISION

Subpt A--Language "a plasticizer, filler, color, or extender" deleted and language "an antioxidant, color, dispersing agent, emulsifier, extender, filler, pesticide, plasticizer, or stabilizer" inserted in lieu thereof. Pub. L. 89-241, Secs. 2(a), 25(1), Oct. 7, 1965, 79 Stat. 933, 938, effective date Dec. 7, 1965.

PROVISION

Subpt A--Language "plasticizers, fillers, colors, or extenders" hdnte 2 deleted and language "an antioxidant, color, dispersing agent, emulsifier, extender, filler, pesticide, plasticizer, or stabilizer" inserted in lieu thereof. Pub. L. 89-241, Secs. 2(a), 25(2), Oct. 7, 1965, 79 Stat. 933, 938, effective date Dec. 7, 1965.

Statistical Notes

PROVISION	Effective date
Subpt. A--See Other Amendments and Modifications for clarifying language covering items 445.05-445.75	
445.40--	
00--Disc. (transferred to 445.4020 & 40).....	*Jan. 1, 1970*
20--Estab. (transferred from 445.4000pt).....	*do*
40--Estab.	*do*
445.50--	
00--Disc. (transferred to 44.5020 & 40).....	*Jan. 1, 1969*
20--Estab. (transferred from 445.5000pt).....	*do*
40--Estab.	*do*

PROVISION	Effective date
446.15--	
00--Disc. (transferred to 446.1510-60).....	*Jan. 1, 1971*
10--Estab. (transferred from 446.1500pt).....	*do*
20--Estab.	*do*
30--Estab.	*do*
40--Estab.	*do*
50--Estab.	*do*
60--Estab.	*do*

TARIFF SCHEDULES OF THE UNITED STATES ANNOTATED (1971)

SCHEDULE 4. - CHEMICALS AND RELATED PRODUCTS
Part 13. - Fatty Substances, Camphor, Chars and Carbons, Isotopes, Waxes, and Other Products

Item	Stat. Suf-fix	Articles	Units of Quantity	Rates of Duty 1	Rates of Duty 2
		Subpart B. - Camphor, Chars and Carbons, Isotopes, Waxes, and Other Products			
		Subpart B headnote:			
		1. For the purposes of this part -- (a) the term "crude", in items 493.02, 493.20, and 493.33, has the same meaning as is given for that term in headnote 3(c) of part 1 of this schedule; and (b) the term "advanced" in items 493.04, 493.21, and 493.36, has the same meaning as is given for that term in headnote 3(d) in part 1 of this schedule.			
		Barbasco or cube root, and dertis, tuba or tuba root:			
493.02	00	Crude	Lb	Free	Free
493.04	00	Advanced	Lb	Free	10% ad val.
493.10	00	Blackings, powders, liquids, and creams for polishing and cleaning, all the foregoing in immediate containers holding not over 10 pounds each	X	3.5% ad val.	25% ad val.
		Casein and mixtures in chief value thereof:			
493.15	00	Casein	Lb	Free	Free
493.16	00	Other	Lb	1.1¢ per lb.	5.5¢ per lb.
493.18	00	Cellulose compounds, not specially provided for	Lb	9.5¢ per lb.	45¢ per lb.
		Camphor:			
		Natural:			
493.20	00	Crude	Lb	0.4¢ per lb.	1¢ per lb.
493.21	00	Advanced	Lb	2.4¢ per lb.	5¢ per lb.
493.22	00	Synthetic	Lb	3¢ per lb.	5¢ per lb.
		Chars and carbons:			
493.25	00	Bone char	Lb	12% ad val.	20% ad val.
493.26	00	Decolorizing and gas or vapor absorbing chars and carbons, whether or not activated	Lb	9% ad val.	45% ad val.
493.30	00	Dextrine and soluble or chemically treated starches	Lb	1.125¢ per lb. 1/	3¢ per lb.
493.35	00	Fibrin	Lb	Free	Free
493.40	00	Mineral salts obtained by evaporation from the waters of a designated mineral spring	Lb	Free	Free
493.42	00	Preparations containing over 50 percent by weight of monosodium glutamate	K	4¢ ad val.	25% ad val.
		Pitch:			
493.45	00	Burgundy	Lb	Free	Free
493.46	00	Marine glue	Lb	9.5% ad val.	20% ad val.
493.47	00	Wood	Lb	0.4¢ per lb.	1¢ per lb.
493.50	00	Products chiefly used as assistants in preparing or finishing textiles, not specially provided for	Lb	7% ad val.	25% ad val.
		Pyrethrum or insect flowers:			
493.53	00	Crude	Lb	Free	Free
493.56	00	Advanced	Lb	Free	10% ad val.

1/ Rate temporarily increased. See item 945.49 in part 2B, Appendix to Tariff Schedules.

A P P E N D I X B

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1970.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1970

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries		First supplier		Second supplier		Third supplier	
	Amount in 1970	Percent change from 1969	Country	Value	Country	Value	Country	Value
Natural drugs, non-narcotic (p. 3)								
435.05	612	-18	Netherlands	230	Nicaragua	199	Rep. S. Af.	80
435.10	4	-63	France	3	India	1/	W. Germany	1/
435.30	2	-66	Ecuador	2	-	-	-	-
435.35	4	-78	Yugoslavia	4	-	-	-	-
435.45	-	-100	-	-	-	-	-	-
435.50	9	-32	Canada	7	Portugal	2	-	-
435.55	20	+32	Spain	19	W. Germany	1	-	-
435.60	-	-	-	-	-	-	-	-
435.65	38	+307	Singapore	30	Cambodia	8	-	-
435.75	1	-17	Kenya	1	Bulgaria	1/	-	-
439.10	12,525	+6	Canada	8,293	India	2,447	Chile	378
439.30	1,353	+127	Argentina	316	Korea	267	Canada	144
Natural drugs, narcotic (p. 13)								
435.40	296	+10	Peru	286	Uruguay	10	-	-
435.70	2,822	+30	India	2,396	Turkey	426	-	-
Caffeine and its compounds (p. 21)								
437.02	2,110	-5	W. Germany	2,081	Netherlands	28	-	-
437.04	-	-	-	-	-	-	-	-
437.06	-	-	-	-	-	-	-	-
Chinchona bark alkaloids and their salts (p. 25)								
437.08	6,270	+11	W. Germany	2,281	Netherlands	2,068	France	835
Miscellaneous non-narcotic alkaloids (p. 31)								
437.00	442	+19	India	289	Israel	152	-	-
437.12	234	+75	Switzerland	177	W. Germany	40	U. K.	15
437.13	107	+80	U. K.	49	Japan	45	Switzerland	10
437.16	101	-10	Israel	66	India	31	U. K.	4
437.18	320	+116	U.S.S.R.	224	Netherlands	85	Italy	3
437.20	4,675	+34	Switzerland	2,622	W. Germany	1,380	Israel	327
437.22	923	-23	Switzerland	721	Italy	127	France	56
437.24	128	+9	W. Germany	48	Israel	45	Italy	25
437.50	1/	-74	U. K.	1/	-	-	-	-
Narcotic alkaloids and related substances (p. 43)								
437.10	-	-	-	-	-	-	-	-
437.14	-	-	-	-	-	-	-	-
437.74	-	-	-	-	-	-	-	-
Antibiotics (p. 51)								
437.30	2,651	+56	U. K.	2,020	Italy	557	Canada	66
437.32	10,988	-13	Ireland	4,301	Italy	2,962	Portugal	1,188
Barbituric acid and its derivatives, nonbenzenoid (p. 57)								
437.36	453	+80	Switzerland	233	W. Germany	217	Japan	2
437.38	8	+310	Japan	3	Peru	2	W. Germany	1
437.40	389	-41	Denmark	277	U. K.	84	Switzerland	14
Chloral hydrate (p. 61)								
437.44	25	-44	U. K.	16	W. Germany	9	-	-

See footnotes at end of table.

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1970

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries: Amount in 1970	All countries: Percent change from 1969	First supplier: Country	First supplier: Value	Second supplier: Country	Second supplier: Value	Third supplier: Country	Third supplier: Value
Enzymes and ferments (p. 63)								
437.46	1,872	-2	Canada	539	N. Zealand	364	France	361
437.47	30	+74	Switzerland	19	W. Germany	9	U. K.	2
437.48	1,152	-46	Congo	282	Uganda	237	Denmark	155
437.49	9,657	-40	Denmark	7,310	W. Germany	844	Japan	494
Gluconic acid and its compounds (p. 75)								
437.51	-	-100	-	-	-	-	-	-
437.52	426	-11	Netherlands	259	Switzerland	64	France	50
Glycerophosphoric acid and its compounds (p. 81)								
437.54	42	+3	France	24	U. K.	14	W. Germany	4
Haarlem oil (p. 83)								
437.55	-	-100	-	-	-	-	-	-
Hormones (p. 85)								
437.56	2,878	+4	France	741	Switzerland	724	W. Germany	366
437.57	18,527	-35	Bahamas	10,471	Mexico	4,565	Netherlands	1,371
437.58	772	-6	Netherlands	433	U. K.	146	Italy	62
437.60	547	+302	Canada	232	Israel	144	Netherlands	109
Menthol (p. 93)								
437.64	5,955	+2	Brazil	5,750	Japan	66	Australia	58
Meso-inositol hexanicotinate (p. 99)								
437.65	-	-100	-	-	-	-	-	-
Santonin and its salts (p. 101)								
437.66	-	-100	-	-	-	-	-	-
Tannic acid (p. 105)								
437.68	539	+40	U. K.	388	France	87	Belgium	64
437.69	83	+12	U. K.	49	Italy	15	Belgium	13
Terpin hydrate (p. 109)								
437.70	73	-11	France	56	Japan	10	Spain	6
Thymol (p. 113)								
437.72	18	-72	W. Germany	16	France	2	-	-
Certain biological products (p. 117)								
437.76	3,462	+68	Belgium	1,530	U. K.	445	El Salvador	432
493.35	-	-	-	-	-	-		-
Vitamins (p. 123)								
437.82	12,924	+19	Japan	4,117	Denmark	2,049	Switzerland	2,044
437.84	206	+67	W. Germany	111	Switzerland	63	Japan	20
437.86	636	+167	Japan	395	U. K.	136	Netherlands	89
Miscellaneous nonbenzenoid drugs (p. 133)								
439.50	9,941	+29	Netherlands	1,564	Canada	1,444	U. K.	1,439

Value of U.S. imports for consumption, by TSUS items included in the individual summaries of this volume, total and from the 3 principal suppliers, 1970

(In thousands of dollars. The dollar value of imports shown is defined generally as the market value in the foreign country and therefore excludes U.S. import duties, freight, and transportation insurance)

Summary title and page; TSUS item	All countries: Amount in 1970	All countries: Percent change from 1969	First supplier: Country	First supplier: Value	Second supplier: Country	Second supplier: Value	Third supplier: Country	Third supplier: Value
Nonbenzenoid drugs in dosage forms (p. 137)								
436.00	5	-69	Japan	4	Canada	1	-	-
438.01	110	+138	U. K.	70	Switzerland	13	Japan	8
438.02	3,536	+857	Belgium	2,961	Canada	253	U. K.	159
440.00	6,830	+51	U. K.	5,623	Sweden	647	W. Germany	181
Cellulosic plastics (p. 141)								
445.20	67	-91	Italy	22	Canada	18	Switzerland	12
445.25	38	-16	U. K.	15	Canada	8	Japan	6
Polyethylene resins (p. 147)								
445.30	2,878	+202	Japan	2,422	W. Germany	338	Canada	95
Urea and amino (including melamine) resins (p. 157)								
445.35	162	-49	W. Germany	63	Sweden	43	Italy	27
Polyvinyl acetate and derivatives, and other vinyl resins (p. 165)								
445.40	8,618	+50	Japan	7,965	W. Germany	351	France	148
445.4540	363	-17	W. Germany	186	France	74	Japan	54
Polyvinyl chloride resins (p. 175)								
445.4520	1,527	+50	Japan	1,237	W. Germany	88	Canada	58
Polypropylene resins (p. 183)								
2/								
Miscellaneous plastics materials (p. 189)								
445.05	1,927	-19	Japan	1,360	U. K.	200	W. Germany	168
445.10	115	3/	Japan	83	W. Germany	31	Ireland	1
445.15	103	+84	Japan	97	Canada	5	Mexico	1
445.50	7,060	-1	France	2,784	W. Germany	1,577	U. K.	1,443
445.75	24	-6	W. Germany	17	Canada	6	Japan	1/
Natural rubber (p. 197)								
446.05	236,498	-15	Malaysia	109,745	Indonesia	53,858	Liberia	26,741
446.10	205	-3	Malaysia	148	W. Germany	42	Ceylon	7
Chlorinated natural rubber (p. 211)								
446.12	363	-38	Italy	202	Japan	87	U. K.	67
Synthetic rubber (p. 215)								
446.15	42,250	+12	Canada	25,227	Japan	12,176	France	1,982
Reclaimed rubber (p. 231)								
446.20	398	-28	Canada	383	Ceylon	15	-	-
Rubber mixtures (p. 239)								
446.30	22	+38	Canada	13	W. Germany	6	Sweden	2

1/ Less than $500.
2/ Included in miscellaneous plastics materials (in item 445.50).
3/ More than 1,000 percent increase.

* U.S. GOVERNMENT PRINTING OFFICE: 1971-437-949/101

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