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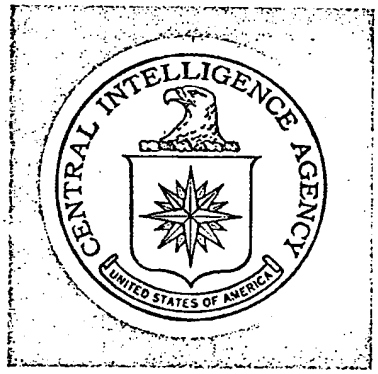

DIRECTORATE OF
INTELLIGENCE

Intelligence Memorandum

The Contribution of Imports to Communist China's Advanced Weapons Program

~~Secret~~
COPY NO. 277

RR IM 67-21
MAY 1967

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CONTENTS

Appendix

Chart

THE CONTRIBUTION OF IMPORTS TO COMMUNIST CHINA'S ADVANCED WEAPONS PROGRAM*

Summary

Imports from Japan and Western Europe of key industrial equipment, materials, and technology play an important role in Communist China's advanced weapons program. These imports help to overcome critical deficiencies in domestic supply and lessen the impact of the withdrawal of Soviet technical support. Over the next few years, China will face formidable difficulties when its own R&D, engineering, and industrial capacity will be taxed severely to support production and deployment of advanced weapons. Thus the degree of industrial and technical support from Japan and Western Europe will more than ever determine the pace, scope, and effectiveness of China's military production programs.

In spite of economic difficulties caused by the excesses of the Great Leap Forward and the withdrawal of Soviet support, Peking has resolutely pushed forward the development of modern weapons. China's principal industrial deficiencies that are of importance to modern weapons development fall into four categories: machinery -- particularly special-purpose and precision machinery; electronic equipment; special metals; and certain key chemicals. In all four the Chinese leadership has been successful in expanding domestic capacity and production since 1960. This advance, however, has been on a narrow front and has been achieved only by concentrating the best manpower and equipment on these high-priority tasks. Imports from Japan and Western Europe have met many important needs in these four areas.

Modern weapons systems now under development in Communist China are based on Soviet systems and consequently have the bulk of the research already proved -- and paid for. China almost certainly is going ahead with its own independent R&D efforts, such as those needed for an ICBM program, and this means a rapid increase in the complexity and cost of R&D.

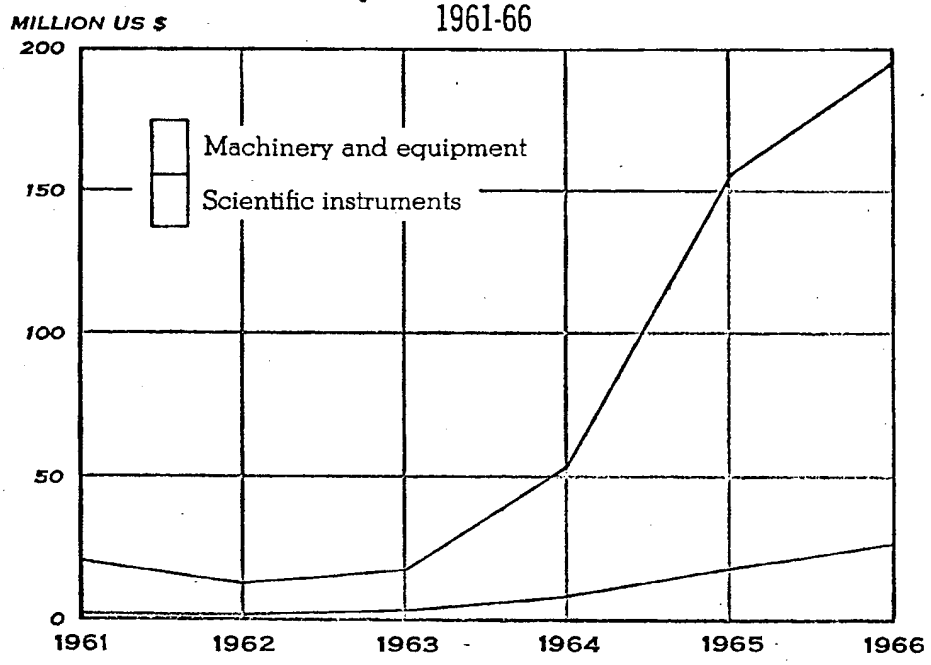
* This memorandum was produced solely by CIA. It was prepared by the Office of Research and Reports and was coordinated with the Office of Scientific Intelligence; the estimates and conclusions represent the best judgment of the Directorate of Intelligence as of April 1967.

Over the next few years, Communist China will depend even more heavily on Japan and Western Europe to supplement domestic efforts to expand its modern industrial capacity (see Figure 1), and imports of key industrial equipment and technology will serve not only to support the modern weapons program but also to relieve the pressure on supplies of manpower and equipment in industry as a whole.

[redacted]

Figure 1

COMMUNIST CHINA
VALUE OF IMPORTS FROM JAPAN AND WESTERN EUROPE
OF MACHINERY AND EQUIPMENT AND SCIENTIFIC INSTRUMENTS*
1961-66



*Excludes imports of transportation equipment and complete plants

[redacted]

I. GENERAL PROGRESS IN INDUSTRIALIZATION

A. The Period of Soviet Assistance

The Chinese Communist leadership has emphasized from the very beginning the development of heavy industry, including military production facilities. The Soviet-style system of rapid industrialization was adopted, and large-scale domestic investment was supplemented by extensive material and technical support from other Communist countries.

In a series of agreements signed between 1950 and 1959, the USSR agreed to supply China with 300 modern industrial plants worth about $3 billion. These plants included almost the entire range of modern industrial installations -- steel mills, electric power stations, machine building facilities, aircraft plants, chemical facilities, and the like. The Communist countries of Eastern Europe also agreed to contribute a substantial number of industrial projects to China's ambitious development program. China could have produced these facilities domestically only after much delay and at a tremendously high cost. In effect, the USSR and Eastern Europe were offering China "instantaneous industrialization." China was able to and did pay for this industrialization through exports of goods that it could produce efficiently at home -- textiles, ores, and specialty foodstuffs.

As a result of increases in domestic production and assistance from other Communist countries, Communist China greatly expanded its industrial base in the first five-year plan period (1953-57). Production of major items increased as follows:

Item	Unit	Production 1952	Production 1957
Crude steel	Million metric tons	1.35	5.35
Coal	Million metric tons	66.5	130.7
Petroleum	Million metric tons	0.44	1.46
Electric power	Billion kilowatt-hours	7.3	19.3
Cement	Million metric tons	2.9	6.9
Sulfuric acid	Thousand metric tons	190	632

B. The Disastrous Leap and the Withdrawal of Soviet Support

During the Great Leap Forward (1958-60), however, a disastrous change occurred in Chinese Communist economic policy. The tempo of production was accelerated to intolerable rates. Manpower and

raw materials were wasted on primitive industrial schemes such as backyard pig iron furnaces. In agriculture, supercollectives -- the "communes" -- were established and quickly led to disruptions in agricultural production and in the distribution of food; the weather, too, was unfavorable for agriculture after 1958. Economic planning and statistical control were dismissed as obsolete attitudes under the slogan, "Let politics command economics."

The Soviet authorities took few pains to conceal their anxiety over the economic policies of the Leap Forward. The USSR had a large political and economic investment in China that was in jeopardy. Moreover, increasing political and ideological differences caused a continuing deterioration in relations between the two Communist giants. Finally in mid-1960 -- and this was perhaps the most momentous single event in the economic history of Communist China -- the USSR peremptorily withdrew the 1,500 Soviet engineers and technicians and brought to a halt practically all of its economic assistance. The massive program of Soviet support ground to a halt. At this time, only about one-half of the scheduled 300 Soviet-aided plants had been completed. Aid from Eastern Europe, too, was reduced to a trickle.

During the winter of 1960-61 the Chinese economy reached its lowest ebb. Industrial production was severely reduced, malnutrition was widespread, and discontent extended even to the army.

C. Picking Up the Pieces

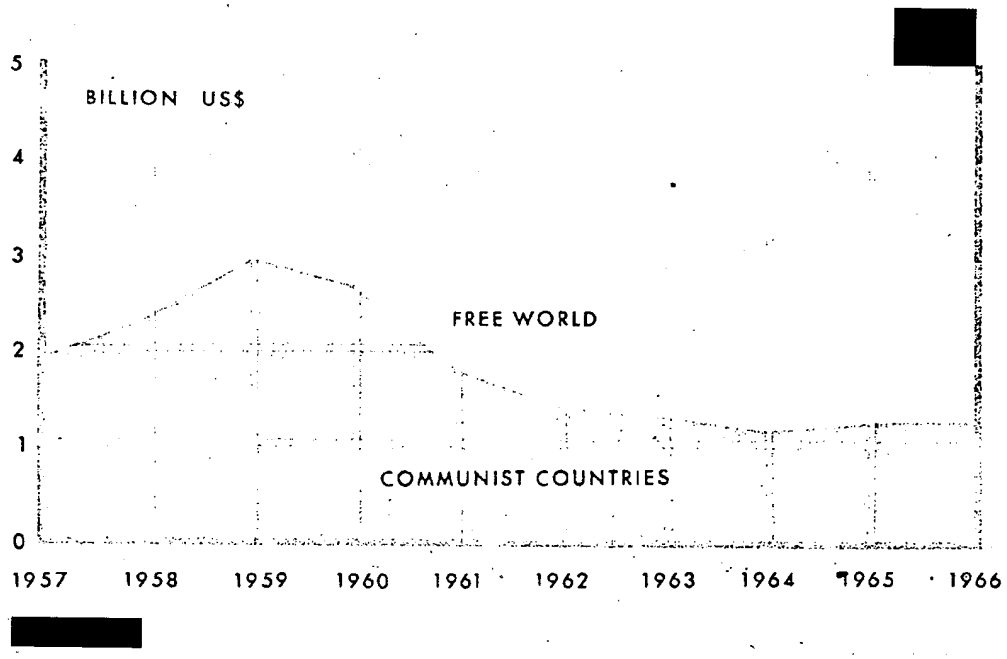
In spite of the collapse of the Leap Forward, Communist China retained the legacy of Soviet and Eastern European assistance -- the plant, the technology, and the trained workers. And it was not long before China began a slow but steady recovery from the depths to which it had plunged at the turn of the decade. By 1966, much of the idled industrial capacity had been put back in operation, but industrial production had not yet recovered its 1960 peak. Agricultural production and the food supply had recovered from the low point of 1960-61, but since 1957, population has grown considerably faster than agricultural production. To help offset the consequent decline in per capita production, China has imported 5 million or 6 million tons of grain each year since 1961.

During this period of recovery, China's trade with the Communist countries fell sharply, whereas trade with the non-Communist world rose, not only because of large grain purchases but also because of growing imports of machinery and industrial materials from Japan

and Western Europe. When China was industrializing under the tutelage of the USSR, more than two-thirds of Chinese trade was with the Communist countries. Since 1960 the situation has been reversed; now two-thirds of China's trade is with non-Communist countries. (See Figure 2)

Figure 2

Communist China: Total Trade
1957-66



D. A New Menace -- the "Cultural Revolution"

In 1966-67, economic recovery in Communist China is being menaced by a new development -- the "Great Proletarian Cultural Revolution." This campaign is perhaps a final attempt by the aging Mao to rekindle the flame of "permanent revolution" in a people whose main desire is economic betterment. Among the earliest targets were writers, professors, scientists, research directors, and other intellectuals and experts, especially those with Western training and contacts. But protection is said to have been granted to experts in high-priority defense industries. This protection apparently has been fairly effective.

In December 1966, Mao extended the revolution into industrial and agricultural enterprises. Production and research were disrupted in a large number of major industrial plants, but the disruptions were not critical or prolonged. The movement of imports and exports was hampered, and trade negotiations were delayed in some cases. Again, these developments probably have not seriously affected Chinese industry.

The cultural revolution is not in harmony either with the needs of modern industry or the wishes of the population for improvement in living conditions. At the moment the regime seems to be cautious in pressing the revolution throughout the economy. Although the revolution apparently has not yet damaged the advanced weapons program, it could become so violent as to cripple seriously the advance of industry and technology.

II. BROAD PROBLEMS IN THE DEVELOPMENT OF MODERN WEAPONS SYSTEMS

A. Need to Update Technology

Communist China has made rapid progress in the development of some modern weapons systems in spite of the disruptions of the Leap Forward and the withdrawal of Soviet support. The Chinese have been able to explode five nuclear devices, to undertake a diversified weapons program, and to embark on other military research and development activities. The Chinese programs probably rely to a large extent on technology supplied by the USSR before 1960, although attempts clearly are under way to push beyond this level. The precise status of Chinese progress is not known, but activity is particularly great in the nuclear, missile, aircraft, and naval fields.

Communist China lags far behind the major industrial nations of the world in industrial production and technology. Yet by concentrating industrial, scientific, and technical resources on weapons development and by purchasing key equipment and materials from abroad, China has steadily progressed in the development of high-priority military hardware. This progress has been achieved, however, only by withholding resources from the civilian economy and by delaying the growth of a general industrial base for the broader needs of the economy. Delays in the development of a modern industrial base will, of course, in turn influence the future pace, scope, and effectiveness of weapons programs.

During the period of Soviet support, emphasis was placed on the growth of basic industries. Since 1960, however, efforts have focused on the expansion of facilities to produce more complex commodities such as certain electronics items, special metals, plastics, synthetic fibers, and other chemical products. Expansion of the key machine building sector has also had a high priority. The need to develop a complex modern industry undoubtedly has been made more imperative by the ever-rising requirements of weapons programs. Since the withdrawal of Soviet support, China has been turning to Free World countries as the only alternative source of advanced machinery, scientific equipment, critical raw materials, and technical data.

B. Chronic Shortage of Skilled Manpower

A continuing key weakness in China's industrial technology is the shortage of well-trained engineers and technicians at the middle and upper levels. The Chinese leadership has had to choose which types

of technical work are to be supported and which neglected. At present, Chinese scientific research work is concerned largely with urgent practical problems, as opposed to general scientific research, and is probably concentrated to an important degree in the military area. The regime can assemble teams of researchers and engineers to focus on a small number of high-priority problems, but its efforts on military programs are at the expense of basic industrial programs.

III. INDUSTRIAL DEFICIENCIES OF IMPORTANCE TO ADVANCED WEAPONS

Generally speaking, Communist China's principal industrial deficiencies that are of importance to modern weapons development fall into four categories: electronics equipment; certain key chemicals; special metals; and machinery -- particularly special-purpose and precision machinery.

A. Electronics Equipment

Among all the inputs needed in a modern weapons program, Communist China is probably in the best position in military electronics equipment. The Chinese profited as much from Soviet assistance in building up a domestic electronics industry as in any other field of modern industry. After 1960, however, new military needs began to be met chiefly by China's own adaptations of foreign-designed equipment. In addition, many varieties of Western electronics equipment can now be purchased by the Chinese, and much of the current Chinese effort is devoted to adapting this equipment to meet specific Chinese military requirements.

As a result of earlier Soviet assistance and of its own extensive research and development, China is believed to be capable of producing much of the control and instrumentation equipment -- including radars, computers, and gyroscopes -- needed for guidance and control of surface-to-surface missiles, surface-to-air missiles, and short-range cruise missiles.

China currently produces enough communications equipment to meet most of the minimum requirements of its ground, naval, and air forces. Most of its deployed ground radar is of domestic manufacture. As the need for more complex equipment develops, however, the Chinese are seeking imports of more electronics and communications equipment, including prototypes, as well as technical data from Japan and Western Europe. The electronics industry also is heavily dependent on imported raw and semi-finished materials (for example, mica, quartz, and high-purity copper) and on high-quality production machinery and testing equipment.

B. Chemicals

The technological development of Communist China's chemical industry lagged behind that of other heavy industries up to 1960. Since then, considerable progress has been made in the production of basic chemicals, fertilizers, and plastics, and since 1965 the Chinese have

placed a high priority on the development of petrochemicals. China's output of chemicals evidently is adequate to meet most of the needs of its advanced weapons programs. Fragmentary information indicates that imports of weapons-related chemicals and equipment have been limited in type and quantity.

China is capable of producing a small number of solid and liquid propellants for missiles and rockets. In the case of solid propellants, the munitions complex at T'ai-yuan produces traditional types of double-base propellants in sufficient amounts for test and development purposes. Of the liquid propellants, China produces alcohol, kerosine, liquid oxygen, and concentrated nitric acid in quantity. China, however, probably produces only small amounts of high-strength liquid propellants such as liquid hydrogen, nitrogen tetroxide, hydrazine, and other amines.

Many plastics are useful in military weapons. The plastics industry of China, however, is relatively new and underdeveloped. Chinese chemists have succeeded in producing some of the more common types of polymers but cannot mass-produce the specialized types that are useful in military weapons. In 1965, China claimed to have developed a domestic capability to produce Teflon; production is limited, however, and quality probably is below Western standards. Teflon has a number of strategic uses in the aircraft and electronics industries and is extremely important (because of its resistance to corrosion) as a gasket material in the gaseous diffusion process for the production of U-235.

Specialized types of synthetic rubbers are needed for military programs, yet China produces very little rubber and imports a variety of types. China still lacks processes capable of mass-producing silicone rubbers, modern stereorubbers, and oil-resistant synthetic rubbers. In the 1950's a 50,000-ton synthetic rubber plant was built by the USSR at Lan-chou; production from this plant still remains far below capacity. Imported plant and technology would be required for expansion of China's synthetic rubber industry.

C. Special Metals

One of the serious Chinese deficiencies in materials for the modern weapons program is the inadequate domestic capacity to produce many alloy and special steels and certain nonferrous metals. China probably has sufficient metallurgical competence and the necessary equipment, including vacuum melting equipment, to produce small quantities of superalloys, electrical steels, and stainless steels, including special types needed for research and development. Substantial increases in

high-grade alloy steel production, however, will depend on an expansion of capacity. In recent years the Chinese have intensified their efforts to develop the production of stainless steel to support the expansion of the chemical industry as well as to supply new military needs such as in construction of nuclear reactors.

China's metallurgical industry probably has sufficient capacity for producing most of the present requirements for commonly used metals and alloys, with the exception of chrome, nickel, copper, and cobalt. Expansion will be required in rolling mill capacity, however, if China is to meet a large part of its requirements for finished steel -- particularly sheet and strip -- from domestic production. Expansion in rolling capacity would require imports of equipment and complete plants.

Little is known of China's ability to produce and fabricate such metals as titanium, tungsten, tantalum, beryllium, columbium, and molybdenum. China's problems with steel processing and its efforts to obtain technology for certain of these metals from abroad suggest that it would have difficulty with the more complicated problems of producing and fabricating these metals.

The principal requirements in increasing the supply, variety, and quality of metallurgical products in the near future are: (a) modern finishing mills, (b) additional metallurgists and skilled production workers, (c) additional equipment and technology needed for the production of the more advanced metals and alloys, and (d) certain mineral raw materials.

D. Machinery

The machine building industry carries the heaviest load in support of China's military programs. Since 1960 this sector of industry has been in a poor position to support simultaneously the development of modern weapons systems and the most pressing civilian needs. Loss of Soviet aid has forced the machine building industry to use its scarce resources to develop greater self-sufficiency in the manufacture and design of new equipment. This industry has had to shift a larger share of its production to the manufacture of specialized equipment required in such facilities as aircraft plants, nuclear reactors, metallurgical plants, and oil refineries. Compounding the problem has been the need for China to obtain from domestic or Free World sources most of the instrumentation and controls and other specialized components formerly obtained from the USSR.

Even so, over the last two or three years, China has made progress by concentrating the industry's best manpower and equipment to meet these requirements. The Chinese have been able to supplement their domestic efforts by purchases from the West of precision and specialized types of machine tools such as jig-borers, gear-making machines, and precision grinders. Chinese imports of machine tools such as these have risen steadily since 1963.

Imports of Free World equipment not only contribute to the filling of large gaps in Chinese capabilities but also provide the Chinese with prototypes for native designs. Imports such as whole machine building plants involve purchase of readymade technology and provide a training ground for Chinese technicians, especially in those instances where contracts include provisions for training by the supplier.

Over the next several years, production in the Chinese machine building industry is likely to increase in amount and variety and should be better able to support, for example, a modern jet aircraft industry. Available resources for jet aircraft production, however, will remain scarce because this line of production requires many of the same engineering skills, metals, and machine processes as missile production. Thus a higher level of competition may occur between these two weapons programs than between these and other programs -- for example, submarine production or the development of nuclear capabilities.

IV. BURDEN OF THE WEAPONS PROGRAM

Communist China's military and military-related programs may take as much as 10 percent of China's GNP. This is a somewhat higher share of GNP -- and a much larger share of industrial production -- than in France and the United Kingdom. Of greater importance, China's weapons program uses manpower, equipment, and materials of the highest quality -- scarce resources that otherwise could be used to build up the civilian sector of the economy. In a conversation with visitors in 1964, Premier Chou En-lai acknowledged that China's pursuit of a nuclear capability had imposed an enormous burden on the economy.

The experience of other countries indicates that military costs will become even greater in the years ahead, especially when Communist China attempts to move various weapons systems into production and deployment. Weapons systems now being developed are based on Soviet designs and hence have most of the basic research already proven. The Chinese would be able to lessen -- but not prevent -- rises in R&D costs if they were willing to settle only for the acquisition of proved Soviet systems and thus the technology of the 1950's. China almost certainly is going ahead with its own independent R&D efforts, such as those needed for an ICBM program, and this means rapidly rising R&D costs.

Total costs will mount even faster as China attempts to place various weapons systems in series production and to deploy them in the field. Even if in the next few years China produces only improved copies of Soviet systems, serious problems will be faced in mastering the production techniques and reproducing specialized parts or components. Production costs relative to R&D costs are likely to be higher for China than they were for the United States or France because those countries already had in existence the industrial machinery, processes, and skills needed to support their production programs. In addition, China will have to meet the heavy annual operating and maintenance expenses of the deployed units.

In the absence of extensive foreign assistance, China's supply of skilled manpower almost certainly will prove to be inadequate to pursue both a high-priority modern weapons program and provide adequately for the civilian economy. Over the next several years, China will continue to be faced with an acute shortage of scientific, managerial, and engineering personnel and will be forced to concentrate its efforts on a narrow range of high-priority industries.

Most of China's best technical talent continues to be those Chinese who were educated abroad, both in the Free World and in the USSR. For top scientific and technical talent, China still relies heavily on those Chinese educated abroad, but significant numbers of China-trained researchers with 5 to 10 years experience are now reaching upper levels of competence. The closing of China's universities because of the cultural revolution is delaying this program.

V. IMPORTANCE OF ASSISTANCE FROM JAPAN AND WESTERN EUROPE

A. Total Imports

China's imports of equipment and technical data from the Free World make a major contribution to its military programs. Since 1961, China has purchased more than half a billion dollars worth of machinery, equipment, and scientific instruments from Japan and Western Europe.* This figure does not include purchases of transportation equipment or the total value of technical data acquired from abroad. The following tabulation shows the sharp rise since 1963 in imports from Japan and Western Europe of machinery, equipment, and scientific instruments:

	Million US $		
Year	Total	Machinery and Equipment [a]	Scientific Instruments
1961	20.6	18.6	2.0
1962	13.4	12.6	0.8
1963	16.6	14.3	2.3
1964	54.4	46.7	7.7
1965	156.9	138.2	18.7
1966 [b]	195	170	25

a. Excluding imports of transportation equipment and complete plants.
b. Annual estimate based on data for first six months.

China has been purchasing increasing quantities of such items as rolling mills, special-purpose lathes and other machine tools, scientific instruments, computers, and other electronics equipment. The shopping list for future imports not only is becoming longer but also includes a larger proportion of items related -- either directly or indirectly -- to the advanced weapons program.

* For a selected list of some of the more important purchases made in 1965-66, see the Appendix.

Many items of strategic equipment included in China's shopping lists fall within COCOM regulations, and the regime has had difficulties in purchasing all the types or quantities of machinery required. However, the COCOM list does not include many items of both direct and indirect importance to China's military program, and some of those items covered by COCOM have been obtained through circumvention of the controls.

B. Complete Plants

Since mid-1963, China's purchases of complete plants from Japan and Western Europe have expanded considerably. The value of these plants totals about $200 million. Most of the purchases have been in support of the civilian economy -- for example, chemical fiber, fertilizer, and plastics plants. However, some of these installations, especially steel and other metallurgical plants, will supply important inputs to the buildup of China's military-industrial base. Furthermore, the purchase of advanced Western technology and equipment for priority sectors of the civilian economy, such as chemicals and petroleum, releases scarce R&D manpower for use in weapons programs.

When purchasing complex plants or equipment involving new technology, the Chinese usually obtain agreement from the manufacturer to supervise installation of the equipment in China, to train Chinese technicians in its use, and to guarantee its continued operation and repair. In some cases the Chinese purchase technical knowhow rather than equipment. For example, in late 1965 the Chinese made such a purchase in a contract entered into with a large Swiss producer of diesel engines.

C. Metallurgical Equipment

During 1966, Communist China took steps to widen the range of products produced in its steel industry, particularly to reduce imports of flat-rolled and tubular steel products. Since early 1966 the Chinese have been negotiating with a Western European consortium headed by the West German DEMAG Corporation for the purchase of: a continuous high-speed hot strip mill, a continuous high-speed cold strip mill, a tube extrusion facility, and (possibly) a planetary strip mill. The proposed facilities would increase China's capacity to produce sheet and plate by 2.3 million tons annually.

In 1965, Chinese imports of finished steel amounted to about $130 million, roughly double the level of 1963, and imports probably were

higher in 1966. Most of the imports consisted of flat-rolled and tubular products -- types of steel that would be produced by the rolling mill equipment under negotiation.

Over the past few years, contracts have been concluded and negotiations have been started for the import of equipment required for production and processing of "space age" metals. Chinese capabilities in the important field of high-temperature and corrosion-resistant materials have been increased primarily by the purchase of foreign equipment and technology.

D. Machine Tools

In general, the machine tools currently being developed in China are not the type suitable for production of the large-dimensioned precise parts required to fill weapons fabrication requirements. Thus as the demand for precision machinery becomes greater, China must of necessity rely on imports from the industrialized nations of the Free World.

Imports of high-grade machine tools for all purposes, military and civilian, have come primarily from West Germany, Switzerland, the United Kingdom, Japan, and, more recently, France and Italy. The increasing importance of Free World supplies is reflected by the following tabulation, which gives the value of imports from principal Free World suppliers in 1964 and 1965.

	Thousand US $	
	1964	1965
West Germany	2,594	4,359
Switzerland	1,440	4,308
United Kingdom	1,663	3,592
Japan	614	2,557
Total	6,311	14,816

Purchases from these countries have continued to increase, reaching a level of up to $20 million in 1966. Purchases include jig-borers, heavy-duty horizontal boring and milling machines, high-speed internal grinders, fine-pitch precision gear machines, and others. Virtually

all of the machine tools being purchased in the West ostensibly are for nondefense end uses; however, most probably are intended to be used directly in support of military industries.

E. Industrial Materials

Imports of industrial materials also contribute to modern weapons production. Total imports of industrial materials have been rising sharply and were about $250 million in 1966, excluding imports of fertilizer. Small quantities of certain materials critical to the development of China's advanced weapons programs have been imported -- for example, Teflon, ion-exchange resins, high-purity copper, special steels, refractory metals (such as titanium, beryllium, and tantalum), and high-purity graphite needed in atomic research.

F. Technical Data

A distinct contribution to Communist China's weapons production program comes from the acquisition of foreign technical data. China is constantly gathering technical documentary information through open sources in Japan and the West, such as libraries, bookstores, universities, and scientific publishing houses. Chinese scientific and technical delegations obtain technical data from visits to Free World factories, laboratories, and universities, as well as through other direct personal contacts. Scientists and engineers visiting China often undergo intensive questioning about technical matters. Some technical information also is purchased directly by the Chinese or is transmitted in connection with negotiations or sales of equipment.

G. Circumvention of Controls

Finally, of course, the Chinese are able to acquire invaluable technology through clandestine channels: contract negotiations and shipments are carried out covertly in violation of COCOM and other controls; there are false declarations regarding the end use of the equipment; and deception is employed -- by shipping equipment a piece at a time (to avoid identification), by hiding the fact that China is the ultimate destination, and by falsifying export documents.

H. Future Importance of Assistance

Over the next few years China will depend more heavily on Japan and Western Europe to supplement domestic efforts to support its modern industrial capacity. As the production of modern weapons

increases and as China is forced to rely more and more on its own R&D and engineering resources to support the development of new weapons programs, additional types and quantities of special materials, advanced equipment, and modern technology will have to be acquired from the Free World. Imports of modern equipment and technology will serve not only to support weapons programs but also to relieve the pressure on supplies of skilled manpower and equipment in industry as a whole. Thus substantial increases in imports of this type and continued negotiations for additional kinds of equipment and materials are likely. This trend almost certainly will continue unless China either has an unexpected rapprochement with the USSR or suffers an economic breakdown from the excesses of its present cultural revolution.

APPENDIX

COMMUNIST CHINA: SELECTED MAJOR IMPORTS OF MACHINERY, EQUIPMENT, AND SCIENTIFIC INSTRUMENTS FROM JAPAN AND WESTERN EUROPE 1965-66

Item	Country	Date a/*	China's Present Position	Relevance to Advanced Weapons Program
Electronic and scientific equipment and instruments				
Instruments for bio-environmental monitoring	Japan	Aug 1965	Does not produce	Necessary for human engineering for development of high-altitude and high-performance aircraft
Vibration generating and testing equipment	Japan	1965	Negligible domestic production	Essential to shake-test nuclear weapons and components of aircraft and missiles
Electron tubes (magnetrons, klystrons, and traveling wave tubes)	Japan	1965-66	Produces many power tubes but imports replacements for foreign tubes and new types of tubes for prototypes	Power tubes of this type are used in military radars for controlling surface-to-air missiles, antiaircraft guns, and tactical missiles; in air defense radars; and in strategic ballistic missiles
Automatic echosonde radar tracking system	Japan	Dec 1965	Not produced	Missile range instrumentation
Precision gyro balancers	Japan	Nov 1966	Negligible capability	Equipment for testing gyro mechanisms to be installed in missiles
Electronic digital instruments (counters, interval timers, and recorders)	Japan	1965-66	Attempting to establish production of electronic digital instruments	Can be coupled with various types of sensing element (transducers) for use in nuclear physical measurements
Electron microscope	Japan	Dec 1965	Negligible production	Can be used in production control of certain nuclear fuels
X-ray microanalyzer	Japan	Dec 1965	No production	Can be used to analyze microstructure of materials and welds in aerospace vehicles

* Footnotes follow on p. 24.

Item	Country	Date [a]	China's Present Position	Relevance to Advanced Weapons Program
Electronic and scientific equipment and instruments (continued)				
Potentiometers	United Kingdom	1966	Produces some varieties	Miniature precision types are circuit components in advanced weapons but are controlled by COCOM definitions (IL 1568)
Photomultiplier tubes	United Kingdom	Oct 1966	Negligible production; imports large quantities	Used in nuclear weapons effects studies
Differential thermal analyzer	West Germany	1965-66	No production; highly specialized item	Used at Oak Ridge to measure changes in structure of crystalline materials under varying temperatures
Air contamination (radiation) monitor, model RA-202T	Italy	Dec 1966	Produces this type	Can be used to monitor radioactivity near atomic material production or atomic weapons tests
Chemical equipment				
Teflon plastic fabricating equipment	Japan	Jul 1965	Probably short of special equipment for fabricating Teflon into end use products	Reportedly used to produce temperature-resistant wire and cable; possibly used to make piping, gaskets, and other components in gaseous diffusion plant; Teflon products also used in missiles and in electronics industry
Sophisticated pulverizing equipment	Japan	1963 [b]	Negligible production	With a few small changes, this equipment could be used for processing such fine-grained ingredients of solid rocket fuel as ammonium perchlorate

Item	Country	Date [a/]	China's Present Position	Relevance to Advanced Weapons Program
Chemical equipment (continued)				
Hydrogen peroxide	Japan	1965-66	China's imports, chiefly from Japan, are of low concentration (35 percent) hydrogen peroxide	Has wide industrial use as a bleaching agent; product could be concentrated with some additional equipment and used as oxidizer for missile propellants or as energy source for propellant turbine pumps
Polyester resin plant and technology for plastics-reinforced glass fiber	United Kingdom	1966	The UK probably delivered most of the equipment by end of 1966; the Chinese are emerging as producer of polyester resins and reinforced glass fibers	Equipment and technology could be used for construction of missiles and aircraft
Metallurgical equipment				
Consumable-electrode vacuum furnace	Japan	1965	First known in China	Essential to produce high-purity heat-resistant steels and refractory metals, including tungsten, molybdenum, beryllium, titanium, columbium, and zirconium, all of which are important in atomic energy development and/or manufacture of missiles
Two electric arc furnaces, five metric tons each	Japan	1965	China has many of them	Can be used in production of stainless steel used in manufacture of missiles
Vacuum and atmospheric rolling mills (two sets, type VIARM-4)	Japan	1965-66	No known mills of this type	Capable of rolling refractory metals (titanium, molybdenum, tantalum, columbium), uranium and plutonium, under a reducing or inert atmosphere; such mills have strategic significance for atomic energy or missiles

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Item	Country	Date [a/]	China's Present Position	Relevance to Advanced Weapons Program
Metallurgical equipment (continued)				
Cold-strip steel rolling mill	West Germany	1966	Will be first known of this type in China	Can roll stainless steel strip which if sufficiently wide could be used for missiles
Sendzimir-type cold steel rolling mills	West Germany	1965-66	Will be first known of this type in China	Produces ultra-thin sheet strip and foil of stainless steel, titanium, and other refractory metals which are used in missiles
Twenty-roll planetary mill	West Germany	1966	No known mills of this type	Capable of rolling refractory metals in thin strips to close tolerances; such materials important in missile program
Machine building equipment				
Three hydraulic machinery plants	Japan	1965-66	Little capability to produce such plants	Production of servo mechanisms for control of movement and direction of air weapons systems. Also provides technological basis for developing Chinese capability for producing such servo devices
Air and electronic gauge plant	Japan	1966	No capability	Will provide quality control of precision machine products of the sort used in nuclear weapons and in aerospace products

Item	Country	Date [a]	China's Present Position	Relevance to Weapons Program
Machine building equipment (continued)				
Precision machine tools			China has little capability to produce to the necessary quality	All of these machines are capable of precise machining necessary for components of nuclear weapons and/or aerospace systems
Honeycomb milling machine	Netherlands	Dec 1965		
Three Ecomil vertical copy milling machines	West Germany	Jul 1966		
Universal boring and milling machine, model F63.10	West Germany	Jun 1966		
Vertical milling machines 1,000-mm width bed	France	Jun 1965		
Jig-borers (several dozen)	Japan	1965-66		
Boley precision turning lathe with special accessories, model DW-4	West Germany	Apr 1966		
Boley precision sliding, surfacing and screw-cutting lathes, model 5LZ with special equipment	West Germany	Jul 1966		

a. Normally date of import, but equipment for some of the larger mills comes in over a period of years.
b. This item from 1963 is included as of special interest.

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