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ECONOMIC INTELLIGENCE REPORT

**THE ELECTRONICS INDUSTRY OF POLAND
1955-60**



CIA/RR ER 60-7

March 1960

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

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FOREWORD

The purpose of this report is to evaluate the status of production of electronics in Poland and the present and future role of this industry in the Polish economy and in production of electronics for the Sino-Soviet Bloc. Although Poland is among the lesser producers of electronics in the Bloc, the potential for expansion of the electronics industry exhibited in the last few years and the planned future production of electronics in Poland indicate a role of increasing importance in production of electronics in the Bloc.

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THE ELECTRONICS INDUSTRY OF POLAND*
1955-60

Summary and Conclusions

Before World War II the electronics industry of Poland consisted of a small number of assembly plants either owned outright or operating under license by foreign electronics firms. In the postwar years this industry has been expanded substantially and now comprises a group of approximately 20 nationalized enterprises capable of producing a relatively wide range of electronic components, subassemblies, and finished equipment. In spite of rapid growth, however, the electronics industry is far from being comprehensively developed, and Poland is still dependent on outside sources of supply for many types of finished electronic equipment and also for materials and components to support domestic producers of electronics.

Growth in production of electronics in Poland, as shown for each major class of equipment in Figure 1,** has been particularly rapid during the current Five Year Plan (1956-60). It is estimated that the value of production of electronics in 1960 will be approximately five times that in 1955. Annual increases in production have ranged from 16 percent in 1956 to a high of 67 percent in 1958. Estimated rates of increase in 1959 and 1960, however, will be considerably below the rate of increase achieved in 1958. In relative terms, these annual increases in production of electronics have been impressive and have exceeded by far annual increases of from 9 to 10 percent in the total industrial production in Poland. In absolute terms, however, the estimated value of production of electronics in 1959 of 2.8 billion zlotys*** (US \$60 million) represents less than 1 percent of the total industrial production and about 4 percent of the total production by the machinery and metalworking industries in Poland.

* The estimates and conclusions in this report represent the best judgment of this Office as of 1 March 1960.

** Following p. 2.

*** Unless otherwise indicated, zloty values throughout this report are based on estimated factory prices and are given in 1956 zlotys. Dollar values are given in current US dollars. Zlotys may be converted to US dollars at an estimated rate of exchange for the electronics industry of 47 zlotys to US \$1. For methodology, see Appendix A.

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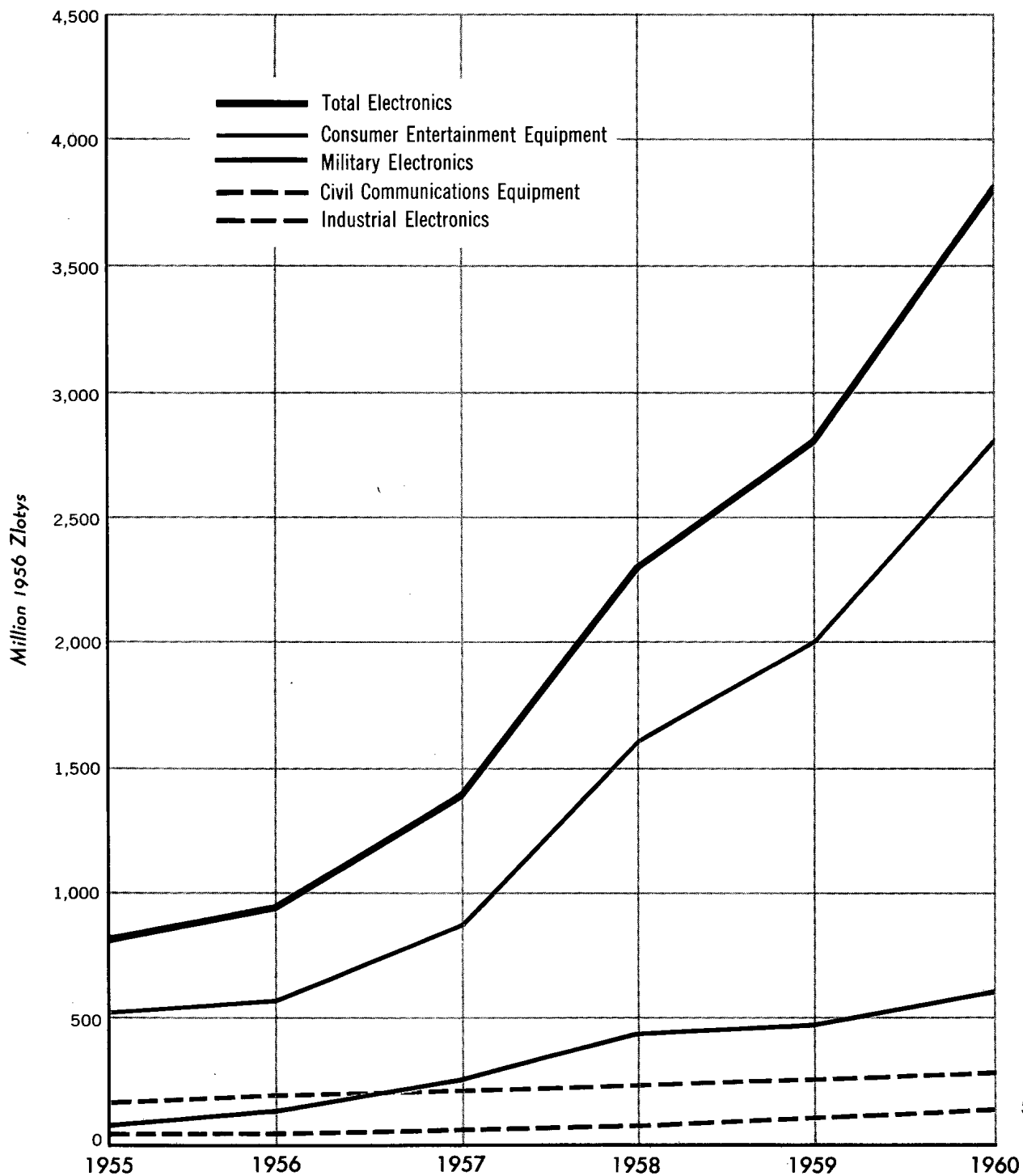
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Production of consumer entertainment equipment has been predominant in production of electronics in Poland since 1955, and estimates of the future production indicate that consumer entertainment equipment will represent an even larger percentage of total electronics by 1960. Poland produces a wide range of consumer radio receivers and leads the other European Satellites in the number of radio receivers produced annually. Poland produced about 2,000 television receivers in 1956, increased this production to 57,000 in 1958, and produced 117,000 receivers in 1959. This rapid increase in production of television receivers, which have a relatively high unit value, has contributed very significantly to the rapid growth in the value of the total production of electronics in Poland.

In terms of value, production of military electronics ranks second to that of consumer entertainment equipment. Radar equipment makes up the greater part of the military electronics produced in Poland. The rapid increase in volume of production of radar sets also has been a highly important factor in the rapid growth in production of electronics in Poland. At the initiative of the USSR, and with at least formal if not genuine approval by the other member countries of the Warsaw Pact, Poland has been assigned responsibility for producing much of the military radar equipment to be used throughout the European Satellites. Production of radar equipment in Poland includes a fire control (FC) radar set designed in the USSR and a Polish radar set used for early warning (EW) and ground-controlled intercept (GCI). In addition to these military radar sets, Poland has initiated production of marine navigational radar equipment. At present, the greatest strength of Poland in production of radar equipment lies in the capacity that has been built up for the assembly of radar sets. This capacity exceeds that of any other European Satellite even though components for production of radar equipment must still be imported and Polish capabilities in research and development of radar lag behind those of East Germany, Hungary, and possibly Czechoslovakia.

In the other sectors of the Polish electronics industry, increases in production have been smaller. The civil communications equipment produced in Poland, besides being entirely inadequate in volume, is technologically obsolescent in comparison with the latest equipment produced in the USSR and other European countries. Similarly, production of industrial electronics, which includes electronic test and measuring instruments and electronic computers, is inadequate to satisfy domestic needs and, in terms of operational characteristics, is not as satisfactory as similar equipment produced in East Germany, Czechoslovakia, or several of the countries outside the Soviet Bloc. The outlook for improvements in production of civil communications equipment in the near future is not good. Additions to plant capacity

POLAND
ESTIMATED PRODUCTION OF ELECTRONICS
BY MAJOR CLASS OF EQUIPMENT, 1955-60



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for production of this equipment will be relatively insignificant through 1960. In the area of industrial electronics, however, it is estimated that future growth will be somewhat more rapid than that for civil communications equipment. Poland has initiated development of electronic digital and analog computers, and current plans provide for production of such computers during the period 1960-65. Although the high unit value of electronic computers will contribute to rapid growth in the monetary value of Polish industrial electronics, production of electronic devices for industrial use in Poland will continue to be impeded by inferior technology and limited domestic production of necessary components.

The inadequacies characterizing the Polish electronics industry are most clearly reflected in the continuing necessity for Poland to import a wide range of electronic equipment and components not only from Soviet Bloc but also from non-Bloc countries. Imports of equipment for transmission of radio, television, and wire communications have been and still are necessary for the extension of the Polish communications network for civil and military use. Imports of special electron tubes, transistors, and other electronic components are necessary for the continued production of radar and military communications equipment. Input and output devices must be imported for use in development and production of electronic computers in Poland. In addition, germanium and silicon must be imported for producing semiconductor devices. Although the dependence on imports of electronics in Poland is being reduced gradually, it is estimated that no appreciable change in status will be obvious until after 1960.

I. Organization

A. General

Before World War II the electronics industry of Poland consisted of assembly plants either owned outright or operating under license by foreign electronic firms such as Phillips of the Netherlands and Ericsson of Sweden. The plants of the electronics industry, particularly those in western Poland, suffered considerable damage during the war. Postwar development of the Polish electronics industry was slow during the years through 1949, and the pace increased only slightly during the Six Year Plan (1950-55). Assistance in the development of the industry during this postwar period was supplied primarily by the USSR. During the Five Year Plan (1956-60), however, increasing assistance from other

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Soviet Bloc and non-Bloc countries has permitted an accelerated development of the technological capabilities and productive capacity of the Polish electronics industry.

B. Present Administrative Organization

The electronics industry of Poland presently is under the broad jurisdiction of the Ministry of Heavy Industry and is controlled directly through several branch associations (Zjednoczenie Przemyslu -- ZP). Most of the plants producing electronics are controlled by either the Association of Teletechnical Industry (ZP Teletechnicznego) or the Association of Electronic Industry (ZP Elektronicznego). A few plants producing components are under the Association of Electric Machines and Apparatuses (ZP Maszyn i Aparatów Elektrycznych). These branch associations were organized to conform to the policy aimed at decentralization of control instituted in the USSR in 1957-58. As yet, however, Poland has not abolished the industrial ministry level of control as was done in the USSR and in East Germany in 1958, and there is no evidence of any significant change in production of electronics in Poland as the result of the reorganization within the Ministry of Heavy Industry.

C. Plants and Construction

Approximately 20 plants produce most of the electronics in Poland. There is a concentration of plants in the Warsaw area, but important facilities also are located at Dzierzoniow (Reichenbach), Bydgoszcz (Bromberg), Lodz, Wroclaw (Breslau), Gdynia, and Danzig. The plants in the Warsaw area employ approximately 60 percent of the labor force in the electronics industry and contribute a very high proportion of the total production of consumer entertainment equipment, radar, communications equipment, and components in Poland.

New and proposed construction of plants to produce electronics during the current Five Year Plan includes a plant for production of cathode ray tubes at Stara Iwiczna, the T-1 Radio Plant (Zakłady Radiowe) in the Grochowe suburb of Warsaw for production of radar, a plant to produce television receivers and kinescope equipment in Danzig, and an industrial complex for producing electronic instruments and computers in Wroclaw. Additional plant capacity has been constructed at the T-3 Radio Plant imienia Marcina Kasprzak (Zakłady Radiowe imienia Marcina Kasprzak) in Warsaw and the A-4 Electric Light Manufacturing Plant imienia Roza Luksemburg (Zakłady Wytworcze Lamp Elektrycznych imienia Roza Luksemburg) in Warsaw, the leading producer of electron tubes in Poland.

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D. Labor Force

The labor force employed in production of electronics in Poland was estimated at about 30,000 in 1959* compared with 25,000 in 1955. Although the Five Year Plan called for a 100-percent increase in the labor force by 1960, delays in the construction and equipping of new production facilities have made the achievement of this goal most unlikely. The labor force includes a large percentage of women, as is true in the electronics industries of other countries. Although official Polish sources chronically complain of a shortage of engineers and trained technicians in the electronics industry, contacts between US and Polish specialists in electronics indicate that the leading technical institutes in Poland are graduating many electronics engineers well trained in several disciplines, including radar. There has been no serious problem in Poland, as there has been in East Germany and Hungary, over the loss of technically competent persons by defections to the West.

The distribution of the labor force among the subsectors of the electronics industry according to estimates for 1958 is as follows:

<u>Class of Equipment</u>	<u>Percentage of Total Labor</u>	<u>Percentage of Total Gross Production</u>
Consumer entertainment equipment	40	60
Military electronics	18	17
Civil communications equipment	10	9
Industrial electronics	4	2
Components	28	12

The value of production per worker in these subsectors varies considerably depending on the age of the production machinery, the degree of standardization and automation, and the degree to which quality control is an important factor. Workers producing consumer entertainment equipment have the highest annual value of output per worker, whereas those producing military electronics, industrial electronics, and components have a relatively low annual output per worker.

II. Production Trends, 1956-60

During the present Five Year Plan (1956-60) the Polish electronics industry has concentrated on developing new capacity for production

* This estimate is based on the sum of reported labor forces among the majority of the 20 primary producers of electronics in Poland.

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of radar equipment for both military and civil maritime use, production of radio and television receivers for consumer entertainment, and production of electronic components. Capacity for producing civil communications equipment has remained fairly constant, and although the importance of producing electronic instruments and computers for industrial use has been recognized in Poland, the tendency has been for Polish authorities to rely on imports from countries more advanced in electronics as long as these imports continue to be made available.

Production of electronics in Poland has increased substantially during each year of the current Five Year Plan. The large annual increases shown for production of electronics in Table 1* are a reflection primarily of the relatively low rate of production prevailing in the industry in 1955 and of the introduction into series production of electronic equipment such as television receivers and radar sets having high unit values. Series production of television receivers was started in 1956. Production in 1957 was about 7 times that in 1956, in 1958 more than 3 times that in 1957, and in 1959 more than 2 times that in 1958. Radar equipment was developed and series production initiated in 1955 with substantial increases being made in production during 1956 and 1957.

The annual increases in production by the electronics industry of Poland have been consistently larger than corresponding annual increases in the total industrial production or in production by the machinery and metalworking industries. In 1956, for example, the gross industrial production increased 8.9 percent, whereas production of electronics increased 16 percent. In 1957 the gross production by the machinery and metalworking industries that include electronics increased 14.8 percent, whereas production of electronics increased 48 percent. Similarly, in 1958 the gross production by the machinery and metalworking industries increased 14.3 percent, whereas production of electronics increased 67 percent. In 1959, gross industrial production increased 9 percent, whereas production of electronics increased 22 percent.**

The annual percentage increases in production of electronics in Poland are not the most significant measures of the development of the electronics industry. The capacity of the electronics industry to satisfy domestic requirements for its products or to produce an exportable commodity is a more realistic measure of the gains made in the electronics industry. In this respect, gains in Poland have

* Table 1 follows on p. 7.

** Although estimates of annual increases in industrial production and in production by the machinery and metalworking industries were based on gross values, whereas increases in production of electronics were based on net values, the comparisons are believed to be valid.

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Table 1

Estimated Production of Electronics in Poland a/
 1955-60

<u>Class of Equipment</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>
	<u>Million 1956 Zlotys <u>b/</u></u>					
Consumer entertainment equipment	520	570	860	1,600	2,000	2,800
Military electronics	80	140	260	440	480	600
Civil communications equipment	170	190	210	230	250	280
Industrial electronics	36	43	53	65	93	130
Total <u>c/</u>	<u>810</u>	<u>940</u>	<u>1,400</u>	<u>2,300</u>	<u>2,800</u>	<u>3,800</u>
	<u>1955 = 100</u>					
Index of total	100	116	172	286	348	470

- a. Based on estimated factory prices.
 b. Values have been rounded to two significant digits.
 c. Totals are derived from unrounded data and may not agree with the sums of their rounded components.

been less spectacular. Facilities for the assembly of radio and television receivers for consumer entertainment, for example, probably have become adequate to supply domestic requirements for the receivers and to provide small quantities for export. In 1959, however, Poland still was dependent on imports of components, picture tubes, receiving tubes, and transistors to maintain high levels of production of receivers for consumer entertainment. Similarly, the development of capacity for assembly of radar sets has not been accompanied by a corresponding development of capacity for producing radar components. Increases in production of electronic instruments, although impressive, have not narrowed significantly the gap between the capacity of Poland to produce this equipment and the increasing requirements for it.

A. Consumer Entertainment Equipment

Consumer entertainment equipment, which includes radio and television receivers and wired loudspeakers, constitutes the largest

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volume of electronics produced in Poland. In 1959, 70 percent of the total value of production of electronics was represented by consumer entertainment equipment. By 1960, as the result of continuing increases in production of radio and television receivers, the value of consumer entertainment equipment is expected to reach 73 percent of the total. The annual production of consumer entertainment equipment, as shown in Table 2,* has increased rapidly since 1956, when Poland initiated series production of television receivers. These increases probably will continue but at a more moderate rate until 1961-62, when, it is estimated, production of television receivers will reach a peak. During this same period, production of radio receivers will be increased moderately to satisfy demands created by the electrification of rural areas now served primarily by wired loudspeakers.

Poland was the largest producer of radio receivers in the European Satellites in 1958, producing 790,000 radio receivers. East Germany ranked second with 609,000, and Hungary and Czechoslovakia followed in that order, producing 458,000 and 300,000 radio receivers, respectively. Production of radio receivers in Poland is still far below Soviet production, which was reported to be 3.9 million in 1958. 1/** In terms of quality, Poland probably ranks behind East Germany, Czechoslovakia, and Hungary in the radio receivers produced. It is believed that the relatively poor quality of Polish radio receivers results primarily from the use of inferior receiving tubes, for designs of radio receivers usually are copies of good foreign equipment. For export, Poland produces a superior quality of radio receiver using imported receiving tubes and other components.

Two plants produce almost all Polish radio receivers. These plants are the T-6 Lower Silesian Radio Plant (Dolnoslaskie Zaklady Wytworcze Urzadzen Radiowych -- DZWUR) in Dzierzoniow and the T-3 Radio Plant imienia Marcina Kasprzak in Warsaw. In addition to these plants, a relatively small number of radio receivers are produced at the T-18 Danzig Radio Plant (Gdanskie Zaklady Radiowe). A modest number of radio receivers for use in automobiles are produced in the T-12 Radio Equipment Manufacturing Plant (Zaklady Wytworcze Urzadzen Elektrownych) in Warsaw, and portable transistor radio receivers were scheduled to go into series production in 1959 at the Bydgoszcz Electro-technical Plant (Bydgoskie Zaklady Wyrobow Elektrotechnicznych -- ELTROS). 2/

It is estimated that the T-6 Lower Silesian Radio Plant produced in 1958 about 57 percent of all Polish radio receivers and 65 percent of the total value of production of radio receivers. The T-3

* Table 2 follows on p. 9.

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Table 2

Estimated Production of Consumer Entertainment Equipment in Poland a/
1955-60

Equipment	1955		1956		1957		1958		1959		1960	
	Thou- sand Units	Million 1956 Zlotys	Thou- sand Units	Million 1956 Zlotys	Thou- sand Units	Million 1956 Zlotys	Thou- sand Units	Million 1956 Zlotys	Thou- sand Units	Million 1956 Zlotys	Thou- sand Units	Million 1956 Zlotys
Radio receivers	461	516	499	558	646	779	790	1,154	750	1,094	800	1,167
Television receivers	0	0	2.2	8.8	16	85	57	411	117	879	200	1,600
Total		<u>516</u>		<u>567</u>		<u>864</u>		<u>1,565</u>		<u>1,973</u>		<u>2,767</u>

a. For methodology, see Table 6, Appendix A, p. 30, below.

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Radio Plant imienia Marcina Kasprzak produced about 39 percent of the units produced and 32 percent of the value of all radio receivers. Production of radio receivers at other plants may be increased slightly in the near future but will not alter appreciably the predominance in this field held by the T-6 plant and the T-3 plant. In addition to civilian production, both of these two plants devote some of their capacity to production of radio equipment for military use.

There are from 15 to 20 different brands of radio receivers being produced at one time in Poland. Many are slight variations of previous models, carrying a different brand name. Basically, Polish radio receivers can be classified into three classes. Class I comprises high-priced receivers having amplitude and frequency modulation, eight electron tubes, and six receiving bands. The receivers are produced under the names Podhale and Slask, the latter being a Podhale receiver combined with a phonograph pickup, and the retail prices for these receivers are 3,200 zlotys and 3,500 zlotys, respectively. Class II comprises medium-priced receivers generally having four or five electron tubes and three receiving bands. In comparison with Class I, Class II covers a wider range of models and characteristics, including radio-phonograph combinations. The retail prices range from 1,325 to 2,200 zlotys. Predominating in this class of receivers are the models Stolica and Mazur. Class III comprises low-priced receivers having three or four electron tubes. Class III includes battery-operated and portable receivers, and the retail prices for receivers in this class range from 810 to 1,000 zlotys.

Poland began series production of television receivers in 1956 and has increased this production rapidly each year. It was announced that production in 1959 was 117,000 receivers. This production, compared with the total production of 57,000 in 1958, gives some measure of the extent to which the capacity to produce television receivers has been increased. Poland ranked behind East Germany and Czechoslovakia in production of television receivers but produced more receivers than Hungary in 1958. In that year, production of 57,000 television receivers in Poland is to be compared with 168,000 in East Germany and about 1 million in the USSR.

Increases in production of television receivers thus far have been limited by the need to import components, particularly cathode ray tubes. Present investment in new facilities for production of cathode ray tubes and the expansion of facilities for assembling television receivers should permit a continued rapid expansion of production of these receivers after 1960. The planned goals for 1965 call for production of 440,000 television receivers. 3/

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The first television receivers produced in Poland were copies of the Russian Avangard. This set, named the Wisla, was phased out of production in 1957 and was replaced by the Belweder, which was of Polish design. There are at least two versions of the Belweder, with two sizes of picture tubes corresponding to US 14-inch and 17-inch tubes. Television receivers are produced primarily at the T-16 Warsaw Television Plant (Warszawskie Zaklady Telewizyjne) in Targowek, near Warsaw. A smaller volume of production has been reported at the T-18 Danzig Radio Plant at Danzig.

Retail prices of Polish television receivers are from 7,000 to 9,000 zlotys depending on the size of the picture tube. The old Wisla receiver sold for about 4,000 zlotys. Purchases on a deferred payment plan are now possible. This plan, along with the extension of the Polish television network from the Warsaw area to other major cities, has created a domestic market adequate to consume planned increases in annual production. There are no indications that Poland exports television receivers, and imports, which have been appreciable in the past few years, should decrease in coming years.

B. Military Electronics

Production of electronics for military use has reached significant proportions in Poland in the past few years. Electronics for military use in 1959 accounted for 17 percent of all production of electronics. Military electronics includes radar, radio and wire communications equipment, and instrumentation for naval vessels and military aircraft. Of these types of electronics, radar equipment is by far the most significant item because of its high unit value. Production of radar equipment accounts for more than 70 percent of military electronics produced in Poland, as shown in Figure 2.* In the field of communications equipment, production for the military consists primarily of radio transmitters and receivers for use by ground, air, and naval forces. There is no evidence that Poland produces electronics for use in missiles.

Since 1957, Poland has become an important producer of military radar equipment for the Soviet Bloc. Although production measured in units is not large compared with that of the USSR, Poland has the capacity to produce both EW-GCI radar equipment and FC radar equipment for use by the armed forces of the European Satellites and for export to underdeveloped countries. The question of whether or not Poland will produce communications equipment for tactical use by the armed forces of the European Satellites is still to be resolved.

* Following p. 12.

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A requirement has been levied on Poland by the USSR, however, to produce some of the new Soviet type of R-series communications equipment. 4/ There has been no appreciable buildup in the capacity of Poland for producing this equipment, although there has been for production of radar. The maintenance of a high rate of production of military electronics in Poland is dependent on guaranteed Bloc markets for this equipment and on the availability of necessary components having high reliability characteristics.

Poland has developed during the past 5 years an industrial base for production of radar equipment, and this base must be evaluated now as significant in terms of the military potential of the Soviet Bloc. In terms of value, the estimated production of radar equipment in 1959 represented about 13 percent of the total production of electronics. Currently, Poland produces a limited range of types of radar equipment, primarily for military use. These include the Nysa-B and Nysa-C height finder (HF) and EW-GCI sets that operate as a unit in the 10-centimeter (cm) band and the SON-9A, an advanced FC radar also operating in the 10-cm band. The estimated production of this military radar in Poland for the years 1955-60 is shown in Table 3.* Poland probably has initiated, in addition to military radar, series production of radar equipment for air traffic control and a marine navigational radar set named Baltyk, which can be used on commercial as well as military vessels. The Baltyk, operating in the 3-cm band, reportedly was tested on a Polish vessel in 1958. 5/

Some measure of the increased status of Poland as a producer of radar equipment in the Soviet Bloc is indicated by the announcement made in Moscow in December 1957 that assigned to Poland responsibility for producing much of the military radar equipment for Warsaw Pact nations. 6/ In addition, Poland has produced radar for export to the United Arab Republic and to Indonesia and has negotiated for exports of radar equipment to other underdeveloped countries. In spite of its advance into export markets, however, Poland has not produced and delivered sufficient radar equipment to satisfy domestic requirements for either military or civil navigational radar. The Nysa type of radar has been seen in use by Polish air defense forces only since 1958, 7/ and Poland has found it expedient to import from Western countries navigational radar for installation on ships constructed in Polish shipyards. 8/

The capacity of Poland to produce radar equipment still is limited by the unavailability of certain components that are not produced domestically. For these components, particularly the ultrahigh frequency (UHF) high-power electron tubes, Poland is dependent on

* Table 3 follows on p. 13.

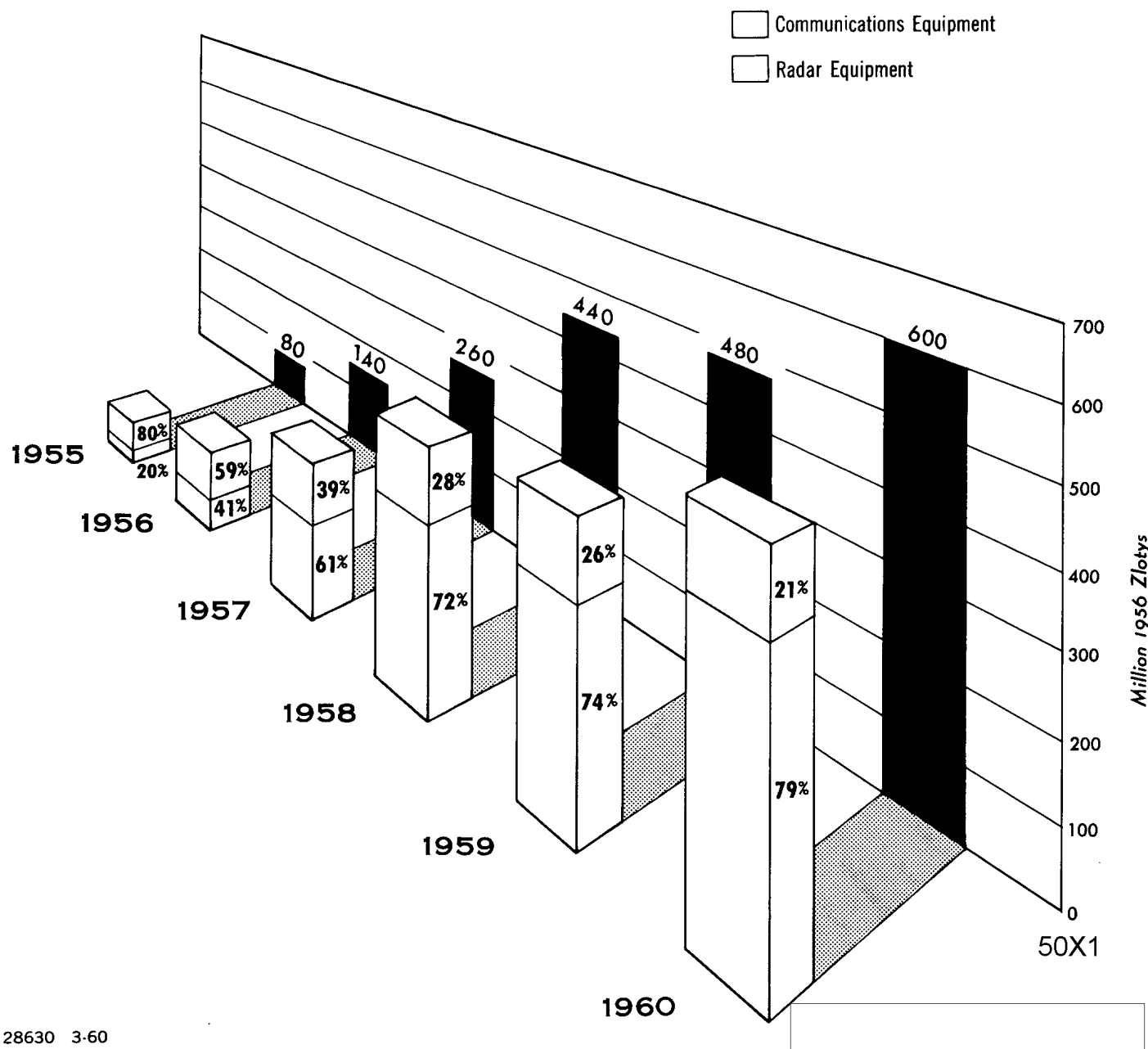
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Figure 2

POLAND

ESTIMATED PRODUCTION OF MILITARY ELECTRONICS

1955-60



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Table 3

Estimated Production of Military Radar Equipment in Poland
1955-60

Equipment	1955		1956		1957		1958		1959		1960	
	Units	Million 1956 Zlotys <u>a/</u>	Units	Million 1956 Zlotys <u>a/</u>	Units	Million 1956 Zlotys <u>a/</u>	Units	Million 1956 Zlotys <u>a/</u>	Units	Million 1956 Zlotys <u>a/</u>	Units	Million 1956 Zlotys <u>a/</u>
SON-4 or SON- 9A <u>b/</u>	4	16	10	40	15	60	30	120	40	160	60	240
Nysa-B and Nysa-C	0	0	2	16	12	96	25	200	25	200	30	240
Total		<u>16</u>		<u>56</u>		<u>156</u>		<u>320</u>		<u>360</u>		<u>480</u>

a. Based on estimated factory prices. For methodology, see Appendix A.

b. Production was shifted in 1957 from the SON-4 to the SON-9A radar equipment.

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imports from the USSR, East Germany, and Czechoslovakia. The display at the 1959 Poznan Trade Fair of a magnetron that was made in Poland and that operates in the L-band frequencies does indicate, however, that some progress is being made in developing Polish capacity to produce the more complex components required for radar equipment. 9/ These components will become increasingly available from domestic sources during 1961-65.

The T-1 Warsaw Radio Plant (Warszawskie Zaklady Radiowe) in the Grochowe suburb of Warsaw is the principal facility producing radar equipment in Poland. In conjunction with the adjoining Industrial Institute for Telecommunications (Przemyslowy Instytut Telekomunikacji -- PITT) and a branch of the institute located at Danzig, the T-1 plant is devoted entirely to work on radar.

Development work on radar in Poland was initiated in 1952 in a section (Technika Lokacji -- TL) of the T-3 Radio Plant imienia Marcina Kasprzak in Warsaw. Production of radar equipment was initiated at the newly constructed T-1 plant in 1955, and the research and development work of the TL section was transferred to the newly established plant. The first radar sets produced were the SON-4 sets, which were designed in the USSR. In 1956, however, the T-1 plant began production of Nysa radar sets that were designed in Poland. In 1957, production of SON-4 radar sets was phased out and was replaced by production of an improved version designated SON-9A.

The Poles have been expanding production facilities at the T-1 Warsaw Radio Plant. Production has fluctuated, however, depending on the erratic supply of components and on foreign orders for Polish radar. At times the plant has been operating on a basis of two and three shifts, but this high degree of activity has not continued over a sustained period. For the most part the plant does not operate at full capacity. 10/

Although facilities for production of radar in Poland are presently larger than those in East Germany or Czechoslovakia, Poland still lags behind these countries in the field of research and development of radar. The rate of progress in research and development of radar in Poland, however, has been stepped up in recent years, and production of radar equipment increasingly includes more equipment incorporating original Polish design, whereas early production consisted entirely of sets of Soviet design. The Warsaw Polytechnical Institute carries radar as a discipline and now annually graduates many electronics engineers specializing in radar research.

For several years, Poland has produced under Soviet license military radio equipment for use in the Polish armed forces. It has

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been reported but not confirmed that Poland now has been assigned responsibility for producing certain Soviet radio transmitters to be used by all of the European Satellites. 11/ Since 1957, Poland has produced the Soviet types of radio -- RBM, RSI, RAF, and RT-10. Production of these military transmitters and transceivers probably has been sufficient to satisfy the requirements of the Polish armed forces.

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Two plants produce most Polish military radio equipment: the [] Radio Plant imienia Marcina Kasprzak in Warsaw and [] Lower Silesian Radio Plant at Dzierzonow. Production for the military at the [] plant reportedly reached a value of 53 million zlotys in 1957. 12/ The plant produces RT-10 radios for armored vehicles; radio transceivers for aircraft; and electronic instruments for aircraft, including radio direction finding equipment for fighter aircraft. The [] plant produces radio equipment estimated to amount to about 50 million zlotys per year.*

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In addition to the military production at the [] plant, the [] Teletechnical Apparatus Plant (Zaklady Wytworcze Teletechnicznij) in Radom and the [] Paris Commune Telephone Equipment Plant (Zaklady Wytworcze Urzadzen Telefonicznych imienia Komuny Paryskiej) in Warsaw produce field telephone equipment for military use. The value of this field telephone communications equipment is not measurable but is estimated to be comparatively insignificant.

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C. Civil Communications Equipment

Poland produces a small amount of civil communications equipment that is not adequate to fulfill domestic needs. The estimated value of civil communications equipment produced in 1959 was 250 million zlotys and represented only 9 percent of production of all electronics. Poland produces telephone and telegraph equipment for industrial and civil communications and a limited number of radio transmitters. In addition to being inadequate in volume of production, the telecommunications equipment produced in Poland does not incorporate the latest developments, because little or no original research and development work is conducted in this field. Modern equipment that is to be introduced into production in Poland is copied from equipment produced by the leading communications firms in other countries of the West and the Soviet Bloc.

At present, Poland produces telephone and telegraph communications equipment in four installations. The T-2 Paris Commune Telephone Equipment Plant in Warsaw is the only Polish plant producing

* For the derivation of this estimate, see the methodology, Appendix A.

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automatic telephone exchange equipment. The T-2 plant, employing approximately 1,000, is also the largest of the Polish plants producing telephone equipment. The laboratories of the State Telecommunications Plant (Panstwowe Zaklady Telekomunikacyjne) in Warsaw develop equipment and produce such telephone components as amplifiers and audio ringing tone generators. The T-9 Teletechnical Apparatus Plant in Radom produces various components for use in telephone communications systems. The Railroad Communications Plant (Kolejowe Zaklady Lacznosci) in Bydgoszcz produces intercom sets, small telephone and telegraph switchboards, and spare parts for teleprinters.

The Five Year Plan (1956-60) required an increase in production of telephone equipment ranging from 25 to 30 percent during the 5-year period except for automatic exchange equipment for municipal exchanges, which was to be increased 130 percent. 13/ The planned increases of 25 to 30 percent probably will be realized by the end of 1960. It is apparent, however, that the substantial increase planned for production of municipal exchanges was based on the planned construction of a new plant in Warsaw that would triple the capacity of Poland for producing municipal exchange equipment. 14/ This installation was still in the planning stage in 1958. Thus the delay in fulfilling the construction plan will deprive Poland of the anticipated new capacity for production of exchange equipment until the next plan period. 15/

Plans for the future call for production of telecommunications equipment that is more advanced than that currently produced in Poland. A 24-channel microwave carrier unit is to be copied from items produced by Beloiannis of Hungary, Siemens and Halske of West Germany, and Ericsson of Sweden. This equipment probably will go into production in 1961. 16/ In production of automatic telephone exchanges, plans have been made to start producing exchange equipment based on the more modern crossbar switching principle instead of the conventional Strowger or step-by-step principle presently used. The crossbar exchange is to be copied from equipment produced by Ericsson. 17/ The eventual production of more modern telecommunications equipment will reduce the heavy dependence of Poland on imported equipment for the extension of its domestic telecommunications systems.

Poland produces only small quantities of conventional low-power and medium-power, short-range radio communications equipment for civil use. The most important producer of radio equipment is an installation known as the Marine Radio Ship Service (Morska Obsluga Radiowa Statkow) in Gdynia, which, as the name implies, produces for marine use radio equipment including sonic depth finders, emergency radio receivers, low-power radio transmitters, radiotelephones, and direction-finding goniometers. With a labor force of only 200, part

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of which is engaged in repair work on marine radio equipment, the Marine Radio Ship Service is incapable of anything more than small-scale production. Similarly, the T-12 Radio Equipment Manufacturing Plant in Warsaw, with a labor force of 300, manufacturing electronics other than radio transmitters, produces only small numbers of medium-power transmitters and transmitters for radiotelephones.

The low rate of production of radio transmitters has made Poland almost completely dependent on imports for transmitting equipment. The extent of this dependence is evident from the equipment in use in the radio stations of the Warsaw area. Of the total of 20 transmitters in the 5 radio stations in Warsaw in 1957, 4 transmitters came from Tesla of Czechoslovakia, 2 from the USSR, 2 from Marconi of England, 7 from Sweden, and only 5 from plants in Poland. ^{18/} A 300-kilowatt (kw) transmitter made by Tesla of Czechoslovakia was installed recently in the Warsaw Central Radio Station, increasing the power of that station to a total of 500 kw. Poland does not produce any television transmitters and must import these transmitters and related equipment from Soviet Bloc and non-Bloc countries.

According to the Five Year Plan, production of radio transmitting equipment in Poland was to be increased 230 percent during 1956-60. This increase probably includes transmitters for military use, for which a considerable increase in production was scheduled. Available evidence indicates, however, that no new productive capacity for radio transmitting equipment has been installed since 1956, making it highly unlikely that the planned increase for this sector of production will be achieved. In addition to the lack of facilities for production, and probably an equally significant deterrent to increases in production of radio transmitters in Poland, has been the unavailability of special electron transmitting tubes and components produced in Poland. Although Poland produces a small number of transmitting tubes, the tubes required for generating high power and high frequency radio transmissions generally must be imported from countries of the Soviet Bloc. These electron tubes are not always available to Poland, however, because East Germany, Czechoslovakia, and Hungary use their own electron tubes in the domestic production of transmitting equipment. Under regulations of COCOM (Coordinating Committee), imports of special transmitting tubes from non-Bloc countries are restricted by embargo to replacements for tubes in non-Bloc transmitting equipment that is being operated in Poland.

D. Industrial Electronics

The smallest subsector of the Polish electronics industry is that which produces equipment classified as industrial electronics. This category of production includes primarily test and measuring

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instruments, electronic computers, and electronic control equipment for automation of industrial operations. In 1959 the value of industrial electronics contributed only about 3 percent to the total value of production of electronics.

Poland is still in the early stages of developing the productive capacity and technical competence necessary for producing industrial electronic equipment on a scale adequate to meet domestic requirements. Polish economic planning has permitted very little investment for increasing the capacity to produce this equipment. The lack of trained technicians and the unavailability of the necessary components have been further factors keeping production of industrial electronics at a low level.

The availability of industrial electronic equipment from other countries, however, has removed much of the urgency from the need to develop this industry in Poland. Before 1957, Poland imported from East Germany and the USSR the majority of the instruments needed for quality control in industrial production. Since 1957, however, many of these instruments have been imported also from countries outside the Soviet Bloc. The continued availability of instruments from both Soviet Bloc and non-Bloc countries may inhibit somewhat the future growth of the domestic production of instruments.

It has become evident, nevertheless, that Poland now desires to promote production of industrial electronics. The long-range plan (1960-75) for the Polish telecommunications industry has taken into account the importance of the availability of suitable test and measuring instruments and has recognized the need for a considerable additional investment for facilities to produce this type of electronic equipment. 19/

Plant capacity for producing electronic instruments in Poland is very limited, but additional capacity is now under construction. A few plants have produced most of the Polish electronic instruments. The T-14 Plant for Manufacturing Electronic Measuring Instruments (Zaklady Wytworcze Elektronowych Przyrzadow Pomiernych) in Warsaw produces oscillographs, voltmeters, and instruments for testing electron tubes. The Plant for Development and Production of Scientific Apparatus (Zaklady Opracowania i Produkcji Aparatury Naukowej Zopan) in Warsaw produced microvoltmeters. The A-4 Installation Equipment Manufacturing Plant (Zaklady Wytworcze Sprzetu Instalacyjnego) in Bydgoszcz produces dosimeters for testing radioactivity. In addition to these plants, several electronic equipment plants assemble test and measuring equipment for use within their own plant. In 1958, construction was started on the Wroclaw Electronic Plant (Wroclawskie Zaklady Elektroniczne) designed to produce instruments, computers,

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and industrial control equipment. 20/ The completion of the Wroclaw plant will increase greatly the productive capacity of Poland in this field.

Poland has started recently the development of electronic computers on a very small scale. The recognition of the importance of this field today is best illustrated by the expansion of the Institute for Mathematical Devices (Zaklad Aparatury Matematycznej) of the Polish Academy of Sciences (Polska Akademia Nauk) in Warsaw from 25 persons in 1956 to about 200 in 1958. This institute has been assigned the responsibility for developing computers, establishing production lines, and maintaining quality control over production. 21/ As yet, however, production has been limited to prototypes and has been carried out at the institute.

Seven analog computers and one digital computer had been completed by the end of 1958. The first general-purpose digital computer was called the "XYZ" and reportedly was a failure. 22/ Further developments incorporating copies of components from the US and the UK were expected to result in the construction of a second digital computer by the end of 1959. This second computer is being designed primarily for regulating processes in the chemical or metallurgical industries. Additional computers incorporating further modifications are planned for installation at the University of Warsaw, the University of Krakow, and the Polish Atomic Energy Agency. Construction of these planned machines probably will not be completed until 1960-61.

Transistors and magnetic components for computers are produced in Poland but also are imported from the West. Because of failure to meet required standards of reliability, only a small portion of the transistors produced in Poland is acceptable for use in computers. Accessory equipment for computer input and output, such as card-punch machines, magnetic tapes, and page printers, also will be purchased by Poland from the West to the extent that they are made available. 23/

E. Components

Poland produces electron tubes, semiconductor devices, and other electronic components but not in quantities sufficient to satisfy the requirements of domestic producers and users of electronic equipment. Estimated levels of production of electron tubes and semiconductor devices during 1955-60 are shown in Table 4.* The failure of the electronics industry to produce the needed quantities of electronic components of dependably high quality is one of the primary factors limiting the expansion of production of electronics in Poland.

* Table 4 follows on p. 20.

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Table 4

Estimated Production of Electron Tubes and Semiconductor Devices
in Poland
1955-60

	Thousand Units					
Equipment	1955	1956	1957	1958	1959	1960
Electron tubes						
Receiving tubes <u>a/</u>	2,600	3,500	4,500	5,900	7,100	8,500 <u>b/</u>
Transmitting tubes <u>a/</u>	3.3	4.6	4.7 <u>b/</u>	4.9 <u>b/</u>	5.1	5.5 <u>b/</u>
Cathode ray tubes <u>a/</u>	0	0	0	16	108	200 <u>b/</u>
Semiconductor devices						
Diodes <u>c/</u>	Negligible	500	700 <u>b/</u>	1,200	1,800	3,500
Transistors <u>c/</u>	0	0	0	Negligible	50	80 <u>b/</u>

a. 24/

b. Estimated from available information on production and from plan data.

c. 25/

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Steps presently being taken to remedy this deficiency probably will not yield significant results until later in the period 1961-65.

The status of Poland in the Soviet Bloc as a producer of electron receiving tubes has increased substantially since 1953. Production at the present time embraces a relatively diverse range of types of electron tubes, including miniature and possibly subminiature tubes. In spite of this progress, production is not sufficient yet both to satisfy the current requirements of producers of consumer entertainment equipment and to provide an adequate supply of electron tubes for replacement needs. It is estimated that Poland produced 7.2 million electron tubes in 1959, of which about 98 percent were receiving tubes. 26/ Production of receiving tubes has more than doubled since 1955. The planned production for 1960 was scheduled at a level of almost 10 million receiving tubes, which, if achieved, would represent a 69-percent increase above production in 1958. Production in 1959, however, was to be increased only 20 percent above 1958. 27/ It is doubtful, therefore, that the required increase of approximately 41 percent can in fact be achieved in 1960, and the plan probably will not be fulfilled.

The only plant in Poland that produces electron receiving tubes is the L-4 Electric Light Manufacturing Plant imienia Roza Luksemburg in Warsaw. This plant produces other electron tubes, besides receiving tubes, as well as incandescent electric light bulbs. The rapid increase in production of receiving tubes called for by 1960 is to be achieved not through the construction of new facilities for production but through increases in efficiency of production at the L-4 plant and through a reduction in the number of types of electron tubes in production. The possible transfer of production of cathode ray tubes to a new plant, however, will contribute to the expansion of production of receiving tubes at the L-4 plant.

Poland started producing cathode ray tubes for use in television receivers and oscilloscopes in 1957. Statistics on production of television picture tubes during 1958 indicated a production of 16,000 units. 28/ Planned production for 1959 called for an output of 108,000 television picture tubes. 29/ It is apparent that this rapid increase has been based on the anticipated transfer of production from the L-4 Electric Light Manufacturing Plant imienia Roza Luksemburg to a new plant, the L-12 Oscilloscope Lamp Plant (Zaklady Lamp Oscyloskowych) in Stara Iwiczna, near Warsaw. When completed, this plant not only will assemble the picture tubes but also will produce the glass envelopes and other components for the picture tubes.

With 1959 production of television sets in Poland of about 117,000 units, it is estimated that the domestic production of television picture tubes in 1959 has not satisfied the requirements of

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producers of television receivers. If the new L-12 Oscilloscope Lamp Plant reached planned capacity of 250,000 tubes in 1960, 30/ however, the domestic production of television picture tubes will be more than adequate to satisfy requirements for the projected production of 200,000 television sets in that year.

Poland produces only a small number of transmitting and special electron tubes. Production in 1959 is estimated at approximately 5,000 electron tubes compared with a reported level of 3,300 units in 1955. 31/ Generally, transmitting tubes for the maintenance of imported radio and television transmitters are imported. Similarly, high-power, high-frequency electron tubes for use in production of radar equipment are imported. At the 1959 Poznan Trade Fair, however, the Poles exhibited and offered for sale a domestically produced magnetron, designated LM-4, having a power output of 800 kw and an operating frequency range between 1,300 and 1,350 megacycles per second (mcs), suitable for use in L-band radar or navigation equipment. The magnetron had been produced at the Union of Industrial Electronics (Zjednoczenie Przemyslu Elektronicznego) in Warsaw. 32/ Although it is traditional for countries of the Soviet Bloc to display items at trade fairs that they are not capable of producing in quantity, the appearance of this magnetron at the Poznan Fair indicates that Poland has made some progress in developing the technology required to produce the more sophisticated type of special electron tubes. At present, Poland does not produce klystrons, thyratrons, or traveling-wave tubes in series quantities, although such electron tubes may be under development in the research institutes.

Poland has in series production a small number of semiconductor devices. Primarily, production of these devices consists of germanium diodes manufactured from supplies of germanium imported from countries outside the Soviet Bloc. In 1958, Poland produced 1.2 million germanium diodes, and production in 1959 was scheduled to include 1.8 million germanium diodes and an initial series of about 50,000 germanium transistors. Current Polish plans provide that production of semiconductor devices by 1965 will reach 9 million units to be equally distributed between transistors and diodes. 33/

Although production of semiconductor devices in Poland has reached fairly significant proportions in relation to production in other European Satellites, transistors continue to be imported from the West in large numbers. For example, during the 2-month period June-July 1959, Poland imported 29,000 transistors from the Netherlands alone. 34/ Some of these transistors probably are for use in production of transistor radios that Poland initiated in 1959. Polish plans called for an initial production run of 20,000 five-transistor radios in 1959. 35/ Because this production would require quantities

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of transistors far in excess of the planned domestic production in 1959, it seems evident that many of the imported transistors will be allocated to production of transistor radios. In contrast to the inadequate volume of production of transistors in Poland, production of semiconductor diodes probably is in excess of domestic requirements, permitting a balance for exports.

Poland produces capacitors, resistors, selenium rectifiers, and other standard components for use in electronic equipment but not in sufficient varieties to satisfy all domestic requirements. Polish production is consumed, for the most part, by producers of consumer entertainment and civil communications equipment. High-performance capacitors and precision resistors are imported from East Germany and the USSR and from some Western countries.

The T-7 Radio Parts Plant (Fabryka Podzespoloki Telekomunikacyjnych) in Krakow produces most of the Polish resistors, capacitors, and rectifiers. This plant is equipped with modern Czechoslovak machine tools, and quality control is maintained by inspections during production processes as well as periodic spot checking by the plant laboratory. Components are produced to conform to specifications of the Soviet GOST (Gosudarstvennyy Obshchesoyuznyy Standart -- All-Union Standard) and apparently have satisfactory operating characteristics. A relatively small volume of ceramic capacitors are produced at the L-5 Radio Ceramics Plant (Zaklady Ceramiki Radiowej) in Warsaw. The quality of these ceramic capacitors, however, is not up to the standards of ceramic capacitors produced in East Germany or the USSR. A new plant for production of capacitors for radio and television receivers was reported to be under construction in Kutno near Lodz, late in 1957. 36/ No further information has been reported on this plant. If completed, however, it should double the capacity of Poland for producing capacitors.

III. Foreign Trade

Trade in electronics has been particularly significant to Poland. Imports have played an important role in the expansion of the Polish telecommunications net and have provided a supply of electronic components not available from domestic production. Imports of electronics also have provided the basis for the design of most of the electronic equipment developed for production in Poland. Export markets have absorbed some of the Polish production of radio receivers, although there is little doubt that the domestic market could have taken all of this production if it had been made available. In the field of electronics for military use, however, exports have created an economic basis for expansion of production of radar and of military radio communications equipment.

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A. Imports

Poland imports transmitting and receiving equipment for radio and television, wire communications equipment, electron tubes, transistors, test and measuring apparatus, and electronic computers from both Soviet Bloc and non-Bloc countries. The value of these imports of electronic equipment increased moderately from 1955 to 1956, more than doubled in value in 1957, and then increased moderately again in 1958, as shown in Table 5. Information available thus far on imports of electronics by Poland during 1959 indicates that the value of imports from non-Bloc countries probably will be about the same as in 1958. It is estimated that imports of consumer entertainment equipment from Bloc countries were smaller during 1959 and that total imports of electronics from Bloc countries did not increase appreciably during that year.

Table 5

Estimated Imports of Electronics by Poland a/
 1955-58

	Million 1956 Zlotys			
	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>
Soviet Bloc countries				
Consumer entertainment equipment	11.6	14.0	16.3	28.4
Civil communications equipment	5.6	5.7	22.3	38.9
Subtotal	<u>17.2</u>	<u>19.7</u>	<u>38.6</u>	<u>67.3</u>
Non-Bloc countries				
Consumer entertainment equipment	0.1	0.6	2.8	2.2
Civil communications equipment	2.2	3.0	8.5	4.0
Test and measuring apparatus	0.7	1.5	3.8	3.7
Components	0.4	1.5	1.4	1.4
Subtotal	<u>3.3</u>	<u>6.6</u>	<u>16.5</u>	<u>11.3</u>
Total	<u>20.5</u>	<u>26.3</u>	<u>55.1</u>	<u>78.6</u>

a. For methodology, see Appendix A. Totals are derived from unrounded data and may not agree with the sums of their rounded components.

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The large relative increase in value of imports of electronics in 1957 was the result of political as well as economic factors. After the internal disturbances of late 1956, the government of Poland took politically expedient steps to provide increased goods and services for consumer entertainment. In 1957 the number of radio transmitters in operation in Poland was increased from 21 to 33, and radiobroadcasting stations were increased in number from 18 to 22. Two television broadcasting stations were put into operation, thus doubling the operating television stations. ^{37/} These increases in facilities for radio and television broadcasting required imports of communications equipment in 1957 that were significantly larger than such imports in preceding years. In addition to importing the transmitting equipment, Poland increased imports of radio and television sets in 1957 both from countries inside the Soviet Bloc and from countries outside the Bloc.

Another factor influencing the large increase in imports of electronics in 1957 was the relaxation of embargo restrictions on shipments of certain electronic items to Poland from countries outside the Soviet Bloc. Imports of electronics from non-Bloc countries were increased about 150 percent in 1957 above 1956.* Significant increases were made in Polish imports from non-Bloc countries of civil communications equipment, consumer entertainment equipment, and test and measuring apparatus, whereas imports of electron tubes and electronic components declined slightly from the 1956 level.

There is no doubt that imports of electronics have been economically beneficial to the electronics industry of Poland and have made important contributions to other sectors of the Polish economy. By importing test and measuring apparatus and some components, Poland has been able to improve the technological status of its establishments for teaching and research and development, although the capabilities of Poland in research and development in electronics continue to lag behind those of East Germany, Czechoslovakia, and probably Hungary. Imports of electron tubes have permitted Poland to produce electronic end equipment with improved operating characteristics. Imported machinery for making electron tubes has led, in addition, to substantial qualitative improvement in the electron tubes produced by Poland itself. Electronic marine navigational equipment is imported from countries outside the Soviet Bloc for installation on

* The high percentage increase in imports in 1957 might be a slightly inflated figure because of the nature of the statistics available on this trade. The estimate for 1957, based on trade reported by non-Bloc countries, may include contracts for sales of electronics that would not be delivered until 1958 or subsequent years. These contracts would make the above estimate for 1957 artificially high compared with 1958, although the increase above 1956 was appreciably large.

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ships under construction in Polish shipyards. Imported radio communications equipment installed in Polish mines has contributed to increased efficiency of the extractive industries. It also is estimated that the greatly increased communications services of the country, made possible by imported equipment, have had a somewhat less tangible but nonetheless favorable effect on the economy of the country as a whole.

Although the capacity to produce much of the electronics currently imported by Poland could be developed domestically, the availability of imports of this equipment has mitigated the necessity of making large expenditures in this direction. Poland uses imports of electronics from countries outside the Soviet Bloc as models for establishing series production of certain items. This practice in the ever-changing field of electronics has meant that equipment produced in Poland, based on copied developments, lags behind new equipment being produced and marketed by countries doing their own research and development. Because Poland exports only small quantities of a very few types of electronic equipment, however, the inability of domestic producers to compete in foreign markets has not been significant thus far. The practice of copying developments of more advanced countries in communications equipment and consumer entertainment equipment has permitted Poland to concentrate the limited funds and personnel available on the development and production of radar equipment.

B. Exports

As mentioned above, Poland exports only small quantities of electronics. Exports are primarily to underdeveloped countries including the United Arab Republic, Turkey, Lebanon, Iran, and Indonesia and to Yugoslavia and East Germany. Radar sets are exported only in small numbers, but the high unit value of each set makes this export the most significant in terms of value. Although a precise estimate cannot be made, exports of radar sets to Syria, Egypt, and Indonesia valued at between 5 and 10 million zlotys probably were made during the years 1957-58. There is no indication of any projected increase in this rate of export for the immediate future. Radio receivers produced for export have been exported in small numbers to Yugoslavia, East Germany, Turkey, Lebanon, and Iran. These radio receivers are produced according to specifications designed to make the sets compare competitively with similar equipment produced in countries outside the Soviet Bloc. The only other exports of note have been telephone hand sets, and these exports have been on a minor scale.

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APPENDIX A

METHODOLOGY

1. Estimated Value of Production of Electronics

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[REDACTED]

The official statistical yearbooks for Poland and the annual announcements on plan fulfillment contain quantitative data on production of electron tubes, television receivers, and radio receivers. The Polish Five Year Plan (1956-60), as reported in several Polish periodicals, contained output goals in terms of percentage increases for the 5-year period for some items of telephone and radio communications equipment and for electronic measuring apparatus. ^{38/} Inadequate definitions and inconsistent uses of terms describing the classes of electronic equipment or the aggregates, along with gaps in information on some classes of equipment, have made it necessary to make certain assumptions and interpolations based on information from clandestine sources. The series showing estimated value of production of the subsectors of the electronics industry were derived in the following manner.

The price information used below to derive the value series in Table 1, which are the bases for zloty values expressed throughout this report, came from a variety of open-source documents [REDACTED] [REDACTED] In none of these sources, with the exception of the Polish statistical yearbooks, was the price basis for zloty values indicated in any detail. Data on 1956 industrial production in the 1957 Polish statistical yearbook was given in 1956 comparative prices and in selling prices. Comparative prices are equivalent to factory prices, including profits at an undisclosed rate, but excluding the turnover tax on consumer goods. Price information on radio receivers for consumer entertainment, reported in the Polish statistical yearbooks for the years 1955-58, indicates that there have been no changes in the prices established in 1956, at least for this class of electronic equipment. In the absence of any indications of price changes for other electronic equipment, the zloty prices used herein are considered to be based on 1956 zlotys and are estimated factory prices.

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* P. 7, above.

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a. Consumer Entertainment Equipment

Open source literature reports the annual production of radio and television broadcast receivers by the total number of units in Poland for the years 1955-59 and the planned production for 1960 and 1965. 39/ These published figures are totals and do not reflect the product mix.

There is sufficient information, however, [redacted] to estimate the relative rates of production of the three classes of radio receivers for the years 1955-58. The trend has been in favor of an increased share for medium-priced and high-priced radio receivers in the total production. [redacted] the models produced in 1958 indicate that about 49 percent of all radio receivers were Class III, 41 percent Class II, and 10 percent Class I. In contrast, the estimated relationship among these three classes of radio receivers in 1955 was as follows: 80 percent were Class III, 15 percent Class II, and 5 percent Class I. It is estimated that the 1955 percentages remained constant during 1956 but that production of Class I and II radio receivers in 1957 increased at a more rapid rate than production of Class III radio receivers. The percentage relationships among the three classes of receivers in 1959 and 1960 were estimated to be the same as in 1958.

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Retail selling prices for both radio and television receivers have been reported in many sources. Weighted average retail prices were derived for each class of radio receivers on the basis of these reported retail prices and the levels of production reported for most of the models of radio receivers produced in Poland in 1958. The 1957 Polish statistical yearbook indicates an average turnover tax of 3.3 percent on radio receivers in 1956. Subsequent Polish yearbooks indicate that retail sales prices of radio receivers have remained constant through 1958. Therefore, to arrive at a total value of production in factory prices, the average retail price for each class of radio receivers was deflated by the amount of the turnover tax.

Retail prices and quantities produced were available in various reports for each of the three models of Polish television receivers. According to the 1957 Polish statistical yearbook, retail prices for television receivers did not carry any turnover tax in 1956 but, on the contrary, were about 60 percent below the factory prices ("comparative price"). It is assumed that the retail price, which was established at the time that production was initiated and apparently has remained constant, reflected future factory costs of production that would become lower because of economies resulting from mass production. For estimating the value of production of television receivers, therefore, the retail prices were used, and no adjustment was made for a turnover tax, which, if included in the retail price, would

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be very small. The value of production of the three classes of radio receivers in 1956 comparative or factory prices and the three models of television receivers in retail selling prices is shown in Table 6.*

The unit value of loudspeakers for wired radio service is so low that the value of production of loudspeakers does not alter appreciably the estimated values of the annual production for consumer entertainment equipment.

b. Military Electronics

The estimated value of the annual production of electronics in Poland for military use is the sum of the value of the annual production of radar and communications equipment for military use as shown below (in million zlotys):

<u>Equipment</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>
Radar	16	56	156	320	360	480
Communications	64	80	100	125	125	125
Total	<u>80</u>	<u>136</u>	<u>256</u>	<u>445</u>	<u>485</u>	<u>605</u>

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* Table 6 follows on p. 30.

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Table 6

Estimated Production of Radio and Television Receivers in Poland
1955-60

Equipment	1955		1956		1957		1958		1959		1960	
	Thousand Units	Million 1956 Zlotys a/	Thousand Units	Million 1956 Zlotys a/	Thousand Units	Million 1956 Zlotys a/	Thousand Units	Million 1956 Zlotys a/	Thousand Units	Million 1956 Zlotys a/	Thousand Units	Million 1956 Zlotys a/
Radio receivers												
Class I b/	23	75	25	81	44	143	79	256	75	244	80	259
Class II c/	70	121	75	130	130	225	324	561	307	530	328	567
Class III d/	368	320	399	347	472	411	387	337	368	320	392	341
Subtotal	<u>461</u>	<u>516</u>	<u>499</u>	<u>558</u>	<u>646</u>	<u>779</u>	<u>790</u>	<u>1,154</u>	<u>750</u>	<u>1,094</u>	<u>800</u>	<u>1,167</u>
Television receivers												
Wisla I	0	0	2.2	8.8	9	36	0	0	0	0	0	0
Belweder e/	0	0	0	0	7	49	57	411	117	879	200	1,600
Subtotal	<u>0</u>	<u>0</u>	<u>2.2</u>	<u>8.8</u>	<u>16</u>	<u>85</u>	<u>57</u>	<u>411</u>	<u>117</u>	<u>879</u>	<u>200</u>	<u>1,600</u>
Total		<u>516</u>		<u>567</u>		<u>864</u>		<u>1,565</u>		<u>1,973</u>		<u>2,767</u>

a. Based on estimated factory prices.

b. Class I comprises high-priced Polish radio receivers having amplitude and frequency modulation, eight electron tubes, and six receiving bands.

c. Class II comprises medium-priced Polish radio receivers generally having four or five electron tubes and three receiving bands.

d. Class III comprises low-priced Polish radio receivers having three or four electron tubes.

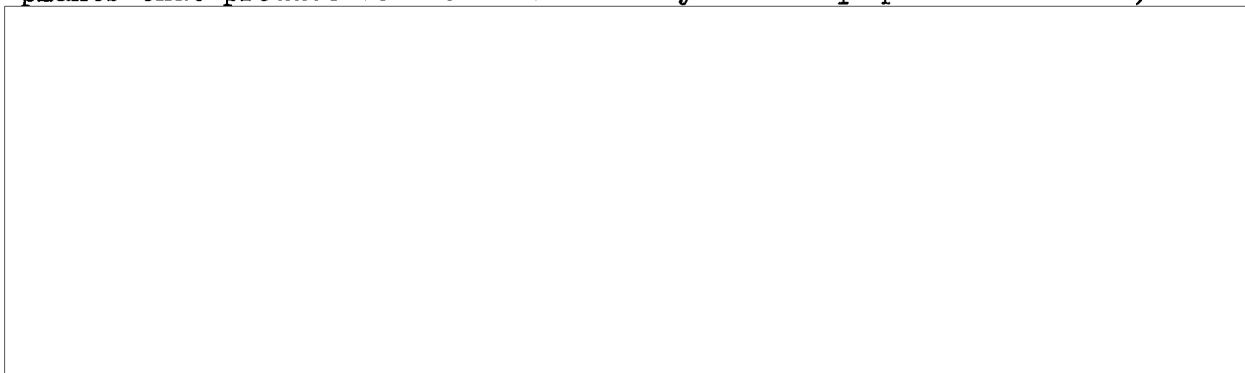
e. The Belweder produced in 1957 was sold at a retail price of 7,000 zlotys. Subsequent models of the Belweder having larger picture screens were priced at 9,000 zlotys. The estimated ratios of production between the smaller set and the larger set varied as follows: 1958, 51 to 6; 1959, 3 to 1; 1960, 1 to 1.

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The value series for the annual production of radio equipment for military use was based on (1) the construction of an estimate of the value of this production for the year 1957 amounting to 100 million zlotys and (2) construction of an index from a variety of reports indicating the general trend in production of military radios during other years relative to 1957. The figure of 100 million zlotys for 1957 was derived by aggregating the estimated production by the two plants that produce most of the military radio equipment in Poland,

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There is no specific information on which to base an index of production of radio equipment for military use. There are sufficient data, however, to develop the trends of this production during the years 1956-60. On the basis of what is known about the types of radio equipment produced and on the basis of the actual and planned initiation of production of Soviet types of military radio equipment, it is estimated that Polish production of radio equipment for military use increased about 25 percent annually in 1956-58, when Poland was producing several Soviet types of military radio equipment and reportedly was initiating quantity production of the R-118 mobile military radio transmitter. For 1959-60, however, it is estimated that the annual increases in production of military radio equipment will be small or nonexistent. This assumption is supported by a report that the T-3 Radio Plant imienia Marcina Kasprzak was making a gradual conversion from military to civilian production. ^{44/} It is further supported, although negatively, by the absence of information indicating any increases in the facilities for producing this equipment in Poland. The resulting index shown below is merely a rough approximation of the achievements in production of military radio equipment during the 5-year period:

<u>Type of Measurement</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>
Index (1955 = 100)	100	125	156	195	195	195
Value (million zlotys)	64	80	100	125	125	125

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c. Civil Communications Equipment

There is relatively little information available with which to derive a value series for production of civil communications equipment in Poland. The Five Year Plan (1956-60) indicates the planned increases for the period for certain types of communications equipment, including telephone hand sets, automatic and manual telephone exchange equipment, and radio transmitting equipment. 45/ From the reported indexes on these various types of equipment a weighted average increase for the entire sector of civil communications equipment was derived. The estimating of appropriate weights was based on a general analysis of the reported volume of production of each type of equipment involved and an estimate of the possibility of reaching planned goals. For example, production of radio transmitting equipment for the civil communications system was given a low relative weight because, except for military radio equipment, the value of production of radio transmitters in Poland has remained relatively small. In addition, reports of progress achieved thus far in the plan period do not indicate that an appreciable increase in production of radio transmitters for civil use can be accomplished by 1960. Similarly, plans for the increasing production of automatic municipal exchanges have not been fulfilled, because of continuing difficulties in obtaining components and delays in construction of new productive facilities. 46/

On the basis of the weights selected, the total growth in production of electronics for use in civil communications during 1956-60 was computed at 60 percent, as shown in the following tabulation:

<u>Equipment</u>	<u>Planned Percentage Increase <u>47/</u> 1956-60</u>	<u>Estimated Weight</u>
Telephone hand sets	22	3
Automatic municipal exchanges	130	2
Automatic subscriber exchanges	30	3
Other telephone apparatus	25	3
Radio transmitting equipment	230	1
Weighted average increase	60	

From this figure of 60 percent, representing the total increase in production of civil communications equipment, a rounded figure of 10 percent was derived as representing average annual increases for this subsector during this 5-year period.

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Available information suggested only one method by means of which it would be possible to construct a base-year estimate for the total value of production of civil communications equipment: the multiplication of a reasonable estimate of the labor force for this subsector by a reasonable estimate of the value of output per worker per year. For the year 1957 it was possible to establish that approximately 4,000 persons worked in Polish plants producing civil communications equipment. In 1957 the value of output per worker on military electronics at the T-6 plant was approximately 53,000 zlotys.* Although productivity usually is lower in production of military communications equipment than in production of other electronics, there is enough comparability with productivity in civil communications equipment to warrant the use of the known value of production per worker in the absence of other information. As a rough check on the correctness of the magnitude of the above value, official Polish statistics indicate that the average output per worker in the machinery and metalworking industries, which generally is higher than that for output in the communications industry, was 75,000 zlotys in 1957. In addition, it was reported that output per worker at the T-3 Radio Plant imienia Marcina Kasprzak in production of consumer radio receivers was 130,000 zlotys in 1957. ^{48/} Productivity per worker in consumer radio receivers is the highest of all electronics. The product of 4,000 workers and an output per worker of 53,000 zlotys yield a total value for production of civil communications equipment of approximately 210 million zlotys in 1957.

The derived index and value series for production of civil communications equipment in Poland follow:

<u>Type of Measurement</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>
Index (1955 = 100)	100	110	121	133	146	161
Value (million zlotys)	174	191	210	231	254	280

d. Industrial Electronics

The value estimated for production of industrial electronics in Poland is based on an estimated value of production in 1957 and an index that was based on the total planned increase for electronic measuring apparatus as announced in the Five Year Plan. ^{49/} The estimated value of production in 1957 was derived by the same methodology

* This estimate is based on military production valued at 53 million zlotys and a labor force of approximately 1,000.

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as used for civil communications equipment.* The estimated labor force of 1,000 and output per worker of 53,000 zlotys yield a value of production of industrial electronics of 53 million zlotys.

The average annual planned increase, based on the reported 5-year planned increase for production of measuring apparatus of 500 percent, would be about 43 percent. Although this large increase would be possible in the early years of the plan period because of the low volume of production in 1955, it is estimated that early increments were much smaller than this increase and that, only after increases were made in plant capacity and production of analog computers was initiated, an average annual increment of 43 percent would be reached. The index reflects, therefore, a rate of growth during the years 1956-58 of about one-half of that during the last 2 years of the plan period. The resultant estimated index and values of production of industrial electronics follow:

<u>Type of Measurement</u>	<u>1955</u>	<u>1956</u>	<u>1957</u>	<u>1958</u>	<u>1959</u>	<u>1960</u>
Index (1955 = 100)	100	122	149	182	262	377
Value (million zlotys)	36	43	53	65	93	134

e. Electron Tubes

A value series for the annual production of electron tubes in Poland was derived by multiplying the figures on physical volume of production of receiving tubes, transmitting tubes, and television picture tubes, as shown in Table 4,** by an estimated average unit price for each class of electron tube. Average unit prices of 1956 for receiving and transmitting tubes of 52 zlotys and 240 zlotys, respectively, were computed from data reported in the 1957 Polish statistical yearbook. The average unit price of television picture tubes was assumed to be the same as that for transmitting tubes. Although not entirely satisfactory, this assumption is more valid for Poland than it would be for East Germany, the USSR, or the US because transmitting tubes produced in Poland are generally of a low level of sophistication, as indicated by the relatively low average zloty prices. The value of production estimated for the three general types of electron tubes produced in Poland in the years 1955-60 is shown below (in million zlotys):

* See c, p. 32, above.

** P. 20, above.

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Type of Electron Tube	1955	1956	1957	1958	1959	1960
Receiving	135	182	234	307	369	442
Transmitting	0.8	1.1	1.1	1.2	1.2	1.3
Cathode ray	0	0	0	3.8	26	48

2. Zloty-Dollar Ratio

There is scant price information on comparable Polish and US electronic items from which to construct a zloty-dollar ratio. It is obvious, however, that the official rate of foreign exchange of 4 to 1 is far below the prevailing ratio for electronics. Computable zloty-dollar ratios for limited pieces of consumer entertainment equipment, military communications equipment, and electron receiving tubes range from 33 to 1 to as high as 67 to 1. In the absence of significant quantities of price data, an unweighted average zloty-dollar ratio for the electronics industry, based on the following zloty-dollar relationships, has been computed at 47 to 1:

Equipment	Price		Zloty-Dollar Ratio
	Zlotys	Dollars	
Electron receiving tubes (average)	57	0.75	76 to 1
Transistor radio receivers	980	30.00	33 to 1
Radio receivers (6 tubes)	1,950	53.00	37 to 1
Television receivers (medium picture tube)	7,000	155.00	45 to 1
RT-10 military radio transceivers	50,000	1,180.00	42 to 1

This derived ratio for the industry should be treated merely as a tentative ratio and has been computed here only to provide a dollar estimate of the value of Polish electronics production that would be closer to the general order of magnitude than could be obtained from using official foreign exchange rates.

3. Estimated Imports of Electronics, 1955-58

Polish imports of communications equipment and television and radio receivers from countries of the Soviet Bloc in 1955-56 were reported in the periodical Handel zagraniczny (Foreign Trade). 50/ Similar data

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on Polish imports in 1957 from both Bloc and non-Bloc countries were available in open sources. 51/ Data on Polish imports of electronics from Bloc countries in 1958, however, included only radio and television receivers with accessories. 52/ It was estimated that imports of communications equipment in 1958 were increased in comparison with imports in 1957 in the same proportion as the known increase in imports of consumer entertainment equipment. The reason for this estimate was that a degree of correlation exists in Poland between the installation of communications equipment for extension of entertainment nets and the availability of consumer entertainment equipment.

Estimates of imports of electronics from countries outside the Soviet Bloc for 1955-58 were based on data from the US Department of Commerce Country-Commodity Series on trade with countries of the Sino-Soviet Bloc. These data included Polish imports of radio receiving equipment and accessories, electroacoustic apparatus and devices, electron tubes, and apparatus for telegraphy and telephony.

In addition to the basic sources cited, the estimates of Polish imports of electronics reflect data on trade between Poland and countries of the West in electronic items on the COCOM embargo list. Summaries of the value of this trade for the last 4 months of 1958 and the first half of 1959 were used to estimate a trend for 1958-60.

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