SECRET

2

PROVISIONAL INTELLIGENCE REPORT

THE OPTICAL INSTRUMENTS INDUSTRY OF EAST GERMANY

CIA/RR PR-130
23 December 1955

1

B1189

10-16-79

CENTRAL INTELLIGENCE AGENCY

OFFICE OF RESEARCH AND REPORTS

SECRET

WARNING

This material contains information affecting the National Defense of the United States within the meaning of the espionage laws, Title 18, USC, Secs. 793 and 794, the transmission or revelation of which in any manner to an unauthorized person is prohibited by law.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

S-E-C-R-E-T

PROVISIONAL INTELLIGENCE REPORT

THE OPTICAL INSTRUMENTS INDUSTRY OF EAST GERMANY

CIA/RR PR-130

(ORR Project 34.643)

NOTICE

The data and conclusions contained in this report do not necessarily represent the final position of ORR and should be regarded as provisional only and subject to revision. Comments and data which may be available to the user are solicited.

CENTRAL INTELLIGENCE AGENCY

Office of Research and Reports

S-E-C-R-E-T

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

CONTENTS

Appendixes

Tables

Illustrations

CIA/RR PR-130
(ORR Project 34.643)

S-E-C-R-E-T

THE OPTICAL INSTRUMENTS INDUSTRY OF EAST GERMANY*

Summary

The optical instruments industry of East Germany, reduced almost to inactivity following World War II, has made a spectacular recovery to its wartime level of production. Between 1948 and 1952, both value of output and employment quadrupled. The value of output in 1954, DME (Deutsche Mark East) 189 million, was 24 percent over the value of output in 1952. In 1954 the East German industry employed about one-quarter as many productive workers as the US industry, being easily the largest producer of optical instruments in the European Satellites.

Although 85 percent of the wartime production of the optical instruments industry of East Germany was consumed by the armed forces, only about 10 percent is used currently for military purposes. The export market is now absorbing 50 percent of the total production, but this market is dwindling because of Western competition and legal restrictions on the use of established trade names. If stocks of unsold goods accumulate, the industry may receive budgetary cutbacks.

Given increased demand, the further expansion of the production of optical instruments in East Germany would easily be possible because equipment requirements are modest and East Germany has skilled labor readily available and an adequate source of optical glass. No expansion is likely, however, unless it is stimulated by unexpected demands by the Soviet Bloc or by an increase in military requirements. For the present, at least, the optical instruments industry of East Germany appears to have reached its postwar production peak.

---

* The estimates and conclusions contained in this report represent the best judgment of ORR as of 1 November 1955.

I. Introduction.

A. General.

1. Definition.

The term optical instrument is used in this report to denote a device which may operate to transmit, reflect, refract, and/or diffract visible light or ultraviolet or infrared radiations by means of precisely formed solid elements such as lenses, prisms, mirrors, and gratings. It also includes the housing or mounting for these elements, a means of adjustment, and such nonoptical accessory components as are needed to make a complete instrument. Such devices are products of what is loosely referred to as the optical instruments industry, a group of plants associated by common principles of design, materials, and manufacturing methods.

Not properly included are certain products which may have a similar nomenclature or purpose but which are produced by other industries, such as the electron microscope, the cathode-ray tube, the mass spectrometer, X-ray analytical instruments (diffraction and absorption equipment), and searchlights and similar illuminating devices which incorporate so-called "lenses" that are not ordinarily formed to the exacting tolerances common to optical instruments.

In some instances, precision instruments not employing optical systems are produced in optical instrument plants. A discussion of these instruments is not included in this report except where specifically noted.

2. Functions.

The functions performed by optical instruments are so many and so varied that a detailed enumeration of them would be impractical.* Some idea of the scope of their functions, however, may be drawn from the following major categories:

* Reference may be made to published texts for a comprehensive review of optical instruments, their principles of operation, and their applications. 1/ (For serially numbered source references, see Appendix E.)

a. Military Optical Instruments.

Fire-control devices.
Observational instruments.
Aerial reconnaissance instruments.
Training equipment.

b. Civilian Optical Instruments.

Industrial, commercial, and engineering instruments (such as those for surveying, shop measuring and inspection, and professional photography).
Medical instruments (such as microscopes, diagnostic and surgical instruments, and ophthalmological instruments).
Research and analytical instruments (such as astronomical instruments and devices for chemical analysis and physical testing).
Consumer instruments (such as eyeglasses, magnifying glasses, photographic equipment, telescopes, and binoculars).

3. Importance.

Optical instruments fill many needs -- for example, as military end items and in industrial equipment and consumer goods. During wartime, military requirements, both direct and indirect, place demands on the producing industries substantially in excess of those imposed by the economy in peacetime. The demand for military end items such as fire-control devices, observational instruments, aerial reconnaissance instruments, and training equipment rises sharply, and this demand is superimposed on increasing requirements for both medical and industrial instruments. Such a contingency becomes the more serious because there are, in general, no suitable substitutes.

Although the production of optical instruments fills a wide variety of needs which must be met in modern economies and which may become critical during a war, its contribution to Western economies and to that of East Germany normally is small. Roughly 0.5 percent* of the total labor force of East Germany found employment in

* See V, A, p. 18, below.

the optical instruments industry in 1953, and the contribution of the industry to the gross national product probably did not exceed the same proportion. Despite the lack of data, it is estimated that the combined direct and derived employment attributable to the production of optical instruments would not account for over 1.5 percent of the total labor force.

The high rate of growth exhibited by the optical instruments industry of East Germany in the period following World War II decreased sharply in 1954 and will continue to level off in 1955 and 1956.* Consequently, it is probable that the industry will not contribute a larger share to the gross national product in the near future and may decline in relative importance.

B. History.

In Germany in the century preceding World War II the production of optical instruments developed from an empirical craft pursued by a few independent artisans into a highly technical industry resting on a sound theoretical basis and employing thousands of workers. Even before World War I, Germany's world dominance in this field was unchallenged, and as recently as 1945 its optical instruments industry was the largest in the world. 2/

After World War II and the partition of Germany, East Germany retained about one-third of the prewar optical instruments industry, including the important centers in Jena, Dresden, and Rathenow. It also retained the principal central European producer of optical glass, VEB (Volkseigene Betrieb -- People's-Owned Enterprise) Jenaer Glaswerk Schott und Genossen, formerly Schott und Genossen, Jena. 3/ During 1945 and 1946 the industry was dismantled thoroughly, and 90 percent or more of its production equipment was removed to the USSR. 4/

Even with its production facilities thus severely crippled -- and despite such other adverse factors as Soviet demands for large reparations deliveries and the loss of key personnel through conscription to the USSR and defection to the West -- the postwar East German industry recovered notably to achieve by 1953 an output probably about equal to that of the same area in 1944.

* See II, B, p. 12, below.

In addition to rebuilding the domestic optical instruments industry of East Germany, East German skilled labor, technical experts, and production equipment have been forced since World War II into the development of the optical instruments industries of both the USSR and the European Satellites. Before World War II, Germany dominated most of the European industries, either exporting finished products to other nations or controlling their small industries as subsidiaries. In the postwar period there seems to be a deliberate policy of building up the production of the other Satellites in spite of the fact that East Germany rapidly regained a position where it could meet the optical instruments requirements of the other Satellites. The fact that deliberate encouragement was extended to the smaller industries of the other Satellites is attested by Soviet orders compelling the leading East German firm, VEB Carl Zeiss Jena, to furnish, against its will, considerable quantities of production equipment and data to Polish and Czechoslovak optical instrument plants. 5/

C. Technology.*

1. Comparisons.

There are few noticeable differences in technological development between the optical instruments industry of the US and that of East Germany. Those differences which do exist in their instruments are in the favor of the US and generally are related to more "gadget" features than to fundamental principles of design. Although such features may not be materially important to the functioning of the instruments, they do affect vendibility, and this factor has had an adverse effect on the competitive position of East Germany in the export market. 6/

With respect to production equipment, the optical instruments industry of East Germany may be inferior, at least temporarily, in the following:

a. In the Application of Digital Computers to the Calculation of Optical Systems.

The calculation of optical systems is one of the most laborious tasks known in practical mathematics, and the use of the digital computer in the US in recent years has encouraged

* For additional discussion of the technology of the production of optical instruments, see Appendix B.

the development of more exacting and more complex optical system designs than were practicable previously. Because neither the USSR nor any of the European Satellites is known to have produced a practical digital computer as yet, 7/ the optical instruments designers of East Germany may not currently have access to this advanced design aid.

b. In the Ruling of Diffraction Gratings.*

Efforts of the research department of VEB Carl Zeiss Jena to reproduce the diffraction-grating ruling machines previously developed, and removed by the USSR after World War II, were not effective at least up to mid-1953. Spectroanalytical instruments employing diffraction gratings have not appeared among the postwar products of the optical instruments industry of East Germany. 8/

The other European Satellites have no optical instruments industries approaching that of East Germany in technological development. Even Czechoslovakia, which has grown markedly since World War II, lags behind East Germany in the diversity and complexity of production, in facilities for research in the design of optical instruments, and in the level of development of manufacturing methods.

If desired, it seems probable that the USSR could reduce considerably the technological inequalities among the optical instruments industries of the European Satellites by making East German methods and equipment more generally available. By this type of exploitation of East German knowledge, the USSR has already greatly advanced its own optical instruments industry and has provided some degree of aid to the smaller Polish and Czechoslovak plants.** This demonstrated ability to disseminate the more advanced East German technology among the other Satellites, when desired, reduces somewhat the advantages presently accruing to the Western economies from the lack of technological development in the optical instruments industries of the smaller Satellites.

2. Convertibility.

Converting an optical instruments industry from a peacetime to a wartime basis may involve a considerable revision of the

* A diffraction grating is a series of very fine, accurately spaced, straight lines ruled on a suitable surface for the purpose of producing spectra by interference.

** See B, p. 4, above.

product mix but may not necessarily involve much change in the character of the materials and equipment used or in the manufacturing methods. The principal problem, therefore, becomes one of attaining the necessary level of production, which involves the procurement of the necessary production facilities and equipment and the training of an adequate labor force.

Both the production equipment and the labor force of the optical instruments industry may be divided into categories, in terms of product, as follows: those involved in the production of the non-optical components of the instruments and those engaged in producing the optical elements themselves and in assembling the optical instruments. The first group involves principally metal-foundry and machine-shop equipment and personnel, which may be made available in wartime at the expense of less critical industries. For the second group, however, there is no reserve, because it is in a large measure peculiar to the industry. The limiting factors in attaining wartime expansion, therefore, would be the availability of production equipment and of personnel equipped to produce and assemble the optical elements of the instrument.

In this respect, East Germany is fortunately situated. Currently capable of sustaining a production of optical instruments approximately equal to its peak production during World War II and with a considerable apprentice-training program in effect,* the problem of East German industry conceivably could be reduced largely to the procurement of the necessary jigs, fixtures, and tools (commonly produced within the industry) and to the organization of manufacturing methods suited to large-batch production.

The absence of purposeful stockpiling of optical instruments which might be needed by the East German armed forces in wartime offers confirmation of the fact that the facilities of its optical instruments industry are considered to be readily capable of conversion to wartime production.

D. Administrative Structure.

The 16 plant organizations of the optical instruments industry of East Germany are under the immediate direction of the Main Administration for Precision Mechanics and Optics, which is subordinate to

* See V, A, p. 18, below.

the Deputy Minister for General Machine Construction in the Ministry for Machine Construction. 9/

Until late 1953 the optical instrument plants were organized in the VVB (Verwaltung Volkseigene Betrieb -- Administration of People's-Owned Enterprise) Optik. When the former Ministries for Heavy Machine Construction, for General Machine Construction, and for Transportation and Agricultural Machine Construction were combined to form the present Ministry for Machine Construction, 10/ the VVB Optik was dissolved, and the optical instrument plants were assigned to two combines under the Main Administration for Precision Mechanics and Optics, each combine headed by a Leitbetrieb (Directing Enterprise). 11/ Thirteen of the plants are organized in an optical combine having the VEB Carl Zeiss Jena as its Leitbetrieb. Three optical instrument plants and other producers of nonoptical instruments are contained in a precision mechanical combine under the Leitbetrieb VEB Feinmesszeugfabrik Suhl, a producer of precision instruments.

The exact functioning of this reorganized structure is not entirely clear. The most notable result of the changes appears to be a tightening of authority of the Ministry for Machine Construction over the optical instrument plants. The control of the individual plants continues to originate practically in the ministry, which is empowered to deal directly with the State Planning Commission, to allot stocks of raw materials and funds within its sphere, and to police the performance of its subordinate units. Considerably more authority is entrusted to the Leitbetriebe, however, than was entrusted to the former VVB Optik. The individual plants appear to have been reduced almost to the level of branches of the Leitbetriebe, which conduct administration, research and development, planning, personnel management, and quality control; determine production norms; and direct production and sales for the entire group of plants. 12/

Although the new structure reduces even further the self-determination of the individual optical instrument plants, it may have been instituted in an attempt to increase the efficiency of the supervision of the plants by transferring a part of this function from the ministerial bureaucracy to a position closer to the operating level.

Although the Leitbetriebe concept has been attributed to a tendency in East Germany to imitate the USSR, 13/ there is no evidence that the Soviet optical instruments industry is organized in any similar manner. This type of administrative structure appears to be an East German creation, at least in its application to this industry.

II. Supply.

A. Production.

Available evidence indicates that, conforming to the long-standing German reputation for self-sufficiency in the field of optical instruments, the import of such instruments into East Germany is negligible and that the national production, therefore, is a reasonable measure of the total supply.

The estimated output of the optical instruments industry of East Germany in 1946-55 is shown in Table 1.* In view of the wide variety of instruments produced, the production of the industry is presented in total value terms. First it is presented in current East German factory delivery prices (Effektivpreisen) -- that is, the price paid to the producing plants for instruments by the DIA (Deutscher Innen- und Aussenhandel) and the DHZ (Deutsche Handelszentrale), the organizations through which all export and domestic marketing is effected. For purposes of comparison, perhaps a more accurate measure of real production based on the average 1949 output per worker has been included in Table 1. Comparison of the 2 value series indicates that about 21 percent of the reported increase in the current value of output between 1949 and 1953 may be attributed to price increases.

Clearly evident is the very rapid recovery of the optical instruments industry of East Germany after its dismantling in 1946 to a current level of production estimated to be approximately equal to its peak production during World War II. The recovery was facilitated materially by the following factors:

(1) An adequate reserve of skilled labor was available, particularly in the prewar producing centers in Jena, Dresden, and Rathenow.

(2) Optical glass was obtainable from VEB Jenaer Glaswerk Schott and Genossen, Jena. Although the types and quality were not adequate for complete freedom in design, it was generally possible to adapt the design to the glass available.

(3) Requirements for production equipment were modest and traditionally have been fulfilled largely by the industry.

* Table 1 follows on p. 10.

Table 1

Estimated Output of the Optical Instruments Industry of East Germany
in Current and Constant Value a/
1946-55

Year	Current Value: Million Current DME	Current Value: Increase over Previous Year (Percent)	Current Value: Margin of Error (Percent)	Constant Value: Million 1949 DME	Constant Value: Increase over Previous Year (Percent)	Constant Value: Margin of Error (Percent)
1946	4	N.A.	± 100	N.A.	N.A.	N.A.
1947	18	350	± 10	25	N.A.	± 10
1948	39	117	± 10	36	44	± 10
1949	75	92	± 10	75	108	± 10
1950	98	31	± 10	97	29	± 10
1951	114	16	± 10	121	25	± 10
1952	153	34	± 10	142	17	± 10
1953	185	21	± 10	163	15	± 10
1954	189	2	+ 5 - 20	166	2	+ 5 - 20
1955	189	0	+ 5 - 20	166	0	+ 5 - 20

a. For the derivation of the estimates in this table, see Appendix C.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

Regionally, the area of greatest output is in Jena, Bezirk Gera, which in 1954 accounted for 56 percent of the national output of optical instruments. Next in importance are the 11 plants in Bezirk Dresden, which turned out about 27 percent of the 1954 output. Rathenow, Bezirk Potsdam, accounted for approximately 10 percent of the 1954 output, and the balance (about 7 percent) was distributed among 3 plants elsewhere.*

Measured in terms of plan fulfillment, the optical instruments industry of East Germany has established a good postwar record, overfulfilling planned output during 3 of the 4 years for which information is available. The production of the industry during several years (1949-54) of rapid growth is shown in Table 2.

Table 2

Fulfillment of Production Plans in the Optical Instruments Industry of East Germany a/
1949-54

Year	Number of Plants Included	Production b/ (Million Current DME) Planned	Actual	Fulfillment (Percent)
1949	1	45.2	49.8	110
1950	4	70.8	74.3	105
1951	12	120.0	113.6	95
1952	13	145.0	163.1	112
1953	16	N.A.	185 c/	N.A.
1954	16	N.A.	189 c/	N.A.

a. 14/
b. These figures include the production of nonoptical instruments in 1 plant in 1949 and in 2 plants in 1950-52, inclusive.
c. Figure from Table 1, p. 10, above.

* For a list of the major optical instruments plants in East Germany in 1955, see Appendix A, Table 8, p. 27, below, and for the estimated output, by plant, in 1946-54, see Appendix C, Table 9, p. 40, below.

B. Current Problems.

The leveling off of the production of optical instruments in East Germany which occurred in 1954* is expected to become more pronounced in 1955 and 1956.

In its recovery since World War II the East German industry, aided by the worldwide reputation of such names as Zeiss, Ihagee, and others, was able to dispose of an increasing percentage of its expanding production by export until, by 1953, one-half of the national output was being shipped to foreign consumers.** The current serious problems of the industry arise from its dependence upon foreign buyers to support its present high level of production. The following factors are especially pertinent:

1. Lagging Product Development.

In undertaking to reacquire a high level of production in East Germany after World War II, the development of new optical instruments with appeal for foreign consumers was neglected. Partially, this neglect may have been because of the shortage of key design personnel resulting from large-scale conscriptions for service in the USSR and defections to the West. In any event, the East German optical instruments industry entered 1954, for example, with only 5 readily vendible camera models to offer foreign buyers plus 5 others of limited exportability, as contrasted with the ready availability in large quantity of 180 models from the enterprising optical instruments industry of West Germany. 15/

2. Expanding Production in Other Areas.

East Germany is experiencing increasingly intense competition in world markets, particularly from the US, West Germany, Italy, and the USSR. 16/ Japan also is a serious competitor.

In addition, there is evidence that various countries in the Soviet Bloc are becoming self-sufficient in at least a few consumer optical instruments. Soviet-made cameras, for example, may be purchased in such diverse markets as Bangkok, Thailand; Bombay

* See Table 1, p. 10, above.
** See Table 4, p. 15, below.

and Calcutta, India; and Rangoon, Burma; and they have appeared recently in Greece. 17/ It appears that an optical instruments industry is being started in Communist China, one of the principal markets for Satellite products. 18/ The initiation of the production of consumer cameras is expected in 1955 in Poland, Hungary, and possibly in Rumania. 19/

3. Legal Attacks on the Use of Trade Names.

Arguing that it had transferred its activities legally to West Germany since World War II and that the expropriation of its Dresden plant without indemnification did not encompass rights to trade names belonging to the firm, Zeiss-Ikon AG, Stuttgart, West Germany, obtained an order in a Swiss court in December 1953 banning the sale of the long-established products of VEB Zeiss-Ikon, Dresden. In the following months, similar actions by West German Zeiss firms succeeded in barring the sale of many East German optical instruments bearing well-known Zeiss trade names in West Germany, Italy, Belgium, and the Netherlands and caused the impounding of optical goods forwarded from East Germany for exhibit at the Cairo Trade Fair in March 1954. 20/

A large part of the East German export trade in optical instruments since World War II has included instruments using trade names which originally were the property of the Carl Zeiss Foundation, now considered legally to be located in West Germany. The possible extension of sales bans to additional areas of the non-Soviet Bloc world could limit materially the ability of the optical instruments industry of East Germany to continue to distribute about one-quarter of its exports in those markets. Legal counteractions in West Germany having failed, the East German industry has been forced to abandon the use of valuable trade names in connection with much of its non-Bloc trade and to undertake the difficult process of introducing new and unknown trade names in an already highly competitive export market. East German Zeiss products have appeared in the West in 1955 bearing the trade name "Ernst Abbe Jena" instead of "Carl Zeiss Jena."* The West German Zeiss organization, in a statement issued in November 1954, contends it has sole rights to the name "Ernst Abbe." The legal controversy presumably will continue.

* Ernst Abbe assumed management of the firm on the death of Carl Zeiss, its founder, in 1888.

III. Demand.

A. Distribution Pattern.

The distribution pattern of the many types of optical instruments is so complex that it is only treated in general terms. The percentage distribution of the East German output of optical instruments by broad categories, in 1949-53 is shown in Table 3.

Table 3

Estimated Distribution of Optical Instruments Produced in East Germany, by Broad Categories a/ 1949-53

	Percent of Total Production				
Category	1949	1950	1951	1952	1953
Military optical instruments	6	18	7	10	9
Ophthalmic instruments	7	9	6	10	N.A.
Optical instruments and lenses	28	19	31	26	N.A.
Optical photographic equipment	59	54	56	54	N.A.
Total	100	100	100	100	100

a. For the derivation of these estimates, see Appendix C.

Table 3 clearly indicates the low level of production of ophthalmic instruments, which are intended principally for consumption by the Soviet Bloc, and the consistently high proportion of readily vendible photographic equipment. The small percentage of production for the military forces shows significant variation only in 1950, when a first order for 200 Model A-1-p aerial gunnery trainers* for the USSR accounted for about 25 percent of the value of the 1950 production at VEB Carl Zeiss Jena. No trainers were produced in 1951, and the inclusion of 79 units in the 1952 production at Carl Zeiss Jena accounts approximately for the difference shown

* See III, C, p. 16, below.

in Table 3 between the output of military optical instruments in 1951 and in 1952.

B. Exports.

Quantitative estimates of the exports of optical instruments from East Germany in 1951-53 are shown in Table 4.

Table 4

Estimated Exports of Optical Instruments from East Germany a/ 1951-53

Year	Exports (Million Current DME)	Percent of Total Production
1951	36	32
1952	58	38
1953	101	55

a. For the derivation of these estimates, see Appendix C.

Table 4 shows clearly the rapid rise in East German exports of optical instruments in recent years. Well aware of the reputation of its optical instruments, the East Germans have incorporated them regularly in the negotiation of foreign trade contracts. 21/

The general trend of exports is perhaps typified for the optical instruments industry of East Germany by the export plan of VEB Carl Zeiss Jena, producer of over 50 percent of the national output, which in 1953 and again in 1954 contemplated the delivery of about 75 percent of its instruments for export goods to Soviet Bloc countries, including Communist China, with the balance to be distributed in non-Bloc markets. 22/

C. Military Requirements.

Military optical instruments comprised about 20 percent of the gross sales of Carl Zeiss Jena in 1933. By 1939 the proportion of output for the armed forces had reached almost 75 percent and probably exceeded 85 percent during World War II. Data on the prewar production of military optical instruments at other East German plants are lacking but may be inferred from the Zeiss example.

By contrast, military optical instruments have been only a small proportion of the production of the optical instruments industry of East Germany during the postwar years.* The lack of emphasis on this category of production may have stemmed from an increasing self-sufficiency of the USSR and the other European Satellites in the production of such instruments and from a desire to exploit the foreign trade possibilities of established East German optical instruments. It also may have resulted from well-founded suspicions of political disaffection among East German optical instrument workers. 23/ In any case, work for military purposes before 1952 was confined largely to the repair of military optical instruments 24/; the production for the USSR of the type of instruments produced in Germany during World War II; and the production of instruments not designed for employment directly in warfare, such as aerial photographic equipment, aerial gunnery trainers, and radar trainers.

Since early 1952, key technical personnel returning to East Germany from extended periods of service in the USSR have been reemployed in considerable numbers in important design and development posts in the optical instruments industry, 25/ and some evidence of renewed development activity in the field of military optical instruments has been observed, particularly in the fields of photogrammetry and fire control.

VEB Carl Zeiss Jena is the only producer in the Soviet Bloc of the Model A-1-p aerial gunnery trainer, a device resembling an airplane cockpit in which an instructor, for purposes of training, may simulate by optical means various conditions of flight and of aerial combat. Zeiss first produced this complicated instrument in 1950. It shipped 200 units to the USSR in 1950, 79 in 1952, and 135 in 1953. An order for 135 units to be furnished in 1954 probably was increased to about 150 units during that year. 26/

* See A, p. 14, above.

Before 1954 the Model A-1-p aerial gunnery trainer was produced solely for the Soviet Air Force, but two trainers probably were shipped to Communist China in late 1954. 27/ Also, the 1955 export plan of VEB Carl Zeiss Jena contemplates the delivery of 50 of these Model A-1-p trainers to China in 1955. 28/

Influences currently operating to hinder a continued high level of production of consumer optical instruments plus the near-availability of newly designed military optical instruments suggest the probability that the proportion of East German production devoted to military end items will increase.

IV. Future Expansion.

It may reasonably be inferred from the very rapid recovery of the optical instruments industry of East Germany since World War II that production has kept pace with increased capacity. Capacity is defined to allow for the imbalances in inputs which occurred during the period of expansion. Shortages of production equipment in the early postwar years and, at a later date, poor-quality optical components probably retarded the full utilization of the existing supply of skilled labor.

Postwar expansion generally has taken place within the framework of facilities existing at the close of World War II. Stripped plants have been re-equipped, war-damaged buildings gradually have been restored, and plants occasionally have been shifted from one optical firm to another -- for example, the Dresden/Reick plant of VEB Zeiss-Ikon was transferred to VEB Carl Zeiss Jena. 29/

No new optical instrument plants have been constructed, but at least temporary use is being made of idle facilities at the Rheinmetall-Borsig AG, Soemmerda Werke, of the business-machine industry, 30/ and plans to utilize the additional capacity of the same industry at VEB Mechanik Bueromaschinenwerke Optima have been reported. 31/ The production of projection equipment in excess of the current capacity of VEB Filmosto Projektion in Dresden has been transferred to the Geraetewerk Friedrichshagen in Berlin, not previously a producer of optical instruments. 32/

These very modest steps toward an increase in productive capacity tend to support a conservative view on the probable course of output of optical instruments in East Germany in 1955 and 1956.

V. Inputs.

A. Manpower.

One of the most important inputs to the optical instruments industry is labor, about 50 percent of which must be skilled or semi-skilled. The estimated employment in the optical instruments industry of East Germany in 1947-55 is shown in Table 5.

Table 5

Estimated Employment
in the Optical Instruments Industry
of East Germany a/
1947-55

Year	Number of Workers
1947	4,700
1948	6,700
1949	14,100
1950	18,300
1951	22,700
1952	26,700
1953	30,600
1954	31,200
1955	31,200

a. For the derivation of these estimates, see Appendix C.

The distribution of the total labor force in 1951 among various categories has been determined for 10 East German optical instrument plants, which accounted in that year for about 25 percent of the total output of the industry, and is shown in Table 6.*

* Table 6 follows on p. 19.

Table 6

Distribution of the Labor Force in Ten Optical Instrument Plants in East Germany, by Sex and by Duty a/
1951

Category of Workers	Number of Workers	Percent of Total Labor Force
By sex		
Males	2,238	55.3
Females	1,809	44.7
Total	4,047	100.0
By duty		
Administrative workers	338	8.4
Technical workers	307	7.6
Productive workers	2,594	64.1
Helpers	128	3.2
Apprentices, male	275	6.8
Apprentices, female	405	9.9
Total	4,047	100.0

a. 33/

The high proportion of female workers, approximating that of the early years of World War II, is significant, 34/ as is the trend to increase the ratio of females to males in apprentice programs, which tends to place the optical instruments industry in a favorable position in case of a wartime demand for male personnel.

The ambitious training program of the optical instruments industry of East Germany, as shown in Table 6, is being continued with about 4,500 workers enrolled in 1953-54 in apprentice programs dispersed among 13 East German plants. Assuming a 3-year apprentice training period, which appears to be standard in the industry, the expected

annual increase in trained productive workers would appear to be about 1,500, more than the anticipated increase in total employment in 1954 over 1953. Taking into account deaths, transfers, defections, and the possibility that the ratio of productive workers shown in Table 6 is presently not fully representative, it still appears that the apprentice program probably supplied the industry's needs for new productive workers in 1954 and will produce a surplus in 1955. Some of this surplus may be used to replace older workers of questionable political reliability. 35/

In view of the currently expanded condition of the optical instruments industry, it does not seem likely that further requirements for labor in event of a major war would introduce extreme difficulties. Such increases in productive labor as might be necessary could be expedited, as they were by both sides during World War II, 36/ by abandoning the 3-year apprentice program in favor of a 6-month period or more of training designed to produce a single well-developed manipulative skill. By such means, the total skilled labor force could be increased rapidly.

It seems likely that the optical instruments industry of East Germany is capable of supplying its normal requirements for trained productive workers for possible peacetime expansion during the next several years and, by modifying its training program, could meet the demands of wartime expansion without undue delay.

B. Raw Materials.

The optical instruments industry requires small quantities of a wide variety of raw materials. 37/ Its consumption of such basic materials as ferrous metals, plastics, copper, and copper-base alloys is relatively small. On the other hand, it is the only consumer of optical glass and a consumer of an appreciable amount of fine-mesh, closely graded abrasives. Estimates of the major raw material requirements for the production of optical instruments in East Germany in 1950-55 are shown in Table 7.*

The requirements listed in Table 7 are modest quantitatively, but there have been reports at various times of shortages of all the raw materials listed, 38/ as well as of complaints of poor quality. In general, it appears that the optical instruments industry of East Germany is receiving sufficient supplies of these materials on the

* Table 7 follows on p. 21.

Table 7

Estimated Major Raw Material Requirements for the Production of Optical Instruments in East Germany a/ 1950-55

Metric Tons

Raw Material	1950	1951	1952	1953	1954	1955
Optical glass	727	846	1,135	1,372	1,402	1,402
Abrasives, all types	727	846	1,135	1,372	1,402	1,402
Aluminum, all forms	433	504	676	817	835	835
Magnesium, all forms	28	32	43	52	53	53
Brass, all forms	727	846	1,135	1,372	1,402	1,402
Ferrous metals, all forms	930	1,153	1,361	1,565	1,596	1,596

a. For the derivation of these estimates, see Appendix C.

average, but erratic deliveries, 39/ substandard quality, and failure of supplies to conform to specified dimensions and composition 40/ have had deleterious effects on the quality of the instruments, the fulfillment of specific production quotas, and the accomplishment of delivery commitments. 41/

Shortages of other important raw materials have been reported 42/ even when annual requirements are quite small. Of particular importance are the following shortages:

1. Quartz and Fluorite Crystals of Optical Quality.*

The principal East German consumer, VEB Carl Zeiss Jena, required 500 kilograms of quartz crystals and 100 to 150 kilograms of fluorite crystals for the 1953 production program. 43/ Neither material occurs naturally in the European Satellites in the required quality, and attempts to produce these materials synthetically in the Zeiss crystal laboratory have not had significant success. 44/ Attempts at illegal procurement of quartz and fluorite crystals from non-Soviet Bloc sources are continuing 45/ with generally indifferent success.

* For a discussion of the required qualities of these materials and their applications, see Appendix B.

2. Black Instrument Lacquer.

The quality of black instrument lacquer available in East Germany 46/ results in finishes of low durability, which soon develop faults and expose the metallic parts to corrosion, thereby affecting the quality of the optical instrument.

Economies of some raw materials are being achieved by the institution of recovery processes, 47/ but, in normal peacetime production, there is little reason to believe that the deficiencies in the quality and supply of raw materials will be remedied materially within the next year.

In the event of war, the quality and the delivery schedules of raw materials produced in East Germany probably could be improved, as is evidenced by the ready availability of high-grade materials when they are required for the production of military optical instruments and of optical instruments to be shipped to the USSR. 48/ Shortages of materials not produced in East Germany or in the other European Satellites might then be alleviated by deliveries from the USSR, which appears to have adequate domestic sources for most of the raw material requirements of its own optical instruments industry.

C. Component Parts.

The supply of nonoptical components in the optical instruments industry of East Germany differs little from that for raw materials. Small quantities of a wide variety of nonoptical components are required, and the industry has been subjected to intermittent deficiencies in quality and supply, particularly with respect to the following:

1. Small, Precision Ball Bearings.

Small, precision ball bearings are required for use in microscopes, particularly in the fine focusing mechanism, and were formerly obtained from West German sources. Although the 1953 requirements of VEB Carl Zeiss Jena for 26,000 ball bearings apparently were met by East German suppliers, the quality was such that further finishing was required after receipt by Zeiss. 49/ Zeiss has started production of small, precision ball bearings, and improvement in the supply may be expected.

2. High-Quality Camera Shutters.

When Germany was partitioned after World War II, the optical instruments industry of East Germany was cut off from Munich and Calmbach, formerly its sources of high-quality, between-the-lenses camera shutters. The resulting deficiency caused distress among East German producers of high-grade cameras, as is evidenced, for example, by the poor performance of the earlier postwar "Contax" cameras made by VEB Zeiss-Ikon in Dresden. 50/ VEB Zeiss-Ikon undertook to develop the production of camera shutters, but the shutters produced have not been of a highly satisfactory quality. 51/ It is likely that a considerable quantity of camera shutters reaches East Germany through illegal channels, particularly because such items are small, light devices of considerable unit value. 52/

D. Replacement of Capital Goods.

The recovery of the optical instruments industry of East Germany after World War II was facilitated by its modest requirements for production equipment, both in quantity and complexity.

Glassworking machinery is about the only equipment peculiar to the optical instruments industry. Although permitting a high order of accuracy of work, the machinery is in itself simple and traditionally has long been made within the industry.

Automatic screw machines and certain other simple machine tools were available from postwar supplies in East Germany in sufficient quantity to permit the fabrication of the available amounts of raw materials.

As a result of the recent reconstruction of the optical instruments industry and assuming a reasonable balance between the acquisition of production equipment and the expansion of production, it is probable that 50 percent of the industry's equipment is not over 5 years old and that 75 percent is not over 8 years old. As obsolescence is not a major factor, it is not likely that requirements for the replacement of important production equipment will assume noticeable proportions for a considerable period.

VI. Capabilities, Vulnerabilities, and Intentions.

A. Capabilities.

About one-quarter of the size of the comparable US industry in terms of productive employment 53/ and capable of sustained production about equal to its peak production during World War II, the optical instruments industry of East Germany is in a position to contribute substantially to the over-all economy of the Soviet Bloc, both in peace and in war. Highly competent technically and producing a considerable part of the necessary production equipment within the industry, it could assist materially in the development of less advanced optical instruments industries in other European Satellites.

The optical instruments industry of East Germany is readily capable of at least a moderate further expansion. A material increase in production, however, is not likely in the near future, because current production is satisfying domestic and Soviet-Bloc demands and is supplying an annual exportable surplus which is becoming increasingly difficult to market.

B. Vulnerabilities.

The optical instruments industry of East Germany is geographically concentrated largely in the areas of Dresden, Rathenow, and Jena. Its principal source of optical glass also is located in Jena. It is well integrated and capable of rapid recuperation as its recovery since World War II testifies. The industry is vulnerable to the interruption of its supply of major raw materials, to the loss of key technical personnel, and to the malfunctioning of the planning system.

The denial of certain imported materials such as optical quartz and fluorite crystals and boron compounds 54/ (for use in the production of many forms of optical glass), although not resulting in inactivity, has proved distressing in the past and hampers the development of production of advanced types of optical instruments.

C. Intentions.

Recognition by responsible authorities 55/ of the forces operating to limit the continued high level of production in the optical instruments industry of East Germany plus recommendations

for the development of types of instruments acceptable to foreign buyers, the dispatch of trade delegations to various Asiatic and South American countries to spur the sales of instruments, 56/ and the utilization of a system of subsidies to the producers of instruments for export 57/ suggest that a vigorous offensive to recapture dwindling foreign markets is contemplated.

Reductions in about mid-1954 of the advertised prices of certain photographic equipment 58/ and reports of plans to expand production in 1955 of inexpensive box-type cameras 59/ appear to indicate an intention to improve the exploitation of the domestic market.

The considerable proportion of the optical instrument plants in East Germany which were devoted to the production of military optical instruments before World War II has been discussed.* By contrast, the current low level of such production in East Germany does not suggest the imminence of expanded military activity.

* See III, C, p. 16, above.

APPENDIX A

OPTICAL INSTRUMENT PLANTS IN EAST GERMANY*
1955

* For the location of the major optical instruments plants in East Germany, see the map, following p. 34.

Table 8

Plant Area and Name a/*	Location of Main Plant	Major Products	Production b/ (Thousand Current DME)	Remarks
Bezirk Gera				
VEB Carl Zeiss Jena c/	Jena	Civilian: A complete line of optical instruments for professional, industrial, and research purposes, as well as some nonoptical precision instruments such as micrometers, gauge blocks, and electron microscopes. Spectacles, field glasses, binoculars, and camera objectives for civilian use. Optical processing machinery for all types of optical elements. Military: Aiming circles, field glasses, binoculars, range finders, sighting and observational equipment, submarine periscopes, photogrammetric equipment, aerial radar trainers, and aerial gunnery trainers.	106,200	VEB Carl Zeiss Jena is the largest optical instrument firm in the world, comprising 9 plants. Total employment in 1954 was about 18,200, distributed as follows: Plant and Location / Number of Workers Main, Jena 10,000 South, Jena 5,800 North, Jena 200 Saalfeld 1,000 Dresden-Reick 500 Weimar 400 Seebach 100 Eisfeld 100 Winterstein 100 The apprentice program in the South plant has an enrollment of 2,200 in a 3-year course. The firm is self-sufficient with respect to optical processing machinery and optical crystals, except quartz and fluorite crystals. It is the Leitbetrieb of the optical instruments industry of East Germany.

* Footnotes for Table 8 follows on p. 34.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

Table 8
(Continued)

Plant Area and Name [a]	Location of Main Plant	Major Products	Production [b] (Thousand Current DME)	Remarks
Bezirk Dresden				
VEB Zeiss-Ikon [d]	Dresden	Civilian: Cameras (Pentacon, Tenax, Ercona), cinecameras (AK-8, AK-16), projectors (TK-16, D-1, D-2, P-8), and a slow-motion cinecamera (ZL-1). Military: PAU-22 machine-gun camera for the USSR in 1946-47. Plant No. 5 is engaged in a classified design project variously reported to concern bombsights, aerial cameras, or gyroscopic aircraft sights.	13,650	VEB Zeiss-Ikon is the third largest optical instrument firm in East Germany in terms of volume of production. Total employment in 1954 was about 2,500, including 700 apprentices. It obtains optical systems from VEB Carl Zeiss Jena and VEB Feinoptisches Goerlitz. The firm has not been successful in producing a reliable, high-grade camera shutter and has been hampered considerably in production by the lack of such shutters.
Ihagee Kamerawerk A.G. [e]	Dresden	Cameras (Exakta, Exakta-Varex, Exa).	8,950	Ihagee Kamerawerk is the second largest producer of cameras in East Germany in terms of volume of

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

Table 8
(Continued)

Plant Area and Name a/	Location of Main Plant	Major Products	Production b/ (Thousand Current DME)	Remarks
Ihagee Kamerawerk A.G. e/ (Continued)				production. Its cameras are popular on the world market, and particularly in the US. The plant has been described authoritatively as "one of the best foreign exchange earners in the Soviet occupation zone." About 90 percent of its total production is exported to the West. Plant capitalization was largely Dutch, resulting in the plant remaining in private hands until 1951, when it was finally nationalized as a "trust enterprise" and assigned to the former VVB Optik. Total employment in 1954 was about 700, including 75 apprentices.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

Table 8
(Continued)

Plant Area and Name a/	Location of Main Plant	Major Products	Production b/ (Thousand Current DME)	Remarks
VEB Kamerawerk-Staetten Niedersedlitz f/	Niedersedlitz	Cameras (Praktika, Praktina, Praktiflex) for civilian use.	8,000	Total employment in 1954 was about 850, including 175 apprentices.
VEB Feinoptisches Goerlitz g/	Goerlitz	Camera objectives (Helioplan, Primoplan, Primotar, Trioplan, Telemegor, Epidon, Megon) for still cameras and cinecameras.	4,750	The plant has discontinued the production of cameras (Primarflex, Reflex Primar). Total employment in 1954 was about 1,200, including 275 apprentices.
VEB Belca-Werk h/	Dresden	Cameras (Belca, Belfoca, Beltica) for civilian use.	4,000	Total employment in 1954 was about 500, including 100 apprentices.
VEB Welta Kamerawerk i/	Freital	Cameras (Welti I, Welti II, Reflekta, Welta, Welta-Box, Weltina, Sica) for civilian use.	3,600	Total employment in 1954 was about 850, including 150 apprentices.
VEB Filmosto Projektion j/	Dresden	Cineprojectors (Jubilar, Filius) and enlargers (Autofoc) for civilian use.	3,350	Total employment in 1954 was about 400, including 75 apprentices.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

Table 8
(Continued)

Plant Area and Name [a]	Location of Main Plant	Major Products	Production [b] (Thousand Current DME)	Remarks
VEB Feinmesszeugfabrik Dresden [k]	Dresden	Surveying instruments (engineers' levels, alidades, theodolites) as well as such nonoptical instruments as high-precision longitudinal and circular dividing machines and testing equipment for asphalt and tar.	1,900	Total employment in 1954 was about 600, including 125 apprentices.
VEB Altissa Kamerawerke [l]	Dresden	Cameras (Altix, Altuca, Altissa) for civilian use.	1,050	Total employment in 1954 was about 125, including 10 apprentices. The plant was assigned to the former VVB Optik as a "trust enterprise," as was the Ihagee Kamerawerk, discussed above.
Aldo Feingeraetebau GmbH [m]	Dresden	Microscopes and refractometers.	550	Little is known of this plant. The estimated employment in 1954 was 150.
Certo Kamera-Werk [n]	Dresden	Cameras (Super-Dollina II, Certo-Super-Six, Durata) for civilian use.	100	A very small plant, employing about 75 in 1954.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

Table 8
(Continued)

Plant Area and Name a/	Location of Main Plant	Major Products	Production b/ (Thousand Current DME)	Remarks
Bezirk Potsdam				
VEB Rathenower Optische Werke c/	Rathenow	Civilian: Spectacles, field glasses, binoculars, microscopes, a few camera objectives, simple medical-optical instruments, optical processing machinery for making spectacle lenses, and astronomical instruments. Military: Field glasses, binoculars, panoramic telescopes, elbow telescopes, and battery commanders' telescopes.	19,000	VEB Rathenower Optische Werke is the second largest optical instrument firm in East Germany in terms of volume of production. Total employment in 1954 was about 3,000, including 300 apprentices. It is the largest producer of spectacles in East Germany and is second only to VEB Carl Zeiss Jena in the production of military optical instruments.
Bezirk Berlin				
Geraetewerk Friedrichshagen p/	Berlin	Duplicating equipment and slide projectors.	7,300	Production was initiated at Geraetewerk Friedrichshagen in 1953, and the plant received a large quantity of projector production which the VEB Filmosto Projektion was not in a position to handle. The estimated employment in

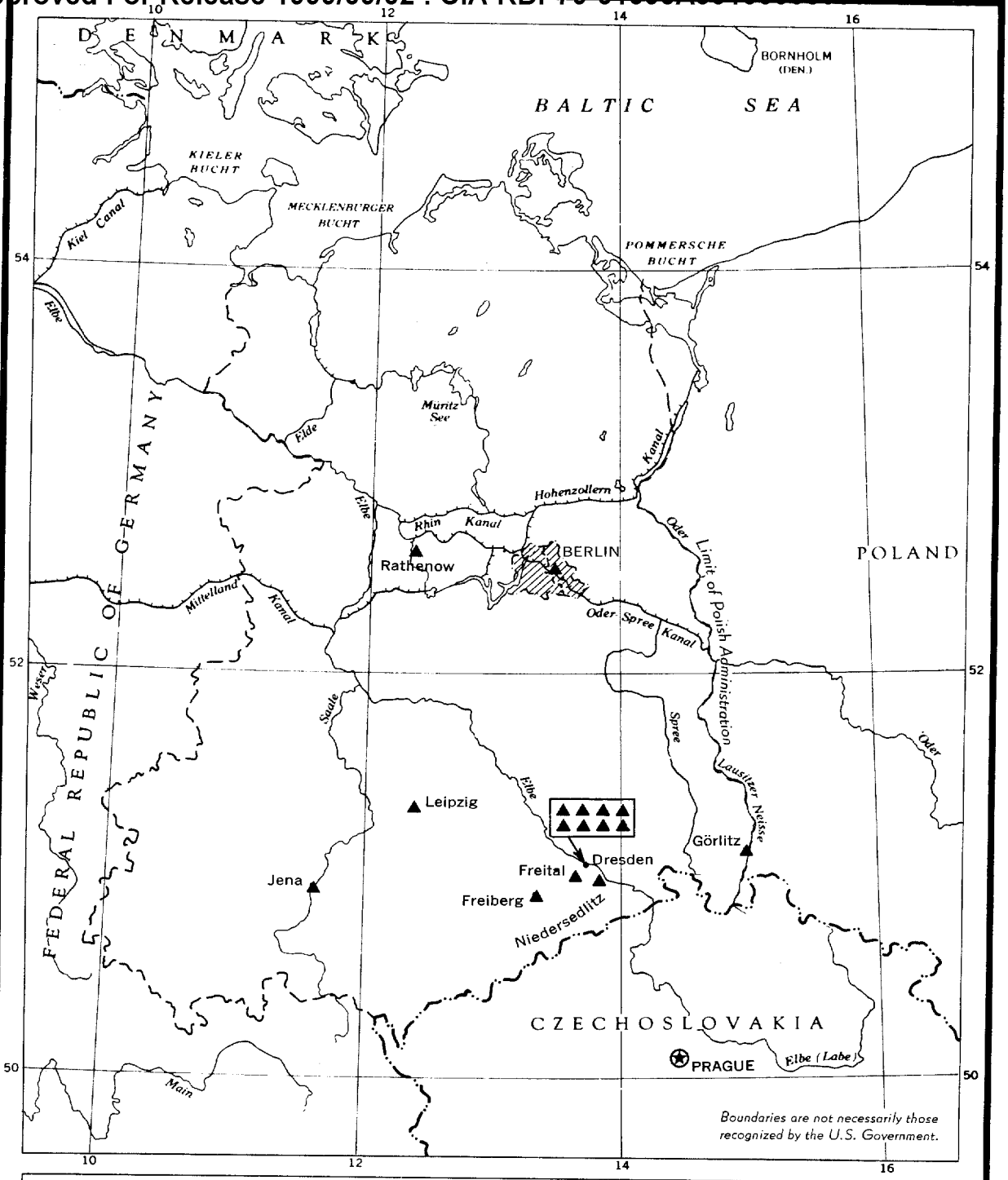
Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

Table 8
(Continued)

Plant Area and Name [a]	Location of Main Plant	Major Products	Production [b] (Thousand Current DME)	Remarks
Bezirk Berlin (Continued)				
Geraetewerk Friedrichshagen [p] (Continued)				1954 was 300 on optical work. Very little more is known about it.
Bezirk Karl Marx Stadt (Chemnitz)				
VEB Freiberger Praezisionsmechanik [q]	Freiberg	Civilian: Surveying instruments (theodolites, engineers' levels, peloruses) and navigation instruments (sextants, compasses). Military: Artillery aiming circles, battery commanders' telescopes, and perhaps rangefinders of unknown base.	4,000	Total employment in 1954 was about 1,200, including 150 apprentices.
Bezirk Leipzig				
VEB Hohlux [r]	Leipzig	Large, track-mounted, reproduction cameras, principally for the book-publishing industry.	2,500	Total employment in 1954 was about 550 including 125 apprentices. The plant was assigned to the former VVB Optik as a "trust enterprise," as was the Ihagee Kamerawerk, discussed above.

a. The plants are arranged by areas, and within areas, in a descending order of production.
b. The production figures given are the estimated value of the output of optical instruments in 1954.
c. 60/
d. 61/
e. 62/
f. 63/
g. 64/
h. 65/
i. 66/
j. 67/
k. 68/
l. 69/
m. 70/
n. 71/
o. 72/
p. 73/
q. 74/
r. 75/

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9



EAST GERMANY

Major Optical Instrument Plants 1955

International boundary

0 20 40 60 80 100 Miles
0 20 40 60 80 100 Kilometers

Canal (selected)

SECRET

25055 12-55

APPENDIX B

TECHNOLOGY OF THE PRODUCTION OF OPTICAL INSTRUMENTS

1. General.

The production of an optical instrument involves six major operations within the optical instruments industry, as follows:

Design
Production of raw materials for optical elements
Production of optical elements
Production of nonoptical components
Assembly
Testing

These operations are generally characterized by the high levels of skill, versatility, and experience required of the workers; the close tolerances to which specifications are held; the small size of production lots and the consequent infrequency of continuous processes; the small quantities of raw materials required and the small cost of raw materials relative to that of labor; the diversification and considerable degree of specialization of the production equipment; and the stability of techniques and methods over long periods of time. The brief description which follows is intended only to outline the nature of each operation.

2. Design.

The detailed designing of an optical instrument is a process of compromise -- that is, compromise among the desired instrumental specifications, the characteristics of available optical glasses, the aberrations inherent in optical systems, and the specifications of available grinding and polishing tools and test plates, as well as among such more common factors as costs, anticipated market, available production equipment, and skilled labor. The final design is evolved partly by empirical methods and partly by calculation, the latter being among the most complicated and laborious operations in practical mathematics. Both the quality of the design and the speed with which it is achieved are in direct ratio to the experience of the designer and his familiarity with the facilities of the plant.

In recent years the introduction of the digital computer into design work in the US has expedited enormously the calculations, thereby encouraging the use of more exact (and more complex) mathematical descriptions of optical systems and generally enhancing the role of mathematical operations in developing and checking design specifications.

3. Production of Raw Materials for Optical Elements.

Optical elements are generally made of glass, occasionally of various crystalline minerals, and, in certain cases, of transparent plastics. Regardless of the nature of the materials, its use in optical elements demands a very high degree of optical homogeneity; freedom from color, solid occlusions, and bubbles; transparency; chemical and physical stability; resistance to deformation under stress; the property of taking a high polish; and close adherence to the accepted optical specifications -- that is, of index of refraction and dispersions -- for the specific type from batch to batch.

About 200 glass compositions, with optical specifications distributed over a considerable range, have been developed and are produced in relatively small quantities by a carefully controlled batch process. Raw glass is delivered as chunks, resulting from cooling the batch in its crucible, or as cast slabs. In the US, varieties of glass for which there is large demand are produced by a continuous process in the form of long slabs and, for use in certain applications, by rolling into sheets much in the manner in which plate glass is made. Glass which is intended for processing into spectacle lenses, ophthalmic glass, is not held to such rigid tolerances as is optical glass.

Optical glass undoubtedly is the most critical single material entering into optical instruments and, with very few exceptions, one for which no satisfactory substitute is known.

Crystalline minerals are used for optical elements which must demonstrate physical properties that glasses do not possess, as follows: quartz for the transmission of ultraviolet radiation; sodium chloride, silver chloride, potassium bromide, caesium bromide, and caesium iodide for studies in infrared; calcium carbonate (calcite, Iceland spar) and sodium nitrate for polarization; calcium fluoride (fluorite, fluorspar) and lithium fluoride for correcting for chromatic aberration; and so forth. Most of these materials now are prepared in crystalline form of excellent optical properties by passing

a melt of the material at a slow and closely controlled rate through a sharp temperature gradient which includes the melting point. With the notable exceptions of calcite and fluorite, which have not yet been crystallized successfully, this process has freed the optical instruments industry from dependence upon natural sources for optical crystals.

During World War II, efforts were made to prepare optical elements of various plastics because of the advantages offered by these materials in infrangibility, transparency (greater than that of optical glass in some cases), low weight, and properties favorable to molding directly to final form. Small optical elements of two materials, polystyrene and polycyclohexyl methacrylate, were produced for use in binoculars, tank periscopes, and other military optical instruments, in which they performed quite satisfactorily. In general, however, plastics are regarded as inferior to optical glass except, perhaps, in the production of elements with aspheric surfaces, which are exceedingly difficult to form in glass to the strict tolerances required.

4. Production of Optical Elements.

Optical elements are formed from raw glass blanks by lapping, using successively finer abrasives until the desired configuration is achieved. The process is characterized by the crudeness of the lapping machinery, by its slowness, and by the exceptionally high accuracy of the finished work, the dimensions of which may well have tolerances as rigorous as one millionth of an inch. The abrasives in common use are the following: for rough grinding, carborundum, alundum, corundum, boron carbide, diamond dust, and emery grit; for truing and smoothing, emery powder; for final polishing, rouge which is used almost universally; and for a preliminary polish, burned aluminum oxide and more recently cerium oxide, zirconium oxide, and titanium oxide.

The grading of abrasives is most important, particularly in the finer grain sizes, because a few coarse particles in the smoothing and polishing abrasives can produce deep scratches, which are expensive and time consuming to remove.

A considerable saving in time has been accomplished in recent years through the use of surface generating machines employing cylindrical sintered diamond tools and vacuum chucks and operating upon glass blanks pressed roughly to final form. With this equipment the preliminary roughing to form requires only a minute or two.

Optical crystals are shaped by methods essentially the same as those employed for glass. Plastics, however, have been molded to final form with an accuracy sufficient for certain limited applications.

The ruling of diffraction gratings is performed automatically by machines which require the utmost precision in their manufacture and operation.

Formed optical elements are often "coated" to increase the transmittance of light. This operation consists of the exposure of the element to the vapor of a metallic salt in a vacuum chamber and results in the application of a very thin, uniform layer of the salt on the element surface.

Optical elements frequently are employed in the form of combinations assembled with a cement, Canada balsam being by far the most generally used.*

5. Production of Nonoptical Components.

Aside from the processing of optical elements, the production of components for optical instruments presents no appreciable problems which are unique to the optical instruments industry and which cannot be solved by ordinary foundry and machine shop operations.

6. Assembly.

In the assembly of optical instruments, the only extraordinary operations are those involved in the mounting of the optical elements, some of which must be centered or mounted with a high degree of precision and stability.

7. Testing.

Optical instruments generally require final testing and fine adjustment to precise performance specifications. Unusual skill and long experience are required in this operation, the success of which is predicated upon a thorough knowledge of the instruments, their function, and their anticipated performance.

* German scientists returning from the USSR have told of a Soviet synthetic balsam which is far superior to Canada balsam but which has not been made available to the East Germans.

APPENDIX C

METHODOLOGY

I. Supply.

All evidence indicates that imports of optical instruments into East Germany have been almost nonexistent for many years. Consequently, the domestic production was assumed to be a reasonable measure of the total supply. Early observation of the wide variety of instruments produced by the optical instruments industry of East Germany indicated that production estimates based on the number of units produced would be without meaning. All production estimates, therefore, have been developed in terms of value, using current factory delivery prices.

The published statistics on the accomplishments of the optical instruments industry of East Germany commonly include other products of the Main Administration for Precision Mechanics and Optics, such as measuring instruments, medical instruments, and office machines. This practice precludes accurate separation. Consequently, the industry's output in 1946-53 was developed by a combination of plant studies and output estimates, checked with over-all reported statistics where available. For this purpose, small local plants and ophthalmic shops employing fewer than 25 workers were excluded. Sixteen plant organizations comprise the East German industry, dominated by VEB Carl Zeiss Jena, which, since 1949, has produced annually over one-half of the national output.

All available reports of planned and actual plant production and reports of plan fulfillment since World War II were tabulated, and the sources were noted. Confirmations and inconsistencies were observed, and the values which appeared to be the most trustworthy were accepted as reasonable estimates of the year's production. These estimates of the output of optical instruments in East Germany in 1947-54 are shown in Table 9.* Production estimates for the years for which adequate reports were not available were derived by estimate, or by interpolations or extrapolations from reported production.

* Table 9 follows on p. 40.

Table 9

Estimated Output of Optical Instruments in East Germany, by Plant
1947-54

Million Current DME

Plant [a]	1947	1948	1949	1950	1951	1952	1953	1954
VEB Carl Zeiss Jena [b]	7,000 [c]	18,000 [d]	44,800 [e]	55,350 [f]	59,150 [g]	86,700 [h]	104,000 [i]	106,200 [j]
VEB Zeiss-Ikon [k]	3,500 [l]	6,000 [l]	8,500 [l]	11,000 [m]	11,750 [l]	12,500 [n]	13,650 [o]	13,650 [l]
Ihagee Kamerawerk	1,500 [l]	2,900 [p]	2,900 [q]	4,900 [r]	6,100 [s]	7,650 [t]	8,950 [l]	8,950 [l]
VEB Kamerawerk-Staetten Niedersedlitz	1,500 [l]	2,000 [l]	3,600 [l]	5,450 [u]	5,500 [v]	7,250 [w]	8,000 [x]	8,000 [l]
VEB Feinoptisches Goerlitz	450 [l]	900 [l]	1,350 [l]	1,850 [y]	2,750 [z]	3,750 [aa]	4,750 [l]	4,750 [l]
VEB Belca-Werk	850 [l]	1,750 [l]	2,600 [bb]	2,350 [cc]	3,850 [dd]	3,500 [ee]	4,000 [ff]	4,000 [l]
VEB Welta Kamerawerk	350 [l]	850 [l]	1,250 [gg]	1,450 [hh]	2,650 [ii]	3,350 [jj]	3,600 [kk]	3,600 [l]
VEB Filmosto Projektion	350 [l]	850 [l]	1,300 [l]	1,850 [ll]	2,400 [mm]	2,800 [nn]	3,350 [l]	3,350 [l]
VEB Feinmess Dresden [b]	200 [l]	400 [l]	550 [l]	750 [oo]	1,100 [pp]	1,550 [qq]	1,900 [l]	1,900 [l]
VEB Altissa Kamerawerke	200 [l]	350 [l]	500 [l]	650 [rr]	700 [ss]	950 [tt]	1,050 [l]	1,050 [l]
Aldo Feingeraetebau GmbH	50 [l]	100 [l]	200 [l]	250 [l]	300 [l]	400 [uu]	550 [vv]	550 [l]
Certo Kamera-Werk	50 [l]	100 [ww]	100 [l]	100 [l]	100 [l]	100 [l]	100 [l]	100 [l]
VEB Rathenower Optische Werke	1,600 [l]	3,300 [l]	5,000 [l]	9,400 [l]	14,750 [xx]	17,500 [yy]	17,000 [zz]	19,000 [aaa]
Geraetewerk Friedrichshagen	0	0	0	0	0	0	7,300 [bbb]	7,300 [l]
VEB Freiberger Praezisionsmechanik	250 [l]	500 [l]	700 [ccc]	800 [ddd]	1,950 [eee]	2,950 [fff]	4,000 [l]	4,000 [l]
VEB Hohlux	450 [l]	850 [l]	1,250 [l]	1,750 [ggg]	1,400 [hhh]	2,000 [iii]	2,500 [l]	2,500 [l]
Totals [jjj]	18,000	39,000	75,000	98,000	114,000	153,000	185,000	189,000

a. The order of the plants is the same as in Appendix A. The output of individual plants is rounded to the nearest DME 50,000.

b. Annual output figures are adjusted for the output of nonoptical instruments.

c. 76/

d. 77/

e. 78/

f. 79/

g. 80/

h. 81/

i. 82/

j. 83/ This figure represents planned production.

k. 84/ The output of VEB Zeiss-Ikon in 1946 is estimated to have been DME 3,500 million.

l. This figure is a computed estimate.

m. 85/

n. 86/

o. 87/

p. 88/

q. 89/

r. 90/

s. 91/

t. 92/

u. 93/

v. 94/

w. 95/

x. 96/

y. 97/

z. 98/

aa. 99/

bb. 100/

cc. 101/

dd. 102/

ee. 103/

ff. 104/

gg. 105/

hh. 106/

ii. 107/

jj. 108/

kk. 109/

ll. 110/

mm. 111/

nn. 112/

oo. 113/

pp. 114/

qq. 115/

rr. 116/

ss. 117/

tt. 118/

uu. 119/

vv. 120/

ww. 121/

xx. 122/

yy. 123/

zz. 124/

aaa. 125/ This figure estimates planned production.

bbb. 126/

ccc. 127/

ddd. 128/

eee. 129/

fff. 130/

ggg. 131/

hhh. 132/

iii. 133/

jjj. The total output of the industry is rounded to the nearest million DME. The margin of error for 1947-53 is plus or minus 10 percent. The margin of error for 1954 is plus 5 to minus 20 percent.

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

A. 1946-49.

Reports on the output of the optical instruments industry of East Germany were scarce for the years 1946-49. This period was one of generally low production. The plants were largely engaged in the repair of war damage and in the provision of new production equipment. To obtain estimates of production during this period, an interpolation was made between reported output in 1949 or 1950 and output in 1946 which was assumed to be negligible. Some corroboration of the reasonableness of these approximations was obtained by comparing the national output in 1948 derived by this method -- slightly under DME 39 million -- with the figure of DME 41,531,860 contained in the one available report covering the industry's production in that year. 134/

B. 1950-52.

Numerous reports were available on the output and plan fulfillment of the various optical instrument plants in East Germany in 1950-52. An estimate of the production of Aldo Feingeraetebau GmbH was interpolated between a negligible production in 1947 and a reported production of DME 400,000 in 1952. Available evidence indicates that the production of DME 100,000 reported for Certo Kamera-Werk in 1948 was not followed by an expansion of activity in later years, and this value was assumed to represent the best approximation of its production in the following years.

C. 1953.

Gaps appeared in reports of the output of individual optical instrument plants in East Germany. In those cases where reliable information was lacking, it was assumed, in view of the general trend of the optical instruments industry toward continued expansion in 1953, that extrapolations from the 1950-52 period would be reasonable.

D. 1954.

Insufficient data were available to permit a reliable estimate of the output of individual optical instruments plants in East Germany in 1954, and as an alternative, the status of the optical instruments industry was considered as a whole.

A long-range growth plan for VEB Carl Zeiss Jena contemplates an increase in output of 40.4 percent from 1953 to 1957, 135/ representing an annual growth of approximately 8.8 percent. If this ratio is applied to the industry as a whole, the estimated output of DME 185 million in 1953 may be extended through 1954 and 1955 at DME 201 million and 219 million, respectively.* This assumes that the East German industry is growing at the same rate as its major producer and that the 56 percent of total output contributed by Zeiss in 1953 will remain constant through 1955. This assumption is reasonable because Zeiss has consistently paced the industry in recent years, contributing between 50 and 60 percent of the national production in each year since 1948 and averaging 56.2 percent in 1949-53.

The increase in output in 1954 over 1953, estimated by the method described above, would be the smallest in any year since World War II. There is substantial evidence, however, to support the conclusion that such an increase did not occur. On the side of increase is a short-range plan for VEB Carl Zeiss Jena, 136/ which indicated a planned increase of about 3.5 percent in the total output of 1954 over that of 1953. A 1954 plan for VEB Rathenower Optische Werke showing an increase of about DME 2 million may very likely have been fulfilled because the increase largely comprised Battery Commander (artillery) scopes for China. On the other hand, reliable evidence of a serious intention to increase the output of other optical instruments in 1954 is lacking. Consumer cameras comprise roughly one-quarter of the industry's production, and it is quite unlikely that the production of this commodity which is already overstocked was increased.

To obtain an estimate of output in 1954, it was assumed that 1954 plans for VEB Carl Zeiss Jena and VEB Rathenower Optische Werke were fulfilled and that the remainder of the optical instruments industry did not change its 1953 production rate.

E. 1955.

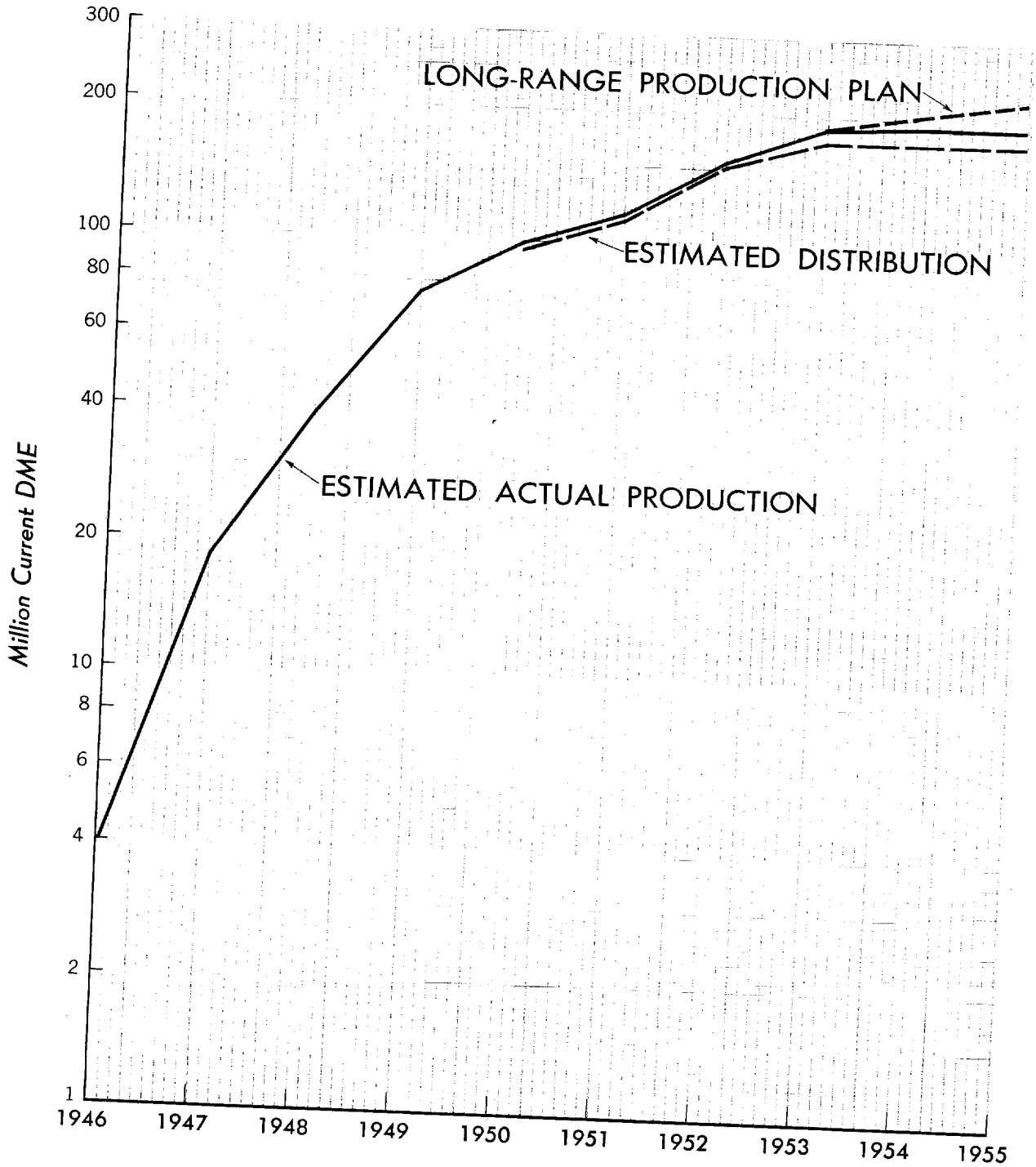
In considering the prospects of the optical instruments industry of East Germany for 1955, it was observed that unsold stocks of instruments at VEB Carl Zeiss Jena at the beginning of 1954 amounted to DME 9.3 million, or about 8.2 percent of its estimated total output of DME 114 million in 1953. At the same time, one of the smaller

* For the estimated output of optical instruments in East Germany in 1946-55, see the chart, following p. 42.

SECRET

EAST GERMANY

ESTIMATED PRODUCTION OF OPTICAL INSTRUMENTS, 1946-55



25066 12-55

SECRET

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9

camera plants had unsold stocks amounting to over 7 percent of its output in 1953. If this situation were representative of the industry, total unsold stocks of optical instruments at the beginning of the 1954 production year may have approximated DME 13 million to 15 million, which is to be contrasted with a probable normal inventory of about DME 3.3 million. No evidence can be found that the industry was able to distribute in 1954 such a surplus as well as its current production. The unsold stocks, indicated in September 1954 to be DME 17.7 million, may have been even larger by the end of 1954. 137/

The amount of credit tied up in the unsold stocks, which had already called forth critical banking comment on the basis of the 1953 accumulation, 138/ and the desirability of liquidating unsold stocks before introducing new instrument models suggest that the disposal of the surplus will be attempted soon. It is difficult now to evaluate the results in 1955 of the efforts of East German trade delegations to spur the sales of optical instruments in South America and Asia, the stimulation to domestic sales which will result from 1954 price cuts, and the influence on export trade of a growing practice of subsidizing producers. Countering such efforts may be such factors as a continuing constriction of non-Soviet Bloc markets and the improved self-sufficiency of Bloc consumers. The necessity for the early liquidation of a surplus probably equal to or greater than the increment of increased annual production, if the long-range growth plan were to be resumed in 1955, appears to preclude any early expansion of production, and the estimated value of production in 1954 is accepted as the best estimate of prospects in 1955 that can be made at this time.

F. Current Price Series.

Estimating the production of optical instruments in East Germany in current delivery prices introduced the question of the effect of price changes on the production series. Perhaps a more accurate measure of real production during the years of most rapid expansion was derived* by applying the average 1949 output per productive worker in terms of value to manpower data for 1947-53, inclusive. Manpower estimates for 1954 and 1955 are made by the same method. This method yields acceptable approximations because by 1949 the product mix had become reasonably stable and continued so in the following years.

* See Table 1, p. 10, above.

G. Plan Fulfillment.

Details of plan fulfillment in the optical instrument plants of East Germany* were assembled from individual plant reports, where there were data in current values. It was found to be impractical to separate the production of nonoptical instruments, which was included in plan figures for VEB Carl Zeiss Jena and VEB Feinmesszeugfabrik Dresden. This separation, however, might influence materially the derived annual fulfillment percentage only in 1949, when the actual production of VEB Carl Zeiss Jena, the only plant for which there are reports, contained about 10 percent of nonoptical instruments in its output. Adequate data on which to evaluate the industry's fulfillment in 1953 and 1954 are not now available.

II. Demand.

A. Distribution Pattern.

Table 3,** which represents the distribution by broad categories of the East German output of optical instruments since World War II, was compiled by separating the output of each plant into three industry numbers of the Standard Industrial Classification 139/ -- that is, Number 3831 (Optical Instruments and Lenses), Number 3851 (Ophthalmic Goods), and Number 3861 (Photographic Equipment and Supplies). This separation was facilitated by the determination that only the largest 2 plants include more than 1 industry number in their production. Those instruments which are reported or which are known by their character to be intended for military use were separated from the others. It is possible that a few instruments might have either civilian or non-combat military use -- for example, a medical microscope, which would be equally useful in a civilian or a military hospital or laboratory. It is believed, however, that any deviation from an exact separation of military optical instruments would not prejudice the conclusions reached in this report regarding the level of postwar production of military instruments. Sufficient data are not available for a reliable separation of the output in 1953 and in 1954.

B. Exports.

Estimated exports of optical instruments from East Germany since World War II*** were obtained by summing the results of a plant-

* See Table 2, p. 11, above.
** P. 14, above.
*** See Table 4, p. 15, above.

by-plant study. Over-all published statistics offered some opportunity for comparison, but they commonly included other products of the Main Administration for Precision Mechanics and Optics, such as measuring instruments. Data before 1951 were considered to be too meager to support reliable estimates.

III. Inputs.

A. Manpower.

The estimate of total employment in the optical instruments industry of East Germany* was derived from individual plant studies, employing interpolations where there was a lack of information. The generally uniform and relatively unchanging technology through the industry contributes to the reliability of such interpolations.

Details of the apprentice programs in the East German optical instrument plants are available in numerous reports. The dispersion of apprentices throughout the industry in 1954 is incorporated in the list of the major plants.**

B. Raw Materials.

The estimates of major raw material requirements for the production of optical instruments in East Germany*** were based on the reported 1953 consumption by the largest producer, VEB Carl Zeiss Jena, 140/ and on the following 2 coefficients derived from US practice:

1. A median value of 101 pounds of ferrous metals per 1,000 production man-hours. 141/

2. An abrasive consumption of 1 pound per pound of optical glass consumed. 142/

These assumptions are considered reliable because of the wide diversity of Zeiss production -- substantially all the types of instruments produced by the industry -- and the relative uniformity and lack of change in the production technologies of the optical instruments industries of both the US and East Germany.

* See Table 5, p. 18, above.
** See Appendix A, Table 8, p. 27, above.
*** See Table 7, p. 21, above.

Derived estimates of fuel and power consumption in the industry were found in each case to amount to less than one-tenth of 1 percent of national supplies and were considered to be insignificant.

APPENDIX D

GAPS IN INTELLIGENCE

Gaps in intelligence which are particularly important to a proper understanding of the present status of the optical instruments industry of East Germany and the influences currently affecting its progress are the following:

1. Administration.

Information presently available is inadequate regarding the function of the East German Leitbetriebe and the relation of individual plants to the Leitbetriebe and to the Main Administration for Precision Mechanics and Optics.

2. Supply.

To assess properly the leveling off of the output of optical instruments which occurred in East Germany in 1954, data are required regarding the current value of production in 1954, with particular reference to any possible readjustment of production rates in the latter part of the year.

3. Demand.

Trade value figures, particularly after 1952, are required for exports of optical instruments by East Germany both to the Soviet Bloc and to non-Bloc countries in such form as to permit the separation of optical instruments from other goods produced by the Main Administration for Precision Mechanics and Optics.

4. Future Expansion.

Related to the subject of the expansion of the optical instruments industry of East Germany would be the procurement of information regarding plans for the dispersion of production away from the areas in which it is presently concentrated -- for example, the transfer of important production processes from the main plants of VEB Carl Zeiss Jena, in Jena, to branch plants located elsewhere.

The purpose of probable Soviet Bloc planning is not clear. It encourages the growth and expansion of the optical instruments industries in the European Satellites which presently are backward in this respect, although the current capacity of the East German industry, which might readily be expanded somewhat, probably would satisfy the greater part of the Satellite requirements. Evidence of any plans to correlate production among the Satellites to preclude the development of competing production would be significant.

APPENDIX E

SOURCE REFERENCES

This report has been based largely on CIA, Army, and Air Force documents reporting principally on the individual plants of the optical instruments industry of East Germany. Coverage provided by these reports is generally good. In addition to the considerable volume of documents pertaining to single plants, some information was available regarding the industry as a whole. 143/

Evaluations, following the classification entry and designated "Eval.," have the following significance:

Source of Information	Information
Doc. - Documentary	1 - Confirmed by other sources
A - Completely reliable	2 - Probably true
B - Usually reliable	3 - Possibly true
C - Fairly reliable	4 - Doubtful
D - Not usually reliable	5 - Probably false
E - Not reliable	6 - Cannot be judged
F - Cannot be judged	

"Documentary" refers to original documents of foreign governments and organizations; copies or translations of such documents by a staff officer; or information extracted from such documents by a staff officer, all of which may carry the field evaluation "Documentary."

Evaluations not otherwise designated are those appearing on the cited document; those designated "RR" are by the author of this report. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.

25X1A

[redacted]

Next 8 Page(s) In Document Exempt

Approved For Release 1999/09/02 : CIA-RDP79-01093A001000080001-9