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PRODUCTION OF BISON AIRCRAFT AT MOSCOW/FILI AIRFRAME PLANT NO. 23 IN THE USSR

CIA/RR IP-582

24 January 1958

CENTRAL INTELLIGENCE AGENCY

Office of Research and Reports

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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.

FOREWORD

The purpose of this project is to estimate the production of Bison aircraft at Moscow/Fili Airframe Plant No. 23 in the USSR. A secondary purpose is to summarize and analyze the background material which contributed to the estimate of production.

The estimate of production of the Bison has been based [redacted] and on observation of Airframe Plant No. 23 [redacted]. The estimate of the future capability of Airframe Plant No. 23 to produce Bison aircraft has been determined from the size of the plant, particularly the size of the final assembly hangar.

This project will be reviewed and reissued periodically to include new intelligence information as available.

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PRODUCTION OF BISON AIRCRAFT AT MOSCOW/FILI AIRFRAME PLANT NO. 23 IN THE USSR*

Summary

68 Bison aircraft (including 3 prototypes) had been produced at Airframe Plant No. 23 by 28 July 1957.

, have reported a total of 127 observations of Airframe Plant No. 23 from February 1955 through July 1957. Analysis of these observations obtained indicates that Airframe Plant No. 23 produced about three Bison aircraft per month during the first half of 1957.

The cumulative production of Bison aircraft at Airframe Plant No. 23 as of 1 July 1957 was 65 airplanes. The 65th Bison is believed to have been shop completed by 1 July 1957.

I. History and Development.

A. History.

The Soviet Bison aircraft initially was observed at the Flight Test Institute (Letno-Ispytatel'nyy Institut -- LII) of the Ministry

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* The estimates and conclusions contained in this project represent the best judgment of ORR as of 1 November 1957.

of the Aviation Industry (Ministerstvo Aviatsionnoy Promyshlennosti -- MAP) at Ramenskoye on 30 July 1953. At that time the aircraft appeared to be in a stage of assembly, and the single long-distance photograph which was available failed to reveal the type of wing or powerplants. (See Figure 1.**) A single Bison aircraft was next observed in rehearsal for the May Day Air Show of 1954 and was observed again during the show. This aircraft is believed to have been the Bison aircraft observed in 1953 and to have been the first of three prototypes.

B. Development.

The several changes in the configuration of the Soviet Bison aircraft observed since the first sighting of a Bison in flight in 1954 indicate a search for more satisfactory flight characteristics. The major modifications may now be completed, as no configuration changes have been observed since July 1956.

Major modifications of the Bison affecting flight characteristics have included enlargement of the wing flaps, addition of wing fences, shortening of the forward fuselage, and elimination of horizontal tail dihedral. Changes in the aircraft relative to its mission requirements include incorporation of a bulge in the bomb bay doors (probably to accommodate a refueling package), installation of a nose boom for aerial refueling, elongation of the nose for new radar gear, and movement of the bombardier-navigator station to a glazed blister on the belly of the aircraft under the cockpit. Minor changes have included the removal of the bulge under the tail turret and the elongation of a round blister on the right side of the fuselage.

All of the above changes were evident by April 1955 except for the elimination of horizontal tail dihedral, the new long nose, and the new bombardier-navigator station. These changes were noted for the first time in July 1956. Although all of these changes reflect an unsatisfactory initial design, the numbers and types of modifications are not particularly unusual in the course of development of an aircraft as complex as the Bison.

** Following p. 2.

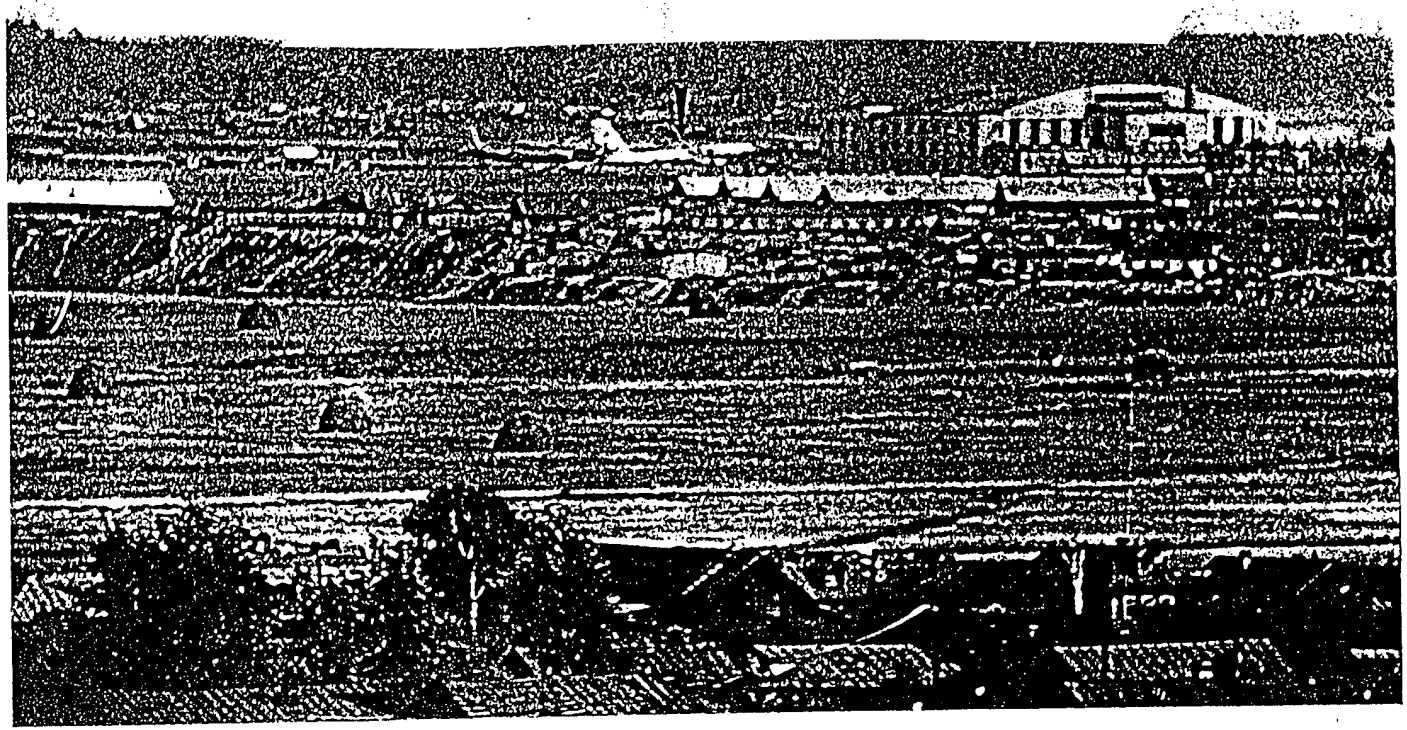

Figure 1. USSR: Initial Observation of Bison Aircraft at the Flight Test Institute at Ramenskoye.

II. Production Site

The production site of the Bison aircraft was unknown until a Bison was seen taking off from Moscow/Fili Airframe Plant No. 23 on 14 February 1955. A single Bison was observed on the ground or in takeoff from Airframe Plant No. 23 on five separate occasions during February, March, and April 1955.

Airframe Plant No. 23 had considerable experience in production of bombers during World War II** and for several years thereafter. Some time after World War II the plant assumed a developmental role and is believed to have been engaged in bomber development until it started producing the Bison.

The covered floorspace of Airframe Plant No. 23 is estimated to have been 2.4 million square feet (sq ft) at the end of World War II. 3/ Reports of noteworthy new construction were received in 1954. This construction was incorporated in three large buildings in the western end of the plant site. The new construction is estimated to have been completed by early 1956, and the total plant floorspace is now estimated to be 2.8 million sq ft.

The final assembly of the Bison aircraft requires a building with headroom of not less than 45 feet (ft) and structural columns about 200 ft apart. Airframe Plant No. 23 has a building (Building No. 15 of Figure 2***) that has 2 bays, each of which is 200 ft wide and 480 ft long. The headroom is about 48 ft. This building, is known to house the final assembly of the Bison.

III. Delivery and Ramp Operations.

A. Method of Delivery

A Bison aircraft was observed taking off from Moscow/Fili Airframe Plant No. 23 on three separate occasions during February,

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** Airframe Plant No. 23 produced the DB-3F and Il-4 light bombers during World War II. Production of the Tu-2 light bomber began at the end of the war, and evidence indicates some production of the Tu-4 medium bomber.

*** Following p. 4.

March, and April 1955. Because the single runway at Airframe Plant No. 23 is only 4,800 ft long (see Figure 3*) and Bison aircraft require a longer runway, on a runway of this length, the Bison can carry only a light load on takeoff and cannot land safely. Bison aircraft have to be flown elsewhere, probably to Ramenskoye, for flight testing. These aircraft are believed to take off after a minimum of ramp operations with only sufficient fuel to get to Ramenskoye.

No evidence of production at Airframe Plant No. 23 was reported from May through August 1955. On 22 September 1955 a Bison was observed in transit on a barge moving downstream on the Moscow River. This sighting indicated that Bison aircraft were being moved from Airframe Plant No. 23 to the LII at Ramenskoye, located about 30 miles southeast of Airframe Plant No. 23. River transport is an unusual and inefficient means of moving Bison aircraft to another location for completion of final assembly and testing. The reason for the decision to use river transport probably was a reluctance to risk so expensive an aircraft as the Bison in takeoffs from the short airfield at Airframe Plant No. 23 -- especially in warm weather when larger ground rolls are required for takeoff.

Two other Bison aircraft were seen being transported by river barge during November 1955. In December, however, two Bison aircraft are believed to have been flown from Airframe Plant No. 23. In January 1956 a Bison fuselage was sighted on a truck (with 2 bogies about 20 ft apart in tandem) on Sadovaya Street just north of Kurskiy Station. This truck was followed by two trucks with low-boy trailers carrying probable Bison wings and a probable Bison tail section.

In February 1956 a Bison aircraft was again observed taking off from Airframe Plant No. 23. Since February, all Bison aircraft are believed to have been flown from the plant.

B. Ramp Operations.

Before the Bison aircraft can be flown from Moscow/Fili Airframe Plant No. 23 after coming out of final assembly, certain operations have to be performed on the ramp. Only the minimum number of flight operations required in the preparation of a Bison for the earliest possible safe flight after plant completion are believed to be performed at Airframe Plant No. 23. After leaving the plant, the aircraft is flown to Ramenskoye, where the final installations, inspections, and functional checks prerequisite to the actual delivery of the aircraft to the customer are carried out.

Figure 2

USSR: LAYOUT OF MOSCOW/FILI AIRFRAME PLANT NO. 23

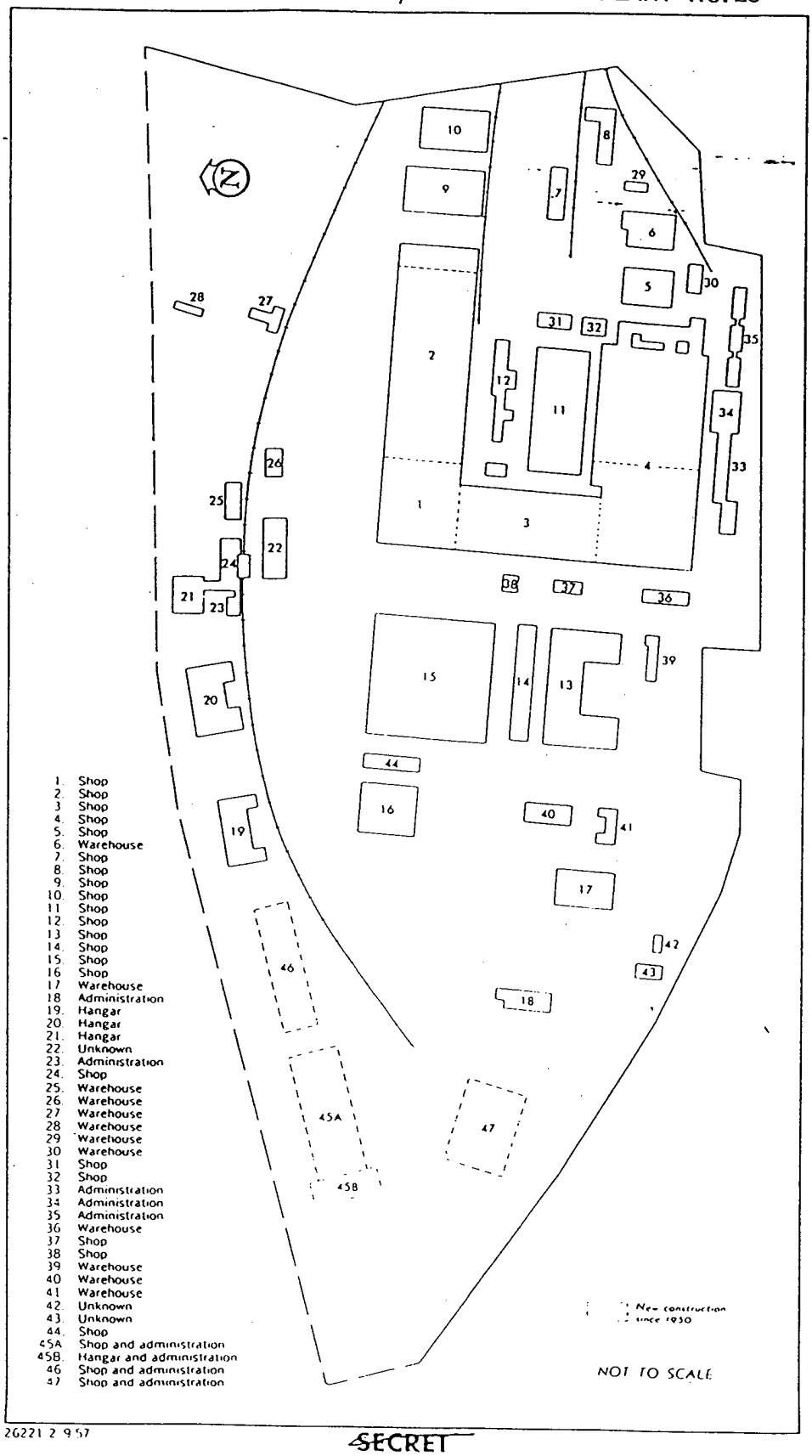

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Figure 3

USSR: VERTICAL PHOTOGRAPH OF MOSCOW/FILI AIRFRAME PLANT NO. 23

The navigational equipment on the Bison would not have to be operational for the short flight from Airframe Plant No. 23 to Ramenskoye, but the communications system would have to be operational. A functional testing of the electrical circuits and components of the communications system probably would be made outside the plant because the test requires freedom from the interference of buildings.

In addition to the check of the communications system, a 24-hour check on fuel leaks, engine runups, checks on the control system and on instruments, safety inspection, and preflight testing probably are carried on outside the plant buildings. Any defects found during these tests must be corrected before the Bison is flown to Ramenskoye.

Discussions with US aircraft manufacturers indicate that the absolutely minimum time that a Bison would spend on the ramp before takeoff is 6 working days. In order to achieve this absolutely minimum time, the aircraft would have to be free of any serious defects. US aircraft manufacturers believe that a realistic ramp time would be 18 working days.*

* ' indicates that between 13 January 1956 and 28 July 1957 Bison aircraft spent an average of at least 18 calendar days on the ramp at Airframe Plant No. 23 before being flown to Ramenskoye.

IV. Indications of Production.

A. Observations.

Before the rehearsals for the 1956 May Day Air Show, [redacted] the only indication of the total number of Bison aircraft produced was the number of aircraft observed in single flights [redacted]

An irreducible minimum number of Bison aircraft as of 20 April 1955 can be established, however, because on that day 11 Bison were seen in a single fly-by.

The Aviation Day Air Show of 3 July 1955 included 12 Bison aircraft, the largest number observed in a single flight during 1955. Larger numbers of Bison aircraft were seen, however, in the rehearsals for the 1956 May Day Air Show. Twenty-two Bison aircraft, the largest number ever observed in a single fly-by, were seen on 26 and 27 April 1956. Since then, no more than 10 Bison aircraft have been observed in a single fly-by. Ten Bison aircraft were observed on six separate occasions during rehearsals for the 1957 May Day Air Show.

In addition to observing Bison aircraft in rehearsals for the air shows, [redacted] frequently have observed Moscow/Fili Airframe Plant No. 23. [redacted] have reported 11 observations of the plant during 1955, 92 during 1956, and 24 during 1957.

On the basis of these observations, reliable estimates can be made for the number of Bison aircraft produced and the dates on which these aircraft were delivered from Airframe Plant No. 23 to Ramenskoye. The estimated departure dates of the Bison from Airframe Plant No. 23 [redacted] are plotted in Figure 6.**

** Following p. 6.

Figure 6

USSR: ESTIMATED MONTHLY AND CUMULATIVE DEPARTURES OF BISON AIRCRAFT FROM MOSCOW/FILI AIRFRAME PLANT NO. 23
December 1955 Through July 1957

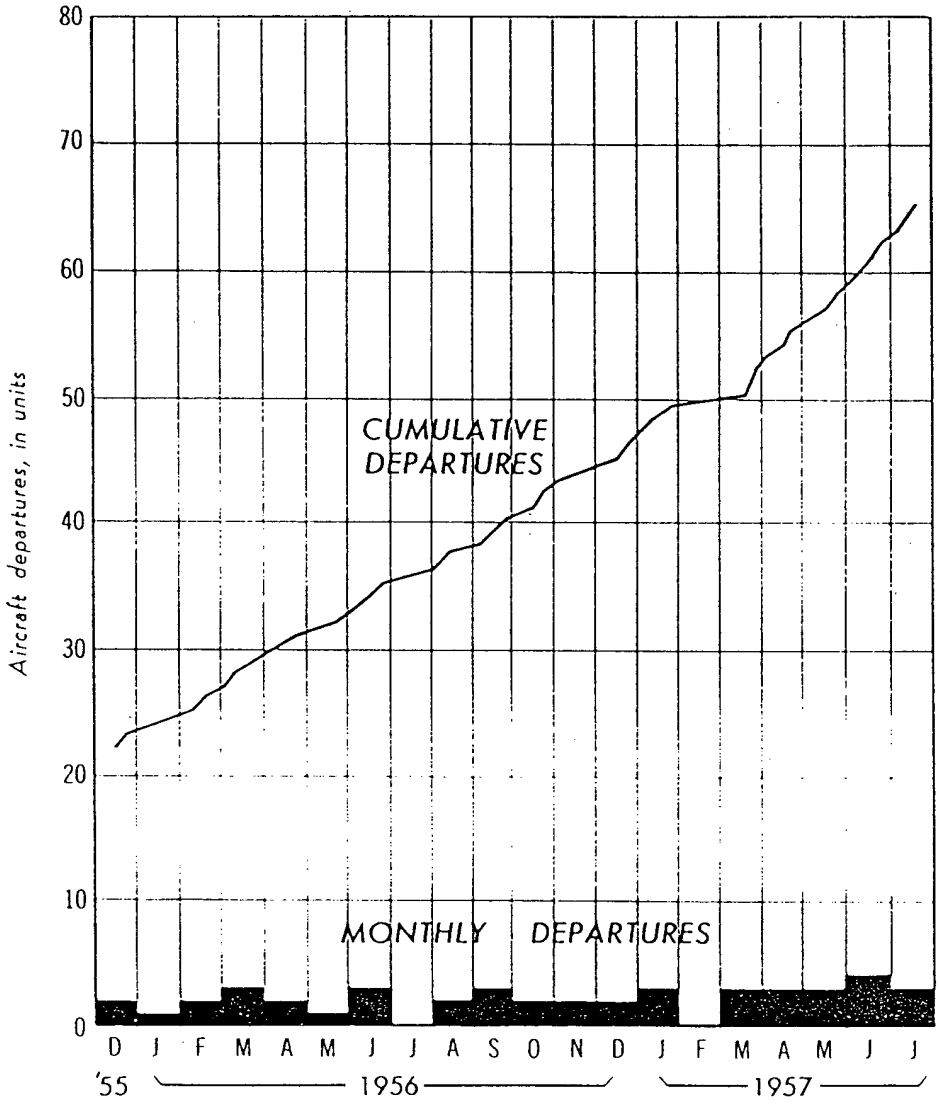

Table 1

Table 1

C. By Month from 1955 Through June 1957.

A reliable estimate of production of Bison aircraft by month can be made for the period January 1956 through June 1957. The estimate of production of Bison aircraft by month during 1955 is less reliable because [redacted] reported only 11 observations of Moscow/Fili Airframe Plant No. 23 during 1955. The estimated production of Bison aircraft by month is given in Table 2* for the period from January 1955 through June 1957.

The estimate of the production of Bison aircraft by month during 1955 was based on the cumulative number of aircraft produced by the end of 1955 and on the number of Bison aircraft seen during rehearsals for the 1955 May Day Air Show. Twenty-three Bison aircraft were estimated to have been produced by the end of 1955. Eleven Bison aircraft are known to have been produced by 28 April 1955. Furthermore, 13 Bison aircraft [redacted] were seen in the practice fly-bys for the 1955 May Day Air Show. Hence at least 13 Bison probably were produced before 1 May 1955. The assumption was made that a crash program existed for the production of the first 12 series-produced aircraft in order to show as many heavy bomber aircraft as possible in the 1955 May Day Air Show. The third prototype was not completed until

* Table 2 follows on p. 11.

Table 2

Production of Bison Aircraft by Month
at Moscow/Fili Airframe Plant No. 23 in the USSR a/
January 1955 - June 1957

Units

Month	Monthly Production	Cumulative Production
Before 1955		2
1955		
January	3	5
February	3	8
March	3	11
April	4	15
May	0	15
June	0	15
July	0	15
August	1	16
September	1	17
October	2	19
November	2	21
December	2	23
1956		
January	2	25
February	3	28
March	1	29
April	2	31
May	1	32
June	3	35
July	1	36
August	2	38
September	2	40
October	3	43
November	1	44
December	4	48

a. Including the three prototypes.

The 65th Bison could have been completed in early July instead of in late June.

Table 2

Production of Bison Aircraft by Month
at Moscow/Fili Airframe Plant No. 23 in the USSR
January 1955 - June 1957
(Continued)

Month	Monthly Production (Units)	Cumulative Production (Units)
1957		
January	2	50
February	3	53
March	3	56
April	4	60
May	2	62
June	3	65

1955, -. No series-produced aircraft were completed before 1955,

D. Peak Monthly Rate.

The production schedule presented in Table 2 and plotted in Figure 7* can be used to determine the learning curve 7/ on which the plant is operating and to determine the number of final assembly positions. The learning curve and the number of final assembly positions, in turn, can be used to determine the peak monthly production rate that can be achieved at Moscow/Fili Airframe Plant No. 23.

The final assembly area is the one controlling factor in the development of a schedule for production of aircraft because it is the area in which space-restricted joining operations are accomplished. This type of operation limits the number of personnel that can be utilized at any particular time. The number of personnel, in turn, controls the flow time for these critical operations and therefore determines the number of units that can be processed through the area in a given length of time. The available final assembly positions

* Following p. 12.

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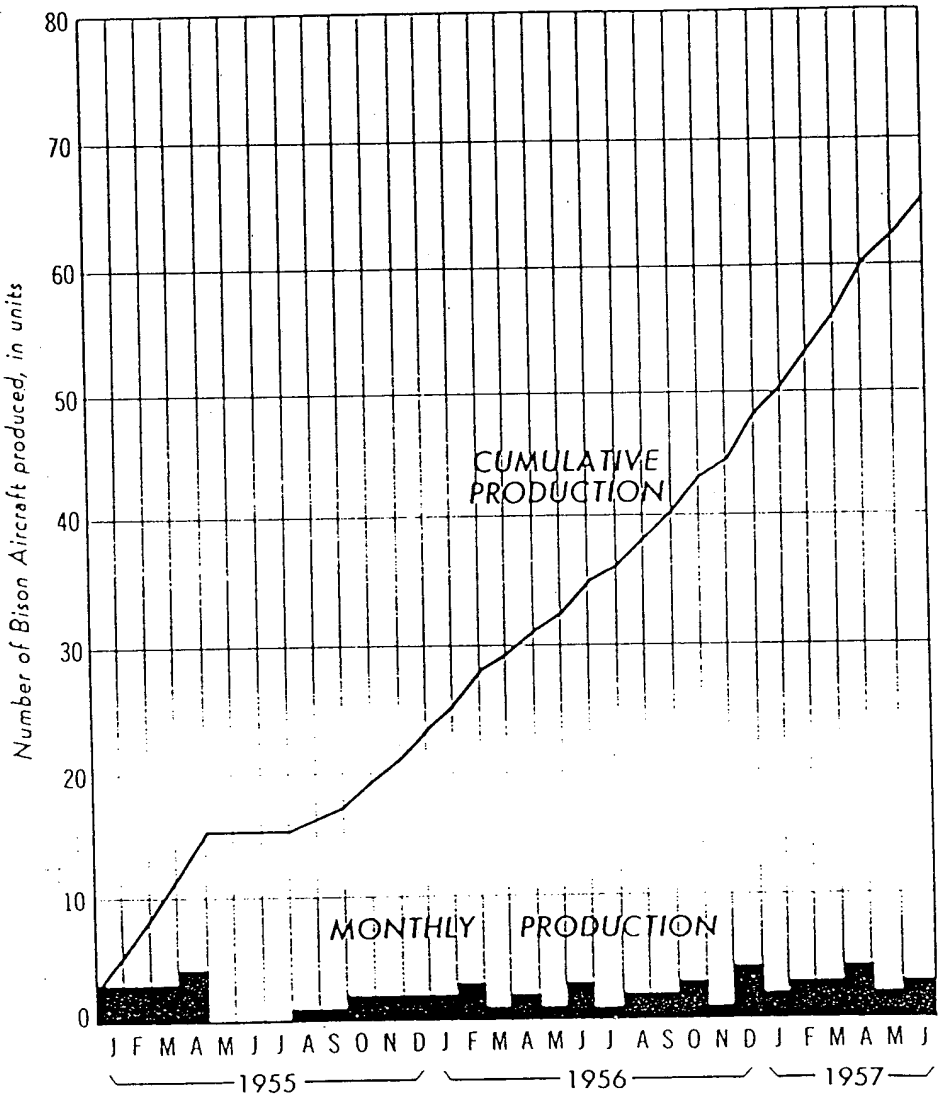
Figure 7

USSR: PRODUCTION OF BISON AIRCRAFT
AT MOSCOW/FILI AIRFRAME PLANT NO. 23
January 1955 Through June 1957



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and the crew loading remain relatively constant throughout the life of the program. Flow time and man-hours, however, reduce progressively as the number of units processed increases. The same number of people are able to produce more and more airplanes with the same expenditure of man-hours per month. The experience of the US aircraft industry indicates that the learning curve is applicable for the final assembly area.

An 83-percent learning curve* will meet the production schedule of Table 2** from the 12th to the 62d series-produced aircraft on the assumption that the plant is working 2 shifts and that each shift works five 8-hour days and one 6-hour day per week. A 4-position final assembly operation with a crew loading of 49 men per position would satisfy the above schedule on a 2-shift operation.

If Airframe Plant No. 23 were working only 1 shift per day, 6 final assembly positions would be required to support the above schedule. The fabrication and subassembly operations, however, would be required to work 2 shifts to support a 1-shift final assembly operation. The average crew loading of 65 men required to support a 6-position-line, 1-shift operation is 30 percent higher than the optimum crew loading used on the US B-52 program. The scheduling of final assembly on a 1-shift operation with the rest of the plant on a 2-shift operation creates a bottleneck and leads to major problems of coordination. To produce the Bison aircraft at the lowest cost with a smaller density of workers, with less duplication of final assembly tools and fixtures, and with easier coordination, the USSR would have produced the above quantities of airplanes on a 4-position, 2-shift final assembly operation.

With 4 final assembly positions, the peak monthly rate of production at Airframe Plant No. 23 would be 3 aircraft per month based on two 46-hour shifts per week and an 83-percent learning curve. On the basis of 6 final assembly positions and two 46-hour shifts per week, the peak monthly rate of production would be 5 aircraft per month, but the plant would have to subcontract 14 percent of its effort. Available information, however, suggests that airframe plants in the USSR subcontract only to a limited degree. Therefore, the peak

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* The average learning curve of the US aircraft industry for production of bombers is 77.1 percent.

** P. 11, above.

monthly rate of production of Bison aircraft at Airframe Plant No. 23 is estimated to be three aircraft per month.*

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38 Pages of Detailed Appendixes Deleted

APPENDIX A

APPENDIX B

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APPENDIX C

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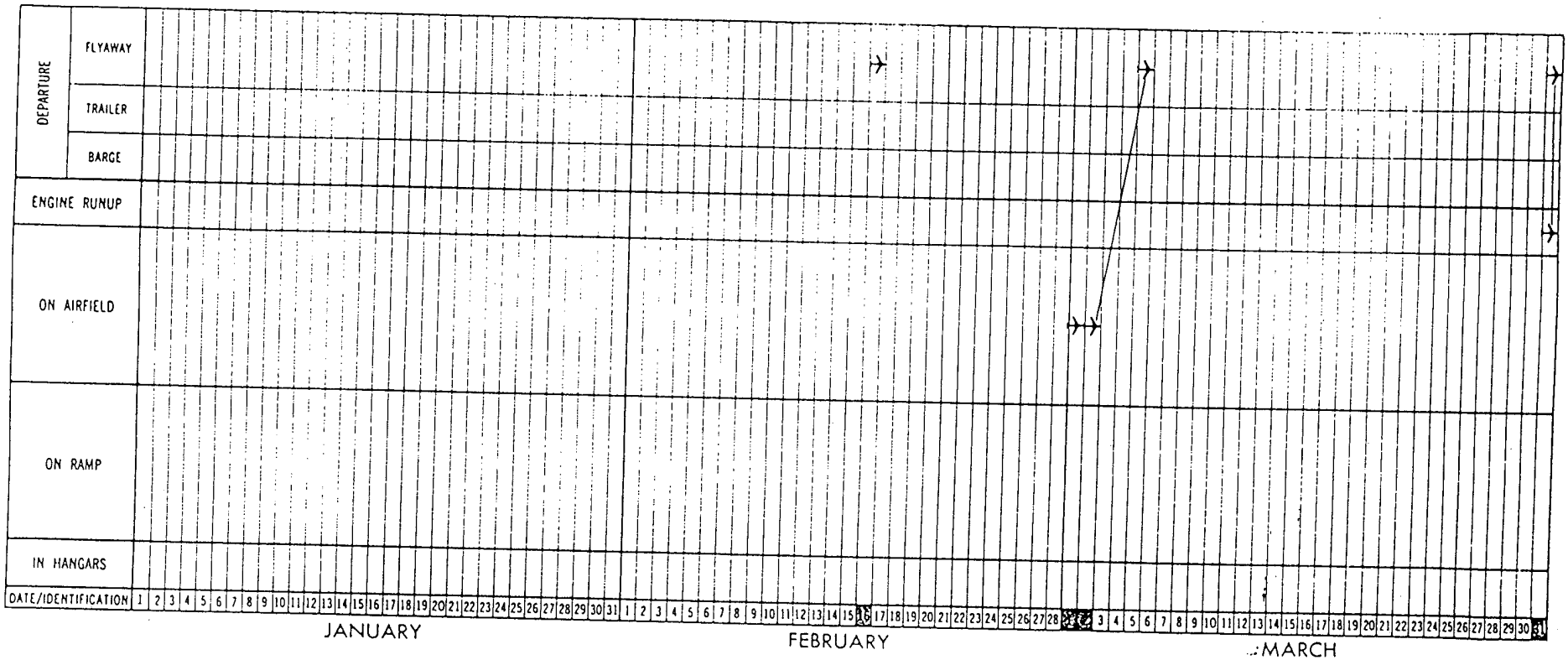
Figure 8

USSR

ACTIVITY OF BISON AIRCRAFT AT MOSCOW/FILI AIRFRAME PLANT NO. 23

JANUARY, FEBRUARY, AND MARCH 1955



DEPARTURE

- Known
- Assumed

IDENTIFICATION

- Visual (complete observation of plant)
- Visual (partial observation of plant)
- Aural

PRODUCTION		
	Quarterly	Cumulative Total
Identified	3	3
Assumed	6	8
TOTAL	9	11

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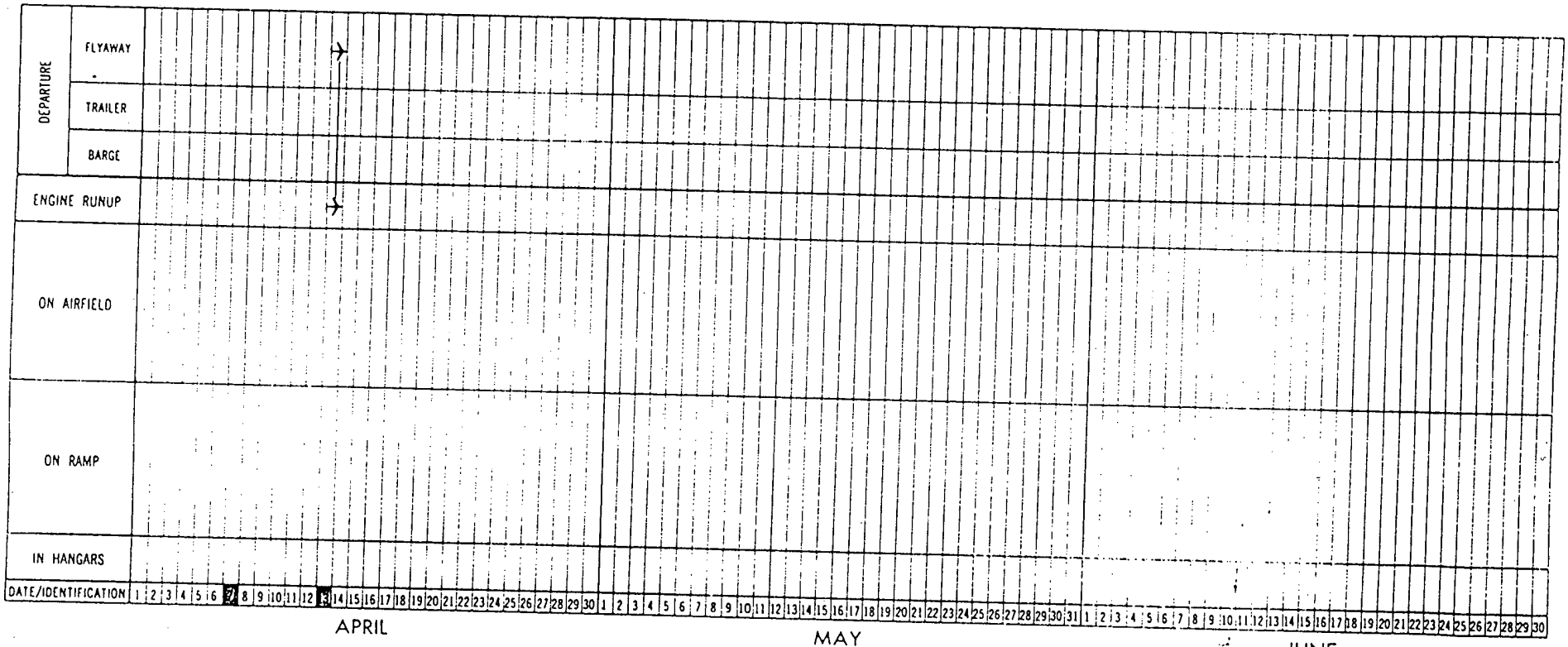
Figure 9

USSR

ACTIVITY OF BISON AIRCRAFT

AT MOSCOW/FILI AIRFRAME PLANT NO. 23

APRIL, MAY, AND JUNE 1955



DEPARTURE

- Known
- Assumed

IDENTIFICATION

- Visual (complete observation of plant)
- Visual (partial observation of plant)
- Aural

PRODUCTION	Quarterly	Cumulative Total
Identified	1	4
Assumed	3	11
TOTAL	4	15

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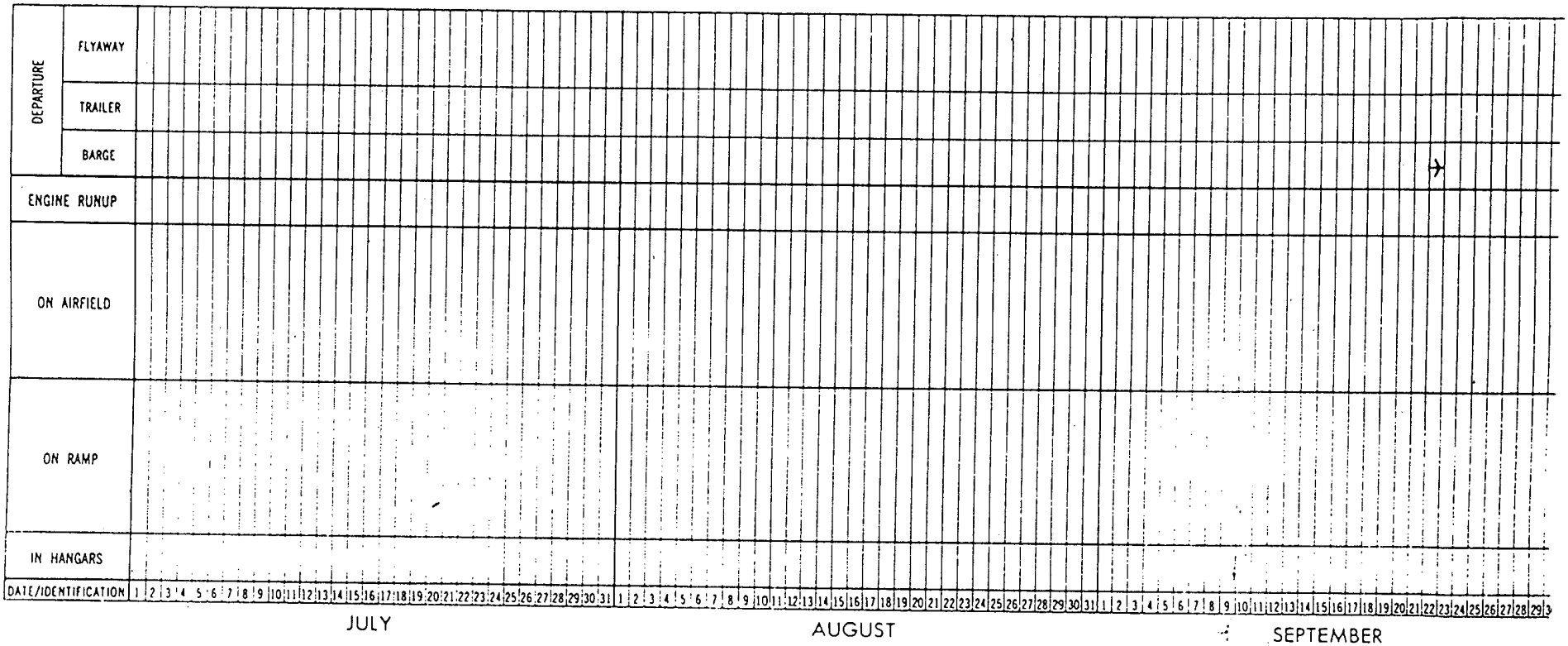
Figure 10

USSR

ACTIVITY OF BISON AIRCRAFT

AT MOSCOW/FILI AIRFRAME PLANT NO. 23

JULY, AUGUST, AND SEPTEMBER 1955



DEPARTURE
- Known
- Assumed

IDENTIFICATION
- Visual (complete observation of plant)
- Visual (partial observation of plant)
- Aural

PRODUCTION	Quarterly	Cumulative Total
Identified	1	5
Assumed	1	12
TOTAL	2	17

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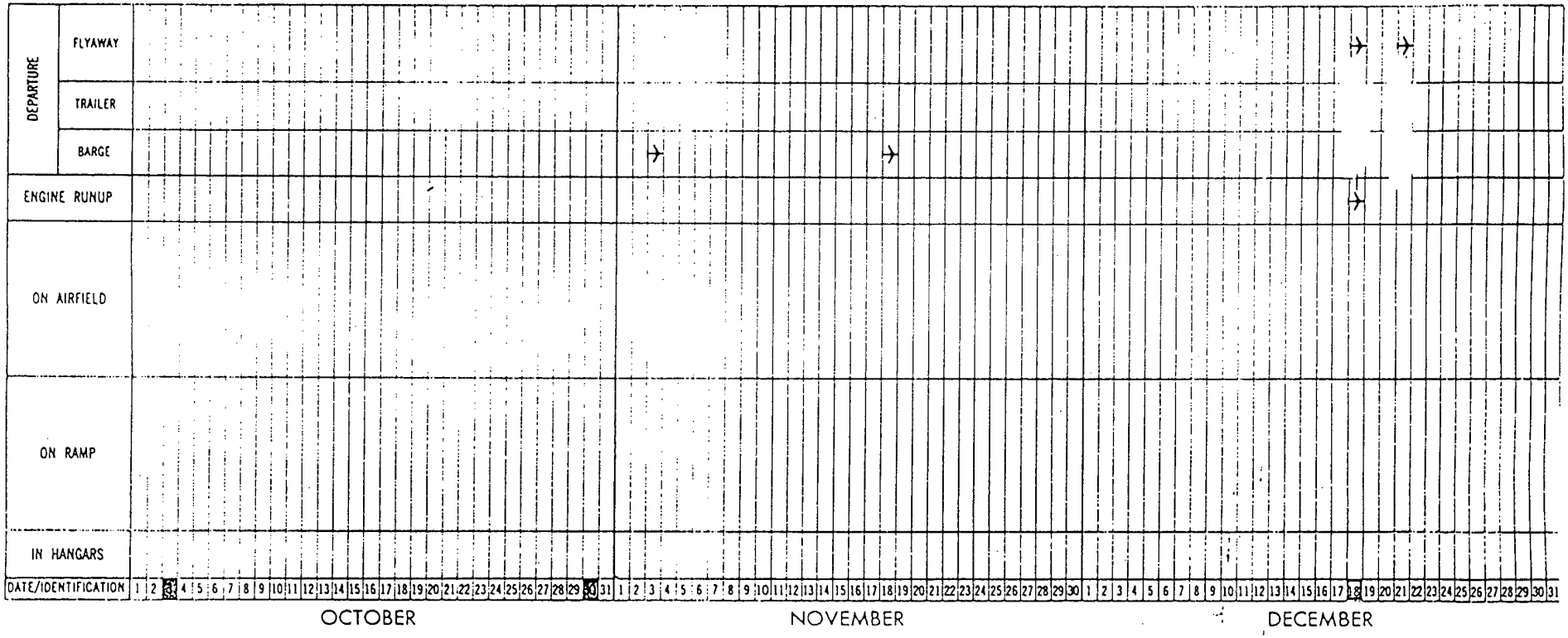
Figure 11

USSR

ACTIVITY OF BISON AIRCRAFT AT MOSCOW/FILI AIRFRAME PLANT NO. 23

OCTOBER, NOVEMBER, AND DECEMBER 1955



DEPARTURE

- Known
- Assumed

IDENTIFICATION

- Visual (complete observation of plant)
- Visual (partial observation of plant)
- Aural

PRODUCTION		
	Quarterly	Cumulative Total
Identified	4	9
Assumed	2	14
TOTAL	6	23

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Figure 19

RELATIONSHIP BETWEEN MAN-HOURS PER POUND OF AIRFRAME WEIGHT FOR THE INITIAL UNIT OF PRODUCTION AND AIRFRAME WEIGHT

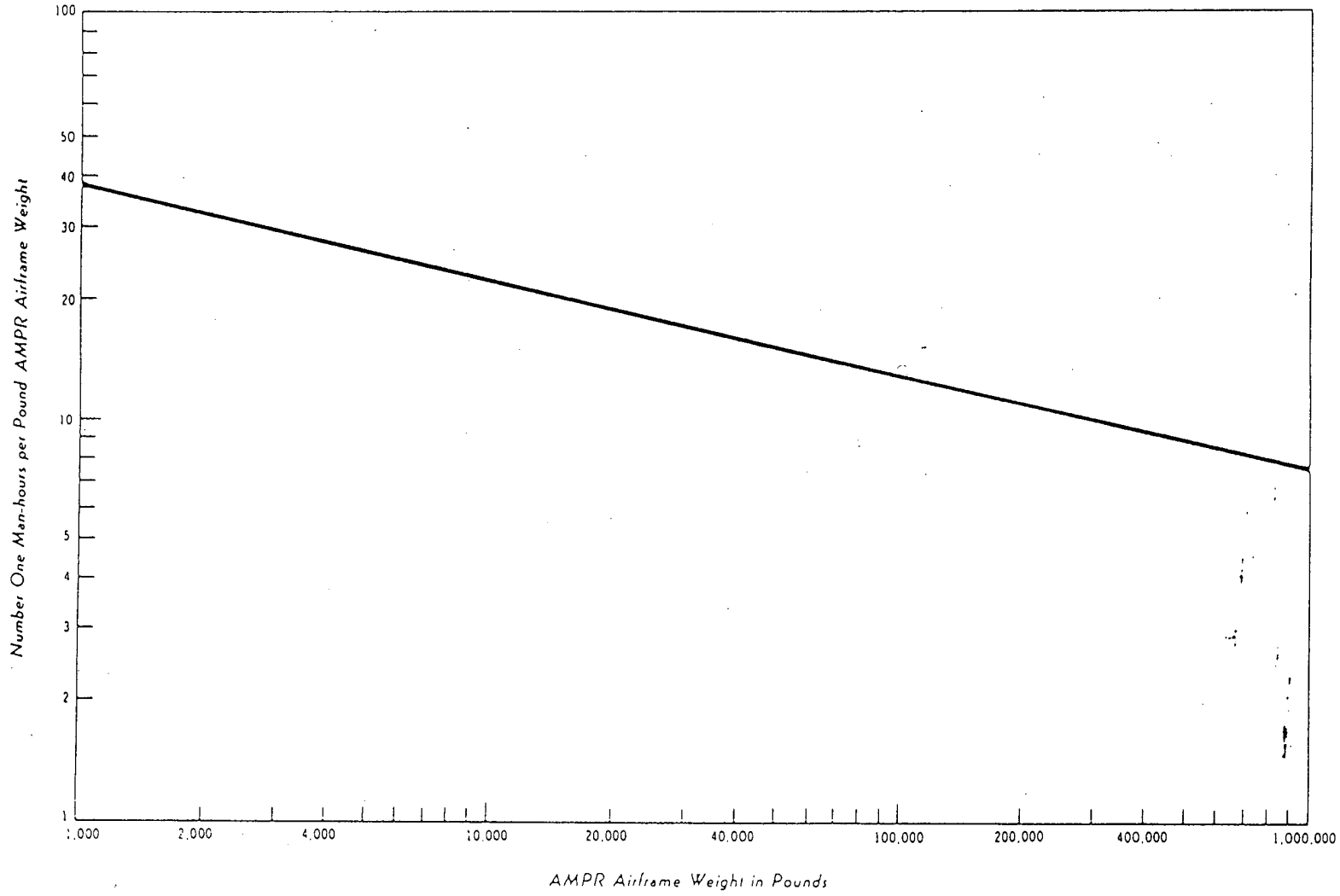

Figure 20

RELATIONSHIP BETWEEN TOTAL COVERED FLOOR AREA AND DIRECT COVERED FLOOR AREA

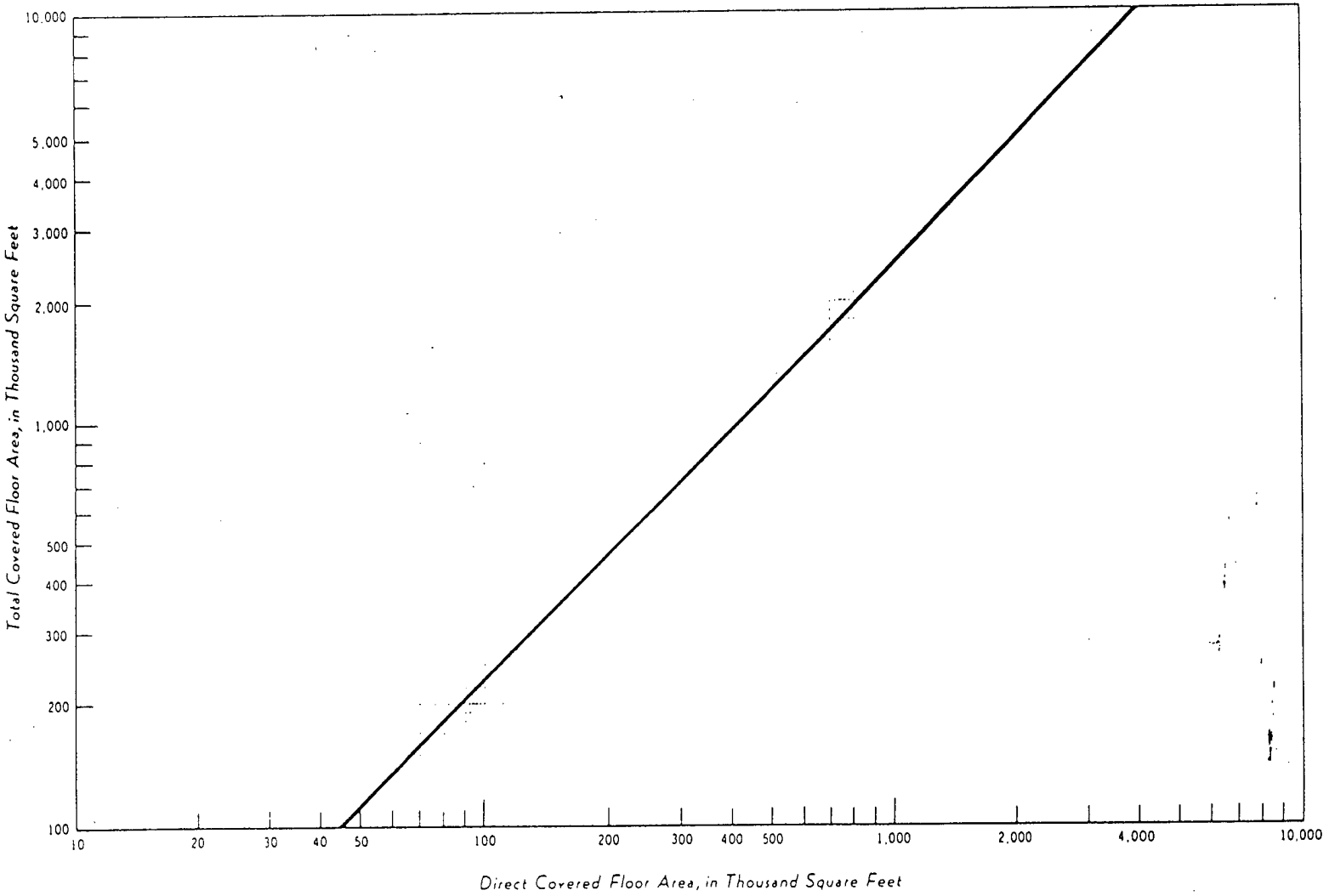

Figure 21

RELATIONSHIP BETWEEN SQUARE FOOTAGE PER DIRECT WORKER ON THE LARGEST SHIFT AND AIRFRAME WEIGHT

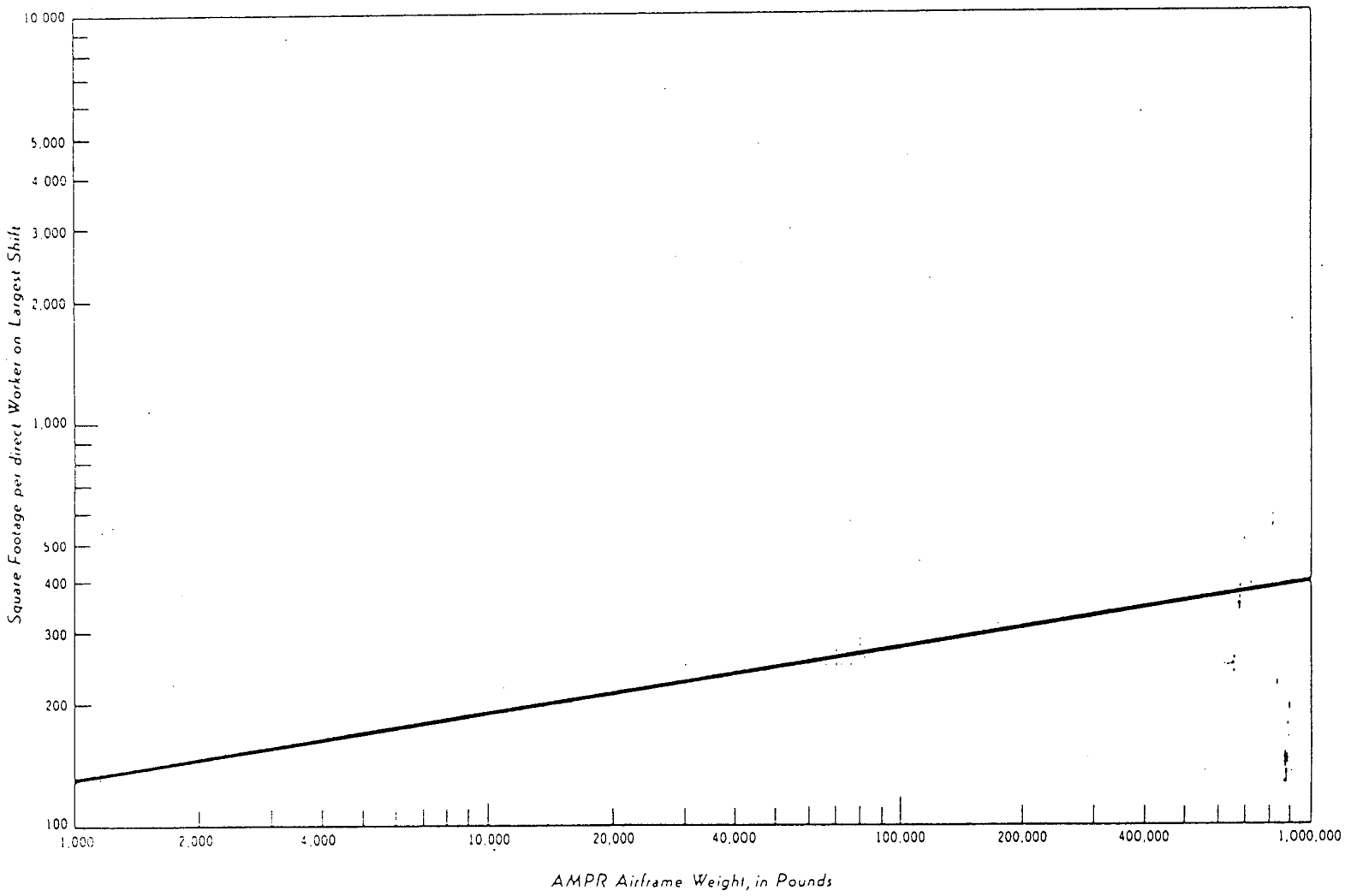

Figure 22

OPTIMUM CREW LOADING FOR FINAL ASSEMBLY

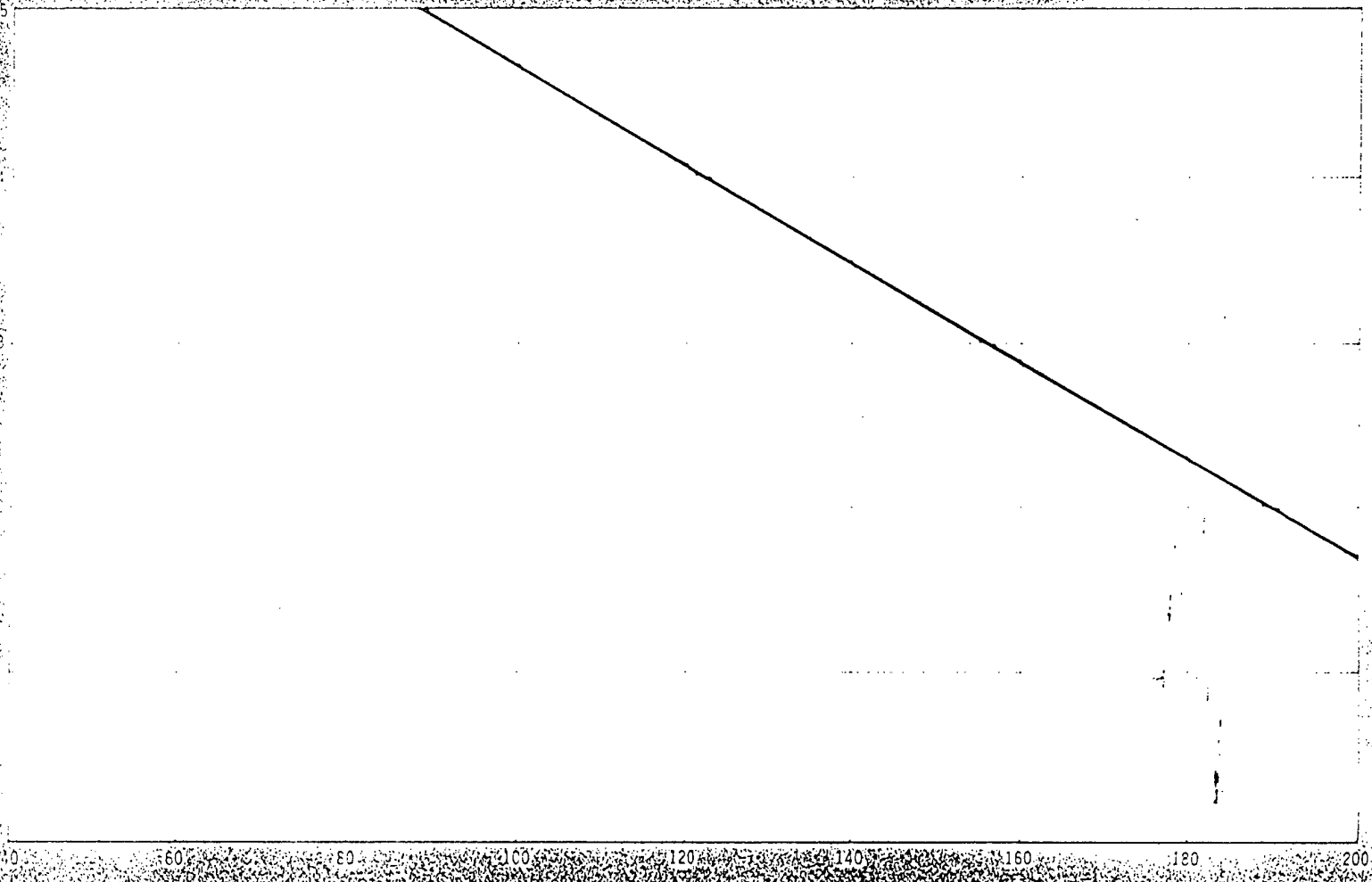

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Table 7

APPENDIX F

APPENDIX G

SOURCE REFERENCES

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 project. No "RR" evaluation is given when the author agrees with the evaluation on the cited document.