CR 151616

"AS-BUILT" DESIGN SPECIFICATION JAN 24 1978

FOR THE

DIGITAL DERIVATION OF

DAILY AND MONTHLY DATA BASES

FROM SYNOPTIC OBSERVATIONS

OF TEMPERATURE AND PRECIPITATION FOR

THE PEOPLE'S REPUBLIC OF CHINA

Job Order 73-763

AD 63-1347-3763-54

Prepared By

Lockheed Electronics Company, Inc.

Systems and Services Division

Houston, Texas

Contract NAS 9-15200

For

EARTH OBSERVATIONS DIVISION

SPACE AND LIFE SCIENCES DIRECTORATE

National Aeronautics and Space Administration

LYNDON B. JOHNSON SPACE CENTER

Houston, Texas

December 1977

LEC- 11680

(NASA-CR-151616) AS-BUILT DESIGN SPECIFICATION FOR THE DIGITAL DERIVATION OF DAILY AND MONTHLY DATA BASES FROM SYNOPTIC OBSERVATIONS OF TEMPERATURE AND PRECIPITATION FOR THE (Lockheed Electronics G3/47 N78-18624 HC A06/MF A01 Unclas 05431

DOCUMENTATION DISTRIBUTION LIST

System: CCEA/Yield Estimation System (YES)

Title: "As-Built" Design Specification For The Digital Derivation of Daily and Monthly Data Bases From Synoptic Observations of Temperature and Precipitation For The People's Republic of China

Job Order: 74-963

Responsible Organization: Applications Software Section, 333-6311

JSC
SF/L. F. Childs
SF2/R. L. Eason
SF4/V. S. Whitehead
TF3/T. E. Barnett
R. G. Stuff

NOAA/J. Hill
T. Phillips
N. Strommen
S. Laduc
C. Sakamoto

USDA/J. Rogers

LEC
C09/D. E. Phinney
B. L. Carroll
C42/J. M. Everette
J. A. Wilkinson
B. H. Jeun
R. L. Davenport
G. L. Barger

Job Order File
Technical Publications (5)
Data Research and Control (3)

"AS-BUILT" DESIGN SPECIFICATION
FOR THE
DIGITAL DERIVATION OF
DAILY AND MONTHLY DATA BASES
FROM SYNOPTIC OBSERVATIONS
OF TEMPERATURE AND PRECIPITATION FOR
THE PEOPLE'S REPUBLIC OF CHINA

Job Order 73-763

AD 63-1347-3763-54

Prepared By

B. H. Jeun

G. L. Barger

APPROVED BY

James A Wilkinson for
Philip L. Krumm, Supervisor
Applications Software Section

B L Carroll
B. L. Carroll, Manager
LACIE Development and Evaluation Department

Prepared By
Lockheed Electronics Company, Inc.

For

Earth Observations Division

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
LYNDON B. JOHNSON SPACE CENTER
HOUSTON, TEXAS

December 1977

LEC- 11680

CONTENTS

1. SCOPE

As an integral part of the Large Area Crop Inventory Experiment (LACIE) which is sponsored by the Department of Agriculture (USDA), the National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA), continued building of daily and monthly data bases to test various advanced wheat yield models is an active objective and goal. The People's Republic of China (PRC) is one of the largest agricultural countries in the world. Winter and spring wheat is one of its major crops; therefore, a knowledge of China's crop production is very important to the LACIE Project. The China data base consists of meteorological information in the form of daily precipitation and maximum and minimum temperatures and their monthly totals and averages, respectively, for about 95 weather stations covering the entire winter and spring wheat production area of China over the period 1965 through 1975. The daily and monthly meteorological information was built up from synoptic (4 or 8 times daily) weather observations available on magnetic tape from the National Climatic Center (N.C.C.) in Asheville, North Carolina.

There are three major sets of computer algorithms for building the China data base, that is: 1) the least squares interpolation; 2) modified version of the max-min program; and 3) the AOV procedure.

The least squares interpolation algorithm is used to generate input variables; the modified version of the max-min program is used to generate daily and monthly precipitation and max-min temperatures; the analysis of variance algorithm is used to carry out a simple statistical hypothesis test on the digital estimated data. The China data base is considered complete and unique. It may be the only one of this kind of meteorological data existing outside, or inside the People's Republic of China.

2. APPLICABLE DOCUMENTS

Action Documentation (AD) 63-1347-3763-54, China Data Base, June 28, 1977

AD 63-1557-4963-22, YES Data Base Maintenance, Oct 17, 1977.

Job Order 73-763

"As-Built" Design Specification for Historical Daily Data Bases for Testing Advanced Models (JSC-12891; LEC-10572), April 1977.

3. System Description

CHINA SYNOPTIC DATA SOURCE

A total of 32 tapes were obtained by the Center for Climatic and Environmental Assessment (CCEA) from the National Climatic Center (NCC) in Asheville, North Carolina, covering World Meteorological Organization (WMO) blocks, 53, 54, 57 and 58 in China for the years 1965 through 1975. Data were contained in 3 tapes per year except for 1968 which has only 2 tapes. These tapes, containing synoptic data (i.e., 4-8 observations per day) for all reporting weather stations within these blocks, are recorded in NCC deck format 9685.

CHINA DATA BASE DESIGN

A total of 95 WMO weather stations providing uniform coverage of the entire winter and spring wheat production area of China (see map on page 3.3), was selected on the basis of relative reliability and consistency of record. Daily precipitation and max-min temperatures are the major meteorological variables generated for the 95 representative weather stations covering the entire winter and spring wheat production area of China over the period from 1965 to 1975. Daily data were stored in the magnetic tapes in the following format:

Character String (per record)	Content
1 - 6	Station number
7 - 8	Year
9 - 10	Month
11 - 12	Day
13	Blank
14 - 16	Daily Maximum temperature*
17 - 19	Daily Minimum temperature*
20 - 22	Blank
23 - 26	Precipitation **

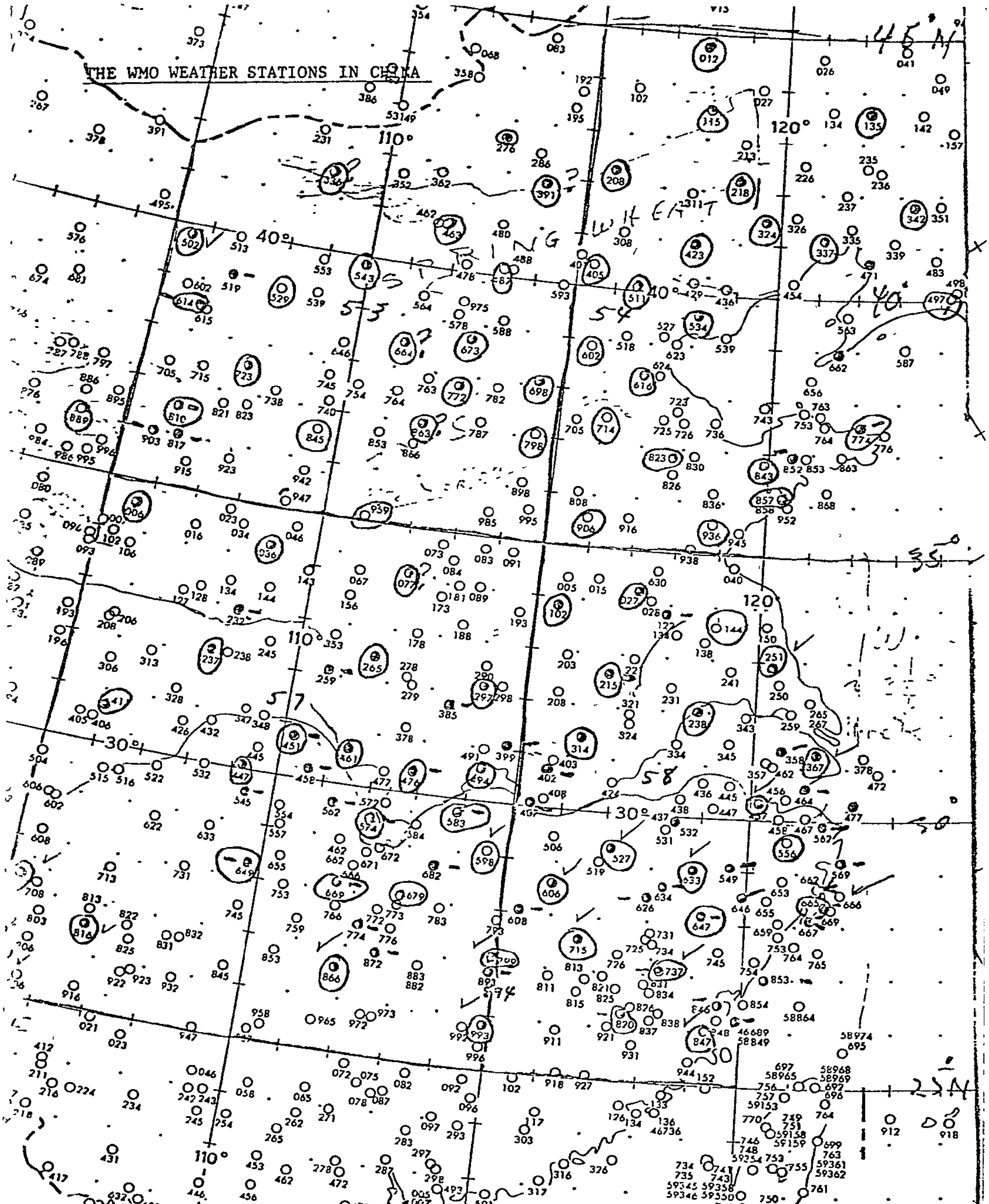
* Temperatures are in whole degrees Fahrenheit with a leading minus sign if negative; missing temperature observations are denoted by 999.

** Precipitation is in hundredths of inches with no decimal points; missing precipitation is indicated by 9999. The above format is known as the Modified Kansas Format (as opposed to NCC Format).

Monthly data were generated by a separate computer program; output is available in hard copies containing the following information:

1. Station
2. Year
3. Month
4. Monthly average maximum temperature
5. Monthly average minimum temperature
6. Monthly total precipitation
7. Total number of observations
8. Number of missing observations
9. Total annual precipitation

This section describes the system software, Appendices A, B, and C contain detail flowcharts for subroutines used.


THE WMO WEATHER STATIONS IN CHINA
45°N
40°
35°
30°
25°N
110°
120°

3.1 HARDWARE DESCRIPTION

All computer algorithms described in this document were written in standard FORTRAN language and will operate on any IMB 360/370 system with FORTRAN compiler and with 1600 BPI magnetic drive. They will also operate on mini-computer systems such as PDP 11/50 with FORTRAN compiler and 800 BPI with minor change.

3.2 SOFTWARE DESCRIPTION

3.2.1 THE DERIVATION OF INPUT VARIABLES

The least squares interpolation computer algorithm was designed to generate a complete set of monthly temperature ranges. The monthly average daily temperature ranges for each weather station are needed as input variables to the max-min program to generate the daily maximum and minimum temperatures for each month. The program consists of one main program and seven subroutines i.e., SUM, COR, LSTSQ, MEQSOL, GRAPH, STANDV AND MULTR, and one IBM built-in library routine, PLTSCT, which is used to plot the scatter diagram for the input data; the above subroutines can be found in computer literature and journals.

SUBROUTINE SUM

This subroutine is used to calculate the total of input observations such as X, X^2 and Y and Y^2.

SUBROUTINE COR

This subroutine is used to calculate the correlation coefficient (r) of the input data, the correlation coefficient is used as a criterion to determine whether a straight line or a 2nd degree curve fits a given set of data; that is, if $|r| > 0.7$, a straight line should be fitted; otherwise, a higher degree curve is required.

SUBROUTINE LSTSQ

This subroutine is used to determine the best fitting equation by establishing the proper matrix equation $AX = B$

For example, if a linear least squares equation is needed then,

$$A = \begin{pmatrix} N & \Sigma X_i \\ \Sigma X_i & \Sigma X_i^2 \end{pmatrix} ; \quad X = \begin{pmatrix} C_1 \\ C_2 \end{pmatrix} \quad ; \quad B = \begin{pmatrix} \Sigma Y_i \\ \Sigma X_i Y_i \end{pmatrix}$$

where C_i are the coefficients of the least squares equation. For higher order least squares polynomials, the elements of different matrices will be changed automatically by this subroutine.

SUBROUTINE MEQSOL

This subroutine is used to solve the matrix equation $AX = B$ which has been determined by the subroutine LSTSQ.

SUBROUTINE GRAPH

This subroutine is used to plot the least squares equation in the X - Y Plane.

SUBROUTINE MULTR

This subroutine is used to calculate the multiple correlation coefficient (RMULT) which serves as the criterion to determine if a 2nd degree or higher order least squares equation is needed.

SUBROUTINE STANDV

This subroutine is used to calculate the standard deviation of a given set of data points; this subroutine is needed in the subroutine MULTR.

3.2.2. THE COMPUTATION ALGORITHMS

There are two major computer algorithms for building the China data bases. One for generating the daily data and the other for generating monthly data. All programs are written in standard FORTRAN language.

The computer program for daily data is a modified version of the max-min program which is basic to the non-linear statistical model developed by a research team at Kansas State University led by Dr. Arlin Feyerherm, Professor of Statistics. Complete information about the max-min program can be found in the "As-Built Design Specification for Historical Daily Data Bases for Testing Advanced Models", prepared by Buddy H. Jeun and K. Williams and published by the National Aeronautics and Space Administration (NASA), Lyndon B. Johnson Space Center, Houston, Texas 77058, April 1977.

In generating daily precipitation for the PRC, the precipitation amounts reported at synoptic hours 0600, 0900, 1200, and 1800 (GMT) were totaled. (When a similar application was carried out for the USSR only 0600 and 1800 (GMT) observations were summed). The reporting conventions differ region-to-region and must be verified locally by summing the data by day, month, and year. The computer algorithm that generates the monthly meteorological data, i.e., average maximum and minimum temperature and total precipitation, consists of one main routine and five subroutines, which are SORTMD, DMEAN, TOTAL, ANP and PBAR, and one built-in function, i.e., EXTERNAL SIGN, which is used to distinguish if the observation is blank or zero, since blank denotes a missing observation for maximum and minimum temperatures and for precipitation, the missing observation is denoted by 9999.

SUBROUTINE SORTMD

This subroutine is used to sort the daily observations by month; in doing so, for every station, the maximum and minimum of temperatures and precipitation for every month are sorted out.

SUBROUTINE DMEAN

This subroutine is used to calculate the average maximum and minimum temperatures for each month. At the same time, it also keeps track of the number of missing temperatures by the argument ICOUNT and KOUNT. In this subroutine, ICOUNT represents the number of missing observations for the maximum temperature and KOUNT represents the number of missing observations for the minimum temperature.

SUBROUTINE TOTAL

This subroutine is used to calculate the sum of a given set of observations. Input arguments are N, DZ and output arguments are SUM and KNT, where N is the number of observations. DZ is an array of N observations. SUM is the total value of N observations, KNT is the number of missing observations.

SUBROUTINE PBAR

This subroutine is used to calculate the monthly total of precipitation to each station. Input argument PC is an array of N observations of precipitation. Output argument PAV is the monthly total of precipitation.

SUBROUTINE ANP

This subroutine is used to calculate the annual precipitation to each weather station. Input arguments are STATN, YEAR, N and VP; output arguments are BP and the missing observations are represented by ICOUNT.

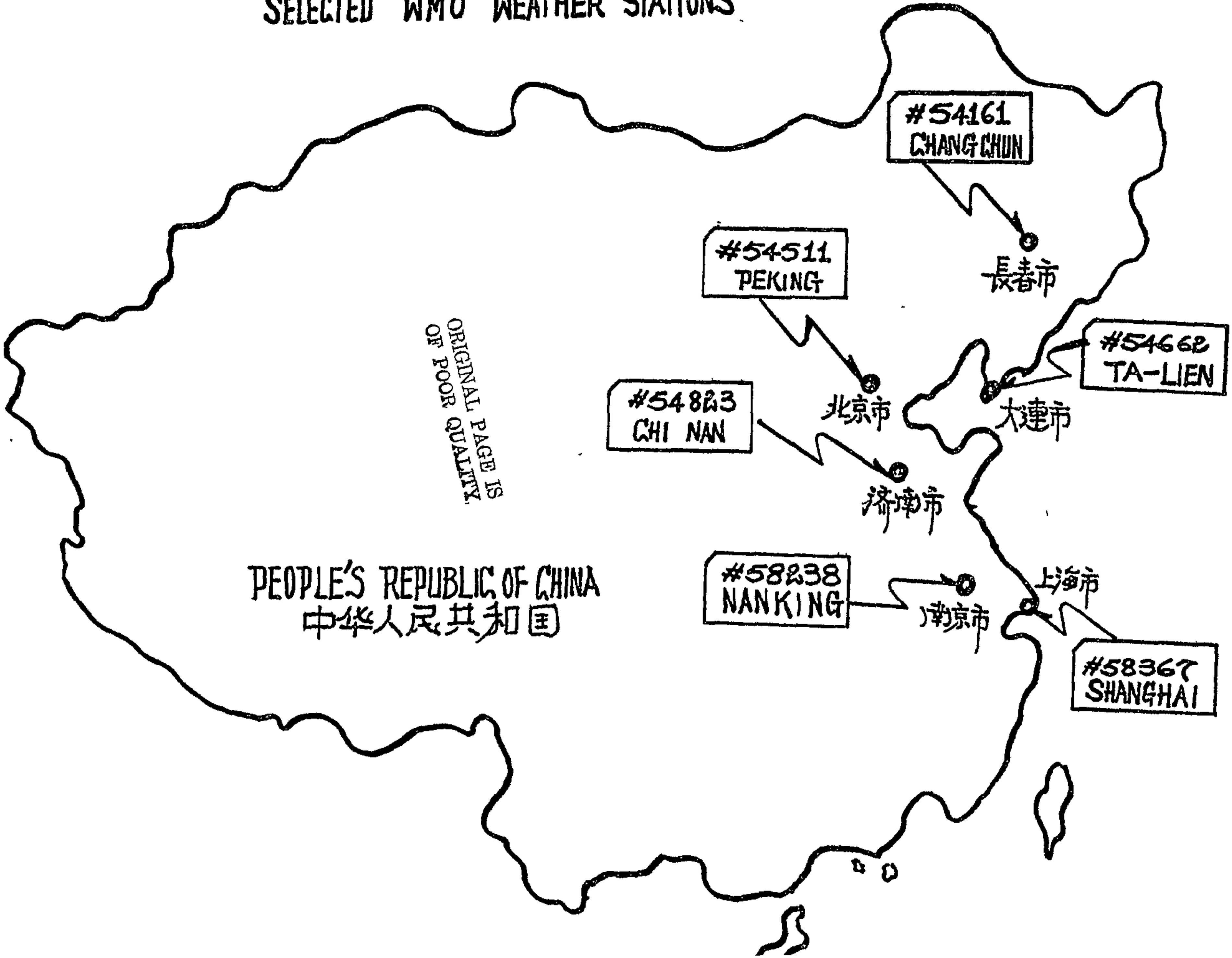
3.2.3. THE EVALUATION OF OUTPUT VALIDITY

The analysis of variance.

This analysis of variance computer algorithm was designed to test the reliability of the monthly data derived from the modified version of the max-min program. A few weather stations were selected for a study comparing the estimated means with PRC published means obtained from the USAF through the National Climatic Center at Asheville, North Carolina and other reliable records from the Hong Kong Royal Observatory and Chinese educational institutions obtained through personal correspondence. The six stations for which comparative monthly temperature data are available are shown on the map on page 3-9. They are confined to the more humid eastern portions of China but they do give a good temperature range north-south across the major wheat-producing area. The tables and graphs (page3-10 through 3-21)include individual monthly average temperatures (EST) as summarized from the computed daily max-min values alongside the most reliable check data (PUB) available. Whether the check data are true internal published amounts or "usually reliable" figures is not known. An analysis of variance (page 3-22 through 3-24) indicates that the estimated mean monthly temperatures are not significantly different from the available check data. The null hypothesis of the analysis of variance is tenable.

For precipitation, only four stations were supplied for comparison (pages 3-25 through 3-29). The WMO station numbers are the same as in daily source tapes but it is suspected the pairs of records compared may come from different, but proximate, rain gauges. Nevertheless, the monthly and annual precipitation totals compare favorably.

SELECTED WMO WEATHER STATIONS

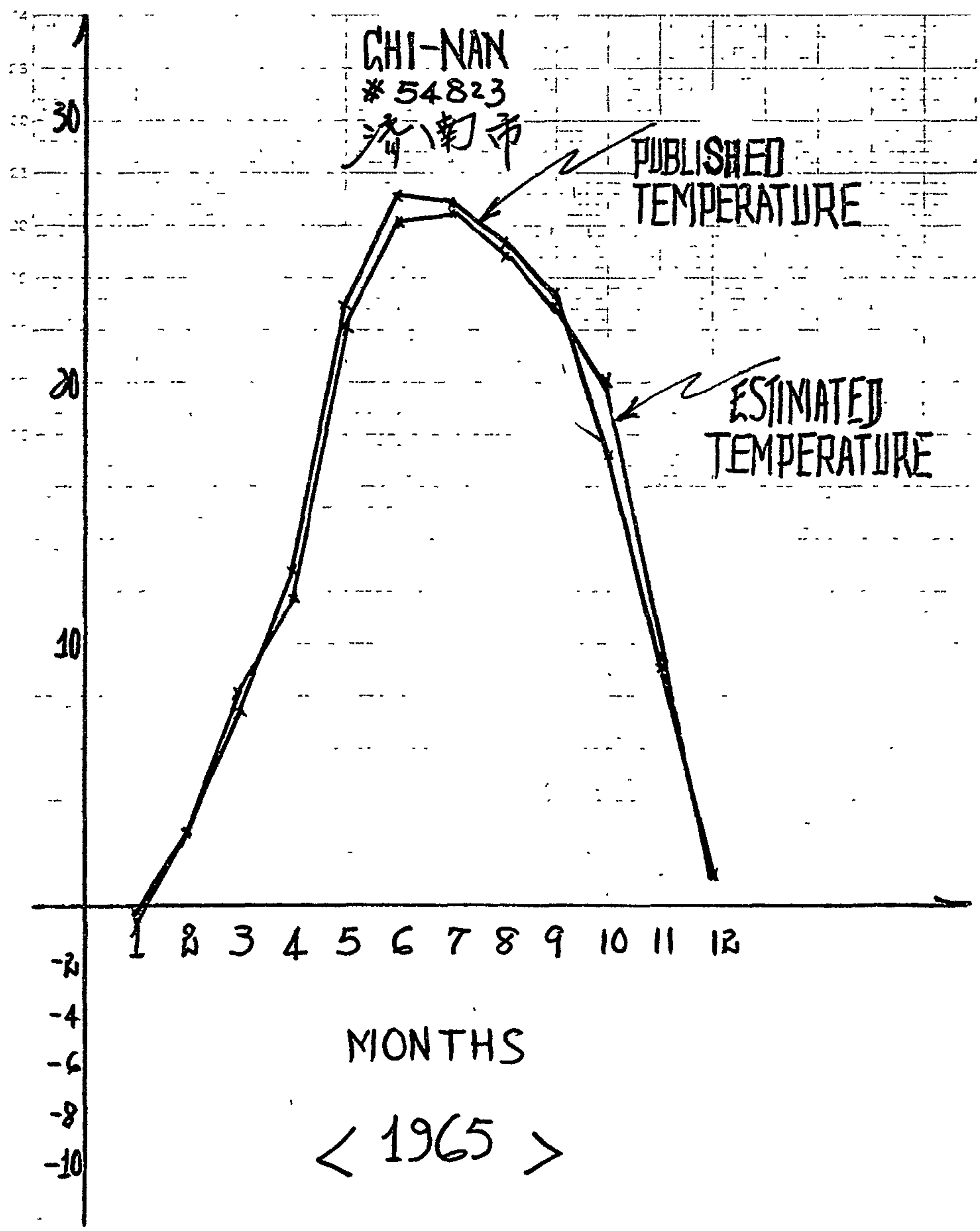


MONTHLY AVERAGE TEMPERATURE

CHI-NAN

#54823

MONTH	1965		1966		1967		1968		1969		1970	
	EST	PUB	EST	PUB	EST	PUB	EST	PUB	EST	PUB	EST	PUB
JAN	-0.38	-0.1	-0.63	0.3	-2.70	-1.1	-3.27	-1.3	-4.66	-3.4	-3.86	-1.8
FEB	2.70	2.7	3.56	4.2	-0.18	0.4	-3.16	-1.3	-4.86	-3.2	0.35	2.7
MAR	8.20	7.8	6.54	7.6	7.25	8.6	7.43	9.4	3.37	5.2	3.21	5.2
APR	11.88	12.7	13.84	15.1	14.50	16.1	14.84	16.7	11.81	14.0	13.04	15.1
MAY	22.48	22.9	21.88	22.7	23.58	25.5	21.29	22.3	19.68	21.4	19.42	21.5
JUN	26.00	27.1	24.50	26.4	25.60	27.3	26.83	28.4	23.76	26.0	22.80	24.8
JUL	27.23	27.7	27.15	27.8	27.48	27.8	25.56	28.7	25.60	27.5	24.82	26.4
AUG	24.89	25.5	27.15	28.1	27.48	28.1	25.56	26.5	25.60	26.9	24.82	25.9
SEP	23.50	23.3	19.47	20.6	18.98	20.2	21.46	22.8	19.92	21.2	19.42	21.2
OCT	20.12	17.6	14.79	15.9	14.66	16.2	12.69	14.2	14.58	16.4	14.31	16.3
NOV	9.14	9.0	8.33	9.4	4.46	6.1	7.27	8.8	4.84	6.7	5.50	7.2
DEC	1.20	1.2	-2.10	-1.0	-4.16	-3.0	1.42	3.2	-1.66	0.3	0.46	1.5

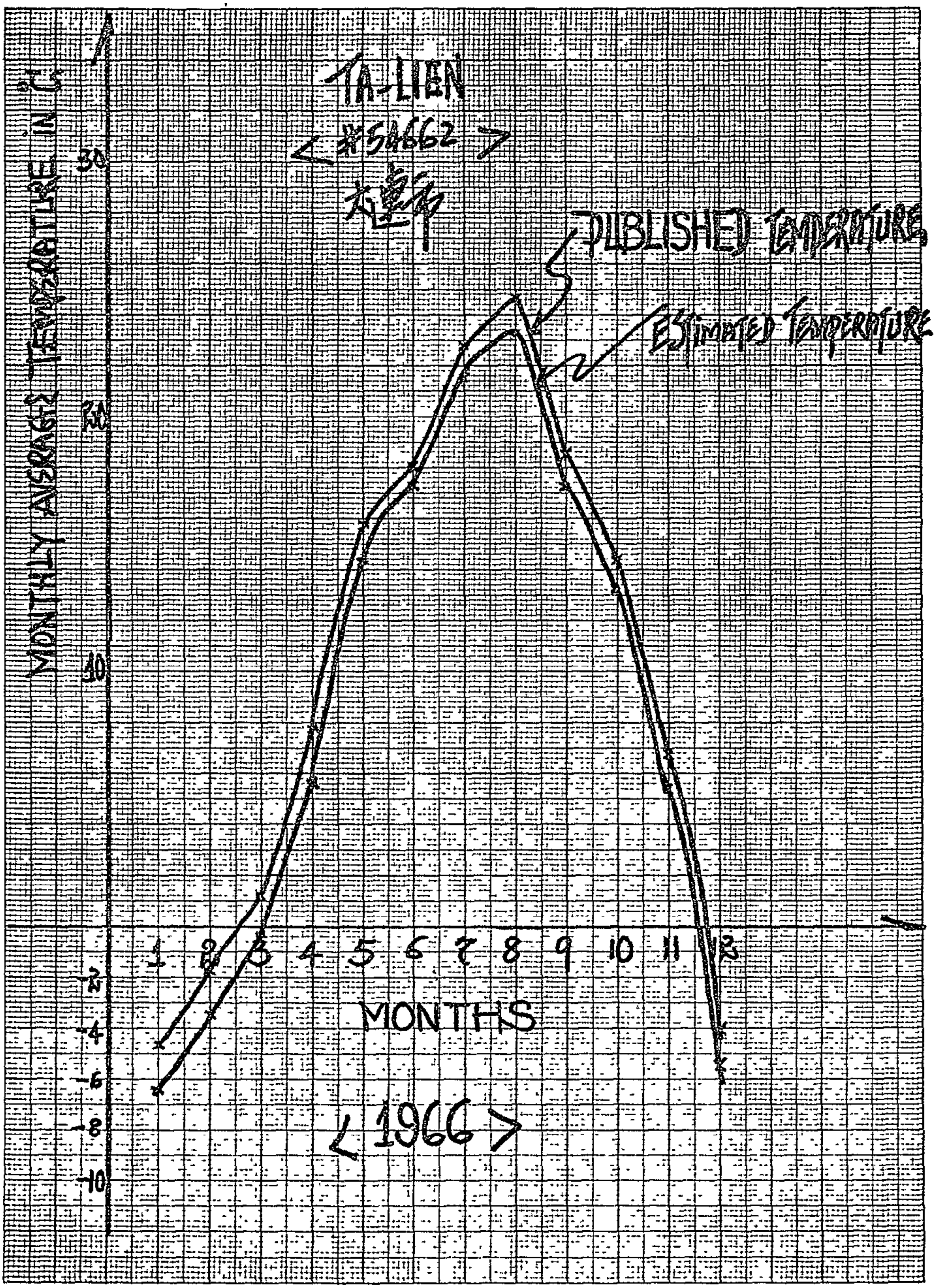

CHI-NAN
54823
济南市
PUBLISHED TEMPERATURE
ESTIMATED TEMPERATURE
30
20
10
-2
-4
-6
-8
-10
1 2 3 4 5 6 7 8 9 10 11 12
MONTHS
< 1965 >

MONTHLY AVERAGE TEMPERATURE

TA-LIEN

#54662

MONTH	1965		1966		1967		1968		1969		1970	
	EST	PUB	EST	PUB	EST	PUB	EST	PUB	EST	PUB	EST	PUB
JAN	-5.60	-4.7	-6.20	-4.5	-6.80	-5.2	-5.16	-5.8	-8.90	-7.1	-7.35	-6.0
FEB	-2.96	-2.3	-3.58	-1.6	-4.95	-4.0	-5.46	-6.6	-9.28	-7.4	-4.17	-2.1
MAR	1.76	2.3	-0.33	1.2	1.52	3.4	4.29	3.1	-1.82	-0.2	-2.68	-0.8
APR	7.03	7.7	5.87	7.9	7.00	9.0	10.81	9.8	6.35	8.4	7.93	9.7
MAY	14.83	15.7	14.26	15.9	14.29	16.6	15.10	14.0	13.02	15.0	14.31	16.5
JUN	19.76	20.1	17.48	18.0	17.40	19.4	20.34	19.2	17.44	19.2	16.25	18.3
JUL	22.00	23.1	21.71	22.6	21.90	23.5	22.26	23.4	21.37	22.5	20.67	21.6
AUG	22.13	22.6	23.34	24.6	24.00	25.3	22.60	24.1	22.34	24.0	22.33	23.8
SEP	20.69	20.7	17.27	18.5	17.11	18.7	19.50	20.7	18.75	19.8	18.50	20.1
OCT	16.19	15.5	13.23	14.2	13.36	14.7	10.68	12.3	11.83	14.0	13.03	14.3
NOV	5.53	6.0	5.47	6.9	2.38	3.9	5.72	7.1	3.70	4.8	4.22	5.9
DEC	-2.77	-2.1	-5.50	-4.0	-6.80	-5.4	-1.65	0.4	-3.71	-1.9	-2.25	-0.6



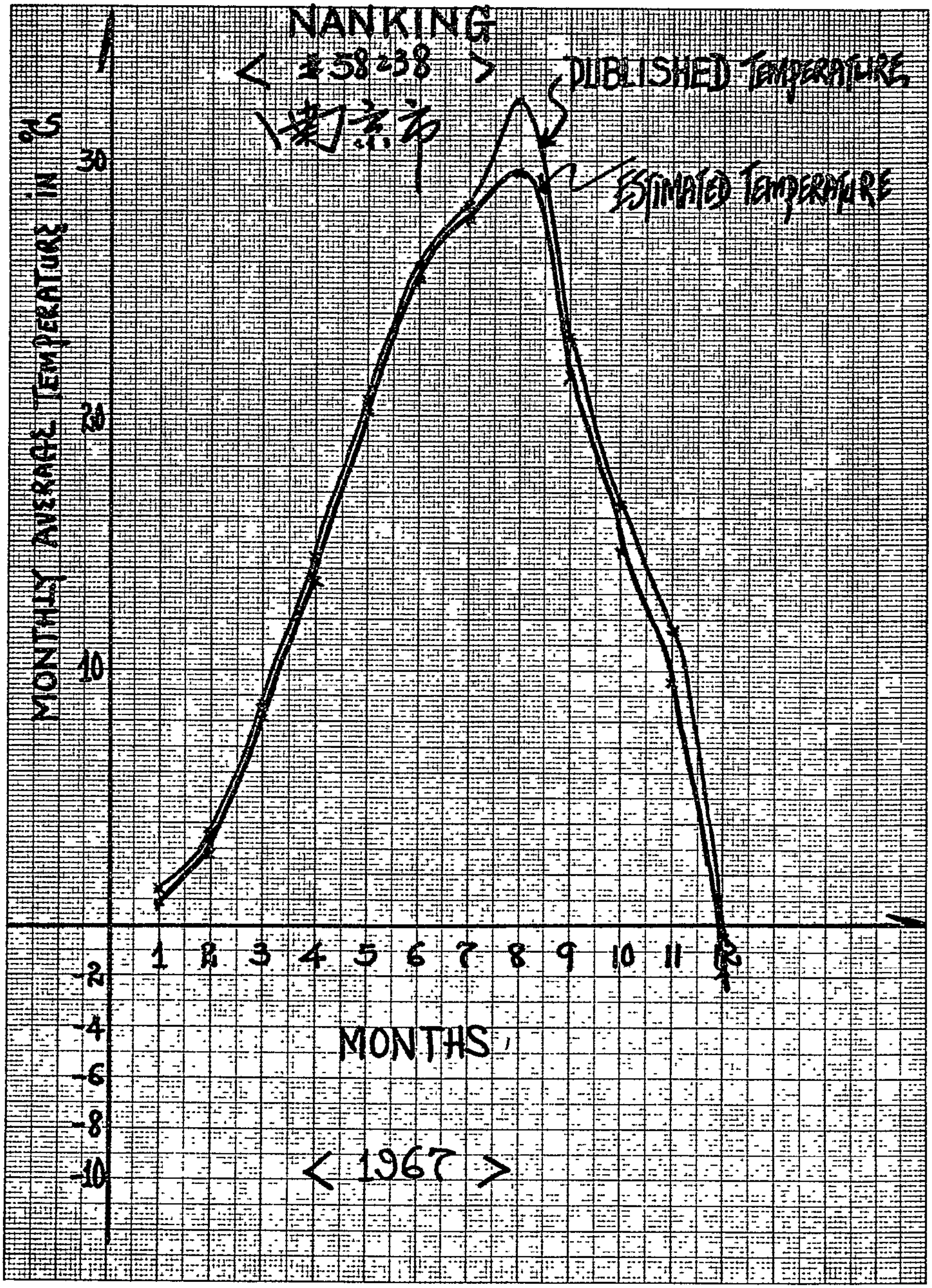
ORIGINAL PAGE IS
OF POOR QUALITY

MONTHLY AVERAGE TEMPERATURE

NANKING

#58238

MONTH	1965		1966		1967		1968		1969		1970	
	EST	PUB	EST	PUB	EST	PUB	EST	PUB	EST	PUB	EST	PUB
JAN	3.41	3.8	2.36	2.9	0.96	1.4	0.35	1.5	-0.15	1.3	-0.68	0.8
FEB	4.37	5.1	4.90	5.9	2.88	3.8	0.76	1.8	-1.56	0.3	4.02	5.2
MAR	7.58	7.9	8.81	9.7	8.04	8.8	8.73	9.7	5.57	7.1	4.60	5.9
APR	12.10	12.7	13.84	14.6	13.33	14.5	16.00	15.1	13.69	14.6	12.89	14.0
MAY	20.31	20.9	18.61	19.8	20.04	20.7	20.78	19.8	20.10	21.3	18.63	20.0
JUN	23.41	23.6	23.51	24.8	25.51	26.0	25.67	24.9	22.10	23.7	22.01	23.3
JUL	27.99	28.4	27.86	28.9	27.36	28.2	27.20	26.8	25.12	26.6	26.55	27.2
AUG	25.26	25.9	28.56	29.6	29.49	30.5	26.43	27.4	26.98	28.4	27.39	28.2
SEP	21.52	22.0	19.96	21.1	21.73	23.0	21.98	23.1	22.96	24.1	21.39	22.6
OCT	16.91	17.0	15.76	17.0	14.95	16.4	14.55	15.4	16.21	17.1	16.15	17.4
NOV	11.31	11.9	9.18	10.4	8.31	9.8	11.22	11.9	6.79	8.3	8.86	10.0
DEC	2.21	3.4	2.26	3.0	-0.56	-0.1	5.92	7.5	2.00	3.2	3.32	4.7



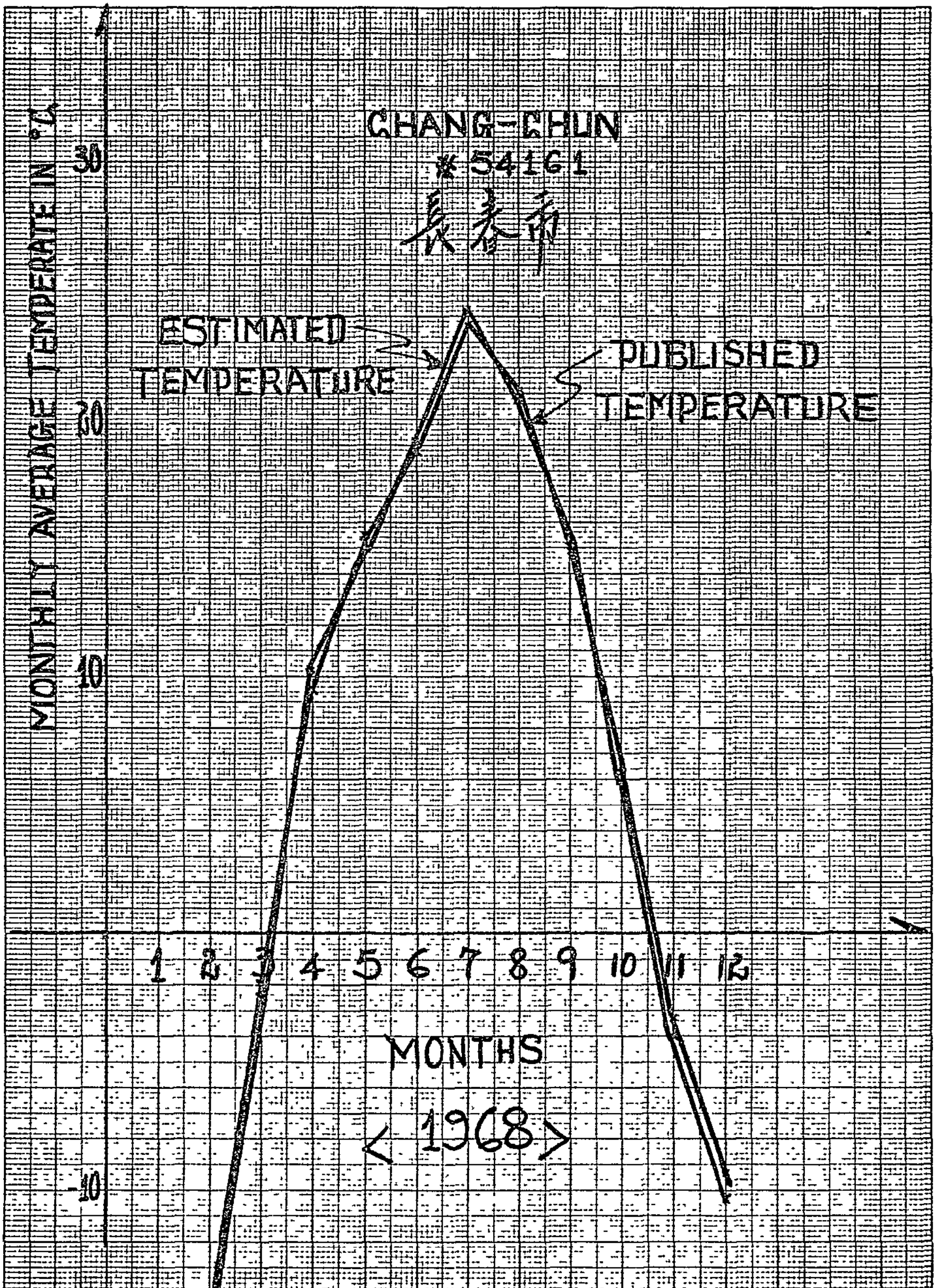
ORIGINAL PAGE IS
OF POOR QUALITY

MONTHLY AVERAGE TEMPERATURE

CHANG-CHUN

#54161

MONTH	1965		1966		1967		1968		1969		1970	
	EST	PUB	EST	PUB	EST	PUB	EST	PUB	EST	PUB	EST	PUB
JAN	-15.49	-15.9	-16.87	-16.9	-14.27	-14.4	-18.43	-17.8	-17.72	-17.8	-20.73	-20.5
FEB	-13.61	-14.0	-10.24	-9.8	-10.92	-11.2	-16.43	-16.4	-15.95	-15.8	-14.20	-13.4
MAR	-4.25	-4.5	-5.22	-4.8	-1.72	-1.3	-2.00	-1.8	-4.36	-4.7	-8.15	-8.1
APR	5.22	4.7	6.26	6.0	7.48	7.6	10.15	9.5	6.37	6.0	8.10	7.9
MAY	15.29	14.9	15.78	16.1	17.68	17.4	15.11	15.3	12.93	13.3	15.66	15.9
JUN	21.51	21.3	20.40	20.3	19.00	18.9	19.11	18.9	18.02	17.9	22.39	21.9
JUL	22.88	22.3	22.52	22.4	23.24	22.9	24.36	23.7	22.75	22.6	22.13	21.7
AUG	20.83	20.4	21.42	21.5	23.25	23.4	21.01	21.2	20.61	20.5	22.28	22.1
SEP	16.25	15.2	13.94	13.8	15.90	15.2	15.07	14.9	14.44	14.4	15.06	15.2
OCT	8.28	7.9	8.38	8.7	9.27	8.7	6.12	6.2	6.65	7.1	7.22	7.5
NOV	-4.30	-4.1	-4.08	-3.2	-6.73	-6.1	-3.98	-3.3	-6.93	-6.6	-2.72	-2.4
DEC	-14.81	-15.3	-15.95	-15.9	-18.30	-17.9	-10.04	-9.2	-16.81	-16.1	-12.42	-12.6



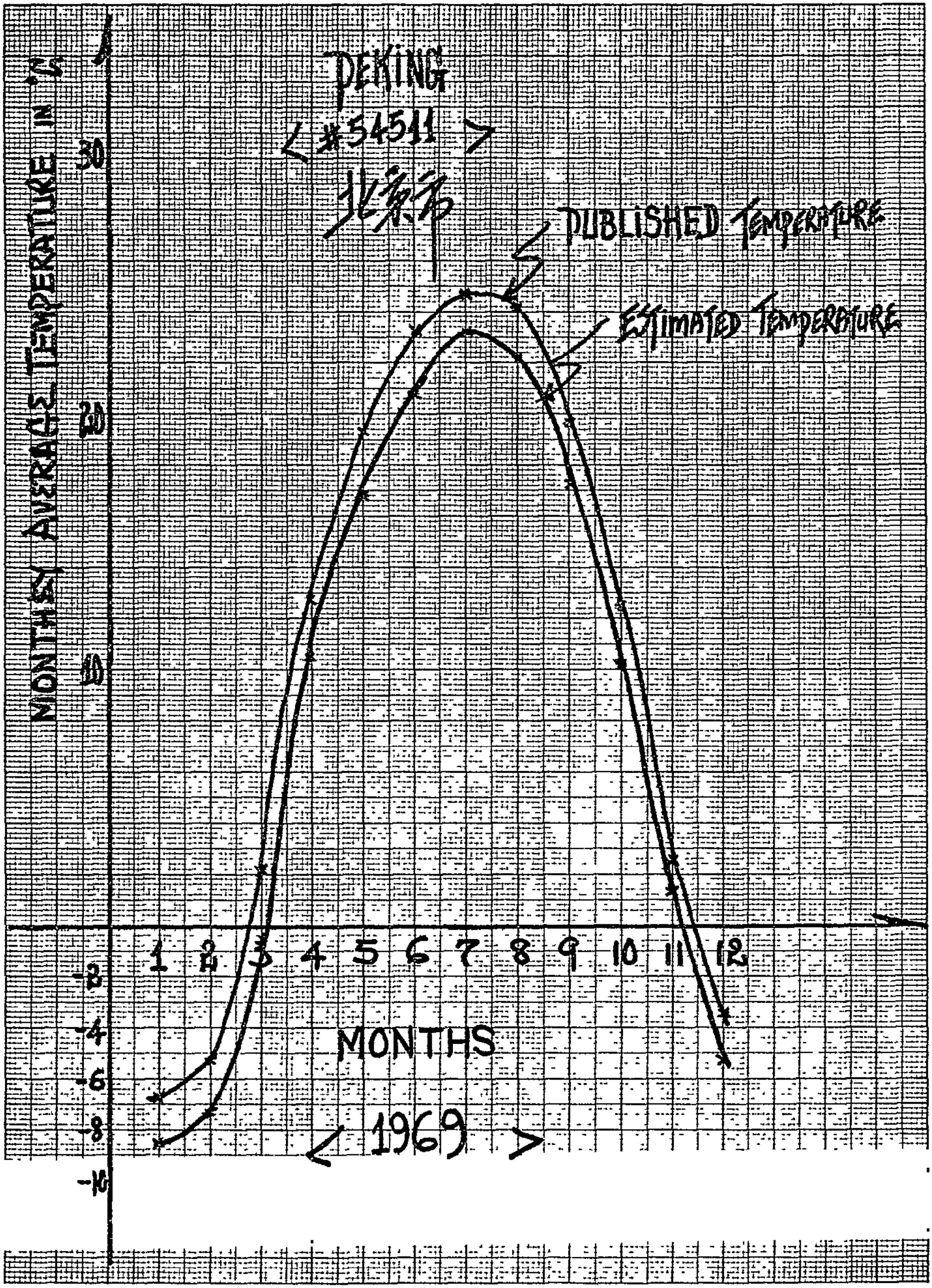
ORIGINAL PAGE IS
OF POOR QUALITY

MONTHLY AVERAGE TEMPERATURE

PEKING

#54511

MONTH	1965 EST	1965 PUB	1966 EST	1966 PUB	1967 EST	1967 PUB	1968 EST	1968 PUB	1969 EST	1969 PUB	1970 EST	1970 PUB
JAN	-7.06	-4.9	-6.50	-5.7	-6.08	-4.8	-6.96	-5.6	-8.22	-6.4	-7.04	-5.6
FEB	-1.41	-1.7	-2.43	-2.5	-4.79	-3.3	-6.37	-4.9	-7.15	-5.1	-4.03	-2.0
MAR	4.50	4.4	1.70	3.4	3.63	4.8	4.38	5.7	-0.15	2.1	-0.10	2.0
APR	10.65	10.9	10.51	12.6	10.45	12.8	12.11	14.2	10.34	12.9	11.31	13.6
MAY	20.35	20.8	17.79	19.7	20.63	22.1	17.61	20.3	16.96	19.3	16.59	19.7
JUN	23.98	24.6	22.28	23.8	21.16	23.7	23.06	25.5	20.92	23.3	20.12	22.8
JUL	25.87	26.9	24.02	25.6	23.63	25.3	25.47	26.9	23.13	24.6	23.16	24.8
AUG	24.19	24.8	23.94	25.0	23.72	25.1	22.68	24.2	22.12	24.2	22.51	27.8
SEP	20.83	20.2	17.35	18.7	16.67	18.3	17.99	19.7	17.56	19.6	17.69	18.9
OCT	16.20	14.1	11.42	12.8	11.44	13.0	9.83	11.2	10.19	12.3	11.31	13.0
NOV	5.42	4.6	2.50	3.7	0.49	2.0	2.86	3.9	1.38	2.8	1.39	3.0
DEC	-4.10	-3.9	-5.70	-4.7	-7.59	-6.0	-3.25	-1.7	-5.09	-3.4	-4.40	-3.1

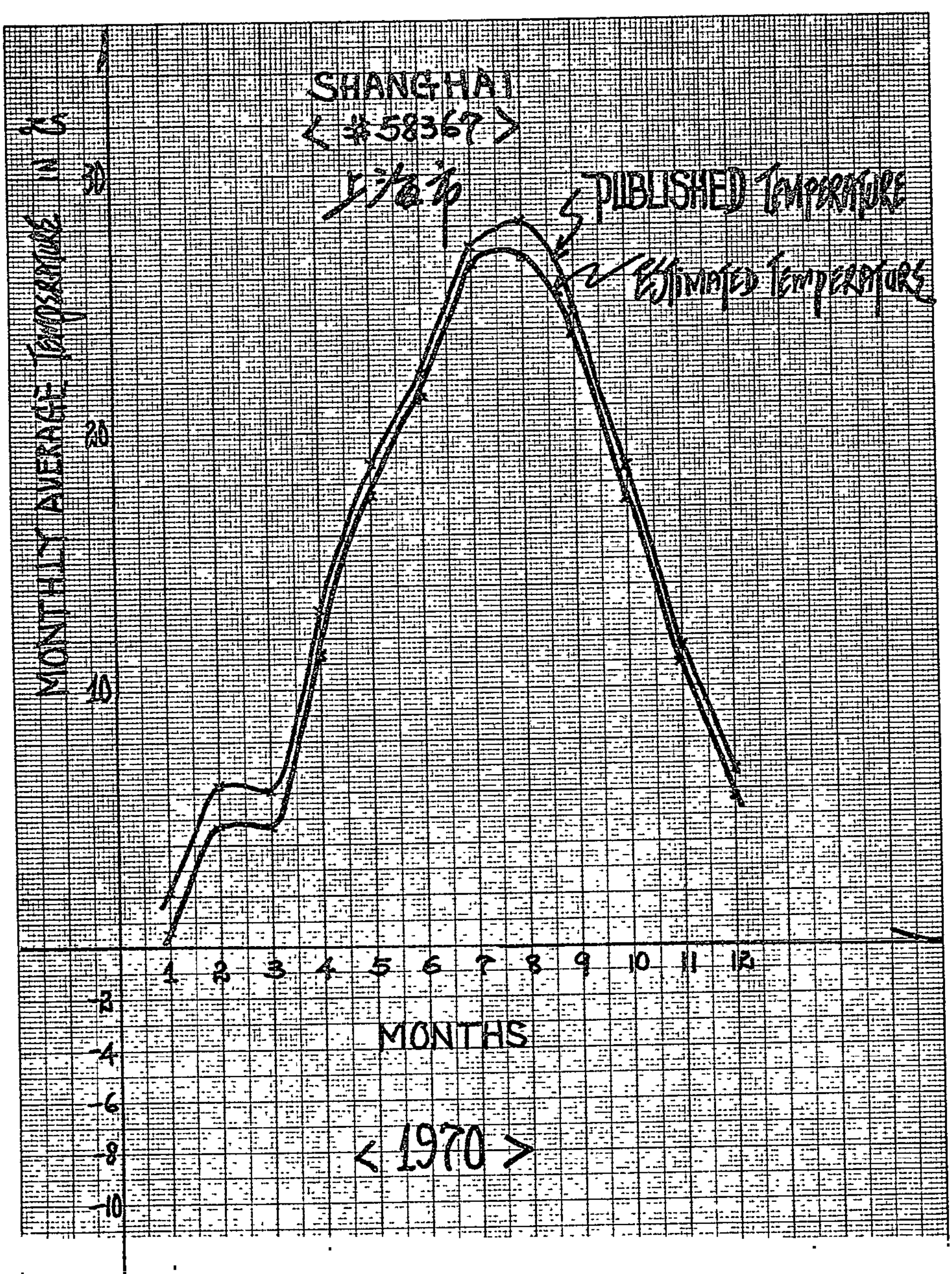

PEKING
<#54511>
北京市
PUBLISHED TEMPERATURE
ESTIMATED TEMPERATURE
MONTHLY AVERAGE TEMPERATURE IN °C
30
20
10
-2
-4
-6
-8
-10
1 2 3 4 5 6 7 8 9 10 11 12
MONTHS
< 1969 >

MONTHLY AVERAGE TEMPERATURE

SHANGHAI

#58367

MONTH	1965 EST	1965 PUB	1966 EST	1966 PUB	1967 EST	1967 PUB	1968 EST	1968 PUB	1969 EST	1969 PUB	1970 EST	1970 PUB
JAN	4.56	5.1	3.62	4.3	1.42	2.0	1.85	2.8	2.10	3.6	0.81	2.0
FEB	4.98	5.7	5.55	6.6	3.50	4.0	0.34	1.8	0.93	2.6	4.80	6.0
MAR	7.34	7.7	9.25	10.2	8.08	8.7	7.94	8.8	5.37	6.8	4.87	6.0
APR	11.10	12.2	13.36	13.8	12.88	13.6	14.11	13.7	12.91	14.2	11.67	13.1
MAY	19.06	19.5	17.64	19.0	18.18	19.3	18.98	18.7	18.55	19.6	17.70	18.7
JUN	21.29	22.2	22.49	23.6	23.91	24.3	22.90	22.6	21.31	22.5	21.19	22.1
JUL	27.28	28.1	26.09	27.1	27.03	28.0	27.07	26.7	25.68	26.7	26.73	27.1
AUG	26.46	26.9	27.44	28.6	28.53	29.5	26.37	27.5	27.10	28.0	26.89	28.1
SEP	21.96	22.7	21.10	22.3	23.14	24.0	22.57	23.7	23.96	25.0	23.85	24.7
OCT	18.09	18.0	16.66	18.1	17.10	18.4	16.08	17.4	16.42	18.0	17.55	18.5
NOV	13.31	13.9	11.13	12.6	11.04	12.5	12.19	13.3	9.26	10.3	11.22	11.8
DEC	4.26	4.9	5.19	6.1	-0.04	1.0	7.88	9.5	3.93	4.9	5.87	6.9


SHANGHAI
<#58367>
上海市
PUBLISHED TEMPERATURE
ESTIMATED TEMPERATURE
MONTHLY AVERAGE TEMPERATURE IN °C
30
20
10
-2
-4
-6
-8
-10
1 2 3 4 5 6 7 8 9 10 11 12
MONTHS
<1970>

ANALYSIS OF VARIANCE

SOURCE OF VARIATIONS	DEGREES OF FREEDOM	SUM OF SQUARES	MEAN SQUARE	F - RATIO
BETWEEN GROUPS	$p - 1$	BSS	$BMS = BSS/(p-1)$	
WITHIN GROUPS	$N - p$	WSS	$WMS = WSS/(N-p)$	$F = BMS/WMS$
TOTAL	$N - 1$	TSS		

WHERE p IS THE # OF GROUPS
N IS THE # OF OBSERVATIONS
R_i IS THE # OF OBSERVATION PER GROUP

$$TSS = \sum_i \sum_j X_{ij}^2 - \left(\sum_i \sum_j X_{ij}\right)^2 / N$$

$$BSS = \sum_i \left(\sum_j X_{ij}\right)^2 / R_i - \left(\sum_i \sum_j X_{ij}\right)^2 / N$$

$$WSS = \sum_i \sum_j X_{ij}^2 - \sum_i \left(\sum_j X_{ij}\right)^2 / R_i$$

$i, j = 1, 2, 3 \cdots\cdots N$

ORIGINAL PAGE IS
OF POOR QUALITY

ORIGINAL PAGE IS OF POOR QUALITY

TA-LIEN(#54662)

LOCKHEED	U.S.AIR FORCE	HONG KONG ROYAL
21.80	23.34	25.000
26.67	27.86	25.000
35.18	36.14	36.000
45.60	45.86	48.000
58.69	60.26	59.000
67.58	68.18	68.000
71.61	73.58	73.000
71.48	72.68	76.000
69.24	69.24	69.000
61.15	59.90	58.000
41.95	42.80	43.000
27.00	28.00	30.000

SUM= 1815.79 SUMSQ= 103413.06

SUM OF GROUP(1) IS 597.95

SUM OF GROUP(2) IS 607.84

SUM OF GROUP(3) IS 610.00

ANALYSIS OF VARIANCE

SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	F RATIO
BETWEEN GROUP	2	6.938	3.469	
WITHIN GROUPS	33	11820.375	358.193	0.010
TOTAL	35	11827.313		

SINCE FCAL<FTAB,SO ACCEPT THE HYPOTHESE

PEKING(#54511)

LOCKHEED	U.S.AIR FORCE	HONG KONG ROYAL
19.28	23.18	23.000
29.44	28.94	29.000
40.45	39.92	41.000
51.17	51.62	57.000
68.64	69.44	68.000
75.17	76.28	76.000
78.58	80.42	79.000
75.54	76.64	76.000
70.50	68.36	68.000
61.18	57.36	54.000
41.77	40.28	38.000
24.65	24.38	27.000

SUM= 1909.19 SUMSQ= 116026.31

SUM OF GROUP(1) IS 636.37

SUM OF GROUP(2) IS 636.82

SUM OF GROUP(3) IS 636.00

ANALYSIS OF VARIANCE

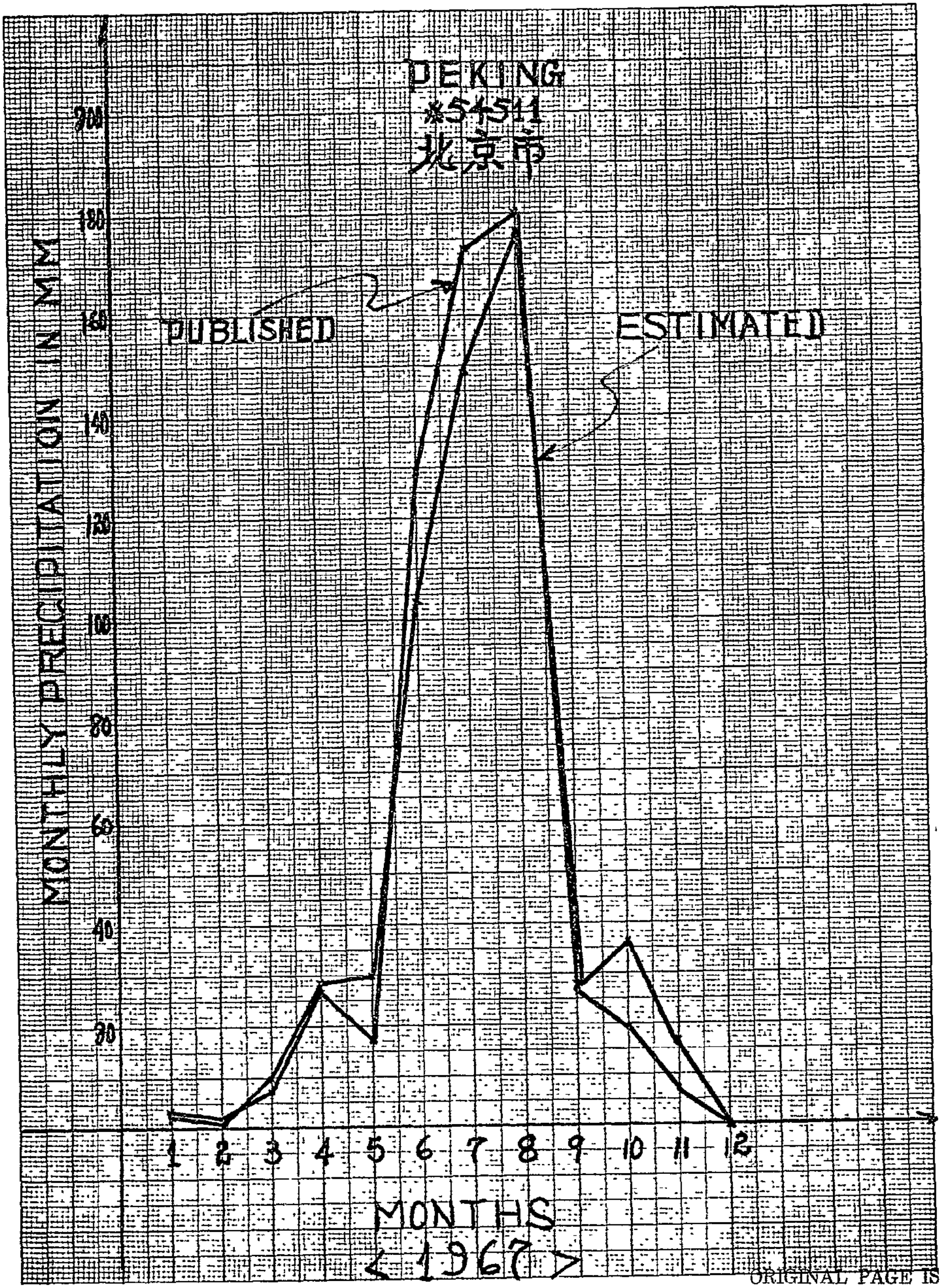
SOURCE OF VARIATION	DEGREE OF FREEDOM	SUM OF SQUARE	MEAN SQUARE	F RATIO
BETWEEN GROUP	2	0.125	0.063	
WITHIN GROUPS	33	14776.313	447.767	0.000
TOTAL	35	14776.438		

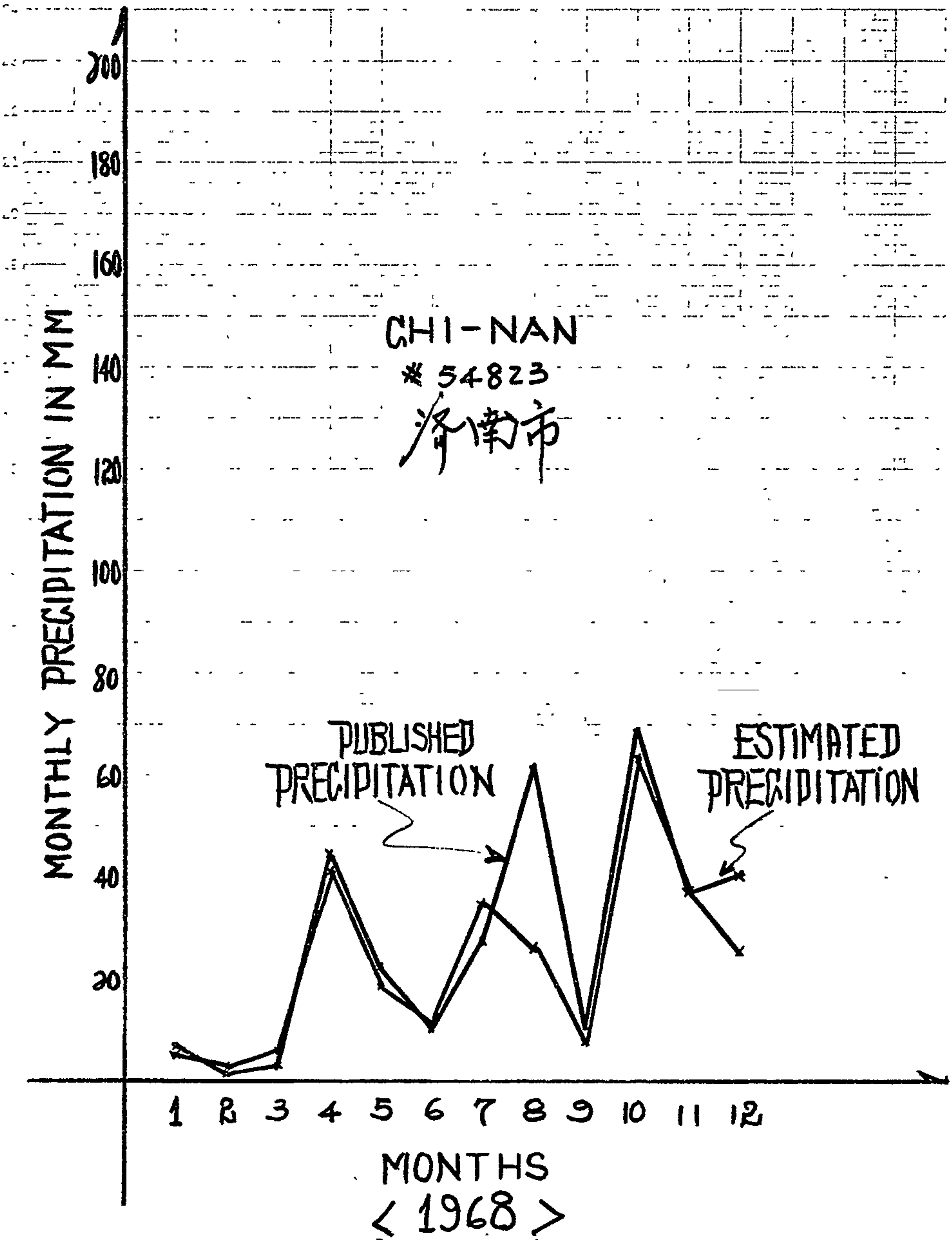
SINCE FCAL<FTAB,SO ACCEPT THE HYPOTHESE

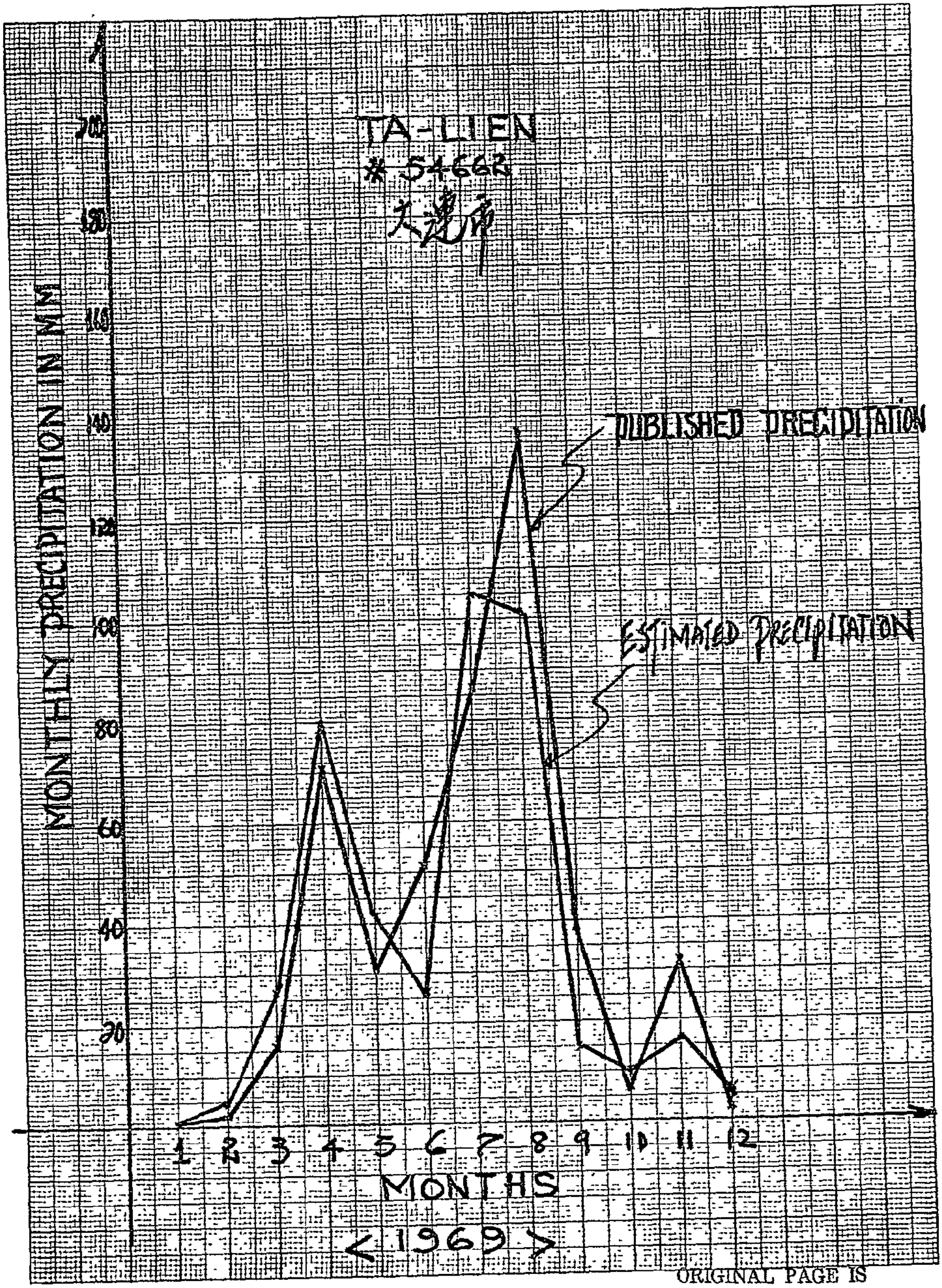
MONTHLY PRECIPITATION

(In Millimeters)

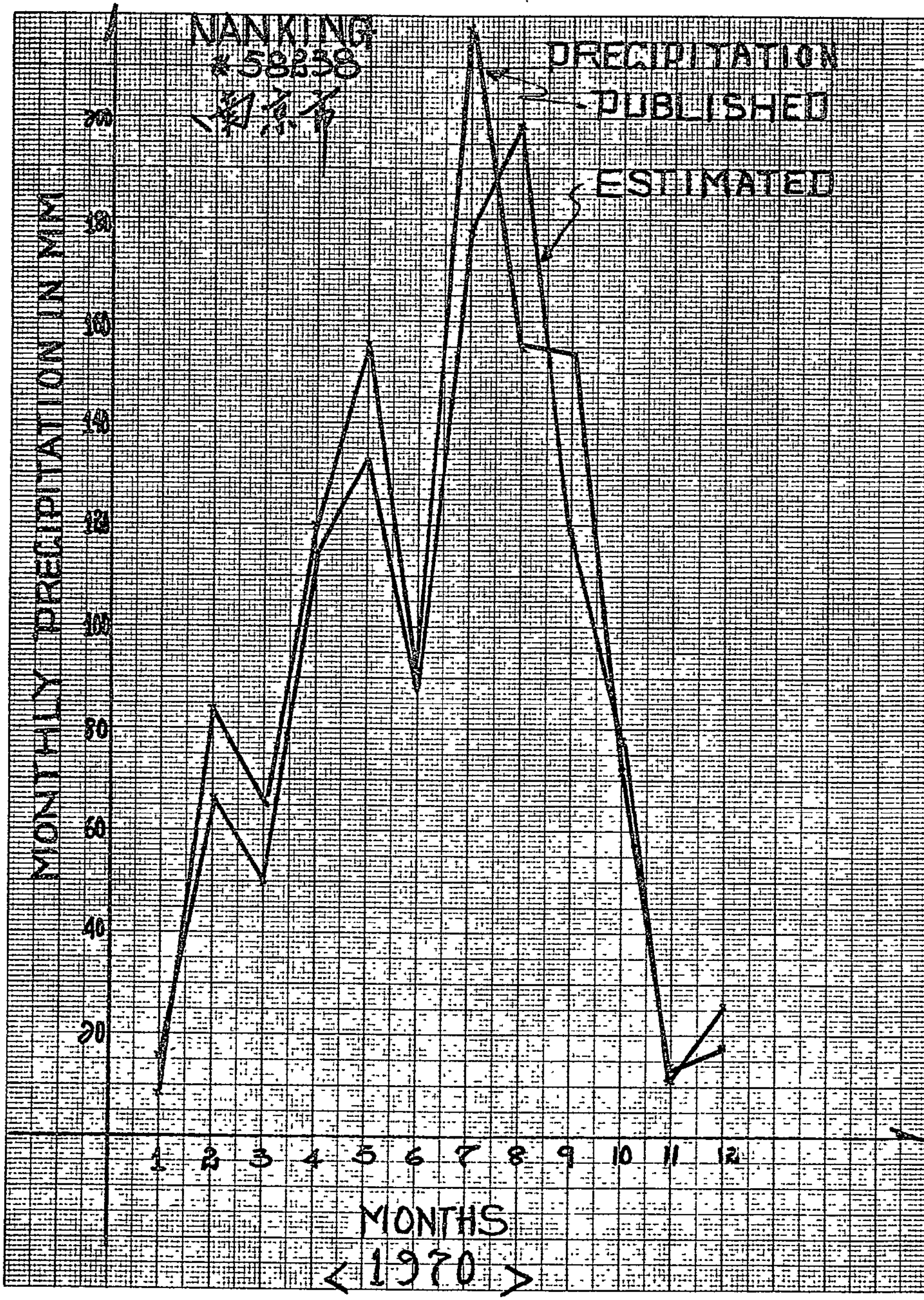
	1967		1968		1969		1970	
	PEKING #54511		CHI-NAN #54823		TA-LIEN #54662		NANKING #58238	
MONTH	EST	PUB	EST	PUB	EST	PUB	EST	PUB
JAN	2.0	2.8	5.8	7.3	0.0	0.7	15.7	9.3
FEB	1.7	2.4	1.7	1.5	5.3	3.4	66.0	84.1
MAR	10.6	7.7	5.8	3.4	27.1	16.0	50.8	66.6
APR	29.7	26.8	41.4	45.1	80.2	70.3	115.8	120.0
MAY	30.2	17.4	19.3	22.1	42.4	32.0	132.0	155.5
JUN	104.6	129.7	10.4	10.0	26.1	51.4	87.1	91.5
JUL	149.1	173.5	34.5	27.9	105.4	87.8	176.2	218.2
AUG	177.1	180.4	25.1	61.3	101.1	137.0	198.8	155.2
SEP	27.4	26.0	8.8	10.2	15.7	38.7	119.3	154.7
OCT	37.8	19.7	64.5	68.9	10.4	7.9	74.4	71.1
NOV	7.5	7.0	37.5	37.5	15.4	32.1	12.9	13.7
DEC	0.0	0.0	40.6	25.5	5.6	4.6	26.4	14.7
ANNUAL (mm)	577.7	593.4	295.4	320.7	434.7	481.9	1075.4	1154.6
TOTAL (in)	22.7	23.3	11.6	12.6	17.1	18.0	42.0	45.0


PEKING
*54511
北京市
PUBLISHED
ESTIMATED
MONTHLY PRECIPITATION IN MM
200
180
160
140
120
100
80
60
40
20
1 2 3 4 5 6 7 8 9 10 11 12
MONTHS
< 1967 >


CHI-NAN
※ 54823
济南市
PUBLISHED PRECIPITATION
ESTIMATED PRECIPITATION
MONTHLY PRECIPITATION IN MM
200
180
160
140
120
100
80
60
40
20
1 2 3 4 5 6 7 8 9 10 11 12
MONTHS
< 1968 >



ORIGINAL PAGE IS
OF POOR QUALITY


NANKING
*58238
南京市
PRECIPITATION
PUBLISHED
ESTIMATED
MONTHLY PRECIPITATION IN MM
200
180
160
140
120
100
80
60
40
20
1 2 3 4 5 6 7 8 9 10 11 12
MONTHS
< 1970 >

4. OPERATIONS

4.1 LEAST SQUARES INTERPOLATION

This program was designed to work on more than one data set which is denoted by a parameter NS.

Each data set contains XP and YP up to 100 observations as input data; in each card, punch XP in columns 2-6 and YP in columns 7-11, with one decimal point at column 5 and column 10 for XP and YP, respectively.

At the end of each data set punch a trailer card with -99.0000.0 in columns 2-11.

Example of a program setup:

```
//   JOB CARD
//SS   EXEC  FCALCMGO,  PARM.FORM = 'MAP'
//FORT.SYSIN              DD             *
     SOURCE PROGRAM OF LEAST SQUARES INTERPOLATION
//GO.SYSIN                DD             *
     DATA CARDS
/*
//
```


4.2 THE MODIFIED MAX-MIN PROGRAM

The daily estimates of maximum and minimum air temperatures and the sum of precipitation measurements reported each day are obtained according to procedures described in "As-Built Design Specifications for Historical Daily Data Bases for Testing Advanced Models", AD 63-1347-4963-08 (JSC-12891, LEC-10572, April 1977).

4.3 THE MONTHLY DATA BASES ALGORITHM

This program needs no input data from cards; all its input variables are read in from the magnetic tape.

Daily data are stored in tapes by years, each file contains one year's daily data, each of 85-95 stations.

Example of a program setup:

```
//     JOB CARD
/*  SETUP        TAPE = 1
//SS    EXEC  FTG1CLG, PARM•FORT = 'MAP'
// FORT•SYSIN            DD          *
     SOURCE PROGRAM OF THE MONTHLY DATA BASES ALGORITHM
//LKED•SYSIN             DD .        *
     INCLUDE BMDSUB  (BMDZ992)
//LKED•BMDSUB            DD   DSN=SYS2•BMD•LOAD, DISP = SHR
//GO•FT   09F001         DD   DSN=CH68A,
//  UNIT=TAPE, VOL =(, RETAIN, SER = X06121),
//  DCB =(RECFM=FB,  LBECL=26,  BLKSIZE=7800, DEN=4),
//  LABEL =(44,,,IN),
//  DISP=OLD, SHR)
//GO•FT10F001            DD   DSN=CH68B
//  UNIT = TAPE, VOL= SER = X06121,
//  DCB= (RECFM = FB, LBECL = 26, BLKSIZE=7800, DEN=4),
//  LABEL = (45,,,IN)
//  DISP = (OLD, KEKP)
//GO•SYSIN               DD
/*
//
```

4.4 THE ANALYSIS OF VARIANCE ALGORITHM

Twelve input cards (one for each month) are required for running the program. Each card contains three estimates of the monthly mean temperature based on the KSU algorithm output, the "published" values obtained through NCC from ETAC for years available and period of record means obtained from various Chinese publications. These values are located as follows:

Columns 1-5 contains KSU estimates
" 7-11 " ETAC record
" 13-18 " period of record means

and each field contains two digits, i.e., one decimal point punched in columns 3, 9, and 15, for KSU, ETAC and period of record means.

Example of a program setup:

```
//   JOB CARD
//SS EXEC  FTG1CLG, PARM.FORT= 'MAP'
//FORT.SYSIN           DD'      *
       SOURCE PROGRAM OF AOV ALGORITHM
//GO.SYSIN             DD       *
       DATA CARD
/*
//
```

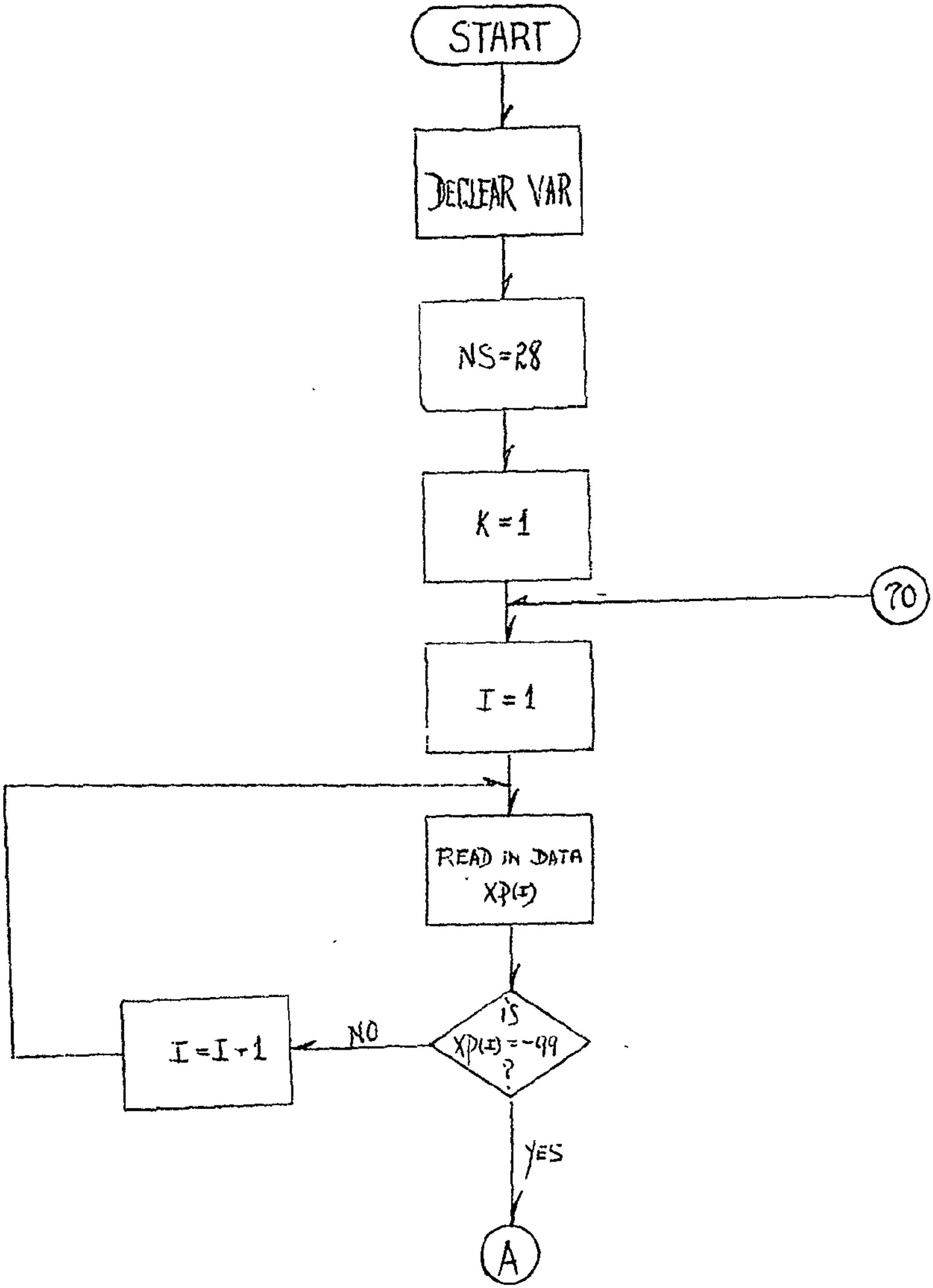
5. ACKNOWLEDGEMENT:

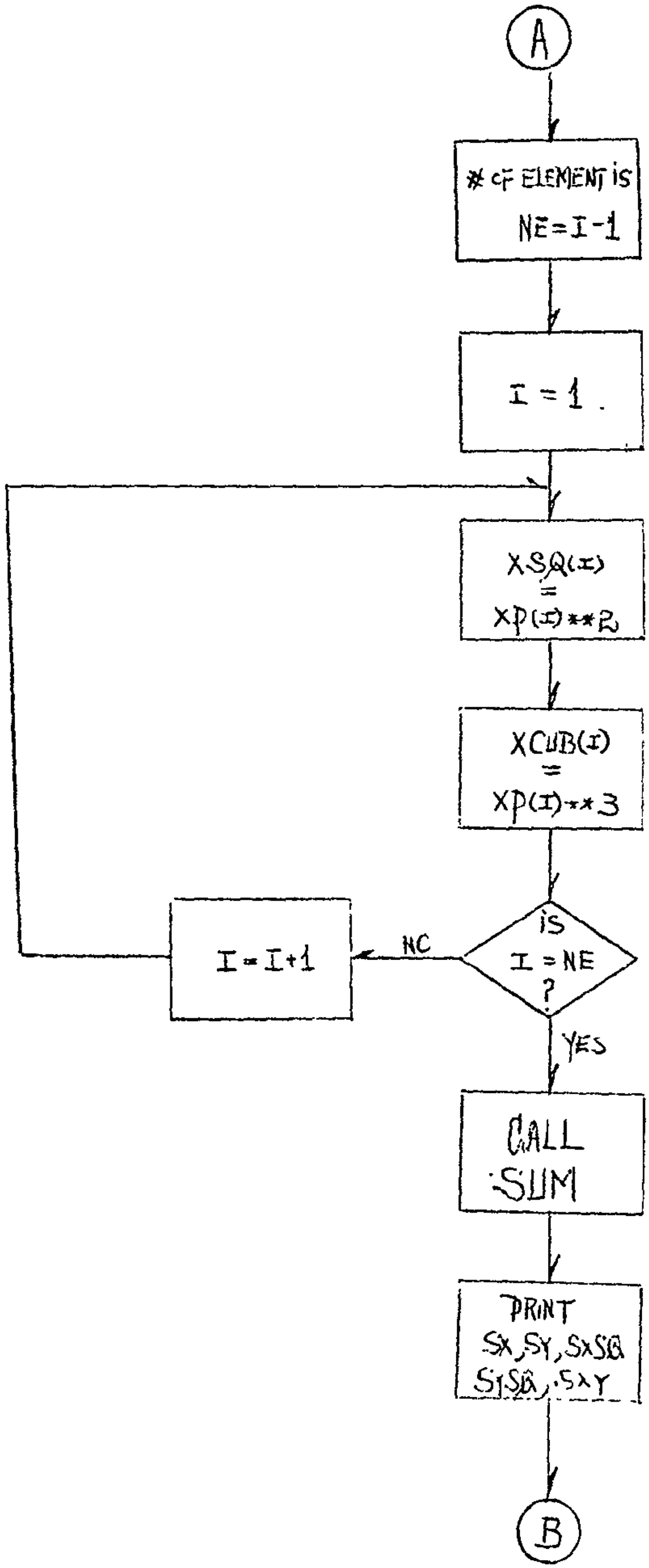
The contribution of the University of Missouri-Columbia, in furnishing computer time for the derivation of these data bases is gratefully acknowledged. Without the cooperation of Dr. Wayne L. Decker, Chairman of the Department of Atmospheric Sciences, University of Missouri-Columbia, this data-source would have been much later in making its appearance.

APPENDIX A

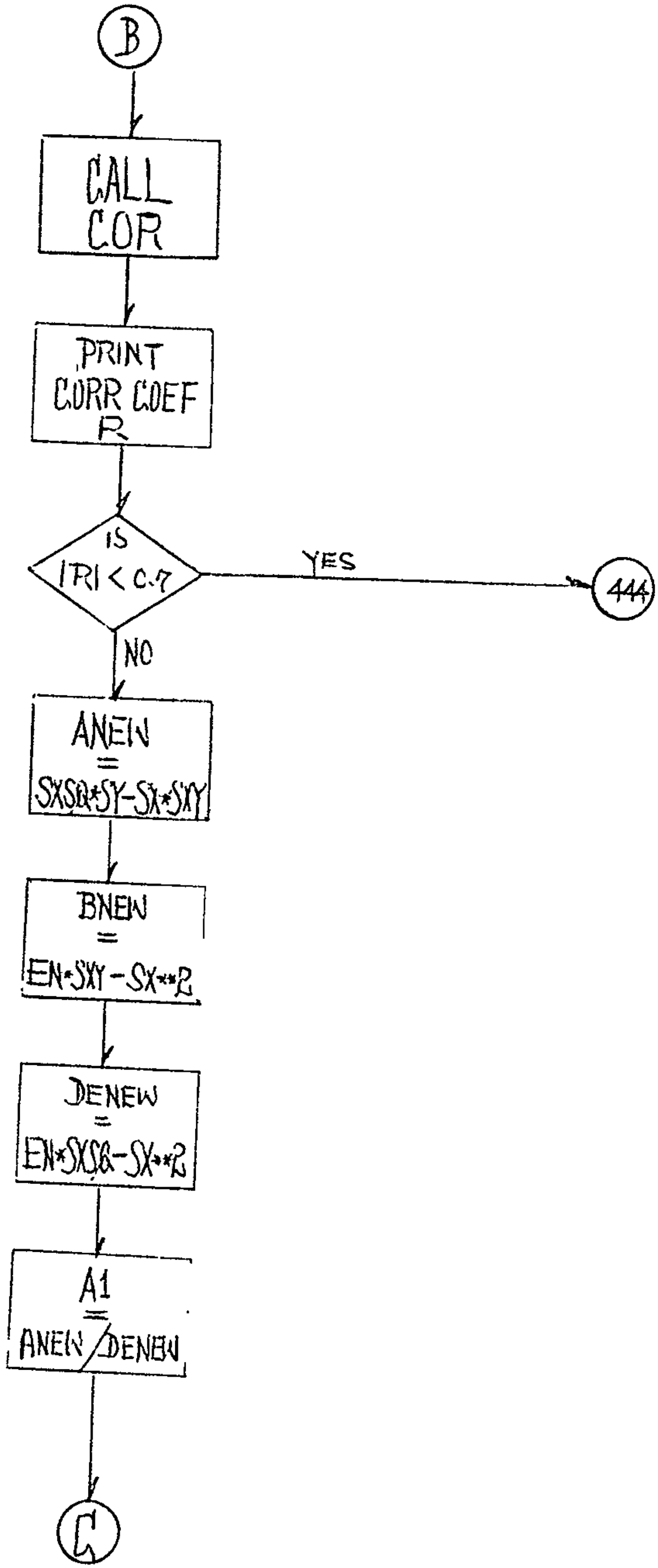
TABLE OF CONTENTS

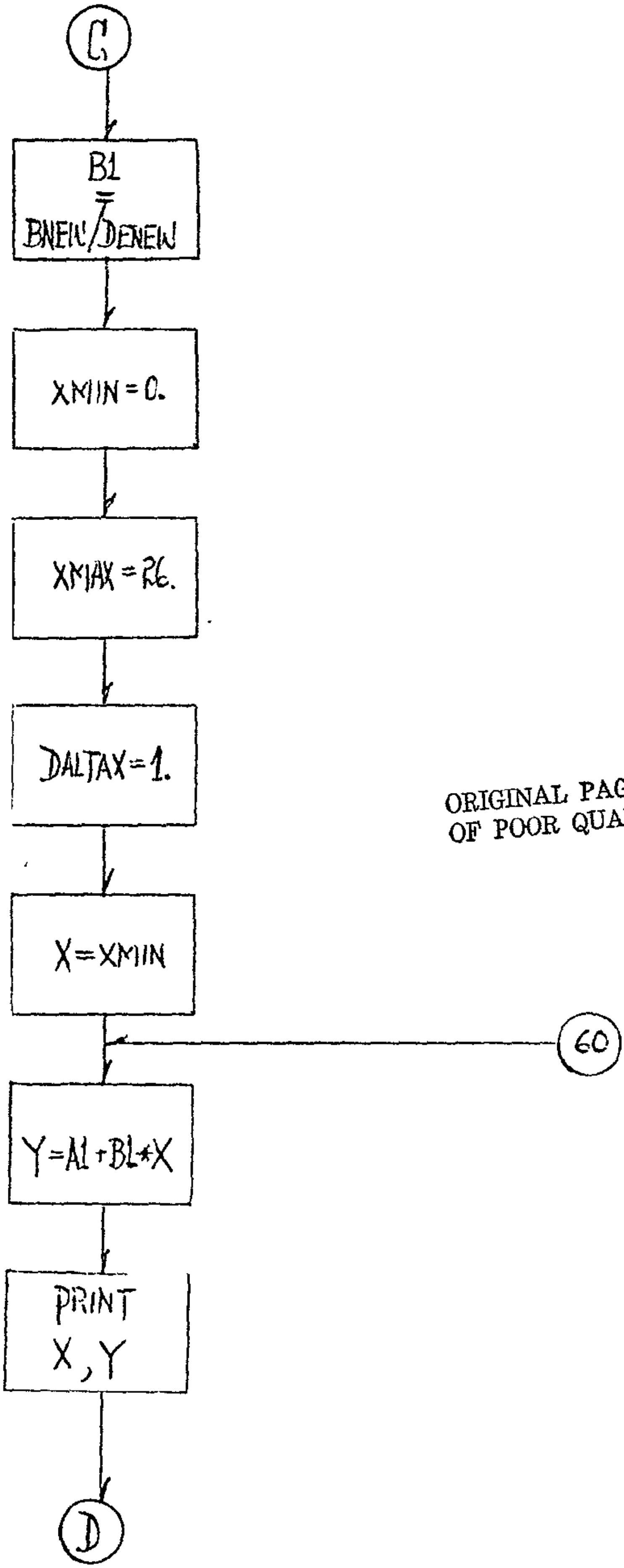
LEAST SQUARES INTERPOLATION



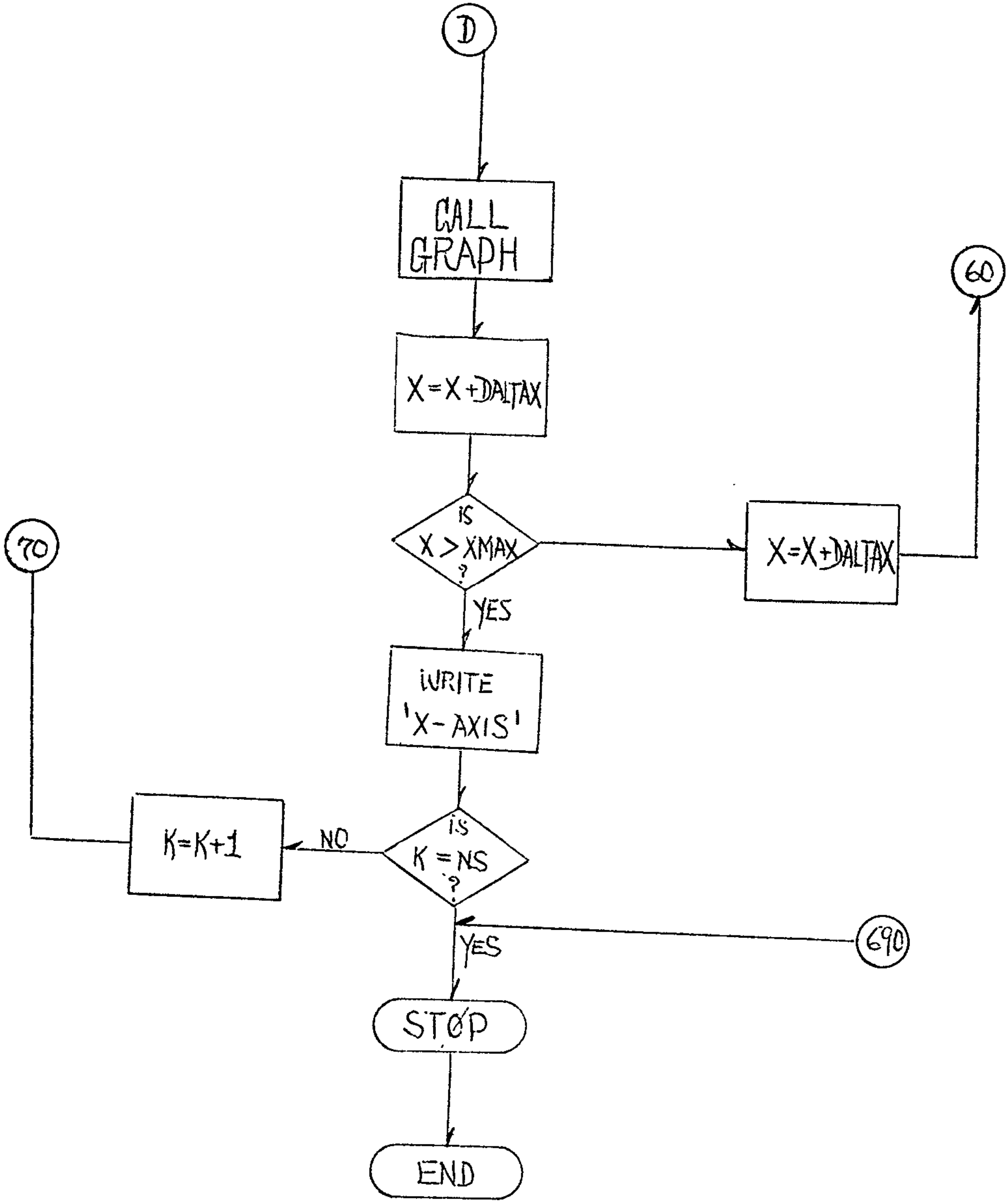


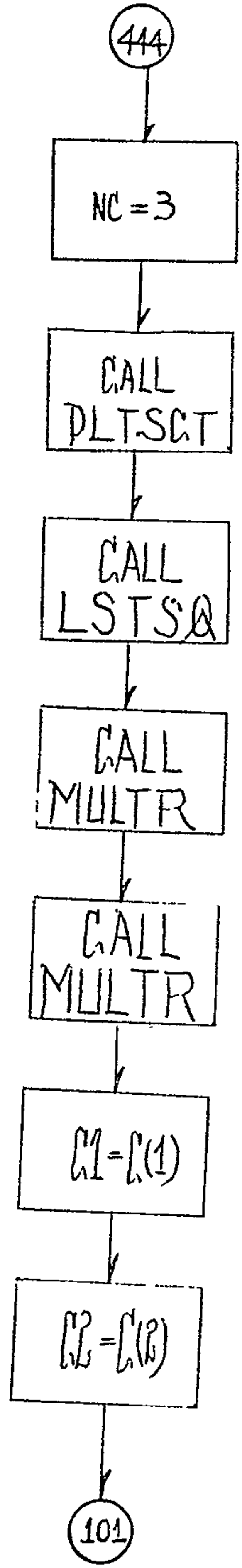
ORIGINAL PAGE IS
OF POOR QUALITY

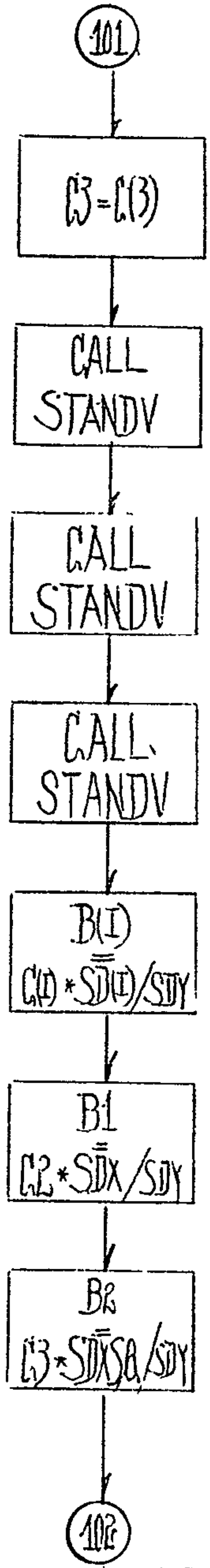

B
CALL COR
PRINT CORR COEF R
IS |R| < 0.7
YES
444
NO
ANEW = SXSQ*SY-SX*SXY
BNEW = EN*SXY-SX**2
DENEW = EN*SXSQ-SX**2
A1 = ANEW/DENEW
C

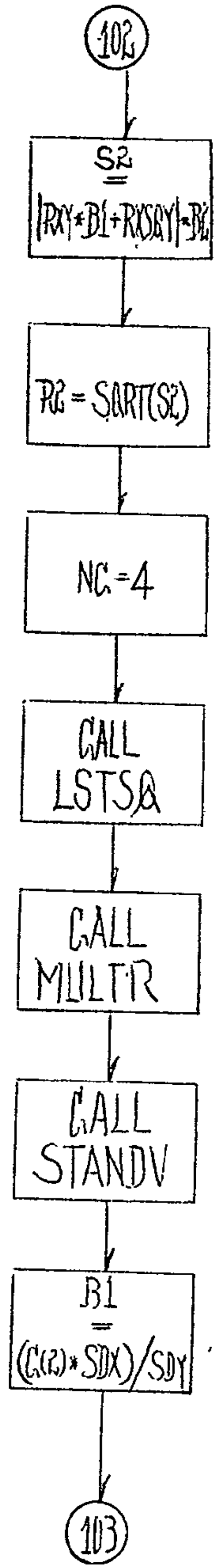


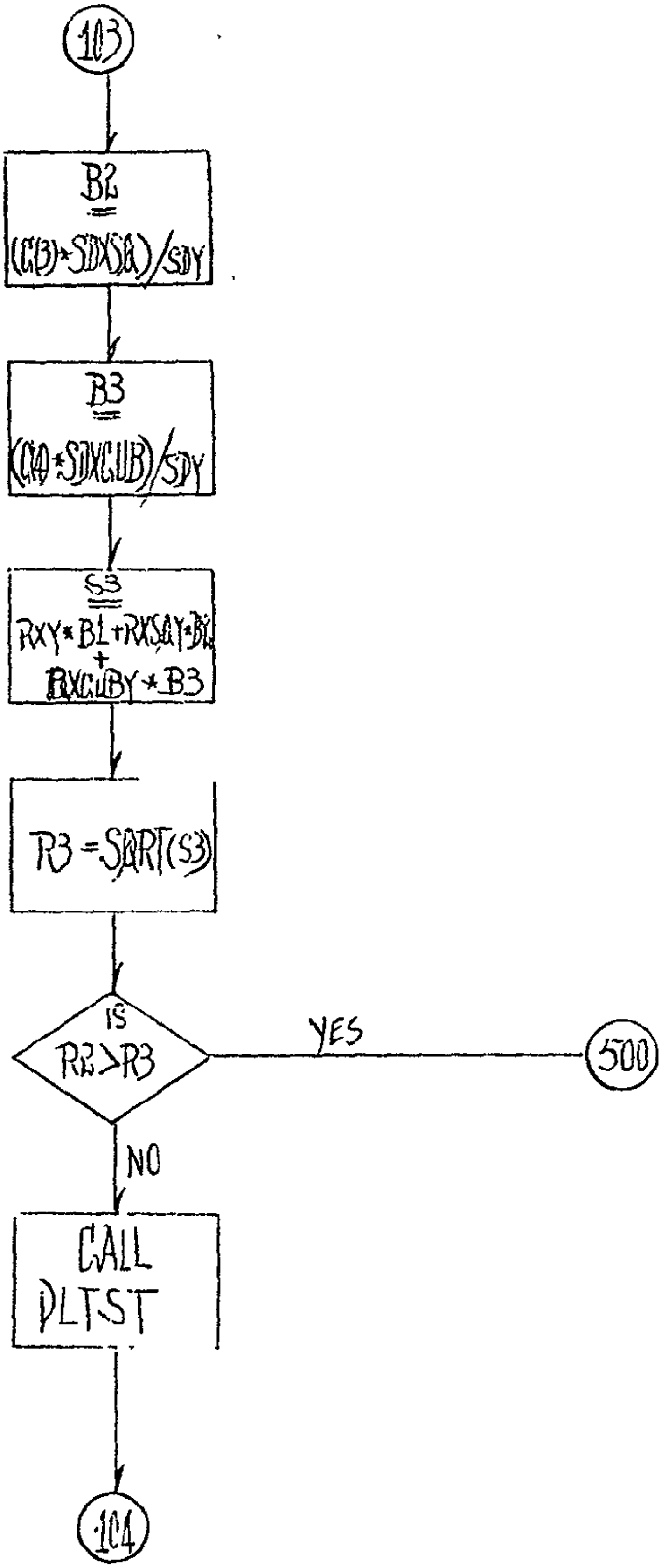
ORIGINAL PAGE IS
OF POOR QUALITY


D
CALL GRAPH
X=X+DALTAX
IS X > XMAX ?
X=X+DALTAX
60
YES
WRITE 'X-AXIS'
70
K=K+1
NO
IS K = NS ?
YES
690
STØP
END

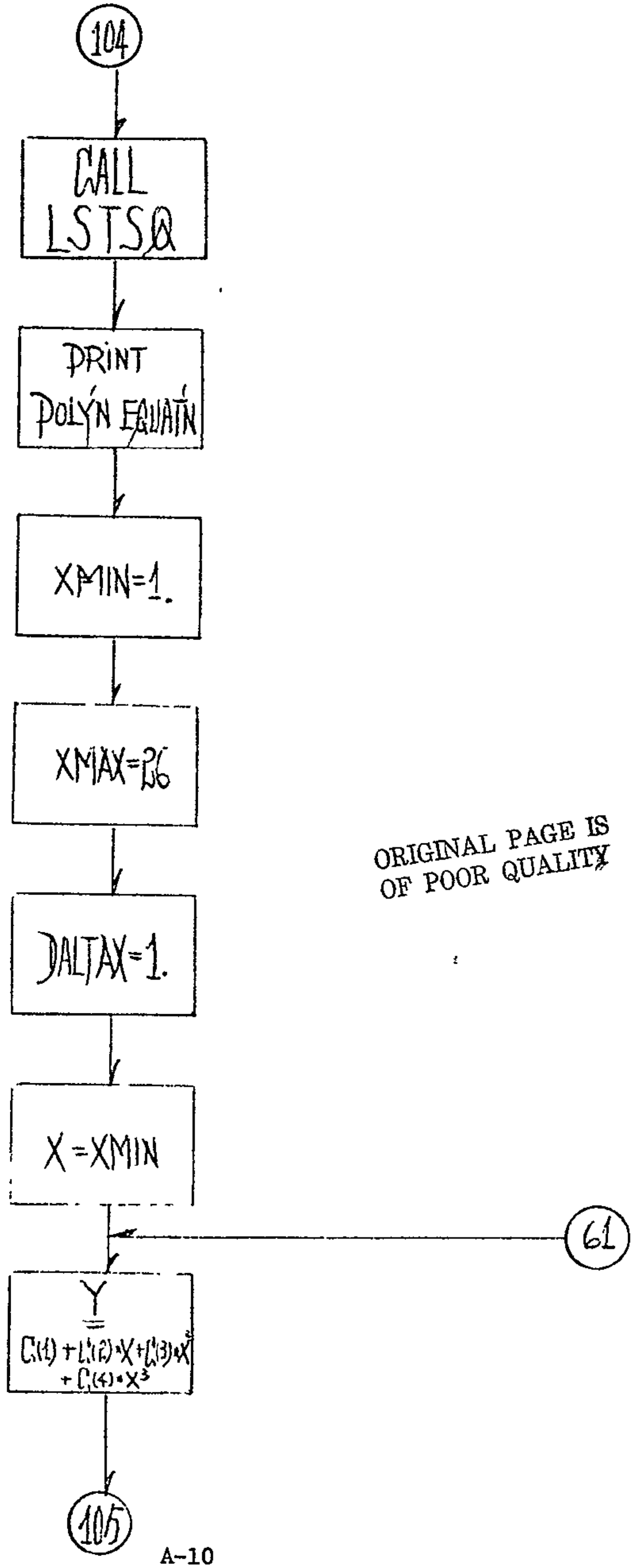

444
NC = 3
CALL PLTSCT
CALL LSTSQ
CALL MULTR
CALL MULTR
C1 = C(1)
C2 = C(2)
101

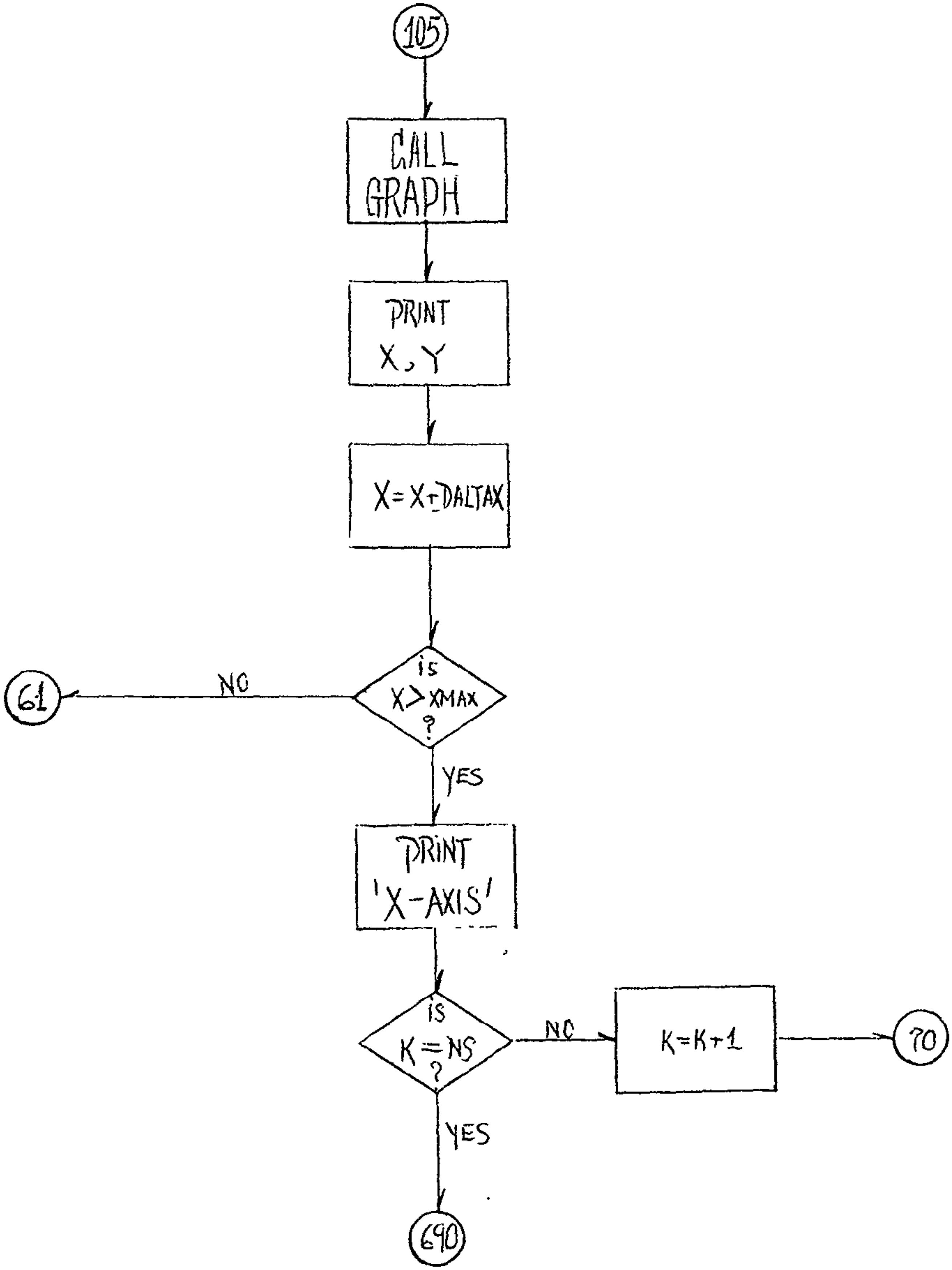

101
C3=C(3)
CALL STANDV
CALL STANDV
CALL STANDV
B(I) = C(I) * SD(I)/SDY
B1 = C2 * SDX /SDY
B2 = C3 * SDXSQ /SDY
102

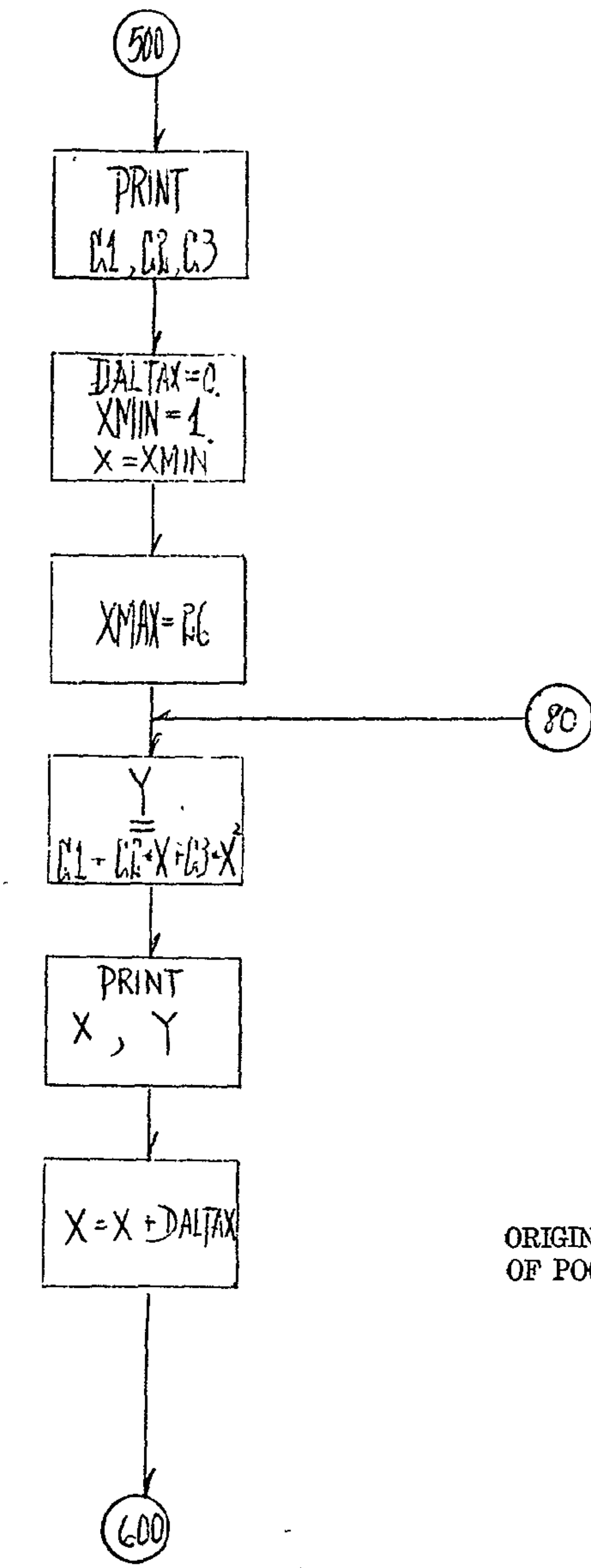

102
S2 = |RXY*B1+RXSBY|*B2
R2 = SQRT(S2)
NC=4
CALL LSTSQ
CALL MULTR
CALL STANDV
B1 = (C(2)*SDX)/SDY
103



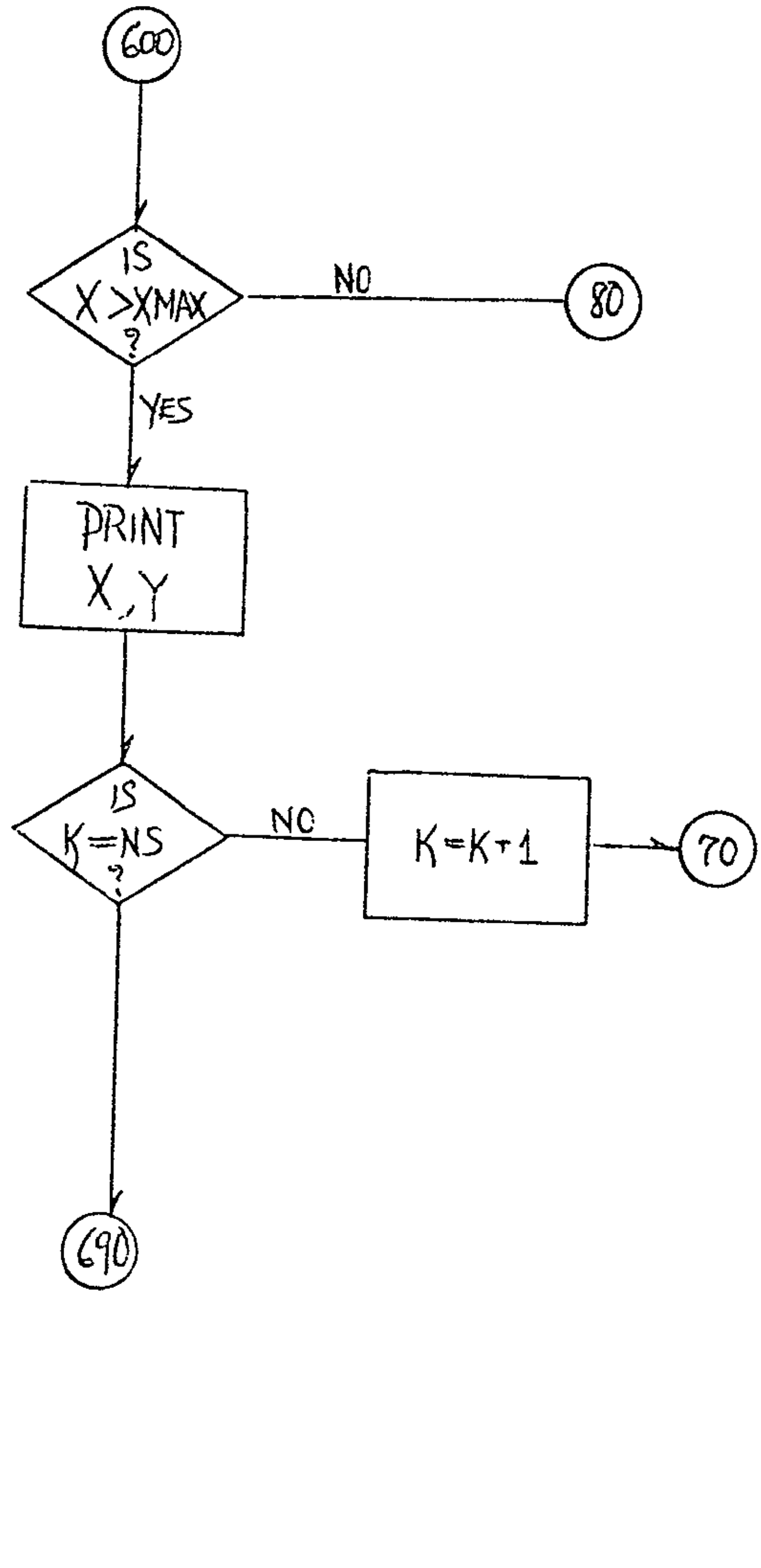
103
B2
(C(3)*SDXSQ)/SDY
B3
(C(4)*SDXCUB)/SDY
S3
RXY*B1+RXSQY*B2
+
RXCUBY*B3
R3=SQRT(S3)
IS
R2>R3
YES
500
NO
CALL
PLTST
104


104
CALL LSTSQ
PRINT POLY'N EQUAT'N
XMIN=1.
XMAX=26
DALTAX=1.
X=XMIN
61
Y = C(1)+C(2)*X+C(3)*X^2 +C(4)*X^3
105


105
CALL GRAPH
PRINT X, Y
X=X+DALTAX
is X > XMAX ?
NO
61
YES
PRINT 'X-AXIS'
is K = NS ?
NO
K=K+1
70
YES
690



ORIGINAL PAGE IS
OF POOR QUALITY


600
IS X >XMAX ?
NO
80
YES
PRINT X, Y
IS K=NS ?
NO
K=K+1
70
690

```
C                    ******************************
C                    * LEAST SQ INTERPOLATION      *
C                    *            BY               *
C                    *       BUDDY H JEUN          *
C                    ******************************
C
C     IN THIS PROGRAM,ALL YOU HAVE TO DO IS TO FIT A SET OF DATA
C     PTS TO THE COMPUTER,AND THE COMPUTER WILL RETURN A BEST FIT LEAST
C     SQ EQUATION FOR YOUR DATA PTS,AND THAT RESULTING EQUATION IS
C     INDEED THE BEST FIT IN THE STATISTICAL SENSE.
C     AND THE RESULTING EQUATION IS USE FOR INTERPOLATION
C
C     THIS PROGRAM CONSISTING OF ONE MAIN PROGRAM AND SEVEN SUBROUTINE
C     SUBPROGRAMS,THAT IS SUBROUTINE SUM,COR,LSTSQ,MEQSOL,AND GRAPH
C     AND STANDV, MULTR
C     SUBROUTINE SUM IS USE TO FIND ALL SUMS FOR X AND Y
C     SUBROUTINE COR IS USE TO FIND THE COR. COEFF
C     SUBROUTINE LSTSQ IS USE TO FIND THE  N  DEG EQUATION
C     SUBROUTINE MEQSOL IS USE TO SOLVE THE N*N SYSTEM OF EQUATION
C     SUBROUTINE GRAPH IS USE TO OUTPUT THE DATA  IN THE FORM OF A
C     STRAIGHT LINE OR A CURVE
C     SUBROUTINE STANDV IS USE TO CALCULATE THE STANDARD DEVIATION OF
C     A GIVEN SET OF DATA PTS
C     SUBROUTINE RMULT IS USE TO FIND THE MULTIPLE CORRALATION COEFF
C     THE CRITERIA TO DETERMINE WHICH ONE IS THE BEST FIT IS ACCORDING
C     TO THE VALUE OF THE MULTIPLE CORRELATION COEFF
C     THE HIGHEST VALUE OF MULTIPLE R IS CONSIDER AS THE BEST FIT
C
C
      REAL XP(100),YP(100),XL(200),YL(200),RES(100)
      COMMON/AREA1/SX,SY,SXSQ,SYSQ,SXY/AREA2/C(25),A(25,25),B(25)
      REAL XSQ(100),XCUB(100)
      NS=28
C     NS IS THE NUMBER OF THE DATA SET TO BE FIT INTO THE REGRESSION LINE
      K=1
    9 WRITE(6,20)K
C     HEADING FOR INPUT DATA
   20 FORMAT('1',52X,'THE INPUT DAT #',I3,' IS;',/60X,'XP',10X,'YP'//
     #'+',59X,3('-'),8X,3('-'))
      DO 111 I=1,100
      READ(5,3)XP(I),YP(I)
    3 FORMAT(1X,2F5.1)
      IF (XP(I).EQ.-99.0) GO TO 222
      WRITE(6,66)XP(I),YP(I)
   66 FORMAT(56X,F7.2,5X,F7.2)
  111 CONTINUE
  222 NE=I-1
      DO 50 I=1,NE
      XSQ(I)=XP(I)**2
      XCUB(I)=XP(I)**3
   50 CONTINUE
      EN=FLOAT(NE)
      CALL SUM(NE,XP,YP)
      WRITE(6,7)
    7 FORMAT(///20X,'THE RESULT OF CALCULATIONS ARE;'/'+',20X,27('_')/)
      WRITE(6,6) NE
```

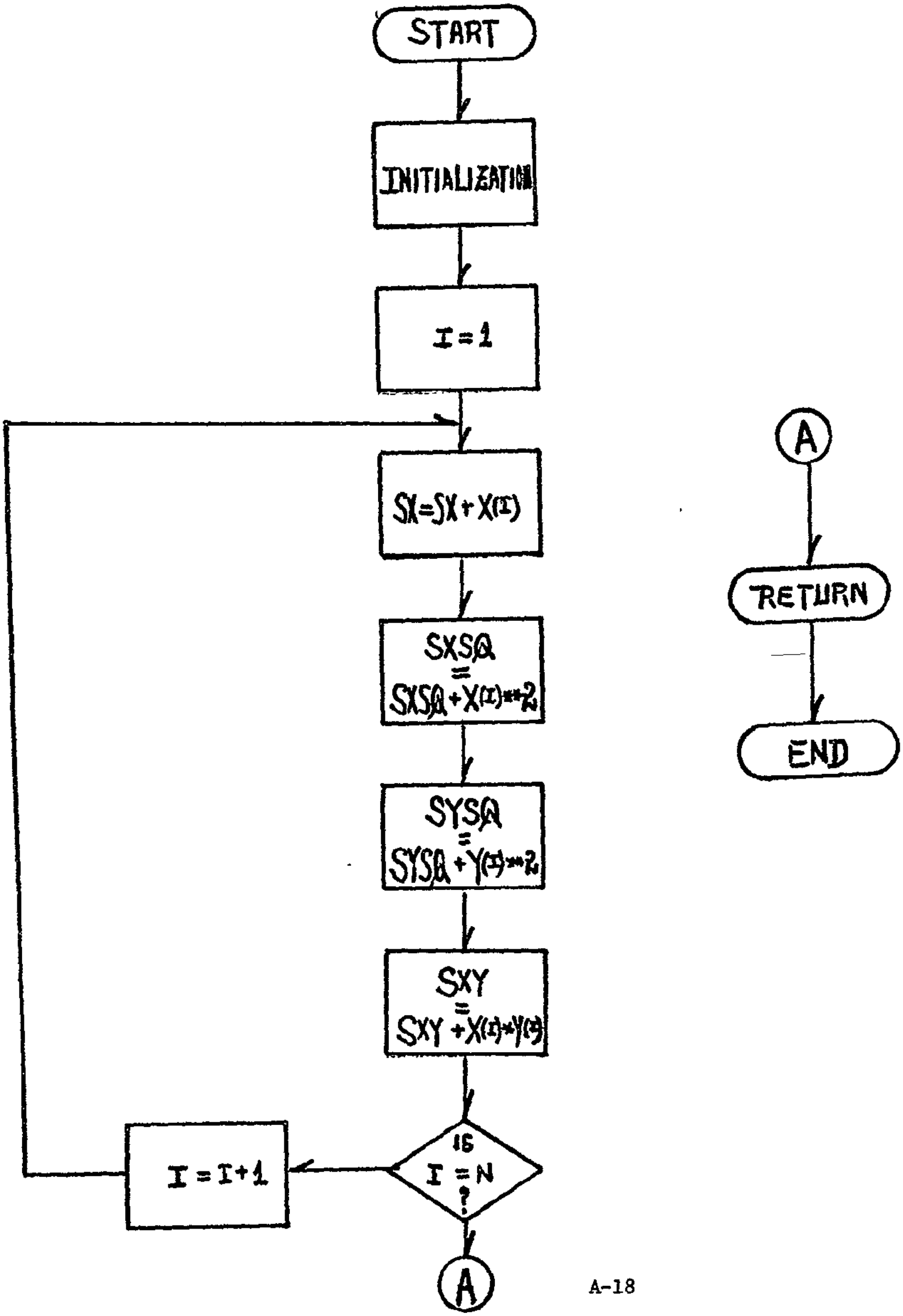
```
0025          6 FORMAT(20X,'N=',I3)
0026            WRITE(6,8)SX,SY,SXSQ,SYSQ,SXY
0027          8 FORMAT(20X,'SX=',F10.2/20X,'SY=',F10.2/20X,'SXSQ=',F10.2/20X,
             +'SYSQ=',F10.2/20X,'SXY=',F10.2)
0028            CALL COR(NE,R)
0029            WRITE(6,77)R
0030         77 FORMAT(//50X,'THE COR. COEFF IS R=',F5.2//)
0031            IF(ABS(R).LT.0.7) GO TO 444
          C     SINCE X AND Y ARE HIGHLY CORRELATED, SO FIT A STRAIGHT LINE
0032            ANEW=SXSQ*SY-SX*SXY
0033            BNEW=EN*SXY-SX*SY
0034            DENEW=EN*SXSQ-SX**2
0035            A1=ANEW/DENEW
0036            B1=BNEW/DENEW
0037            WRITE(6,33)A1,B1
0038         33 FORMAT(//50X,'THE LINEAR REG LINE IS:'/50X,'Y=',F8.2,2X,'+',F8.2,
             +'*X'//)
0039            WRITE(6,21)
0040            XMIN=1.0
0041            XMAX=26
0042            DALTAX=1.0
0043            X=XMIN
0044        666 Y=A1+B1*X
0045            WRITE(6,22)X,Y
0046            CALL GRAPH(Y)
0047            X=X+DALTAX
0048            IF(X-XMAX)666,666,317
          C     FIND A HIGHER DEGREE EQUATION BY THE LEAST SQ METHOD
0049        444 NC=3
0050            CALL PLTSCT(XP,YP,XL,YL,NE,100,2,
             + 36HLEAST SQ INTERPOLATION PLOT
             #,36HTHE MONTHS
             +,36HTHE MONTHLY TEMP RANGE
             +)
0051            CALL LSTSQ(XP,YP,NE,NC)
0052            CALL MULTR(NE,XP,YP,RXY)
0053            CALL MULTR(NE,XSQ,YP,RXSQY)
0054            C1=C(1)
0055            C2=C(2)
0056            C3=C(3)
          C     AFER CALL THE 2ND DEGREE POLYN
0057            CALL STANDV(NE,XP,SDX)
0058            CALL STANDV(NE,YP,SDY)
0059            CALL STANDV(NE,XSQ,SDXSQ)
          C     B(I)=C(I)*SD(I)/SDY
0060            B1=(C2*SDX)/SDY
0061            B2=(C3*SDXSQ)/SDY
          C     THE MULTIPLE R FOR 2ND DEGREE IS:
0062            S2=ABS(RXY*B1+RXSQY*B2)
0063            R2=SQRT(S2)
0064            NC=4
0065            CALL LSTSQ(XP,YP,NE,NC)
0066            CALL MULTR(NE,XCUB,YP,RXCUBY)
          C     AFTER CALL THE 3RD DEGRE POLYN:
0067            CALL STANDV(NE,XCUB,SDXCUB)
0068            B1=(C(2)*SDX)/SDY
```

```
0069              B2=(C(3)*SDXSQ)/SDY
0070              B3=(C(4)*SDXCUB)/SDY
            C     THE MULTIPLE R FOR THE 3DEGREE IS:
0071              S3=(RXY*B1+RXSQY*B2+RXCUBY*B3)
0072              R3=SQRT(S3)
0073              IF(R2.GT.R3) GO TO 500
0074              CALL PLTSCT(XP,YP,XL,YL,NE,100,3,
                 + 36HLEAST SQ INTERPOLATION PLOT
                 #,36HTHE MONTHS
                 +,36HTHE MONTHLY TEMP RANGE
                 +)
0075              CALL LSTSQ(XP,YP,NE,NC)
0076              WRITE(6,25)(I,C(I),I=1,NC)
0077          25  FORMAT(5X,'C(',I1,') =',F15.5)
0078              WRITE(6,11)
0079          11  FORMAT(//50X,'THE LEAST SQ EQUATION IS :'//)
0080              WRITE(6,12)(C(I),I=1,NC)
0081          12  FORMAT(50X,'Y=',F7.2,'+',F7.2,'X','+',F7.2,'X**2','+',F7.2,'X**3')
            C     HEADING
0082              WRITE(6,21)
0083          21  FORMAT('1',45X,'THE GRAPH OF THE BEST FIT LEAST SQ EQUATION IS;'/
                 +4X,'X',5X,'Y',28X,78('_'),'Y-AXIS'/
                 +'+',6('_'),2X,6('_'))
0084              XMIN=1.0
0085              XMAX=26
0086              DALTAX=1.0
0087              X=XMIN
0088         201  Y=C(1)+C(2)*X+C(3)*X**2+C(4)*X**3
0089              CALL GRAPH(Y)
0090              WRITE(6,22)X,Y
0091          22  FORMAT(1X,F6.2,F8.2)
0092              X=X+DALTAX
0093              IF(X-XMAX)201,201,202
0094         202  WRITE(6,318)
0095              GO TO 505
0096         500  WRITE(6,319)C1,C2,C3
0097         319  FORMAT(50X,'Y=',F7.2,'+',F7.2,'X','+',F7.2,'X**2')
0098              XMIN=0.0
0099              XMAX=26.0
0100              DALTAX=1.0
0101              X=XMIN
0102         404  Y=C1+C2*X+C3*X**2
0103              WRITE(6,78)X,Y
0104          78  FORMAT(60X,2F10.2)
0105              X=X+DALTAX
0106              IF(X-XMAX)404,404,505
0107         505  WRITE(6,55)R2,R3
0108          55  FORMAT(//20X,'THE MULTIPLE R FOR THE 2ND DEGREE POLYN IS',F10.2/
                 #20X,'THE MULTIPLE R FOR THE 3RD DEGREE POLYN IS',F10.2//)
0109              IF(K.EQ.NS) GO TO 690
0110              K=K+1
0111              GO TO 9
0112         317  WRITE(6,318)
0113         318  FORMAT(38X,'X-AXIS')
0114              IF(K.EQ.NS) GO TO 690
0115              K=K+1
```

ORIGINAL PAGE IS
OF POOR QUALITY

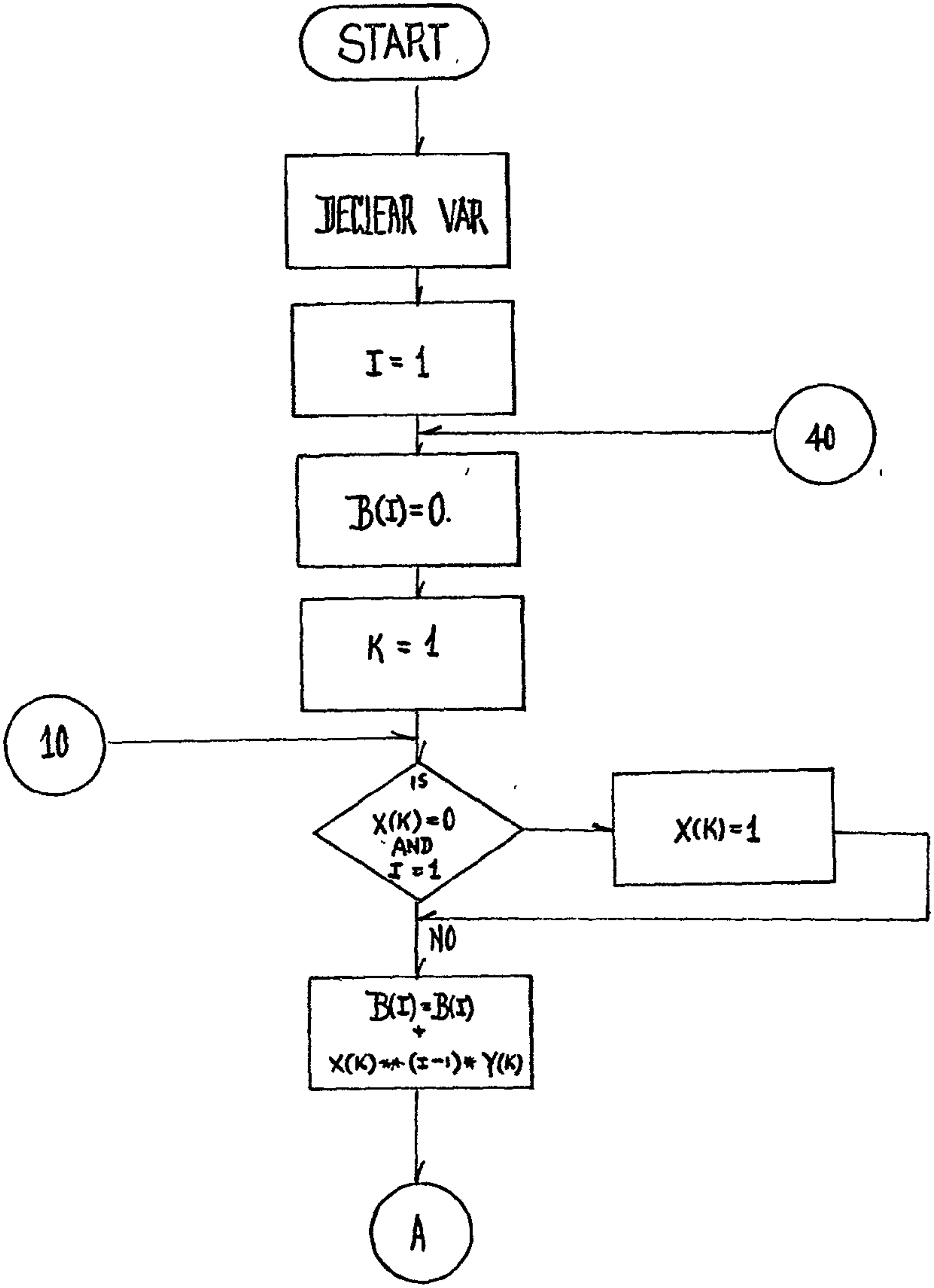
```
          GO TO 9
      690 STOP
          END
```

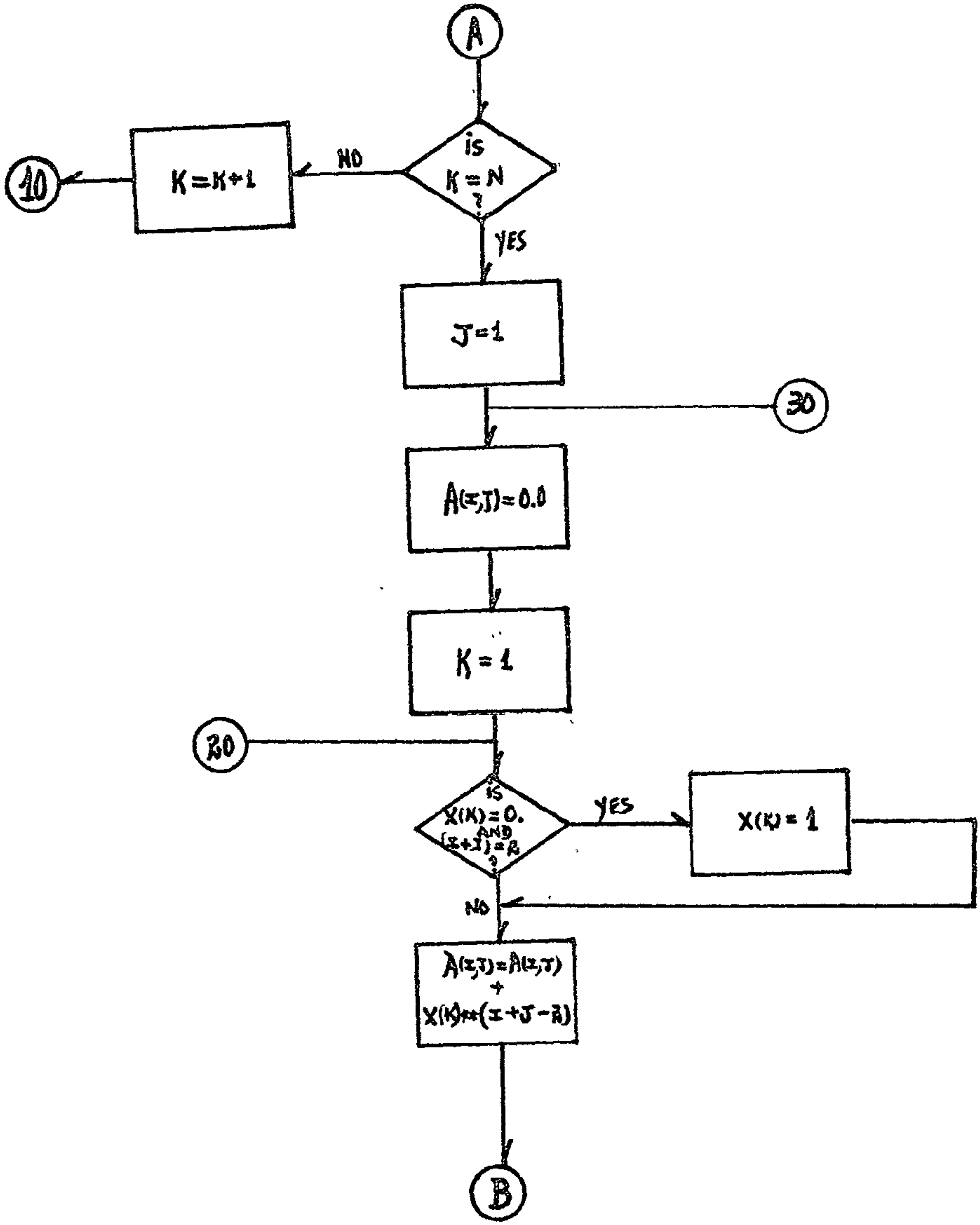
SUBROUTINE SUM

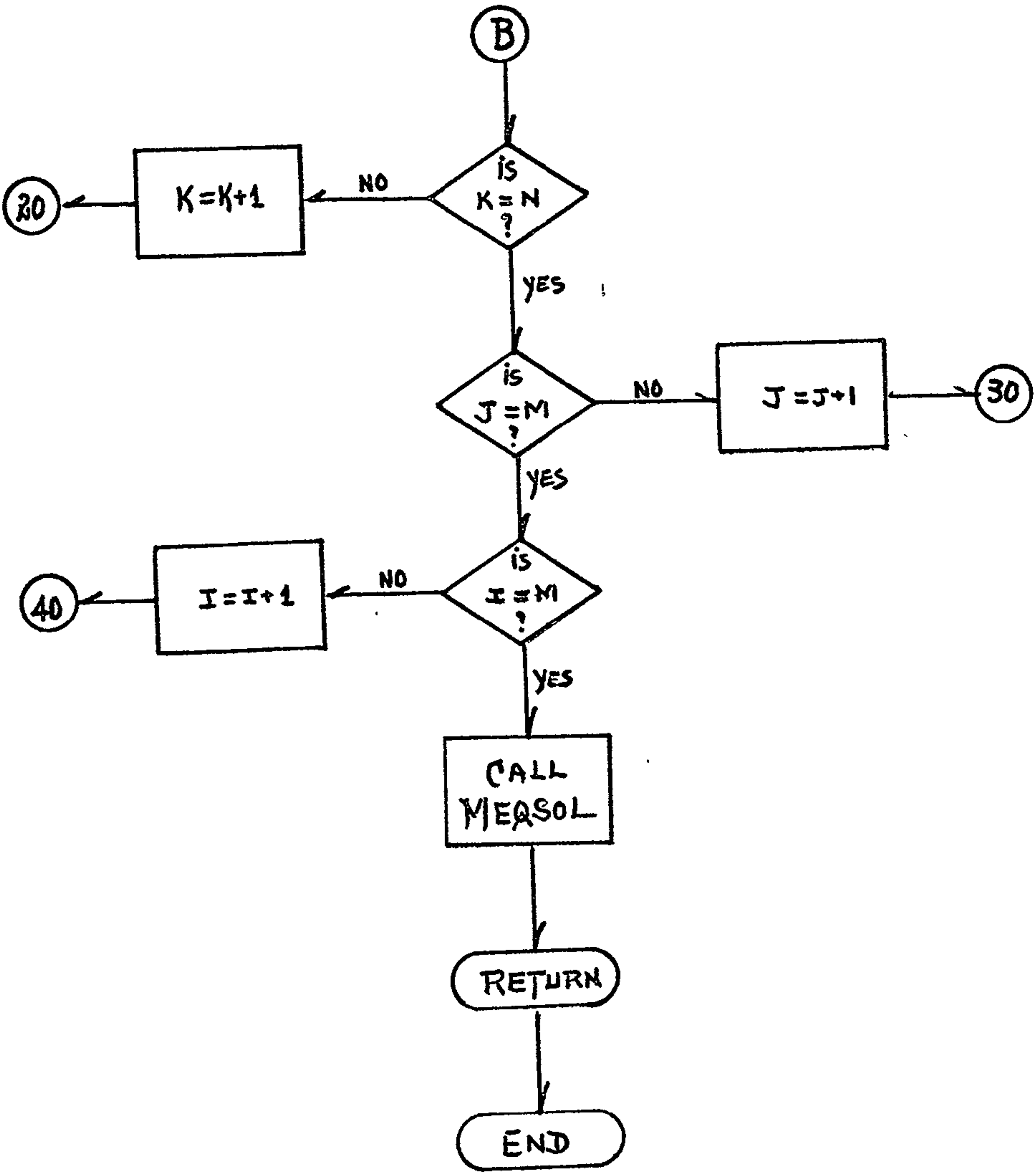


```
      SUBROUTINE SUM(NE,X,Y)
      COMMON/AREA1/SX,SY,SXSQ,SYSQ,SXY
C
C     IN THIS SUBROUTINE SUM, THE INPUT DATA ARE NE,X,Y AND THE OUTPUT
C     ARGUMENTS ARE SX,SY,SXSQ,SYSQ,SXY;ALL VALUES FOR THE SUMS ARE
C     CALCULATED IN THIS SUBROUTINE.
C
      DIMENSION X(100),Y(100)
      SX=0.0
      SY=0.0
      SXSQ=0.0
      SYSQ=0.0
      SXY=0.0
      DO 10 I=1,NE
      SX=SX+X(I)
      SY=SY+Y(I)
      SXSQ=SXSQ+X(I)**2
      SYSQ=SYSQ+Y(I)**2
      SXY=SXY+X(I)*Y(I)
   10 CONTINUE
      RETURN
      END
```

SUBROUTINE LSTSQ

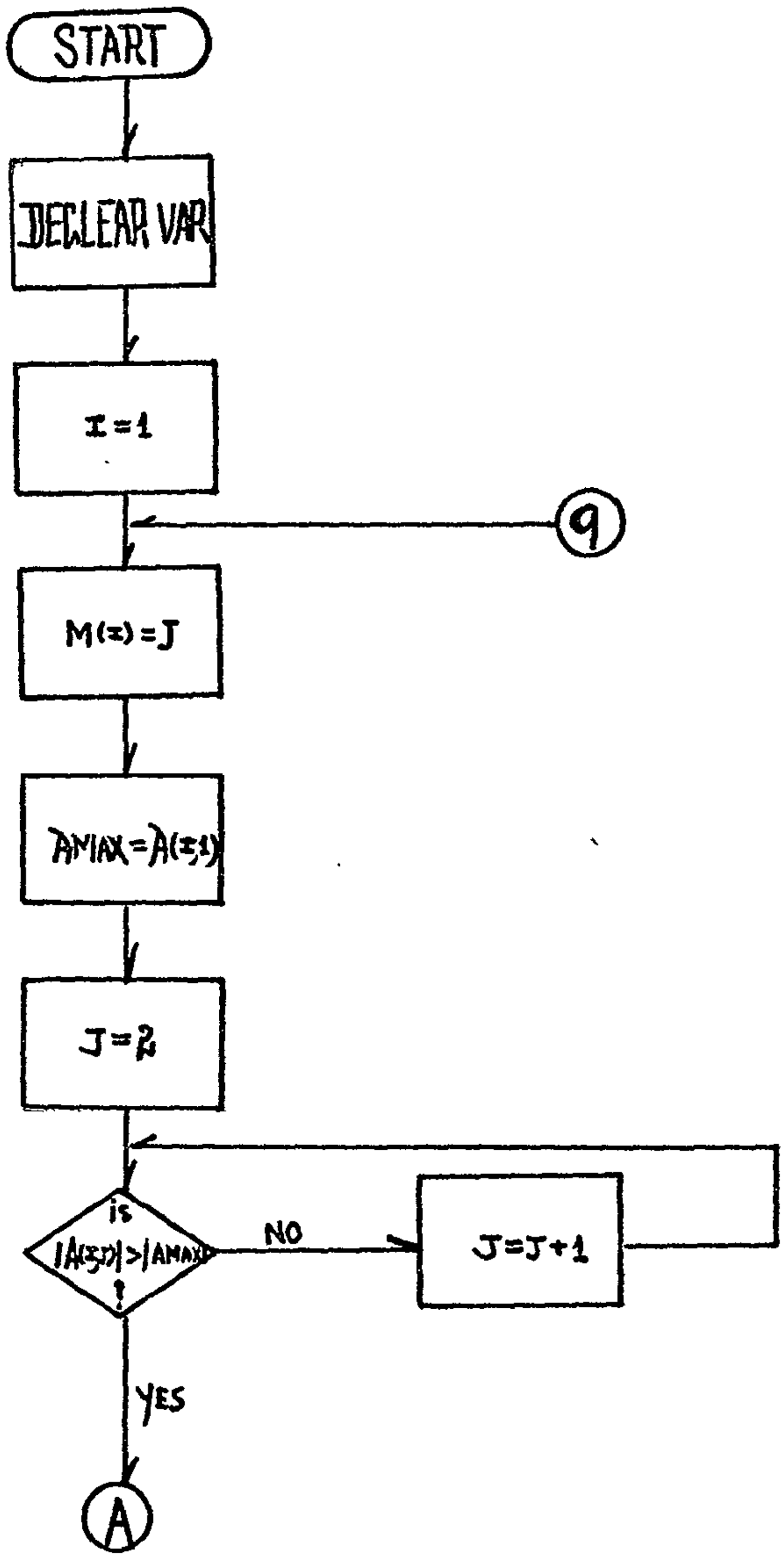


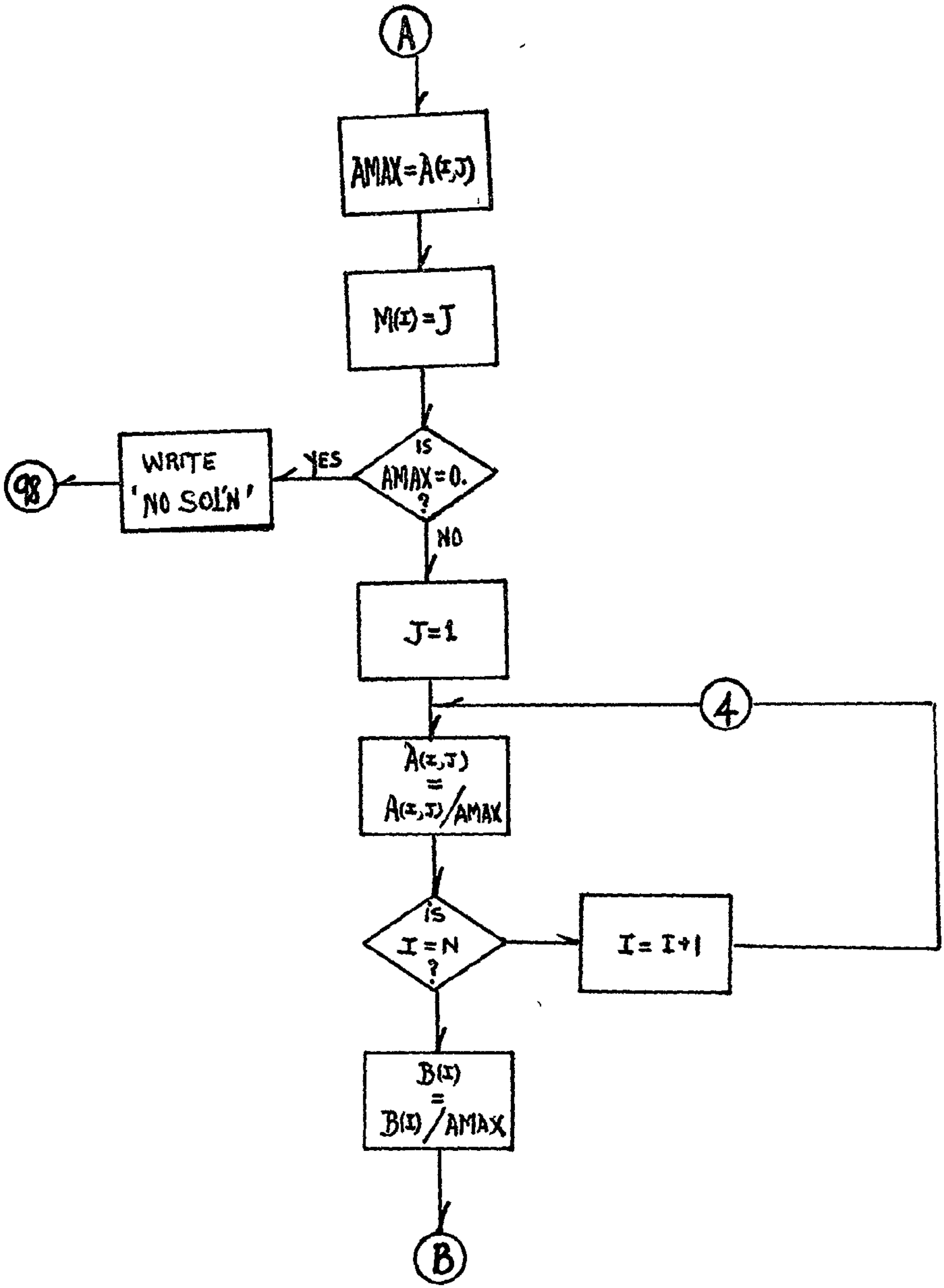

A
IS
K = N
?
NO
K = K + 1
10
YES
J = 1
30
A(I,J) = 0.0
K = 1
20
IS
X(K) = 0.
AND
(I+J) = R
?
YES
X(K) = 1
NO
A(I,J) = A(I,J)
+
X(K)**(I+J-R)
B

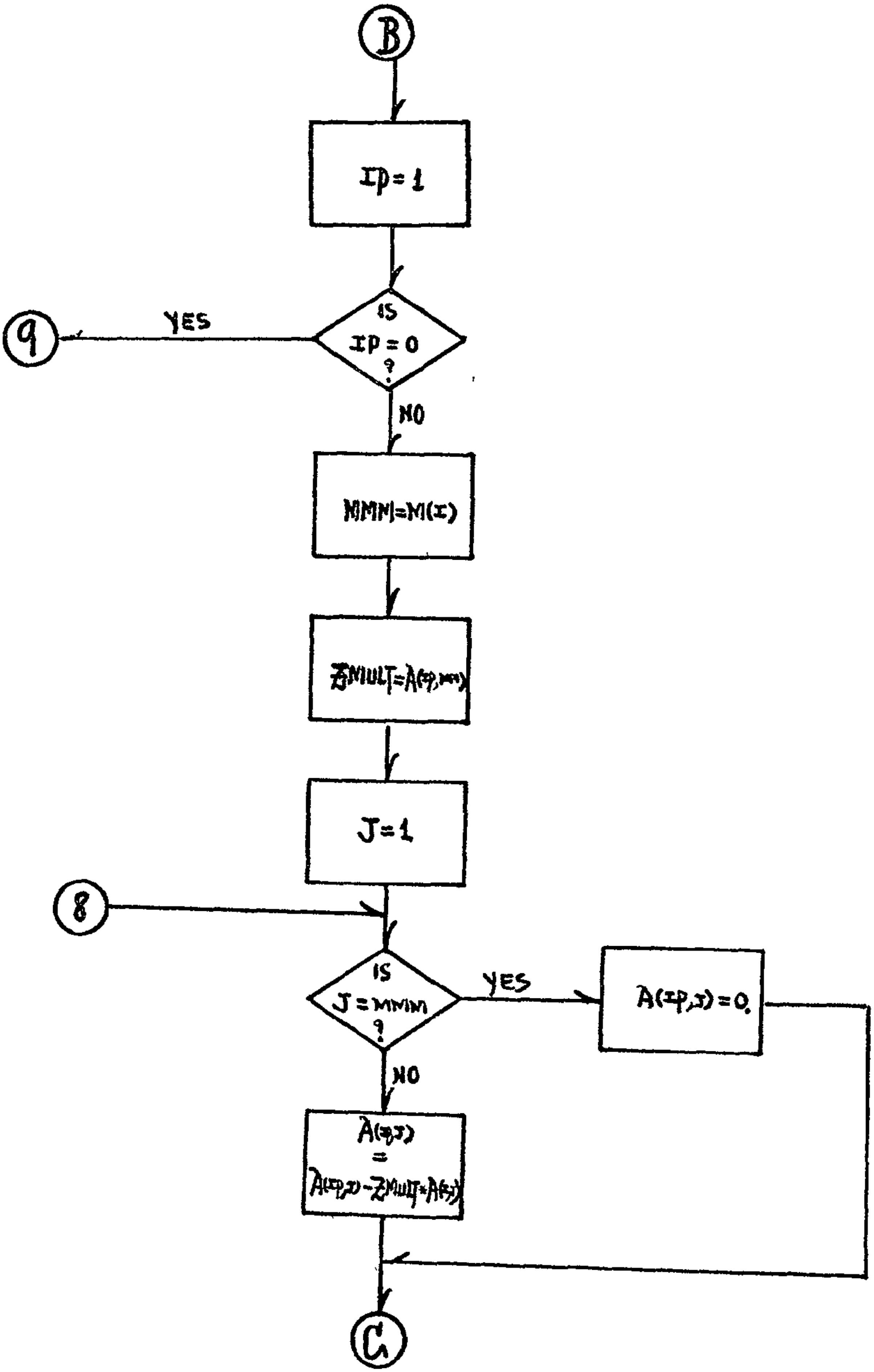

B
is K = N ?
NO
K=K+1
20
yes
is J = M ?
NO
J = J+1
30
yes
is I = M ?
NO
I = I+1
40
yes
CALL MEQSOL
RETURN
END

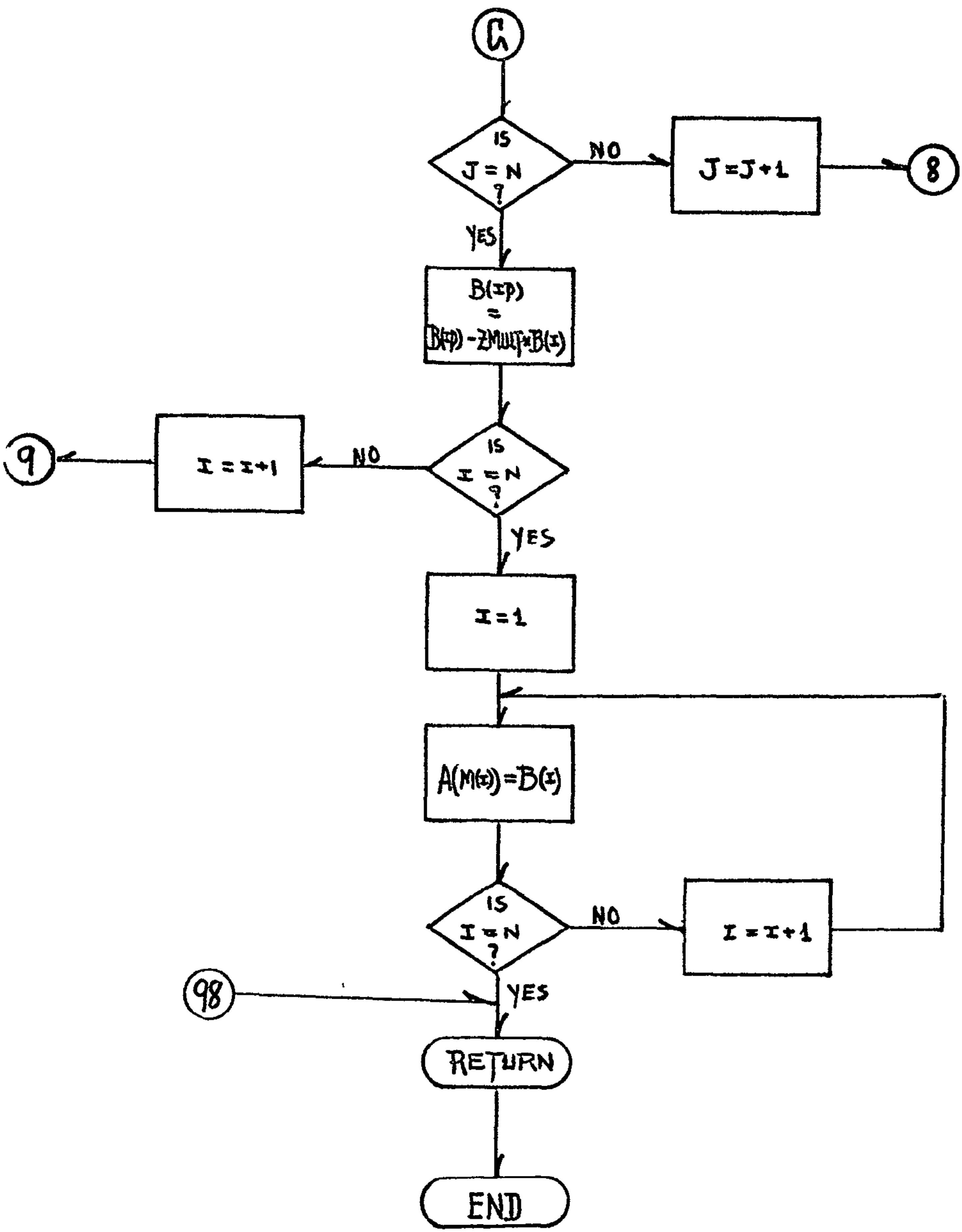
```
      SUBROUTINE LSTSQ(X,Y,N,M)
      COMMON/AREA2/C(25),A(25,25),B(25)
C
C     LEAST SQUARE CURVE FITTING
C     TO FIT N GIVEN POINTS X(N),Y(N) BY A POLYNOMIAL OF
C     M-1 DEGREE, SUM C(I)*X**(I-1) FOR I=1 TO I=M
C     C(M) IS THE OUTPUT COEFF ARRAY
C     NEEDS SUBROUTINE MEQSOL TO SOLVE FOR AC=B
C
      REAL X(100),Y(100)
      DO 7 I=1,M
      B(I)=0.0
      DO 5 K=1,N
      IF((X(K).EQ.0.0).AND.(I.EQ.1))X(K)=1.0
    5 B(I)=B(I)+X(K)**(I-1)*Y(K)
      DO 7 J=1,M
      A(I,J)=0.0
      DO 7 K=1,N
      IF((X(K).EQ.0.0).AND.((I+J).EQ.2))X(K)=1.0
      A(I,J)=A(I,J)+X(K)**(I+J-2)
    7 CONTINUE
      CALL MEQSOL(M)
      RETURN
      END
```

SUBROUTINE MEQSOL




A
AMAX=A(I,J)
M(I)=J
IS AMAX=0. ?
YES
WRITE 'NO SOL'N'
98
NO
J=1
4
A(I,J) = A(I,J)/AMAX
IS I=N ?
I=I+1
B(I) = B(I)/AMAX
B

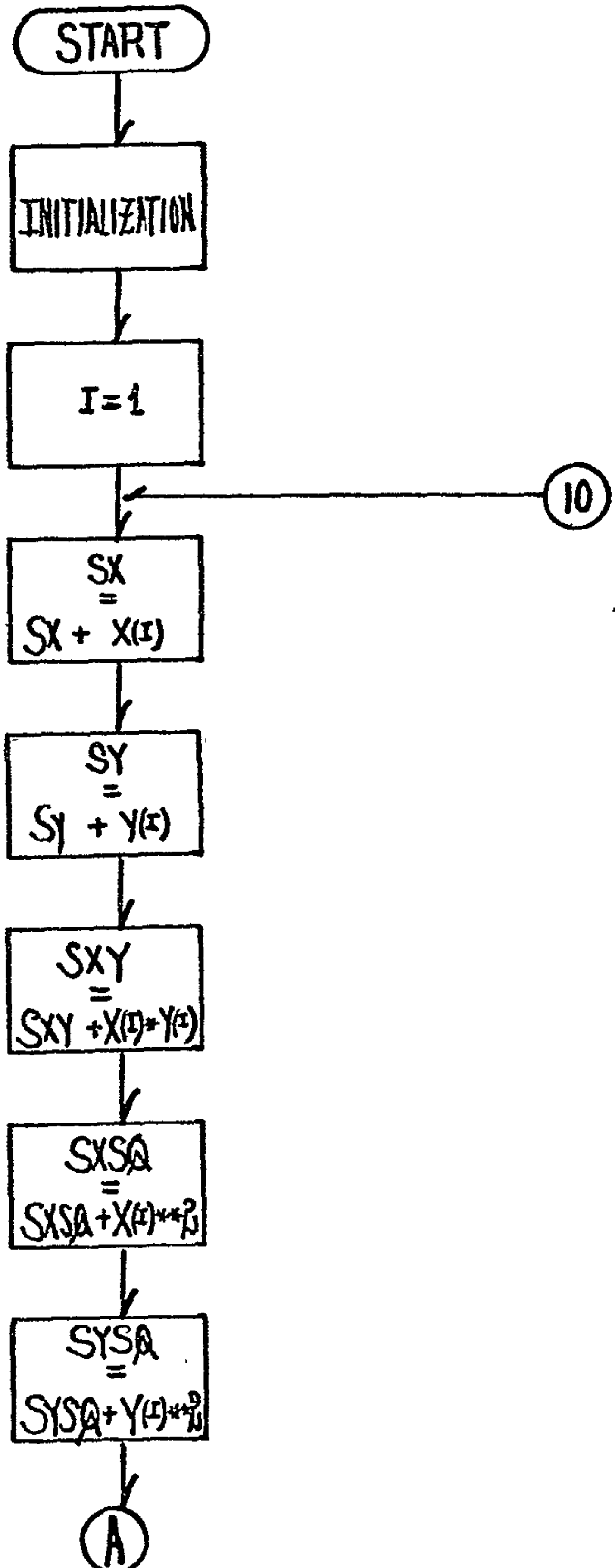

B
IP = 1
IS IP = 0 ?
YES
9
NO
NMNM=NM(I)
ZMULT=A(IP,NM)
J = 1
8
IS J = MNM ?
YES
A(IP,J) = 0.
NO
A(IP,J) = A(IP,J) - ZMULT * A(I,J)
C

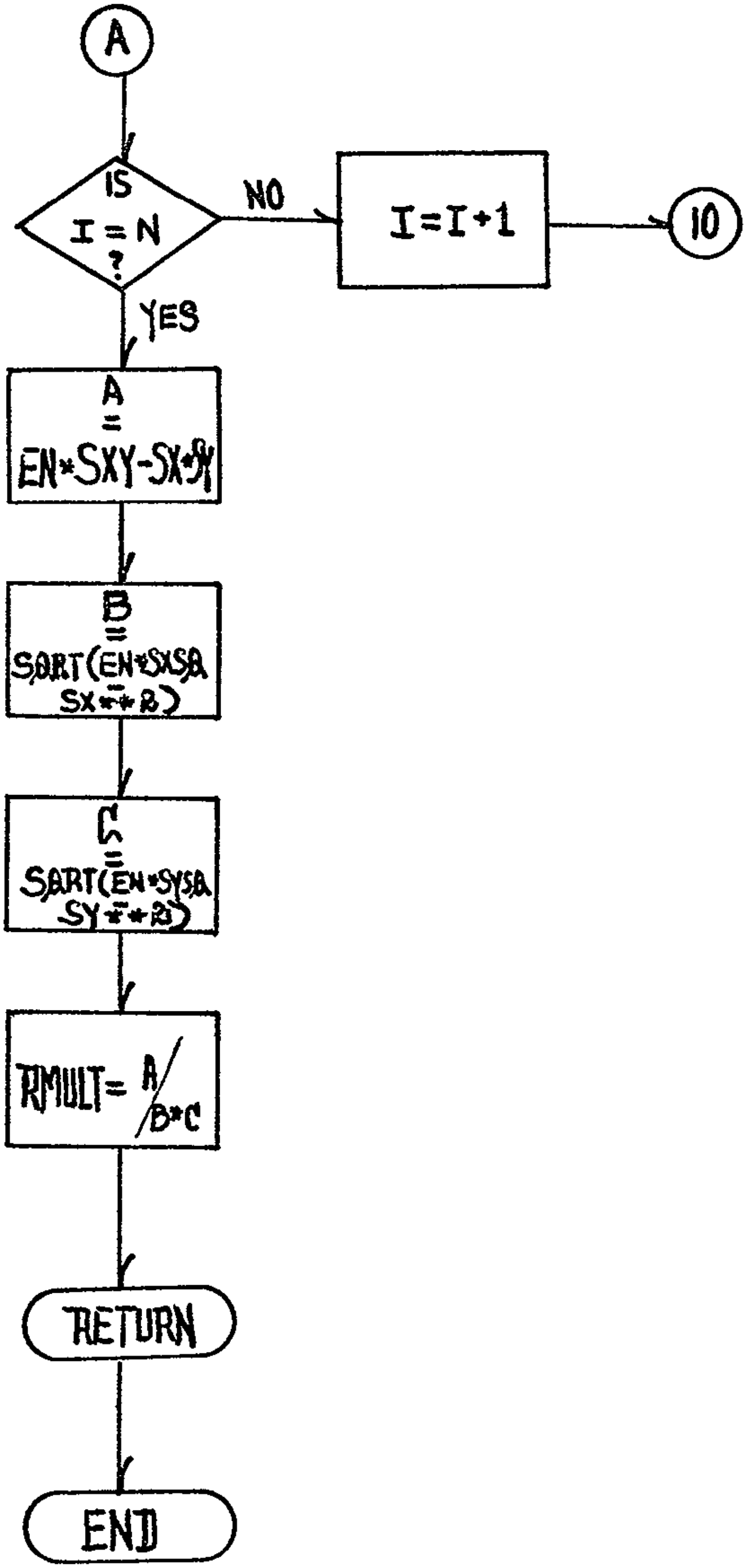


G
IS
J = N
?
NO
J = J + 1
8
YES
B(IP)
=
B(IP) - ZMULT*B(I)
IS
I = N
?
NO
I = I+1
9
YES
I = 1
A(M(I)) = B(I)
IS
I = N
?
NO
I = I + 1
YES
98
RETURN
END

```
      SUBROUTINE MEQSOL(N)
      COMMON/AREA2/X(25),A(25,25),B(25)
C
C     THIS SUBROUTINE MEQSOL IS USE TO SOLVE THE MATRIX EQUATION AX=B OF
C     N,IN THIS PARTICULAR CASE,N IS 4,AND THE RESULT IS RETURNED TO
C     THE MAIN PRGRAM BY THE LEBEL COMMON X(25).IF HIGHER ORDER MATRIX
C     EQUATION IS NEEDED TO BE SOLVE, THEN THE VALUE OF N HAVE TO BE
C     CHANGE
C
      INTEGER M(25)
      DO 9 I=1,N
      M(I)=1
      AMAX=A(I,1)
      DO 2 J=2,N
      IF(ABS(A(I,J))-ABS(AMAX)) 2,2,1
    1 AMAX=A(I,J)
      M(I)=J
    2 CONTINUE
      IF(AMAX) 3,98,3
    3 DO 4 J=1,N
    4 A(I,J)=A(I,J)/AMAX
      B(I)=B(I)/AMAX
      DO 9 IP=1,N
      IF(IP-I)5,9,5
    5 MMM=M(I)
      ZMULT=A(IP,MMM)
      DO 8 J=1,N
      IF(J-MMM)7,6,7
    6 A(IP,J)=0.0
      GO TO 8
    7 A(IP,J)=A(IP,J)-ZMULT*A(I,J)
    8 CONTINUE
      B(IP)=B(IP)-ZMULT*B(I)
    9 CONTINUE
      DO 95 I=1,N
   95 X(M(I))=B(I)
      RETURN
   98 WRITE(6,99)
   99 FORMAT(12H NO SOLUTION)
      RETURN
      END
```

SUBROUTINE MULTR

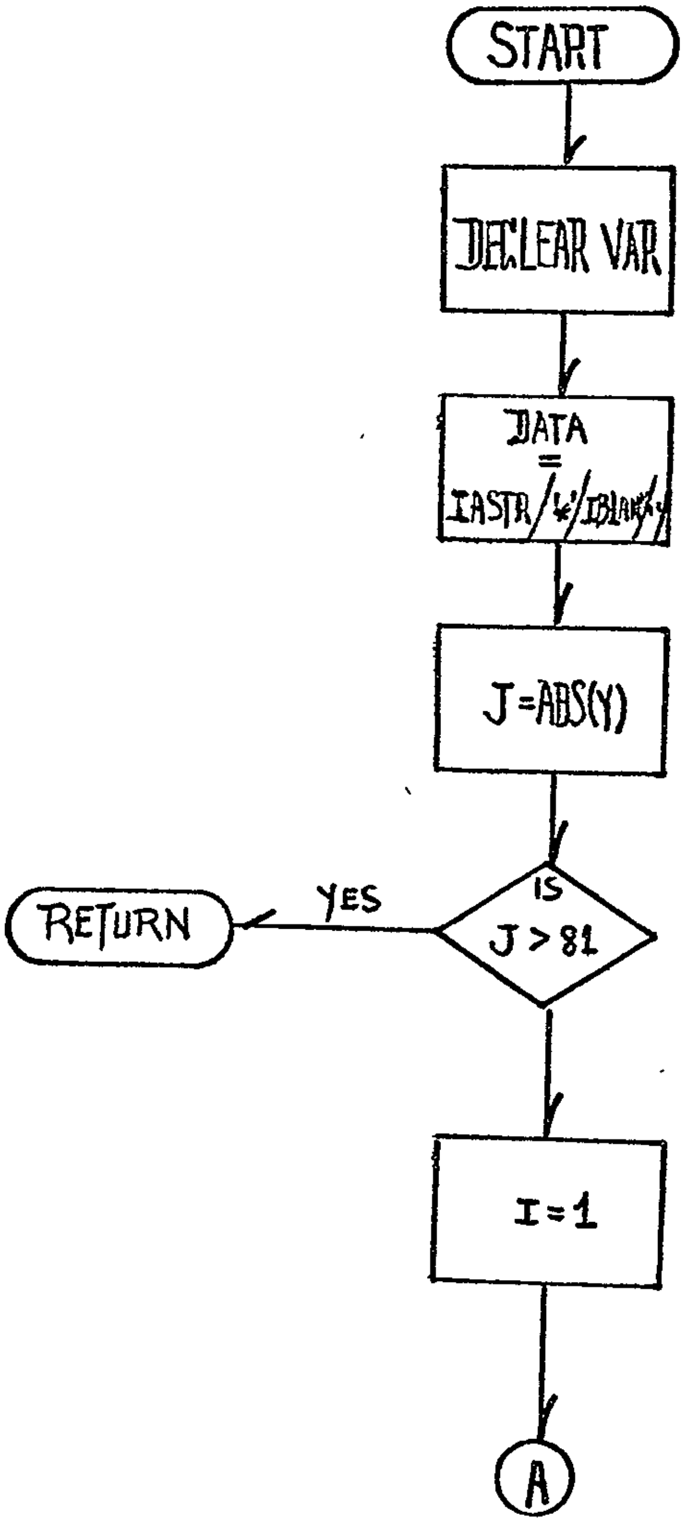


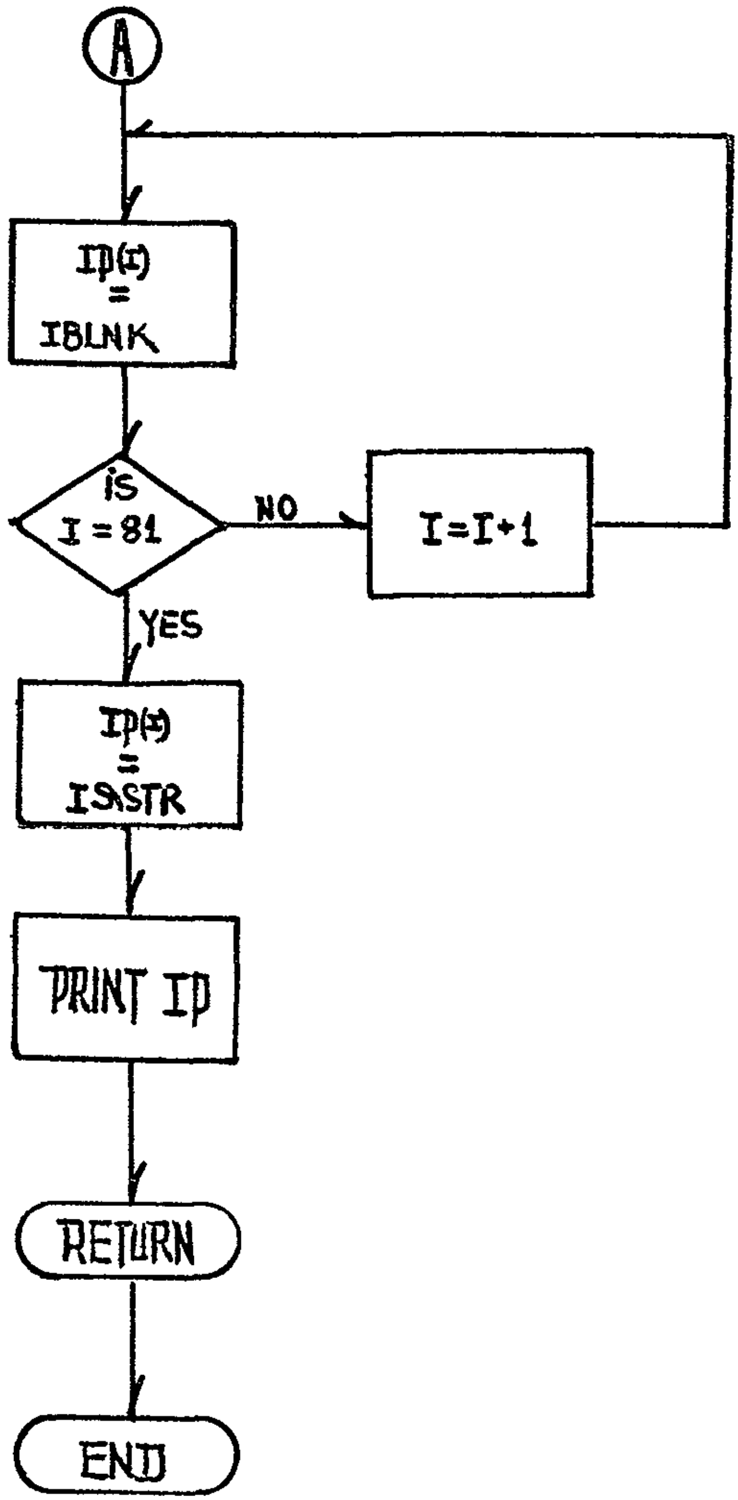


A
IS
I = N
?
NO
I=I+1
10
YES
A
=
EN*SXY-SX*SY
B
=
SQRT(EN*SXSQ
SX**2)
C
=
SQRT(EN*SYSQ
SY**2)
RMULT= A/B*C
RETURN
END

```
                 SUBROUTINE MULTR(N,X,Y,RMULT)
C                THIS SUBROUTINE MULTR IS USE TO CALCULATE THE MULTIPLE
C                CORRELATION COEFF R AND DENOTED THAT BY THE OUTPUT PARAMETER
C                MULTR AND THE FOMULA IS R=SQRT(SUME OF R(I,Y)*B(J)),
C                WHERE B(J) IS THE STANDARDIZE REGREESION COEFFAND THE
C                UNSTANDARDIZE REGREESION COEFF IS B=SD(J)/SD(Y)*B(J)
                 REAL X(100),Y(100)
                 EN=N
                 SX=0.0
                 SY=0.0
                 SXY=0.0
                 SXSQ=0.0
                 SYSQ=0.0
                 DO 100 I=1,N
                 SX=SX+X(I)
                 SY=SY+Y(I)
                 SXY=SXY+X(I)*Y(I)
                 SXSQ=SXSQ+X(I)**2
                 SYSQ=SYSQ+Y(I)**2
             100 CONTINUE
                 A=(EN*SXY-(SX)*(SY))
                 B=SQRT(EN*SXSQ-(SX)**2)
                 C=SQRT(EN*SYSQ-(SY)**2)
                 RMULT=(A/(B*C))
                 RETURN
                 END
```

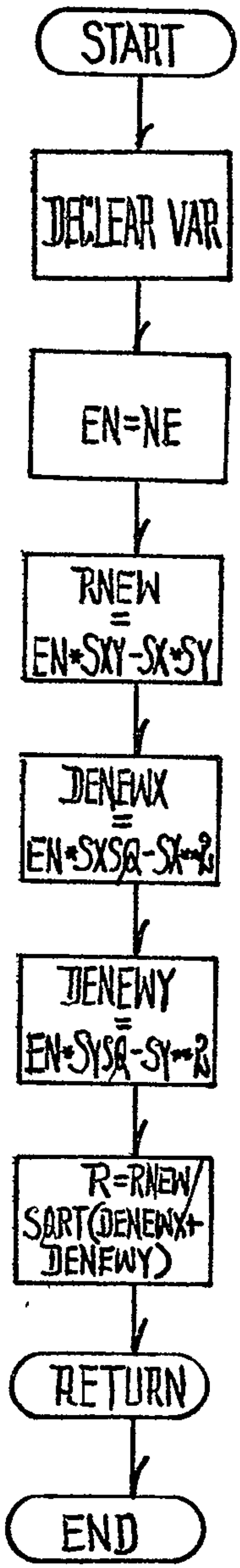
SUBROUTINE GRAPH




A
IP(I)
=
IBLNK
IS
I = 81
NO
I=I+1
YES
IP(I)
=
ISASTR
PRINT IP
RETURN
END

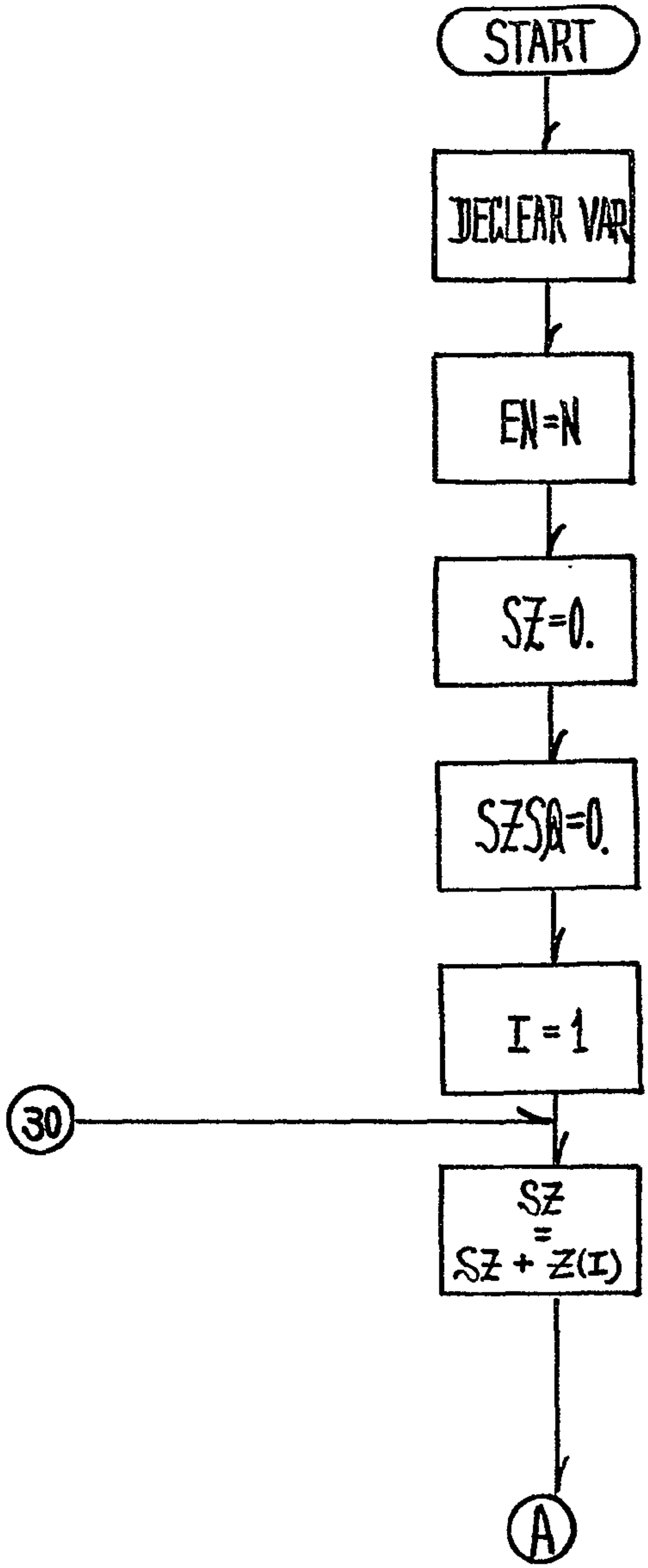
```
      SUBROUTINE GRAPH(Y)
      DIMENSION IP(81)
      DATA IASTR/'*'/,IBLNK/' '/
      J=ABS(Y)
      IF(J-81)500,500,600
  500 DO 333 I=1,81
      IP(I)=IBLNK
  333 CONTINUE
      IP(J)=IASTR
      WRITE(6,51) IP
   51 FORMAT('+',38X,'1',81A1)
  600 RETURN
      END
```

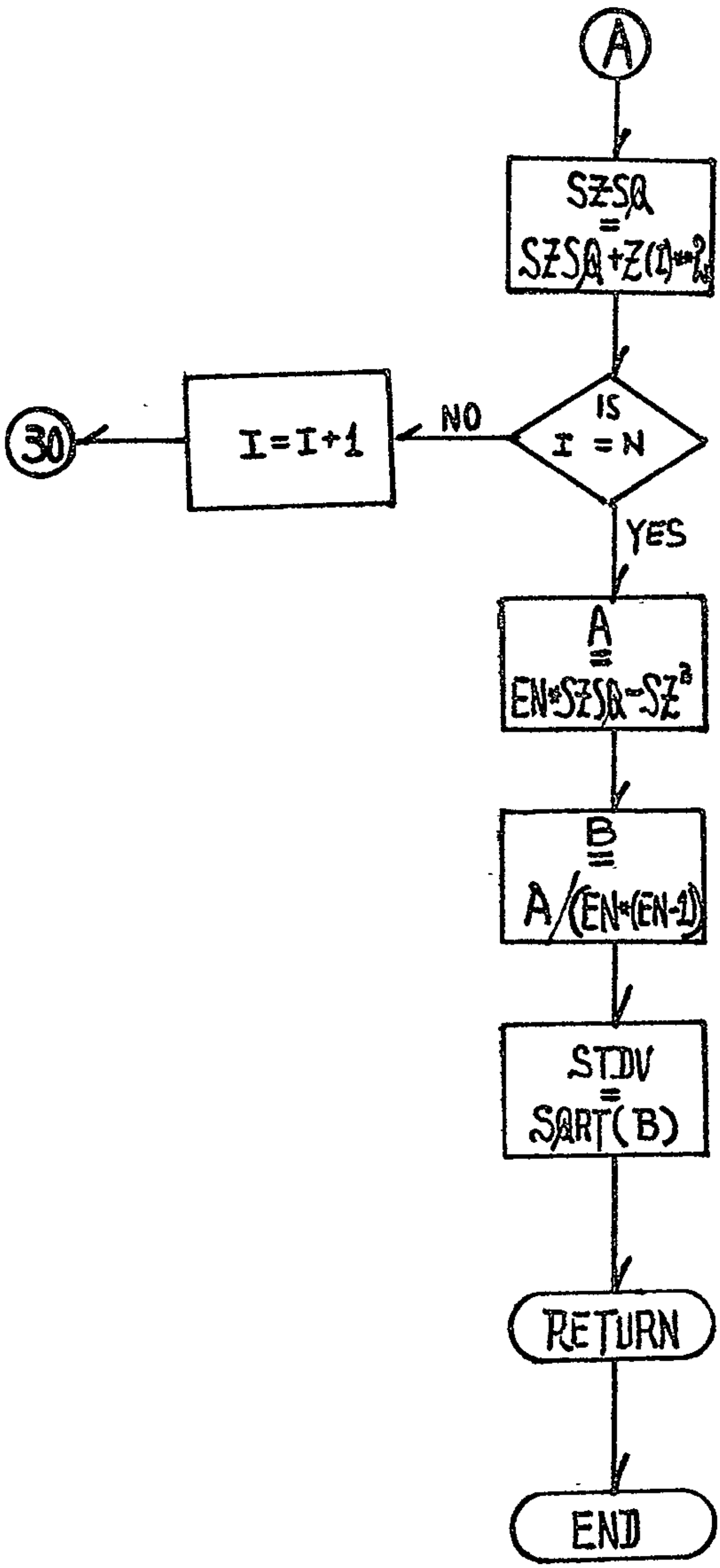
SUBROUTINE COR



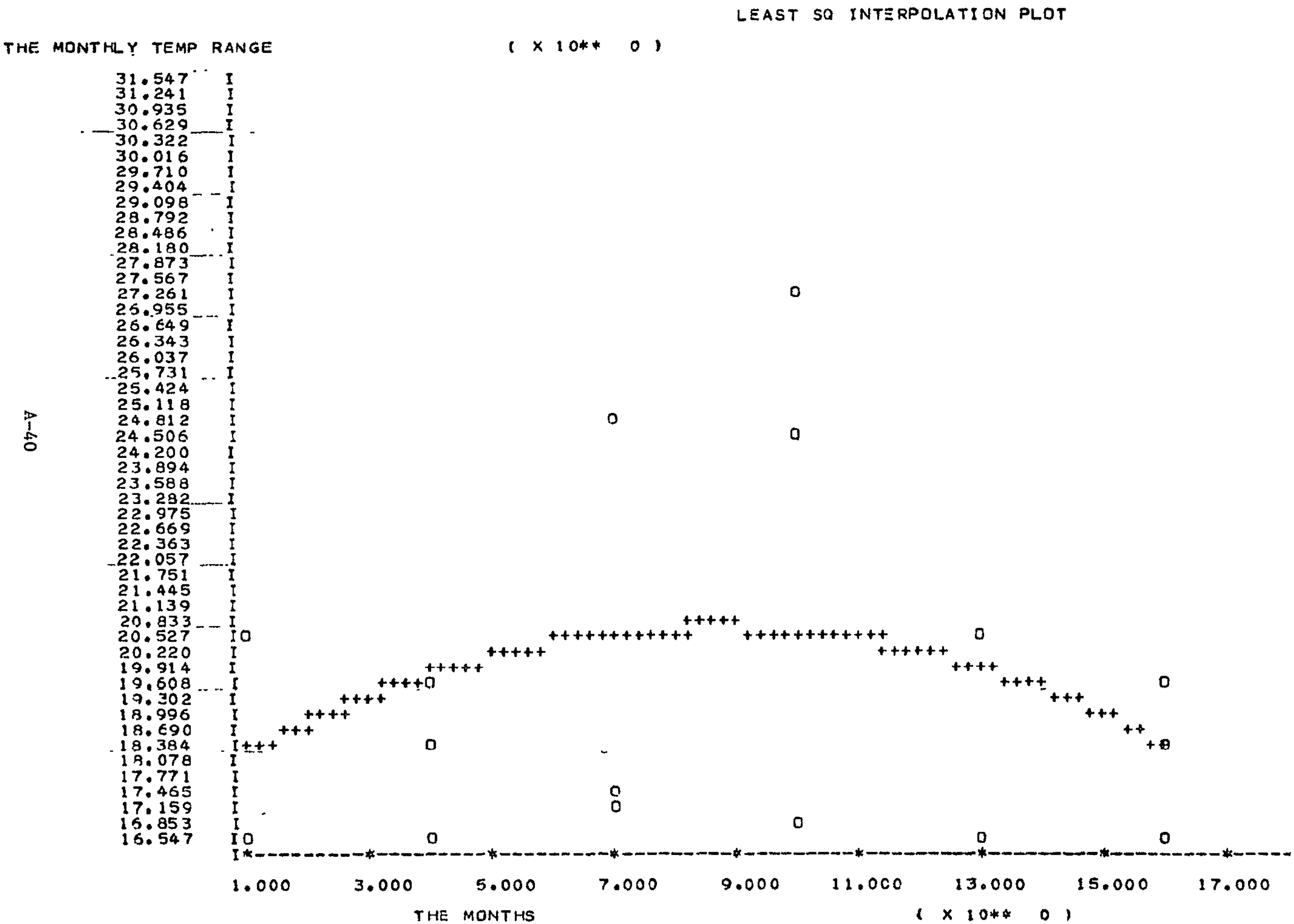
```
0001                  SUBROUTINE COR(NE,R)
0002                  COMMON/AREA1/SX,SY,SXSQ,SYSQ,SXY
              C
              C       IN THIS SUBROUTINE COR,THE INPUT ARGUMENTS ARE NE,SX,SY,SXSQ,SYSQ,
              C       SXY; AND THE OUPUT ARGUMENT IS R;THE COR. COEFF IS RETURN TO THE
              C       MAIN PROGRAM BY R.
              C
0003                  EN=FLOAT(NE)
0004                  RNEW=EN*SXY-SX*SY
0005                  DENEWX=EN*SXSQ-SX**2
0006                  DENEWY=EN*SYSQ-SY**2
0007                  R=RNEW/SQRT(DENEWX*DENEWY)
0008                  RETURN
0009                  END
```

SUBROUTINE STANDV



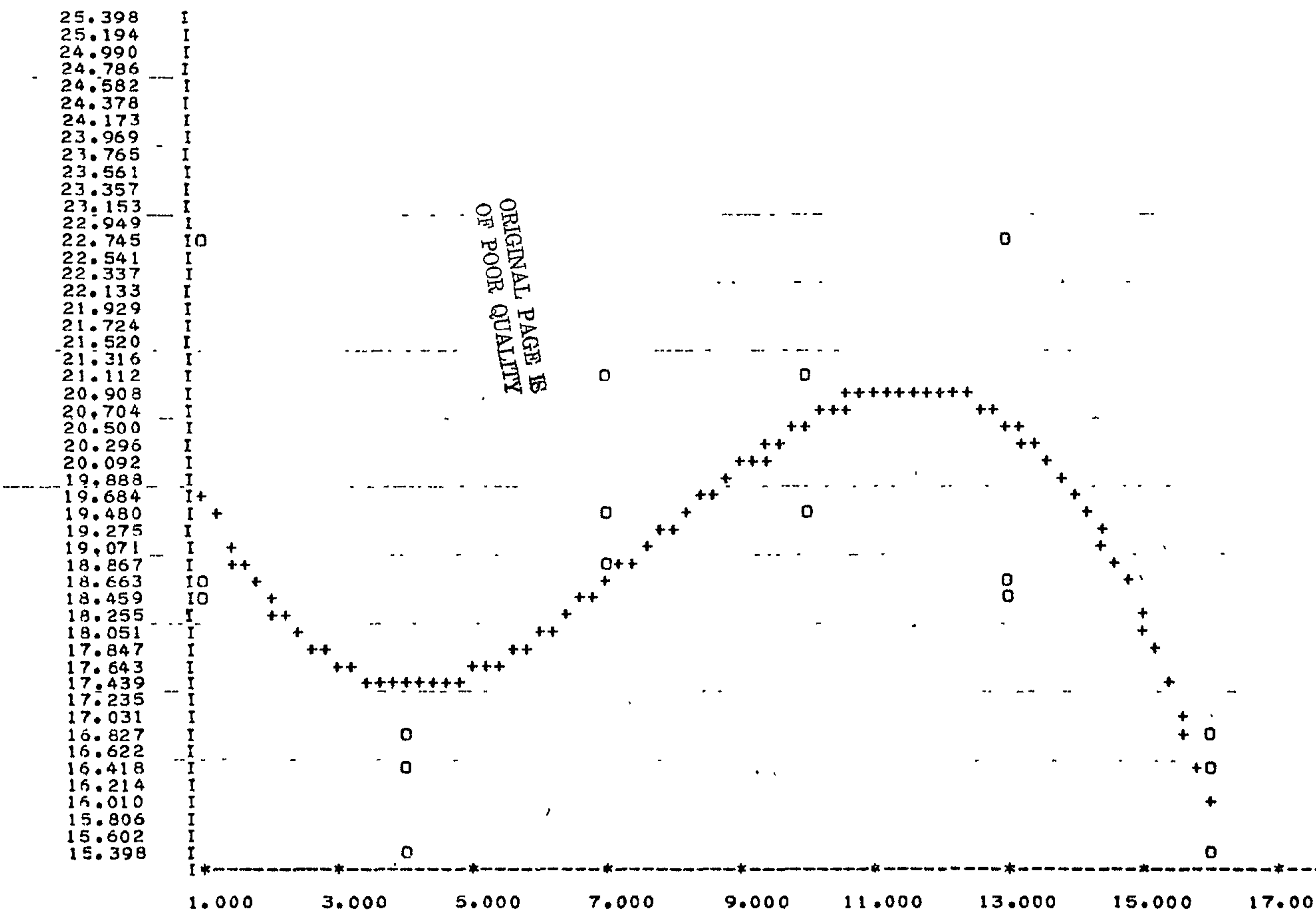

A
SZSQ = SZSQ+Z(I)**2
IS I = N
NO
I=I+1
30
YES
A = EN*SZSQ-SZ**2
B = A/(EN*(EN-1))
STDV = SQRT(B)
RETURN
END

```
0001          SUBROUTINE STANDV(N,Z,STDV)
        C     THIS SUBROUTINE IS USE TO CALCULATE THE STANDARD DEVIATION
        C     OF A GIVEN SET OF DATA PTSAND DENOTED THAT BY THE OUTPUT
        C     PARAMETER STDV
0002          REAL Z(1C0)
0003          EN=N
0004          SZ=0.0
0005          SZSQ=0.0
0006          DO 200 I=1,N
0007          SZ=SZ+Z(I)
0008          SZSQ=SZSQ+Z(I)**2
0009      200 CONTINUE
0010          A=(EN*SZSQ-SZ**2)
0011          B=A/(EN*(EN-1.0))
0012          STDV=SQRT(B)
0013          RETURN
0014          END
```


LEAST SQ INTERPOLATION PLOT
THE MONTHLY TEMP RANGE
(X 10** 0)
31.547
16.547
1.000
3.000
5.000
7.000
9.000
11.000
13.000
15.000
17.000
THE MONTHS
(X 10** 0)

LEAST SQ INTERPOLATION PLOT

THE MONTHLY TEMP RANGE (X.10** 0)

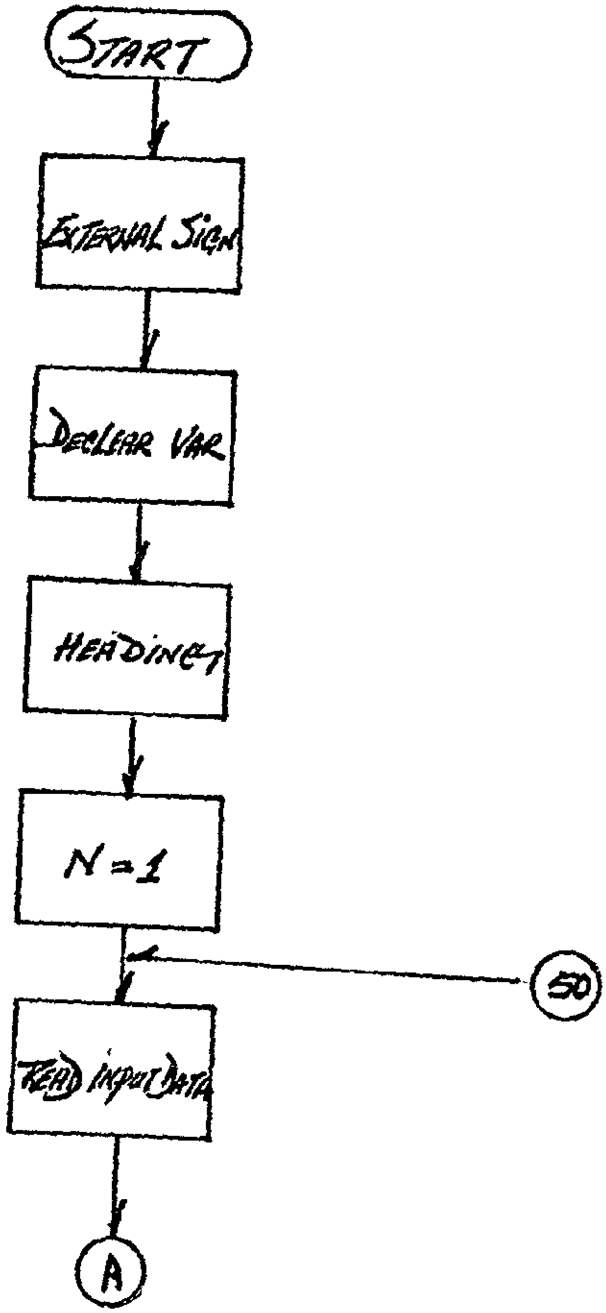


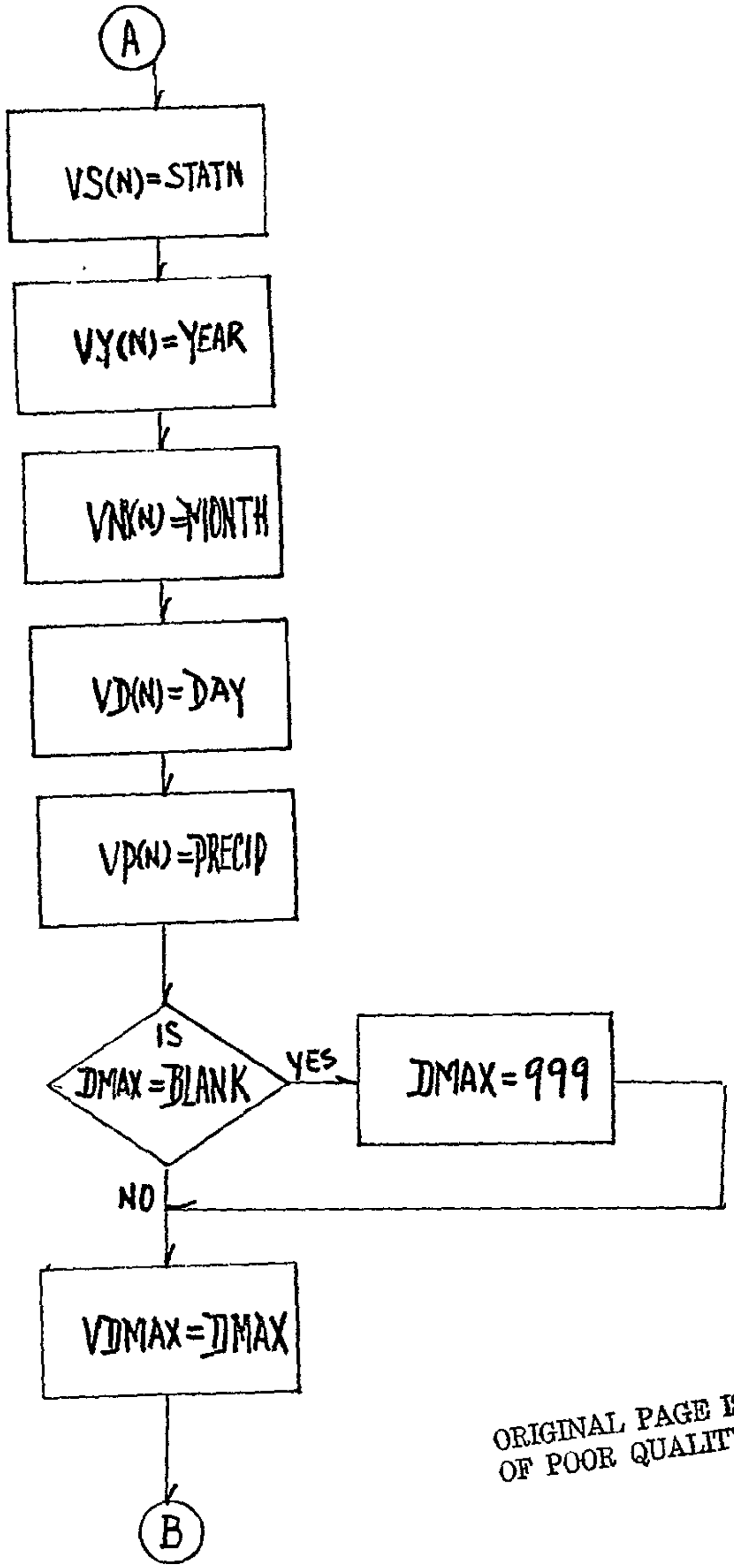
THE MONTHS (X 10** 0)

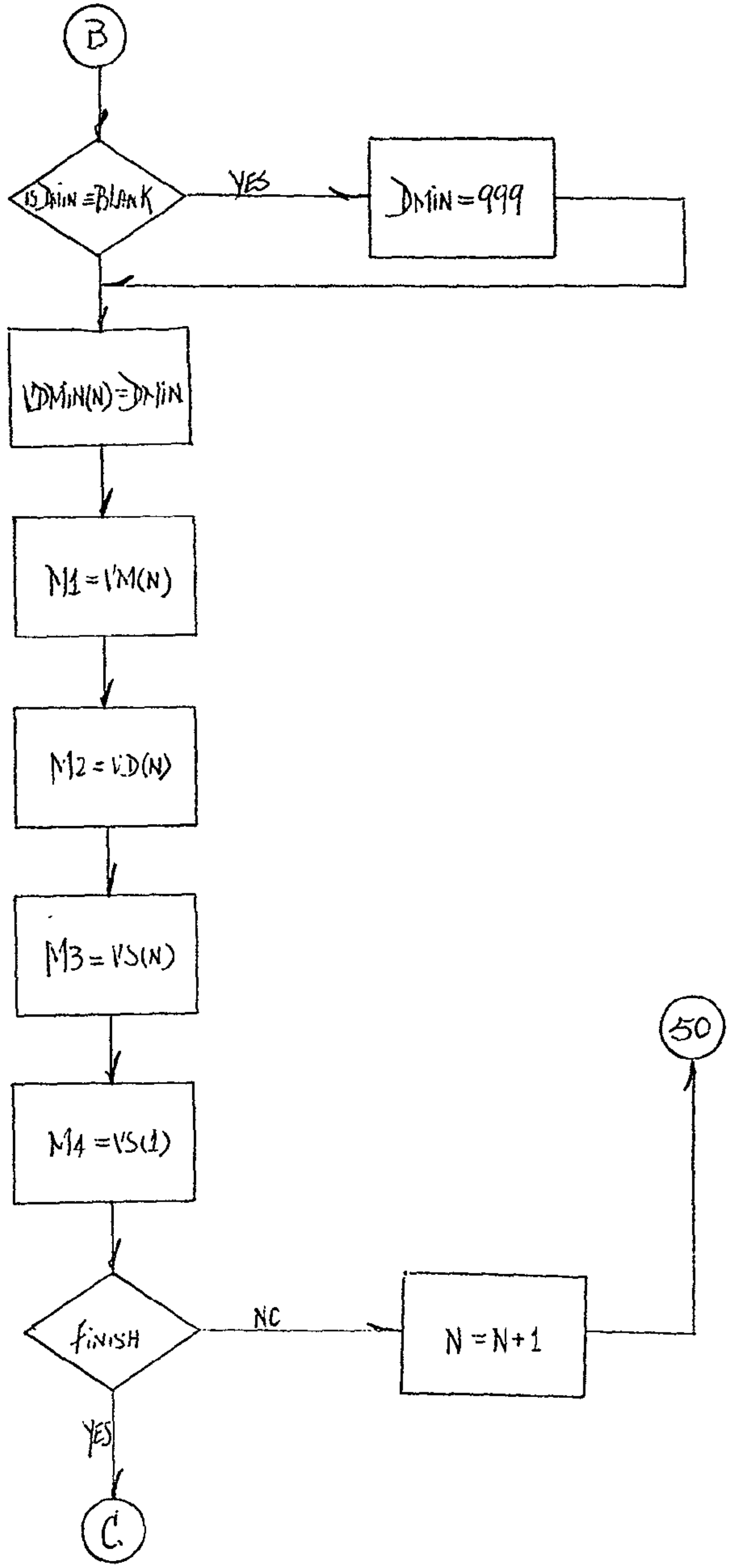
APPENDIX B

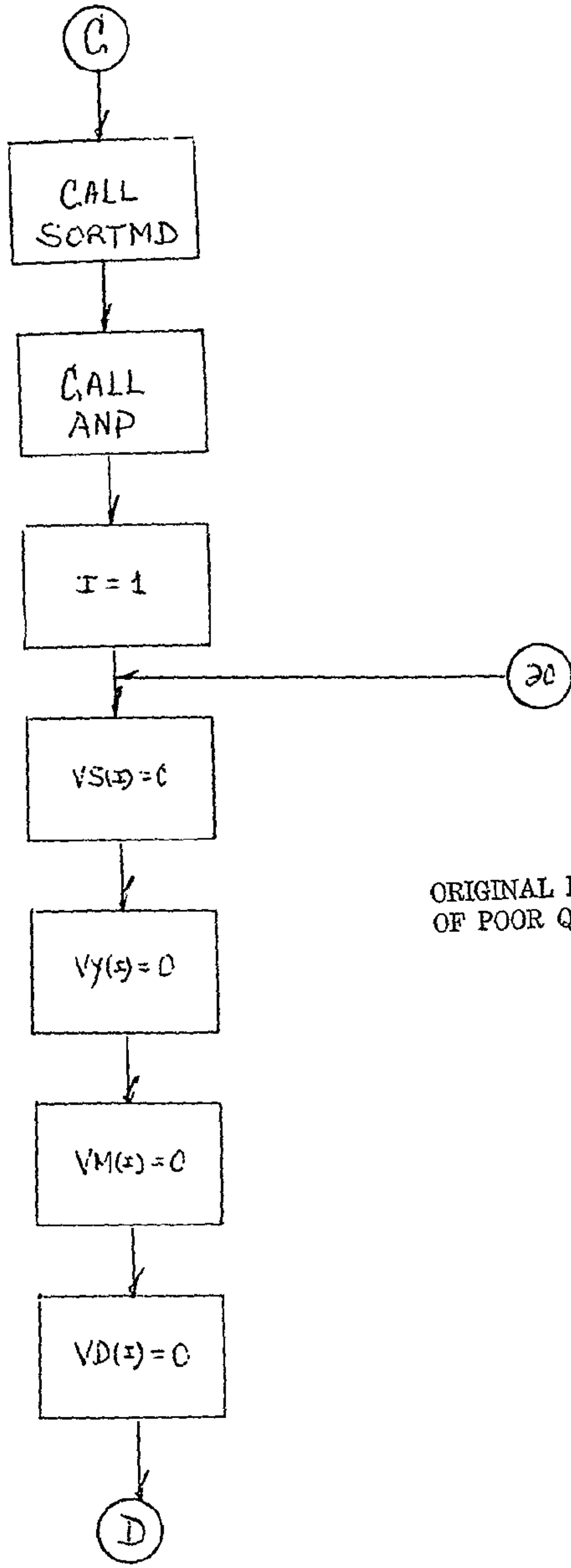
TABLE OF CONTENTS

ESTIMATION OF MONTHLY MAX AND MIN TEMPERATURES AND PRECIPITATION FOR THE ENTIRE WHEAT PRODUCTION AREA OF THE PEOPLE'S REPUBLIC OF CHINA

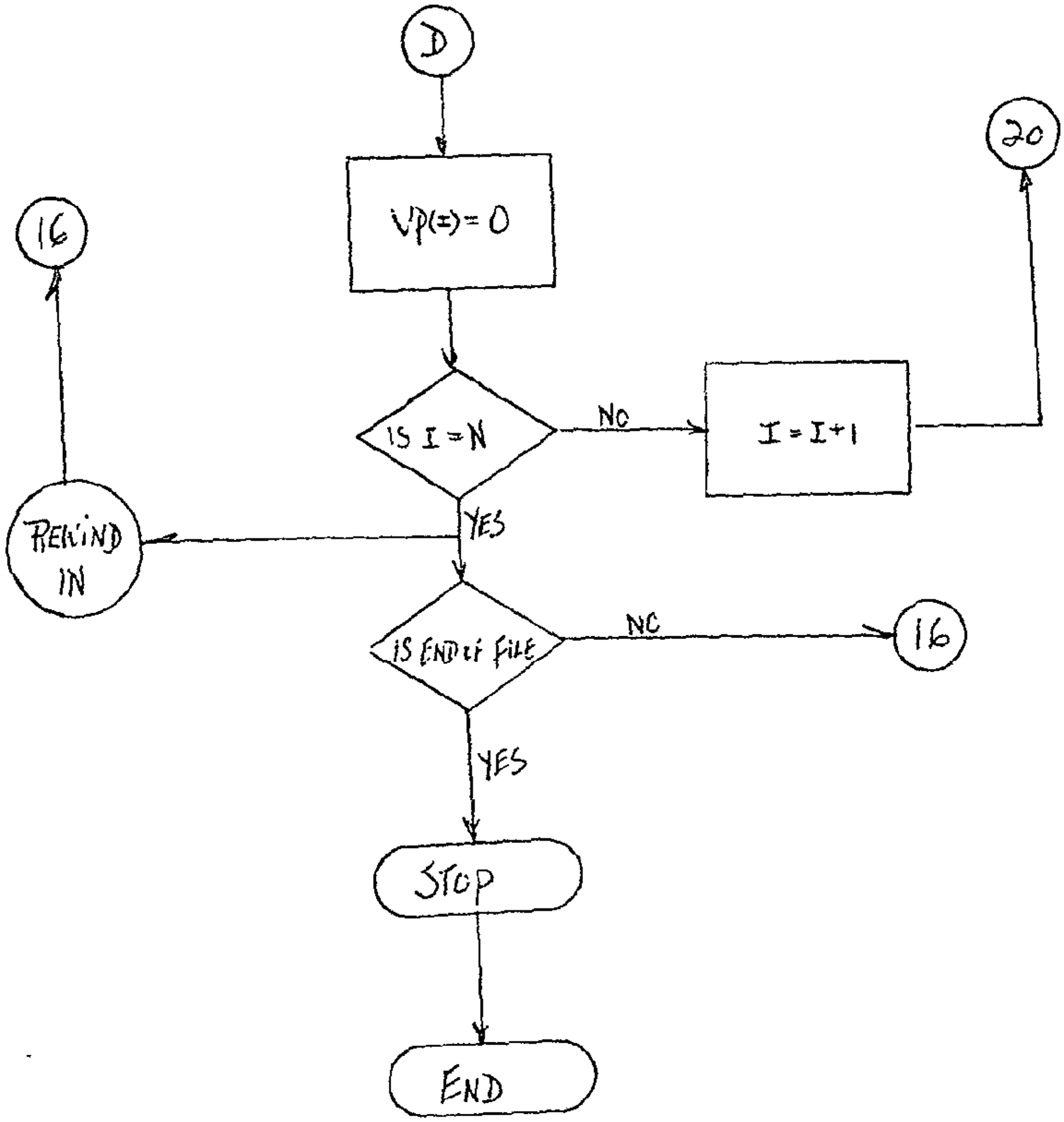



A
VS(N)=STATN
VY(N)=YEAR
VM(N)=MONTH
VD(N)=DAY
VP(N)=PRECIP
IS
DMAX=BLANK
YES
DMAX=999
NO
VDMAX=DMAX
B


B
IS DMIN = BLANK
YES
DMIN = 999
VDMIN(N) = DMIN
M1 = VM(N)
M2 = VD(N)
M3 = VS(N)
M4 = VS(1)
FINISH
NO
N = N+1
50
YES
C



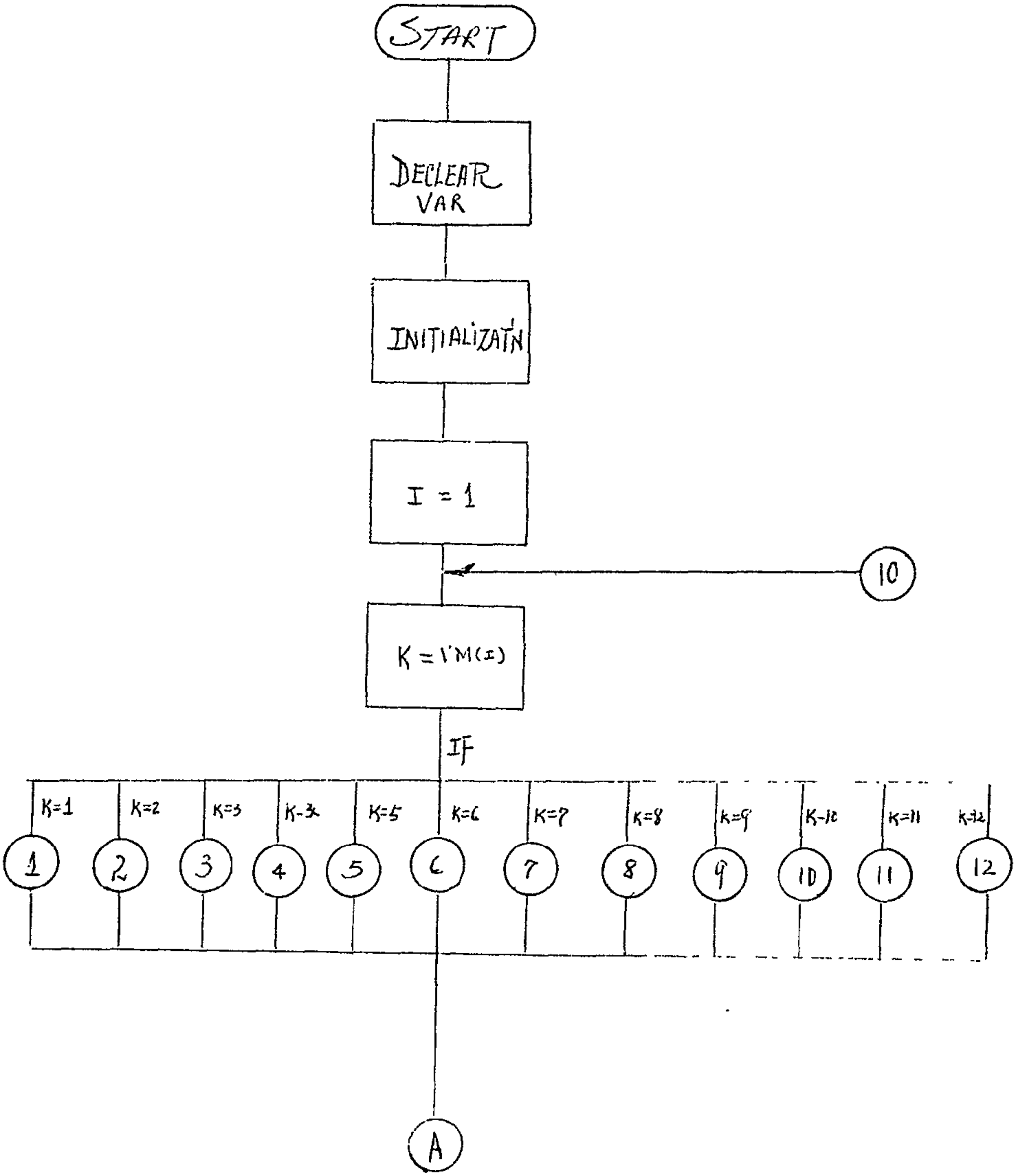
ORIGINAL PAGE IS
OF POOR QUALITY

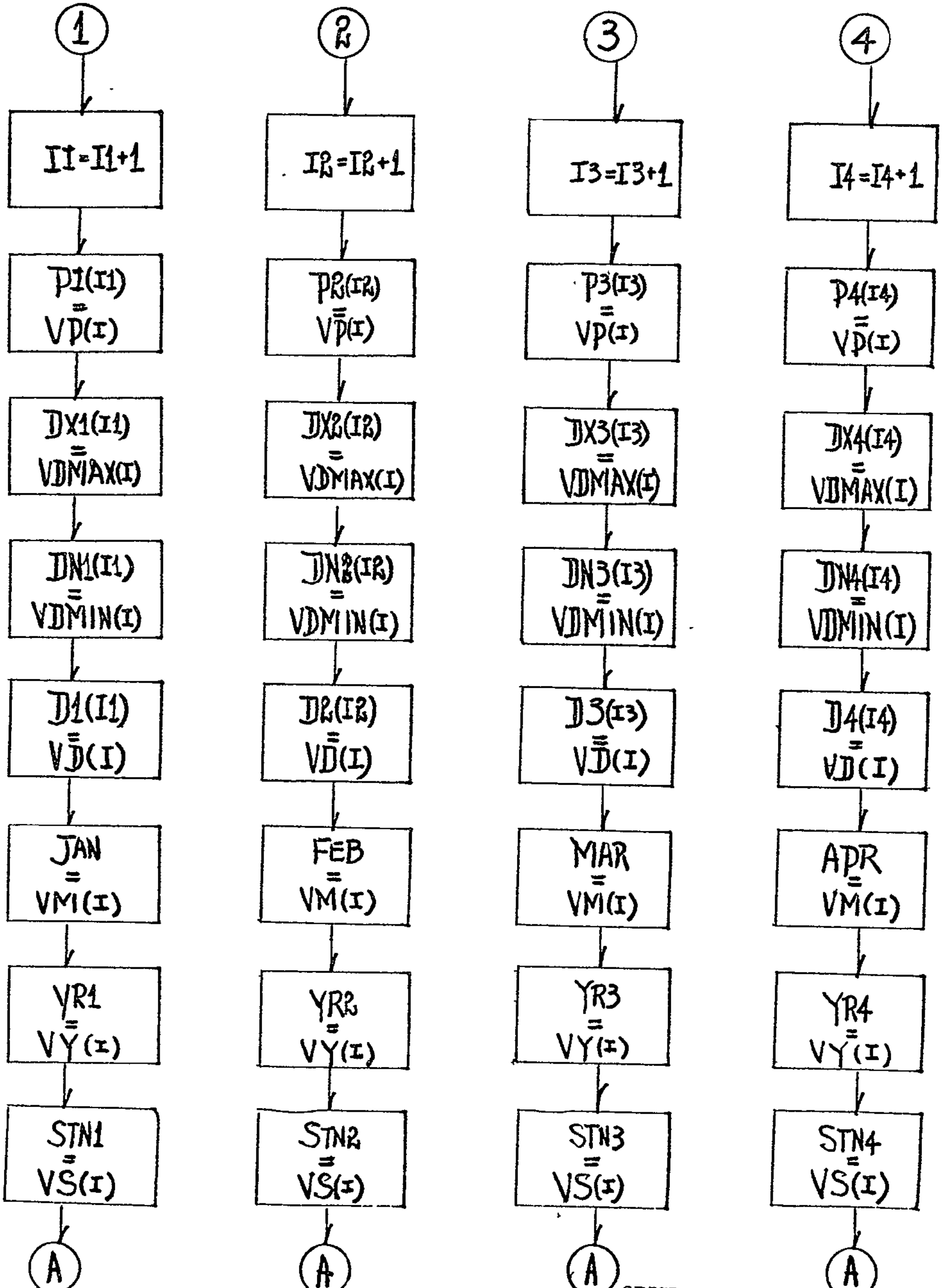


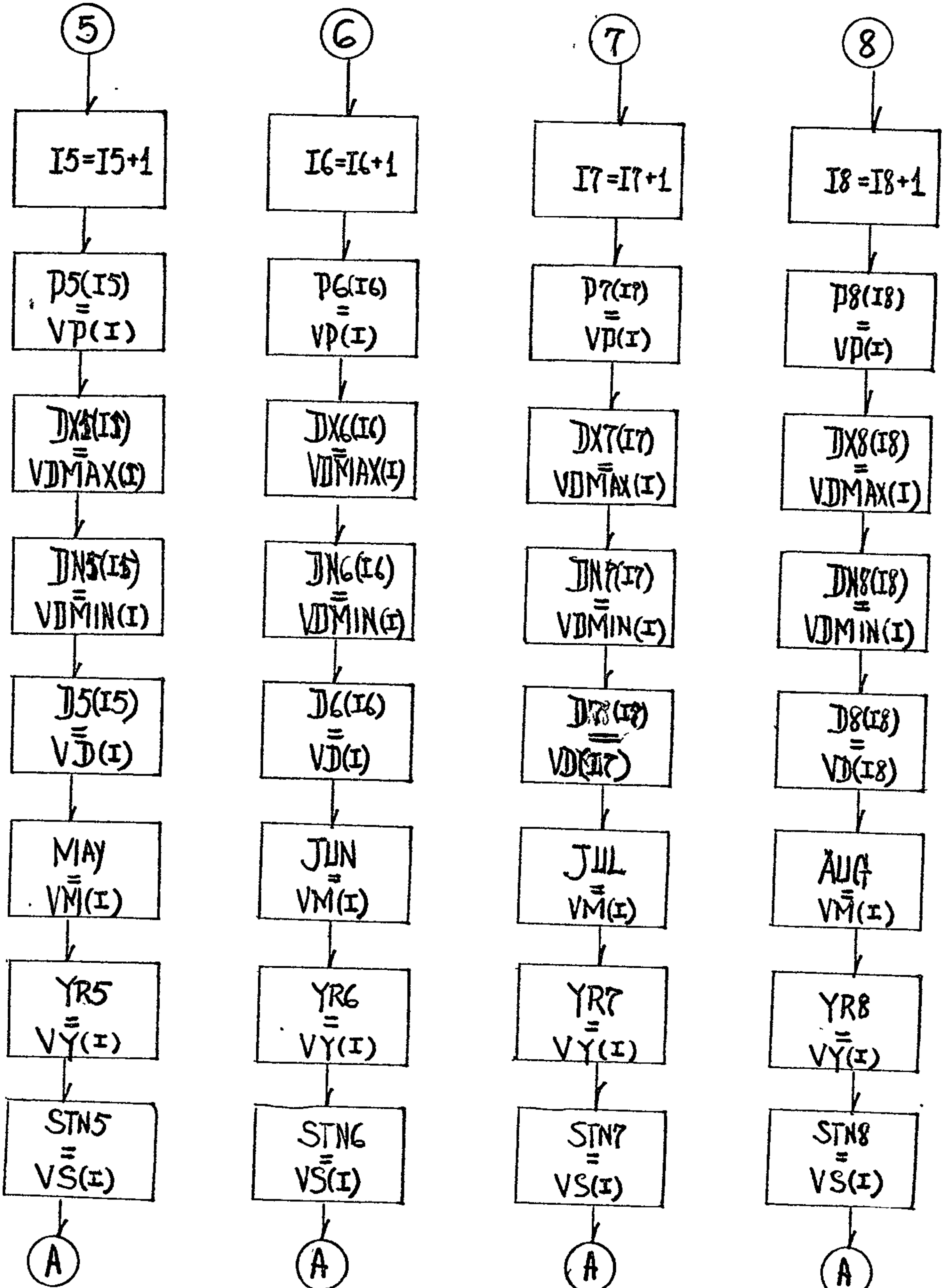
END OF THE MAIN PROGRAM

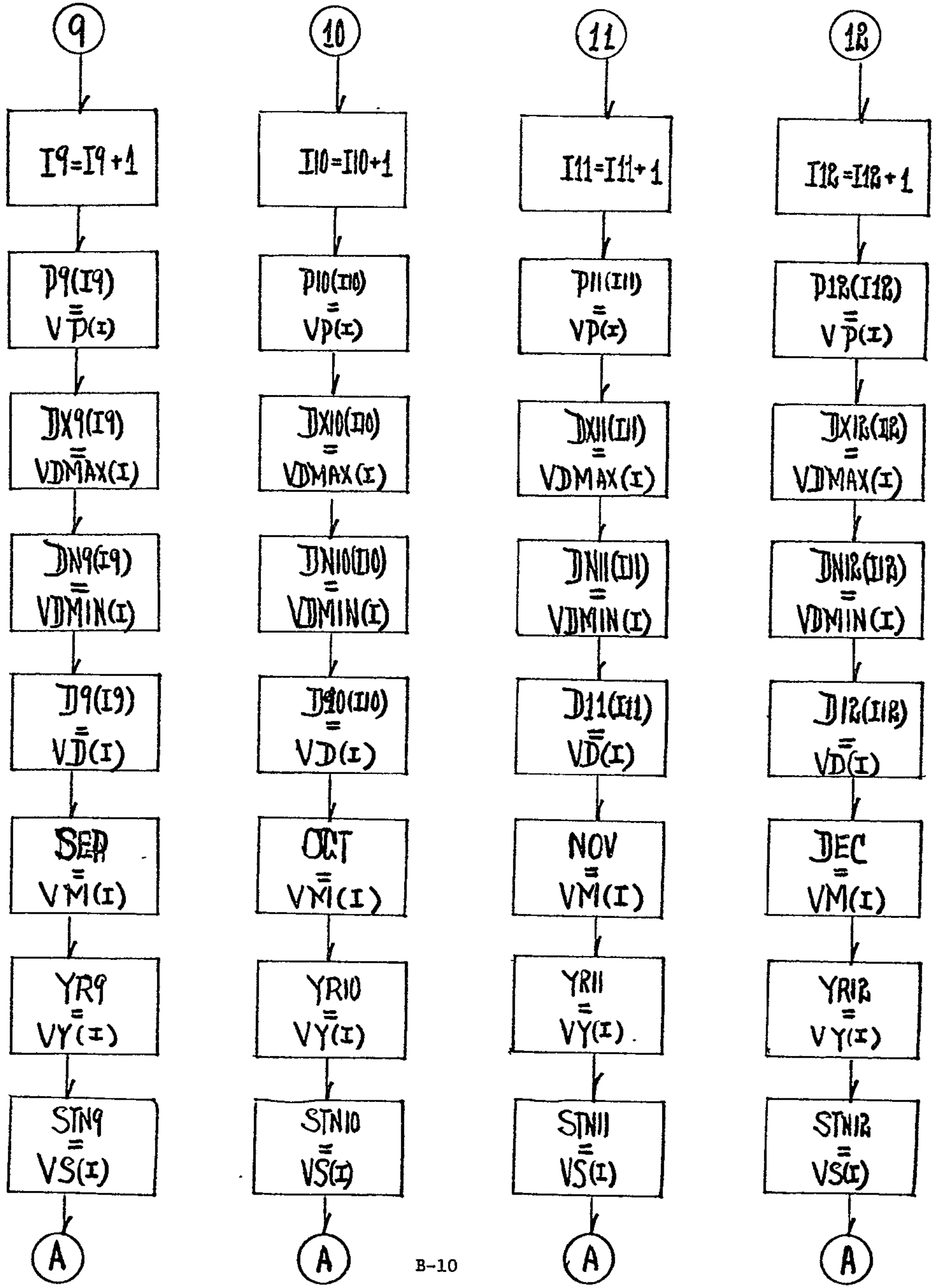
```
0001              EXTERNAL SIGN
0002              INTEGER VS (600),VY(600),VM(600),VD(600),VDMAX(600),VDMIN(600),
                 @VP(600),STATN,YEAR,MONTH,DAY,DMAX,DMIN,PRECIP
0003              INTEGER N1(6),N2(2),N3(2),N4(3),N5(3),N6(3),N7(3)
0004              INTEGER STN1,YR1,BF
0005              REAL RMAX,RMIN
0006              DO 500 IN=9,10
0007              READ(IN,20)N1,N2,N3,N4,N5,N6,N7
0008           20 FORMAT(6A1,2A1,2A1,3A1,1X,3A1,3A1,3X,3A1)
0009           16 N=1
0010           50 READ(IN,40,END=499)STATN,YEAR,MONTH,DAY,DMAX,DMIN,PRECIP,RMAX,
                 @RMIN
0011              VS(N)=STATN
0012           40 FORMAT(I6,3I2,1X,2I3,3X,I4,T14,2F3.0)
0013              VY(N)=YEAR
0014              VM(N)=MONTH
0015              VD(N)=DAY
0016              VP(N)=PRECIP
0017              IF((DMAX.EQ.0).AND.(SIGN(1.0,RMAX).EQ.-1.0))DMAX=999
0018              VDMAX(N)=DMAX
0019              IF((DMIN.EQ.0).AND.(SIGN(1.0,RMIN).EQ.-1.0))DMIN=999
0020              VDMIN(N)=DMIN
0021              M1=VM(N)
0022              M2=VD(N)
0023              M3=VS(N)
0024              M4=VS(1)
0025              IF(((M1.EQ.12).AND.(M2.EQ.31)).OR.((M3.NE.M4))) GO TO 200
0026              N=N+1
0027              GO TO 50
0028          200 CALL      SORTMD(VS,VY,VM,VD,VDMAX,VDMIN ,N,STN1,YR1,VP,PIBAR)
0029              CALL ANP(STN1,YR1,VP,BF,N)
                  CLEAR ALL STORAGE FOR NEXT STATION
0030              DO 300 I=1,N
0031              VS(I)=0
0032              VY(I)=0
0033              VM(I)=0
0034              VD(I)=0
0035              VP(I)=0
0036          300 CONTINUE
0037              GO TO 16
0038          499 REWIND IN
0039          500 CONTINUE
0040              STOP
0041              DEBUG SUBCHK
0042              END
```

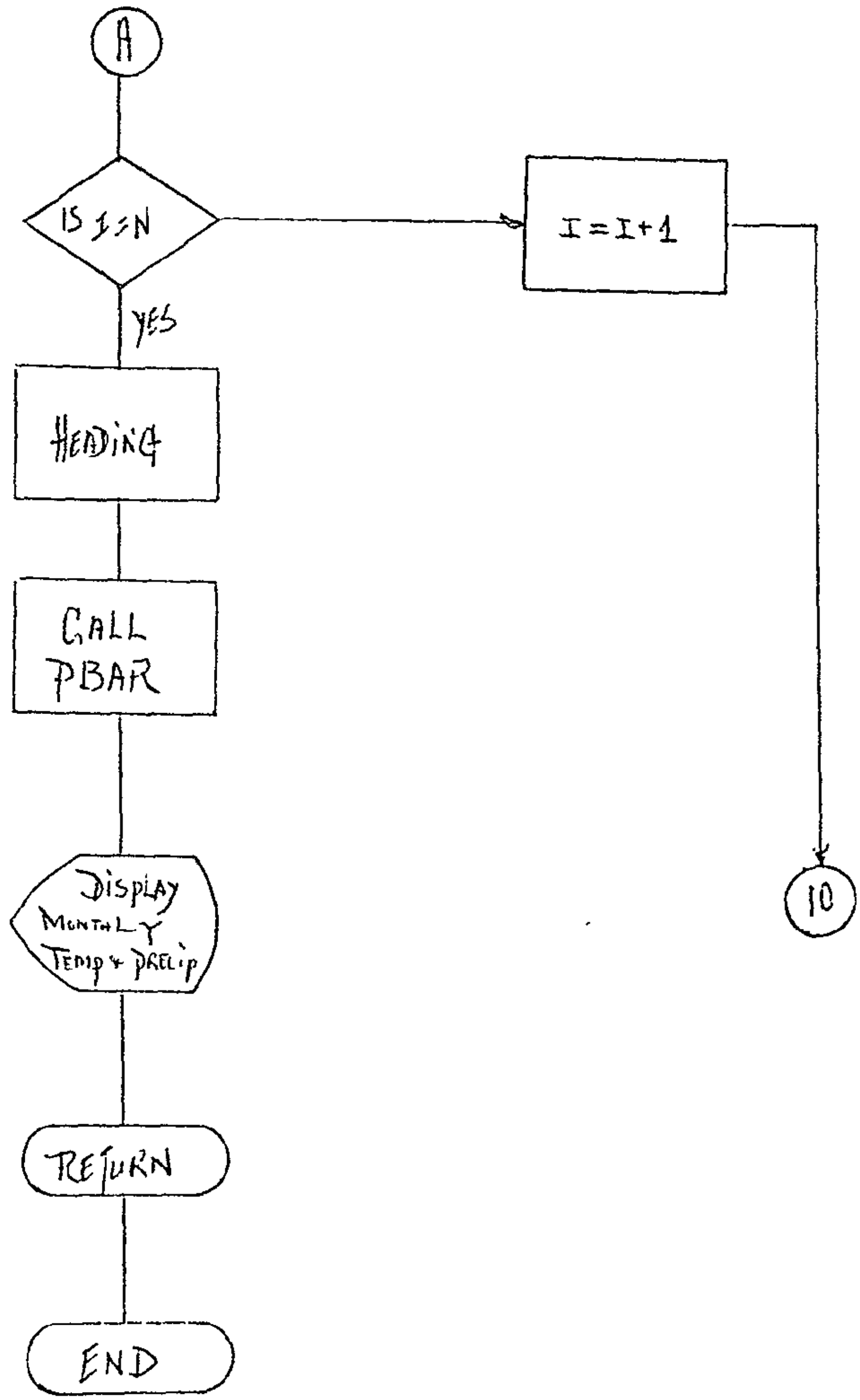
SUBROUTINE SORTMD




1
I1=I1+1
P1(I1) = VP(I)
DX1(I1) = VDMAX(I)
DN1(I1) = VDMIN(I)
D1(I1) = VD(I)
JAN = VM(I)
YR1 = VY(I)
STN1 = VS(I)
A
2
I2=I2+1
P2(I2) = VP(I)
DX2(I2) = VDMAX(I)
DN2(I2) = VDMIN(I)
D2(I2) = VD(I)
FEB = VM(I)
YR2 = VY(I)
STN2 = VS(I)
A
3
I3=I3+1
P3(I3) = VP(I)
DX3(I3) = VDMAX(I)
DN3(I3) = VDMIN(I)
D3(I3) = VD(I)
MAR = VM(I)
YR3 = VY(I)
STN3 = VS(I)
A
4
I4=I4+1
P4(I4) = VP(I)
DX4(I4) = VDMAX(I)
DN4(I4) = VDMIN(I)
D4(I4) = VD(I)
APR = VM(I)
YR4 = VY(I)
STN4 = VS(I)
A


5
I5=I5+1
P5(I5) = VP(I)
DX5(I5) = VDMAX(I)
DN5(I5) = VDMIN(I)
D5(I5) = VD(I)
MAY = VM(I)
YR5 = VY(I)
STN5 = VS(I)
A
6
I6=I6+1
P6(I6) = VP(I)
DX6(I6) = VDMAX(I)
DN6(I6) = VDMIN(I)
D6(I6) = VD(I)
JUN = VM(I)
YR6 = VY(I)
STN6 = VS(I)
A
7
I7=I7+1
P7(I7) = VP(I)
DX7(I7) = VDMAX(I)
DN7(I7) = VDMIN(I)
D7(I7) = VD(I7)
JUL = VM(I)
YR7 = VY(I)
STN7 = VS(I)
A
8
I8=I8+1
P8(I8) = VP(I)
DX8(I8) = VDMAX(I)
DN8(I8) = VDMIN(I)
D8(I8) = VD(I8)
AUG = VM(I)
YR8 = VY(I)
STN8 = VS(I)
A


9
I9=I9+1
D9(I9) = VD(I)
DX9(I9) = VDMAX(I)
DN9(I9) = VDMIN(I)
D9(I9) = VD(I)
SEP = VM(I)
YR9 = VY(I)
STN9 = VS(I)
A
10
I10=I10+1
D10(I10) = VD(I)
DX10(I10) = VDMAX(I)
DN10(I10) = VDMIN(I)
D10(I10) = VD(I)
OCT = VM(I)
YR10 = VY(I)
STN10 = VS(I)
A
11
I11=I11+1
D11(I11) = VD(I)
DX11(I11) = VDMAX(I)
DN11(I11) = VDMIN(I)
D11(I11) = VD(I)
NOV = VM(I)
YR11 = VY(I)
STN11 = VS(I)
A
12
I12=I12+1
D12(I12) = VD(I)
DX12(I12) = VDMAX(I)
DN12(I12) = VDMIN(I)
D12(I12) = VD(I)
DEC = VM(I)
YR12 = VY(I)
STN12 = VS(I)
A


A
IS I=N
I=I+1
YES
HEADING
CALL PBAR
DISPLAY MONTHLY TEMP & PRECIP
10
RETURN
END

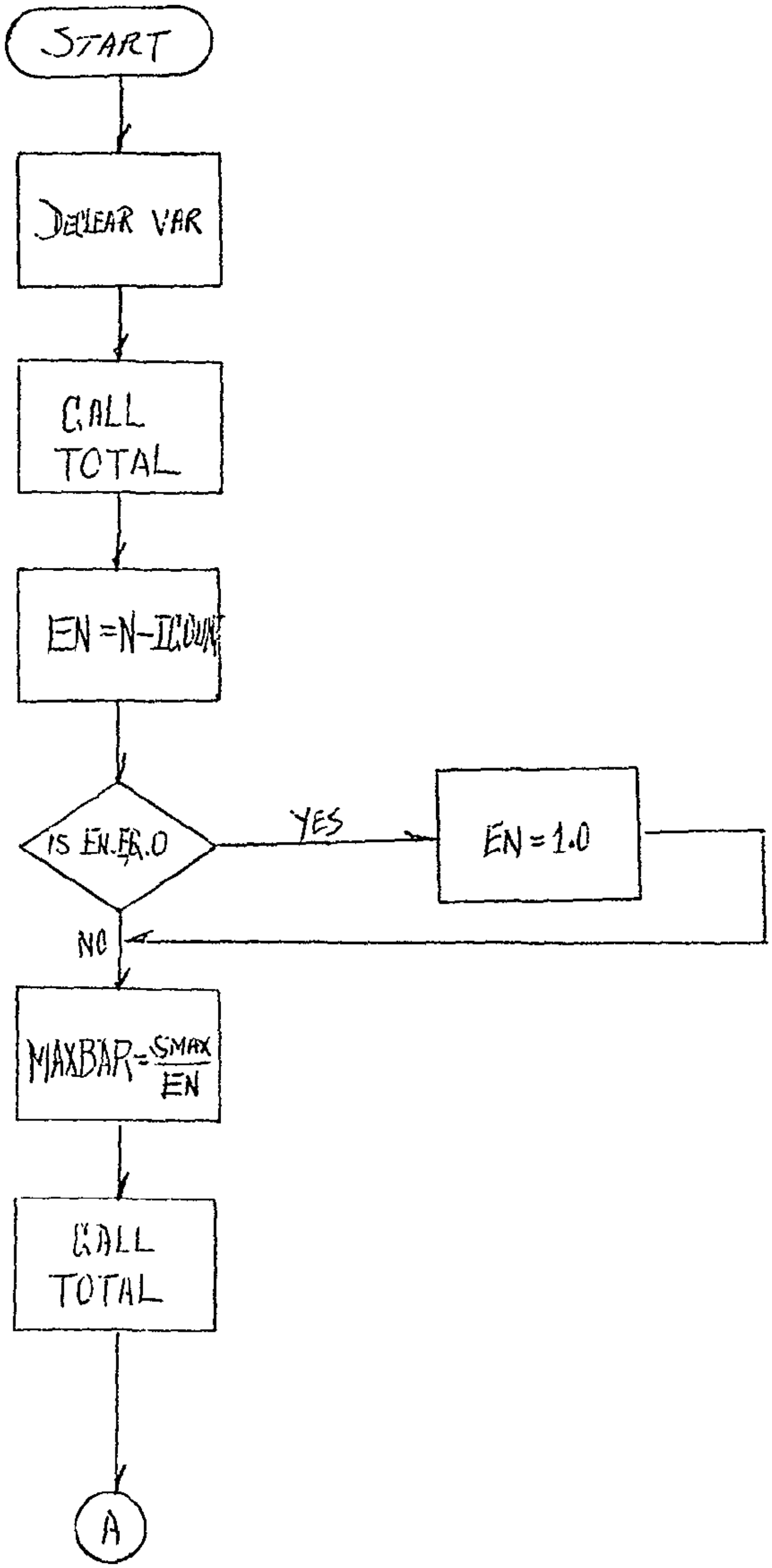
```
              C      THIS SUBROUTINE IS TO SORTED THE 12 MONTHS OBSERVATIONS FOR
              C      EACH STATION
0001                 SUBROUTINE SORTMD(VS,VY,VM,VD,VDMAX,VDMIN ,N,STN1,YR1,VP,PIBAR)
0002                 REAL BM1,BM2,BM3,BM4,BM5,BM6,BM7,BM8,BM9,BM10,BM11,BM12,
                    +BN1,BN2,BN3,BN4,BN5,BN6,BN7,BN8,BN9,BN10,BN11,BN12
0003                 INTEGER DX1(50),DX2(50),DX3(50),DX4(50),DX5(50),DX6(50),DX7(50),
                    +DX8(50),DX9(50),DX10(50),DX11(50),DX12(50),DN1(50),DN2(50),
                    +DN3(50),DN4(50),DN5(50),DN6(50),DN7(50),DN8(50),DN9(50),DN10(50),
                    +DN11(50),DN12(50),I1,I2,I3,I4,I5,I6,I7,I8,I9,I10,I11,I12,YR1,YR2,
                    +YR3,YR4,YR5,YR6,YR7,YR8,YR9,YR10,YR11,YR12,STN1,STN2,STN3,STN4,
                    +STN5,STN6,STN7,STN8,STN9,STN10,STN11,STN12
0004                 INTEGER VS(600),VY(600),VM(600),VD(600),VDMAX(600),VDMIN(600),
                    +JAN,FEB,MAR,APR,MAY,JUN,JUL,AUG,SEP,OCT,NOV,DEC,D1 (50),D2(50),
                    +D3(50),D4(50),D5(50),D6(50),D7(50),D8(50),D9(50),D10(50),D11(50),
                    @D12(50),P1(50),P2(50),P3(50),P4(50),P5(50),P6(50),P7(50),P8(50),
                    @P9(50),P10(50),P11(50),P12(50),VP(400),PIBAR
0005                 INTEGER P1BAR,P2BAR,P3BAR,P4BAR,P5BAR,P6BAR,P7BAR,P8BAR,
                    @P9BAR,P10BAR,P11BAR,P12BAR
0006                 I1=0
0007                 I2=0
0008                 I3=0
0009                 I4=0
0010                 I5=0
0011                 I6=0
0012                 I7=0
0013                 I8=0
0014                 I9=0
0015                 I10=0
0016                 I11=0
0017                 I12=0
0018                 DO 100 I=1,N
0019                 K=VM(I)
0020                 GO TO(1,2,3,4,5,6,7,8,9,10,11,12),K
0021               1 I1=I1+1
0022                 P1(I1)=VP(I)
0023                 DX1(I1)=VDMAX(I)
0024                 DN1(I1)=VDMIN(I)
0025                 D1(I1)=VD(I)
0026                 JAN=VM(I)
0027                 YR1=VY(I)
0028                 STN1=VS(I)
0029                 GO TO 100
0030               2 I2=I2+1
0031                 P2(I2)=VP(I)
0032                 DX2(I2)=VDMAX(I)
0033                 DN2(I2)=VDMIN(I)
0034                 D2(I2)=VD(I)
0035                 FEB=VM(I)
0036                 YR2=VY(I)
0037                 STN2=VS(I)
0038                 GO TO 100
0039               3 I3=I3+1
0040                 P3(I3)=VP(I)
0041                 DX3(I3)=VDMAX(I)
0042                 DN3(I3)=VDMIN(I)
0043                 D3(I3)=VD(I)
```

```
      MAR=VM(I)
      YR3=VY(I)
      STN3=VS(I)
      GO TO 100
    4 I4=I4+1
      P4(I4)=VP(I)
      DX4(I4)=VDMAX(I)
      DN4(I4)=VDMIN(I)
      D4(I4)=VD(I)
      APR=VM(I)
      YR4=VY(I)
      STN4=VS(I)
      GO TO 100
    5 I5=I5+1
      P5(I5)=VP(I)
      DX5(I5)=VDMAX(I)
      DN5(I5)=VDMIN(I)
      D5(I5)=VD(I)
      MAY=VM(I)
      YR5=VY(I)
      STN5=VS(I)
      GO TO 100
    6 I6=I6+1
      P6(I6)=VP(I)
      DX6(I6)=VDMAX(I)
      DN6(I6)=VDMIN(I)
      D6(I6)=VD(I)
      JUN=VM(I)
      YR6=VY(I)
      STN6=VS(I)
      GO TO 100
    7 I7=I7+1
      P7(I7)=VP(I)
      DX7(I7)=VDMAX(I)
      DN7 (I7)=VDMIN(I)
       D7(I7)=VD(I)
      JUL=VM(I)
      YR7=VY(I)
      STN7=VS(I)
      GO TO 100
    8 I8=I8+1
      P8(I8)=VP(I)
      DX8(I8)=VDMAX(I)
      DN8(I8)=VDMIN(I)
      AUG=VM(I)
      YR8=VM(I)
      D8(I8)=VD(I)
      STN8=VS(I)
      GO TO 100
    9 I9=I9+1
      P9(I9)=VP(I)
      DX9(I9)=VDMAX(I)
      DN9(I9)=VDMIN(I)
      D9(I9)=VD(I)
      SEP=VM(I)
      YR9=VY(I)
```

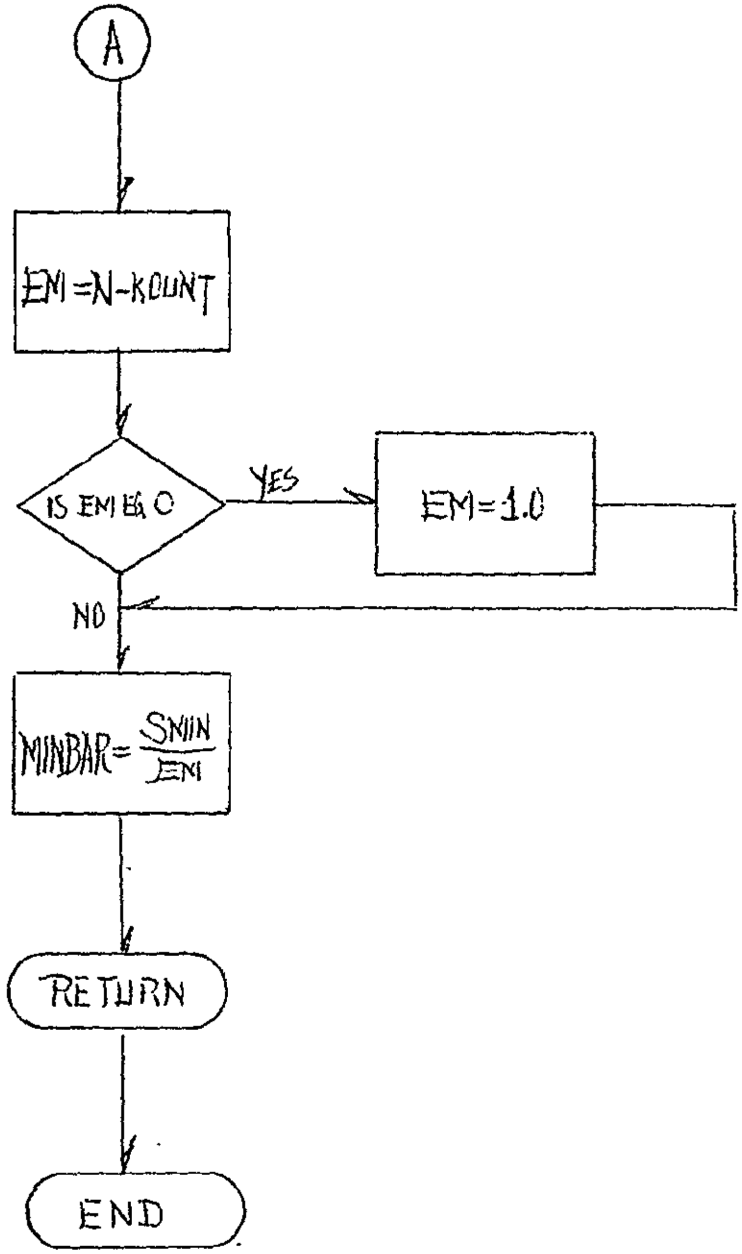
```
      STN9=VS(I)
      GO TO 100
   10 I10=I10+1
      P10(I10)=VP(I)
      DX10(I10)=VDMAX(I)
      DN10(I10)=VDMIN(I)
      D10(I10)=VD(I)
      OCT=VM(I)
      YR10=VY(I)
      STN10=VS(I)
      GO TO 100
   11 I11=I11+1
      P11(I11)=VP(I)
      DX11(I11)=VDMAX(I)
      DN11(I11)=VDMIN(I)
      D11(I11)=VD(I)
      NOV=VM(I)
      YR11=VY(I)
      STN11=VS(I)
      GO TO 100
   12 I12=I12+1
      P12(I12)=VP(I)
      DX12(I12)=VDMAX(I)
      DN12(I12)=VDMIN(I)
      D12(I12)=VD(I)
      DEC=VM(I)
      YR12=VY(I)
      STN12=VS(I)
  100 CONTINUE
      WRITE(6,50)
   50 FORMAT(20X,'THE MONTHLY MAX,AND MIN TEMP TABLE'/
     @20X,'MONTH',5X,'MAX TEMP',10X,'MIN TEMP',10X,'PRECIP'/
     @20X,52('-'))
      CALL DMEAN(DX1,DN1,D1,JAN,YR1,STN1,I1,BM1,BN1)
      CALL DMEAN(DX2,DN2,D2,FEB,YR2,STN2,I2,BM2,BN2)
      CALL DMEAN(DX3,DN3,D3,MAR,YR3,STN3,I3,BM3,BN3)
      CALL DMEAN(DX4,DN4,D4,APR,YR4,STN4,I4,BM4,BN4)
      CALL DMEAN(DX5,DN5,D5,MAY,YR5,STN5,I5,BM5,BN5)
      CALL DMEAN(DX6,DN6,D6,JUN,YR6,STN6,I6,BM6,BN6)
      CALL DMEAN(DX7,DN7,D7,JUL,YR7,STN7,I7,BM7,BN7)
      CALL DMEAN(DX8,DN8,D8,AUG,YR8,STN8,I8,BM8,BN8)
      CALL DMEAN(DX9,DN9,D9,SEP,YR9,STN9,I9,BM9,BN9)
      CALL DMEAN(DX10,DN10,D10,OCT,YR10,STN10,I10,BM10,BN10)
      CALL DMEAN(DX11,DN11,D11,NOV,YR11,STN11,I11,BM11,BN11)
      CALL DMEAN(DX12,DN12,D12,DEC,YR12,STN12,I12,BM12,BN12)
      CALL PBAR(P1,I1,P1BAR)
      CALL PBAR(P2,I2,P2BAR)
      CALL PBAR(P3,I3,P3BAR)
      CALL PBAR(P4,I4,P4BAR)
      CALL PBAR(P5,I5,P5BAR)
      CALL PBAR(P6,I6,P6BAR)
      CALL PBAR(P7,I7,P7BAR)
      CALL PBAR(P8,I8,P8BAR)
      CALL PBAR(P9,I9,P9BAR)
      CALL PBAR(P10,I10,P10BAR)
      CALL PBAR(P11,I11,P11BAR)
```

```
0154          CALL PBAR(P12,I12,P12BAR)
0155          WRITE(6,52)STN1,YR1
0156       52 FORMAT(3X,'STATION #',I5,'  IN  19',I2)
0157          WRITE(6,51) JAN,BM1,BN1,P1BAR,
             @FEB,BM2,BN2,P2BAR,
             @MAR,BM3,BN3,P3BAR,
             @APR,BM4,BN4,P4BAR,
             @MAY,BM5,BN5,P5BAR,
             @JUN,BM6,BN6,P6BAR,
             @JUL,BM7,BN7,P7BAR,
             @AUG,BM8,BN8,P8BAR  ,
             @SEP,BM9,BN9,P9BAR,
             @OCT,BM10,BN10,P10BAR,
             @NOV,BM11,BN11,P11BAR,
             @DEC,BM12,BN12,P12BAR
0158       51 FORMAT(20X,I4,F12.2,10X,F10.2,10X,I8)
0159          RETURN
0160          DEBUG SUBCHK
0161          END
```

SUBROUTINE DMEAN

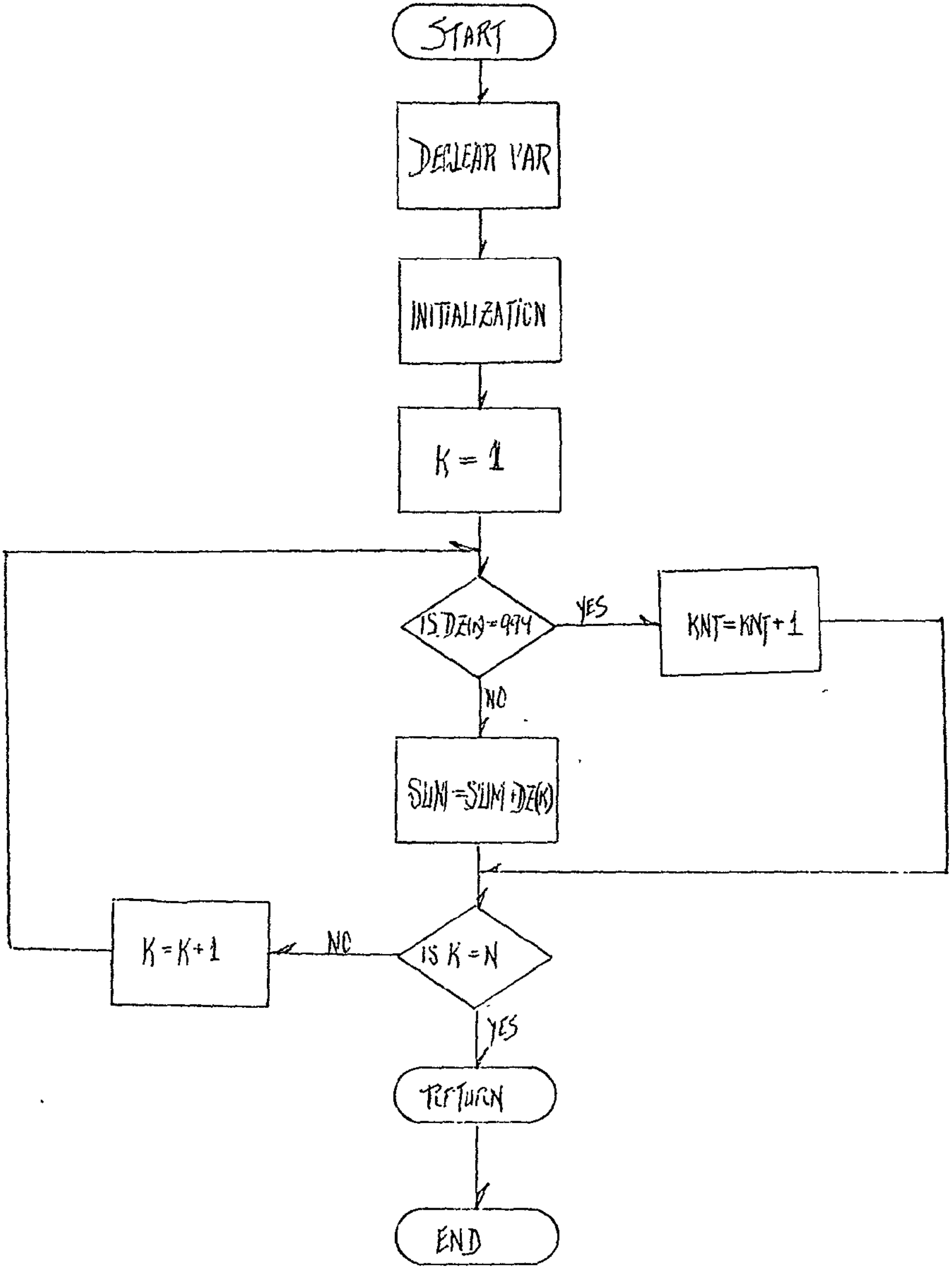


C-2


A
EM=N-KOUNT
IS EM EQ 0
YES
EM=1.0
NO
MINBAR= SMIN / EM
RETURN
END

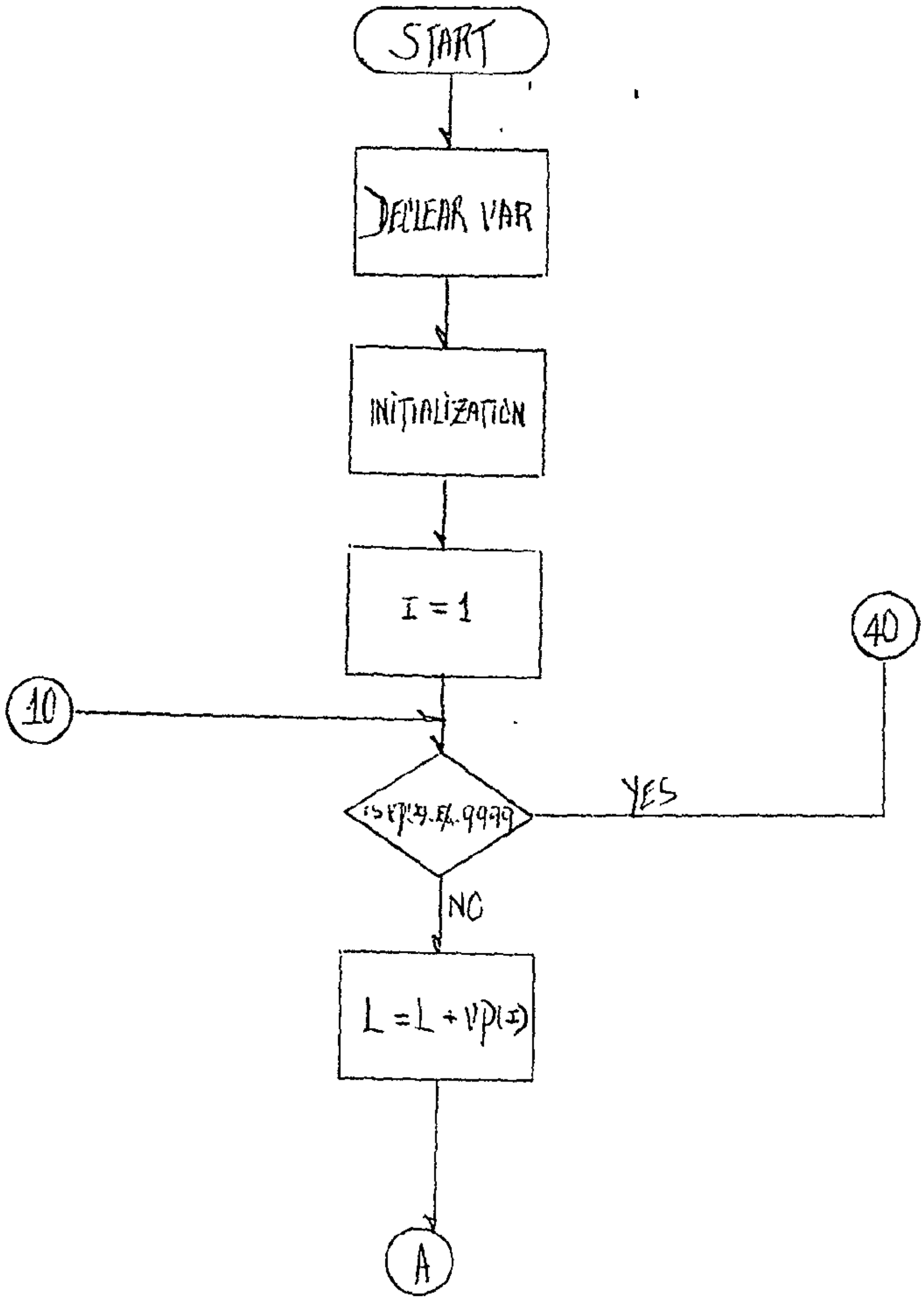
```
C      THIS SUBROUTINE IS USE TO CALCULATE THE MONTHLY MAX,MIN TEMP
       SUBROUTINE DMEAN(DX,DN,D,MON,YR,STN,N,MAXBAR,MINBAR)
       INTEGER DX(50),DN(50),MON,YR,STN
       INTEGER D(50)
       REAL MAXBAR,MINBAR
       CALL TOTAL(N,SMAX,DX,ICOUNT)
       EN=N-ICOUNT
       IF(EN.EQ.0.0)EN=1.0
       MAXBAR=SMAX/EN
       CALL TOTAL(N,SMIN,DN,KOUNT)
       EM=N-KOUNT
       IF(EM.EQ.0.0)EM=1.0
       MINBAR=SMIN/EM
       RETURN
       DEBUG SUBCHK
       END
```

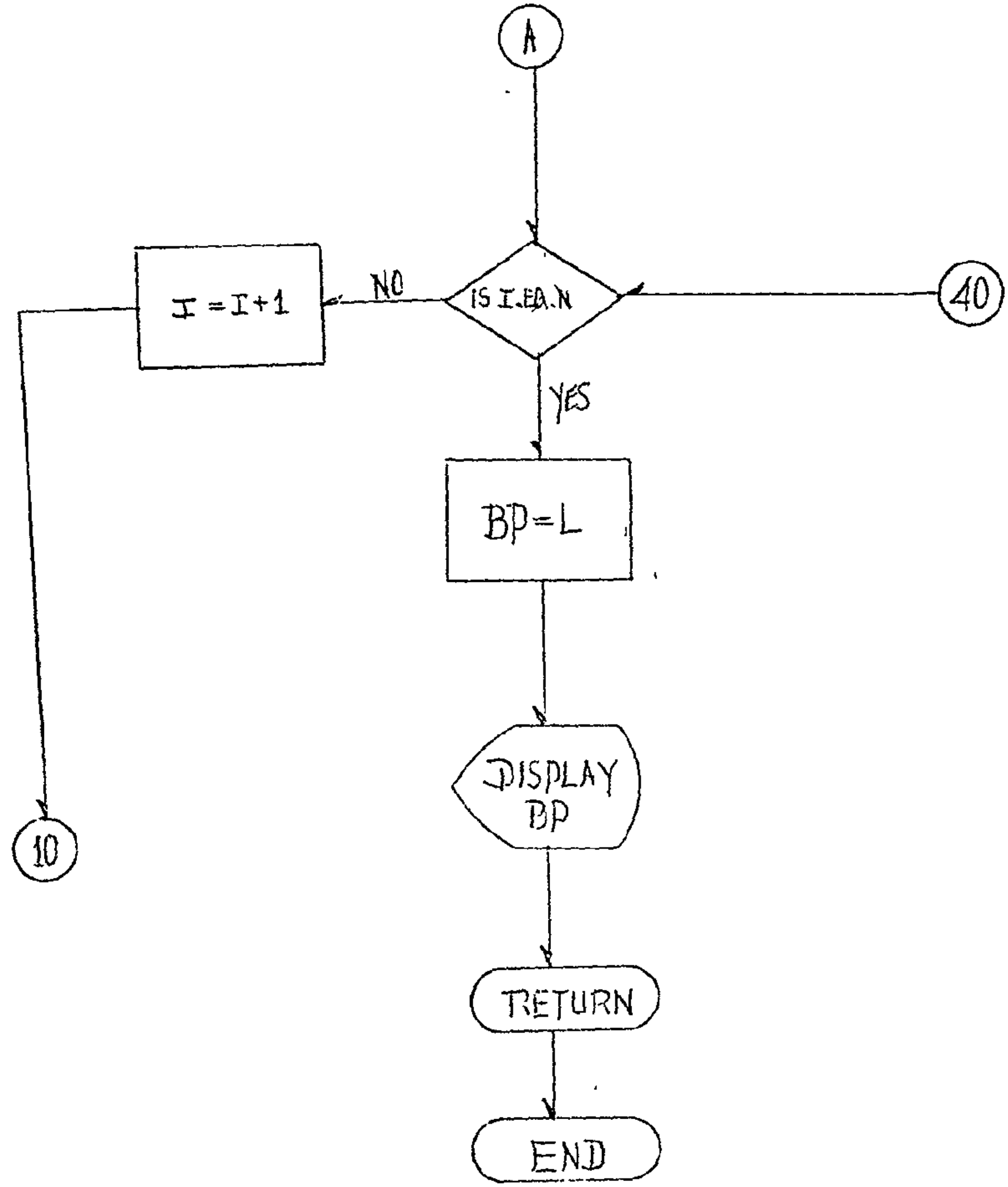
SUBROUTINE TOTAL



```
      SUBROUTINE TOTAL(N,SUM,DZ,KNT)
      INTEGER DZ(50)
      KNT=0
      SUM=0.0
      DO 100 K=1,N
      IF(DZ(K).EQ.999)GO TO 200
      SUM=SUM+DZ(K)
      GO TO 100
  200 KNT=KNT+1
  100 CONTINUE
      RETURN
      DEBUG SUBCHK
      END
```

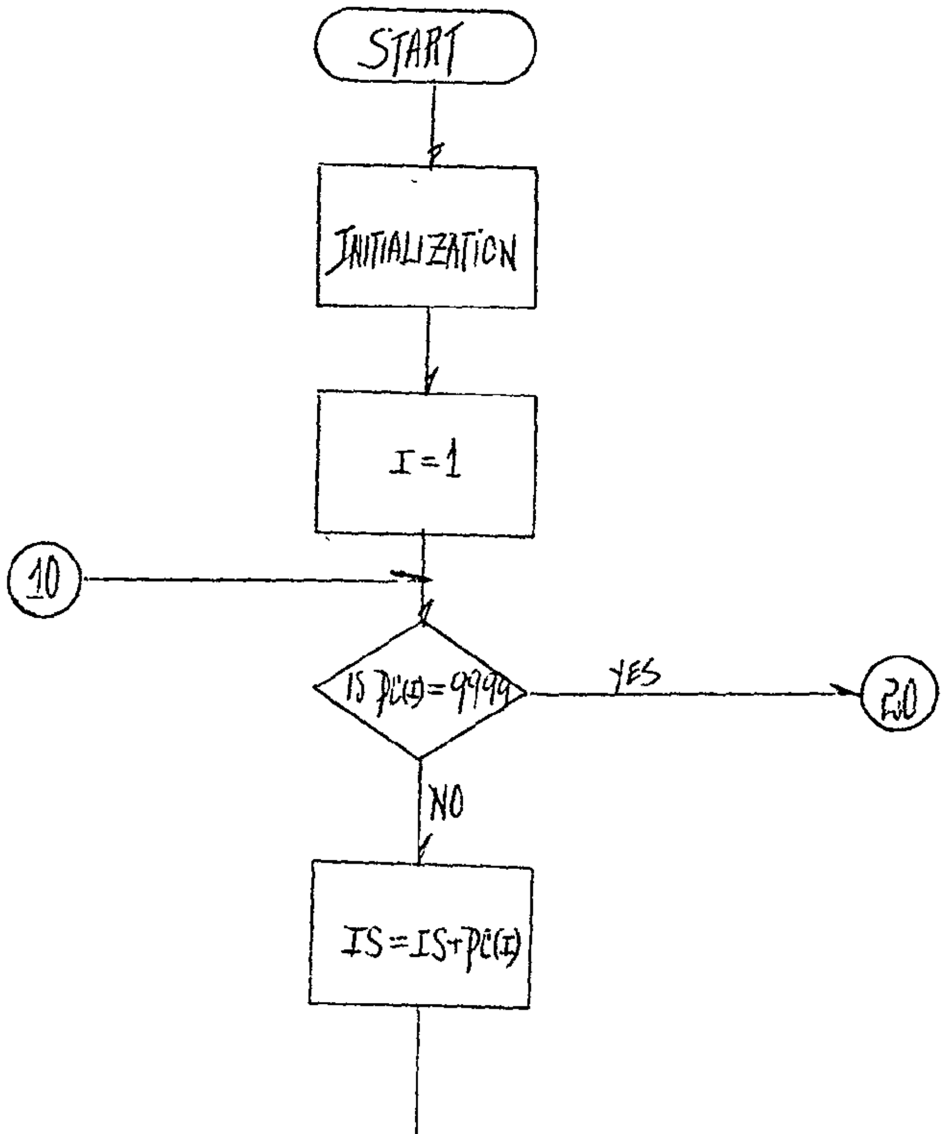
SUBROUTINE ANP

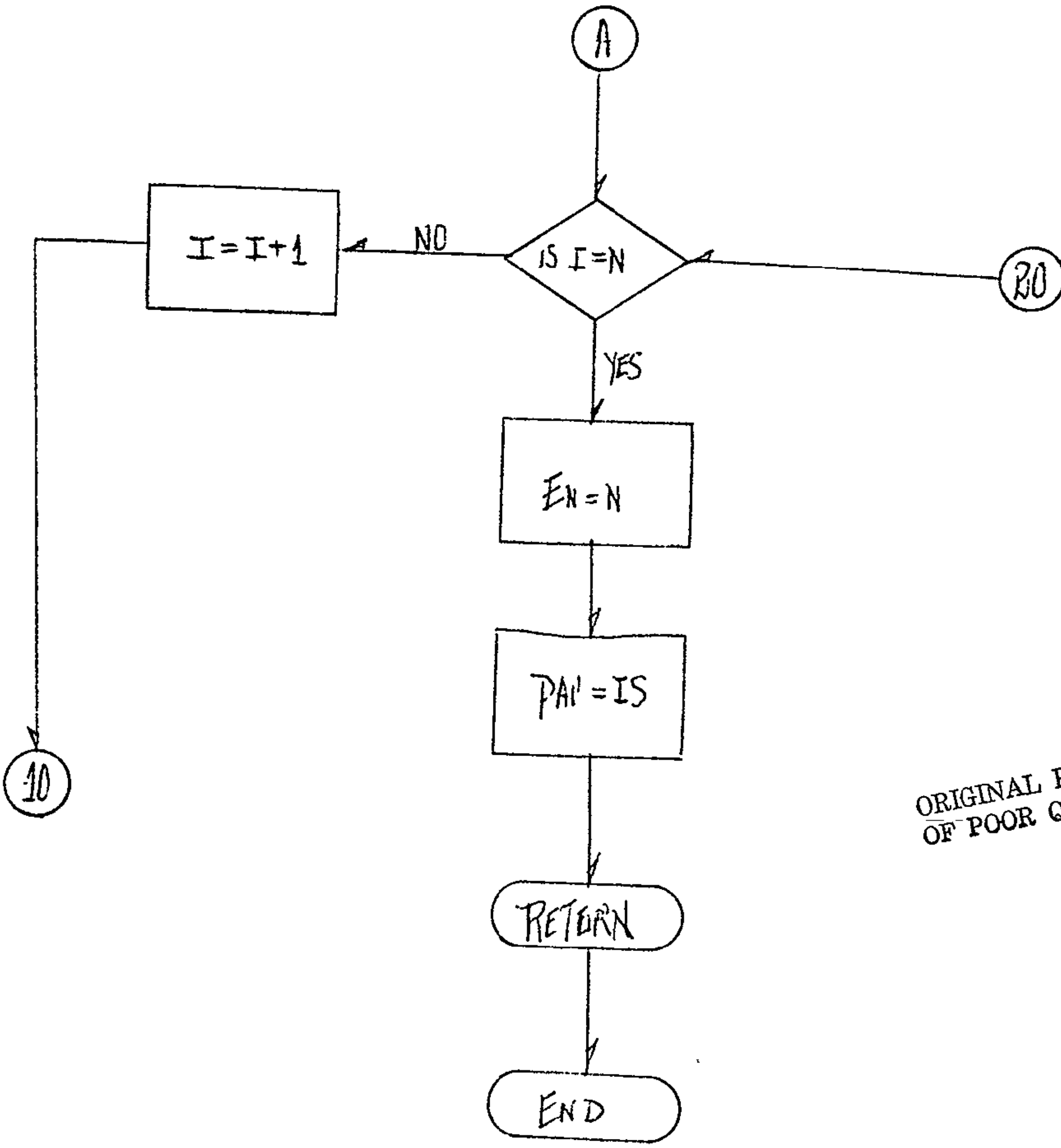



A
NO
IS I.EQ.N
40
I = I+1
YES
BP=L
10
DISPLAY
BP
RETURN
END

```
C      THIS SUBROUTINE IS USE TO FIND THE ANN PRECIP OF EACH STATION
       SUBROUTINE ANP(STATN,YEAR,VP,BP,N)
       INTEGER STATN,YEAR,VP(600),BP
       L=0
       ICOUNT=0
       DO 100 I=1,N
       IF(VP(I).EQ.9999) GO TO 200
       L=L+VP(I)
       GO TO 100
   200 ICOUNT=ICOUNT+1
   100 CONTINUE
       BP=L
       WRITE(6,30)N,ICOUNT,STATN,YEAR,BP
    30 FORMAT(30X,'TOTALA OF OBSERVATIONS=',I8,/
      @30X,'AOF MISSING OBSERVATION=',I8,/
      @30X,'FOR STATION',I8,' IN THE YEAR ',I4,
      @' THE ANNUAL PRECIP IS ',I6)
       RETURN
       DEBUG SUBCHK
       END
```

SUBROUTINE PBAR



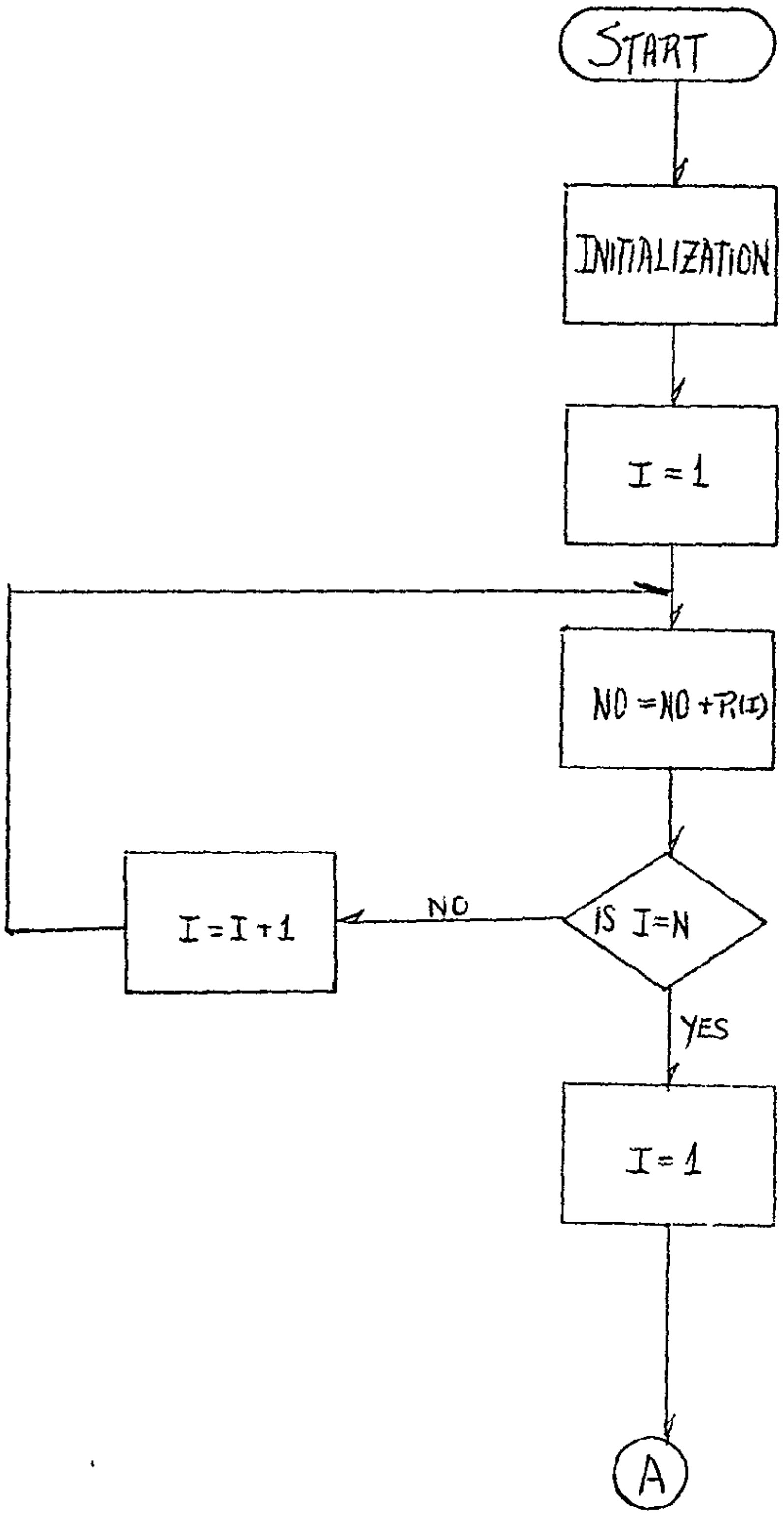

A
IS I=N
NO
I=I+1
20
YES
EN=N
PAN=IS
10
RETURN
END

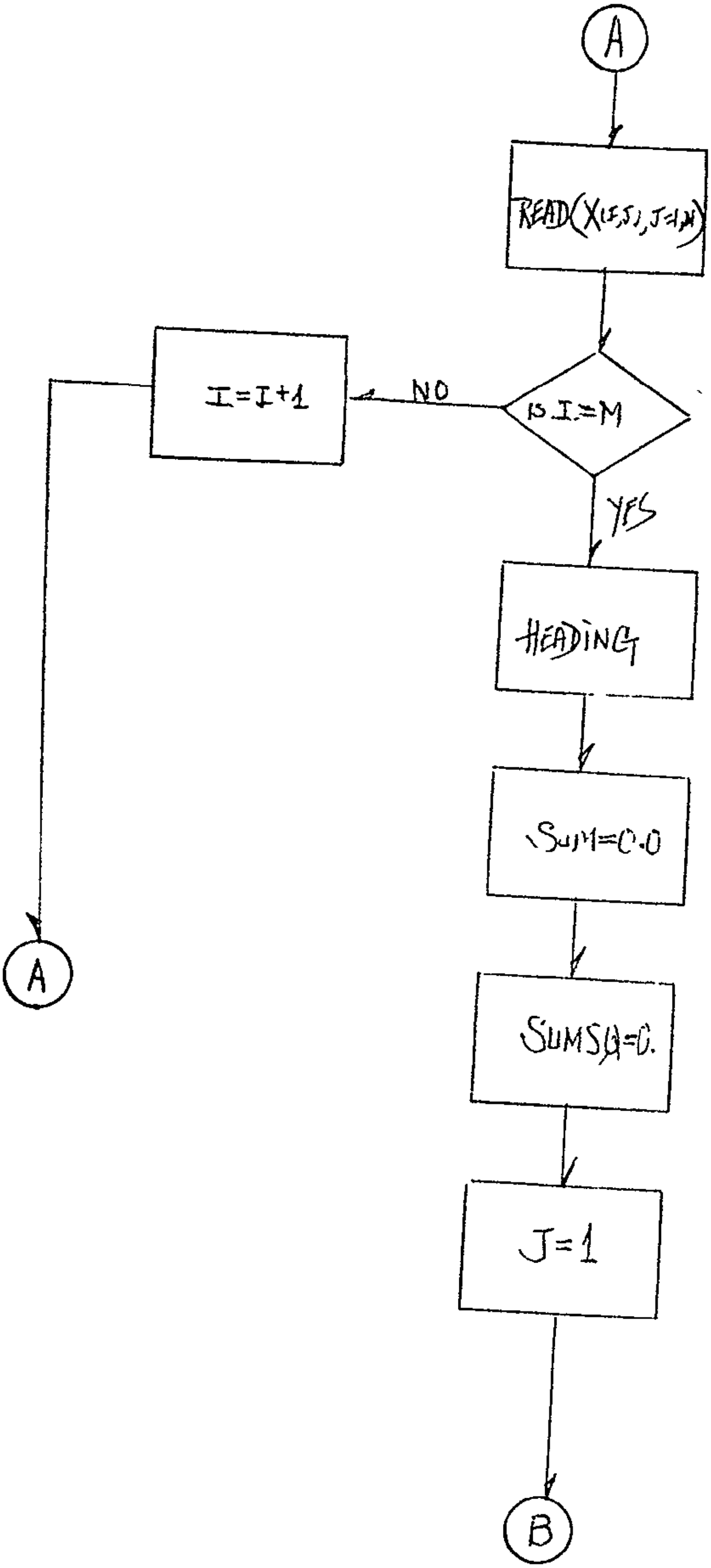
```
      SUBROUTINE PBAR(PC,N,PAV)
      INTEGER PC(50),PAV
      IS=0
      DO 10 I=1,N
      IF(PC(I).EQ.9999) GO TO 10
      IS=IS+PC(I)
   10 CONTINUE
      EN=N
      PAV=IS
      RETURN
      DEBUG SUBCHK
      END
```

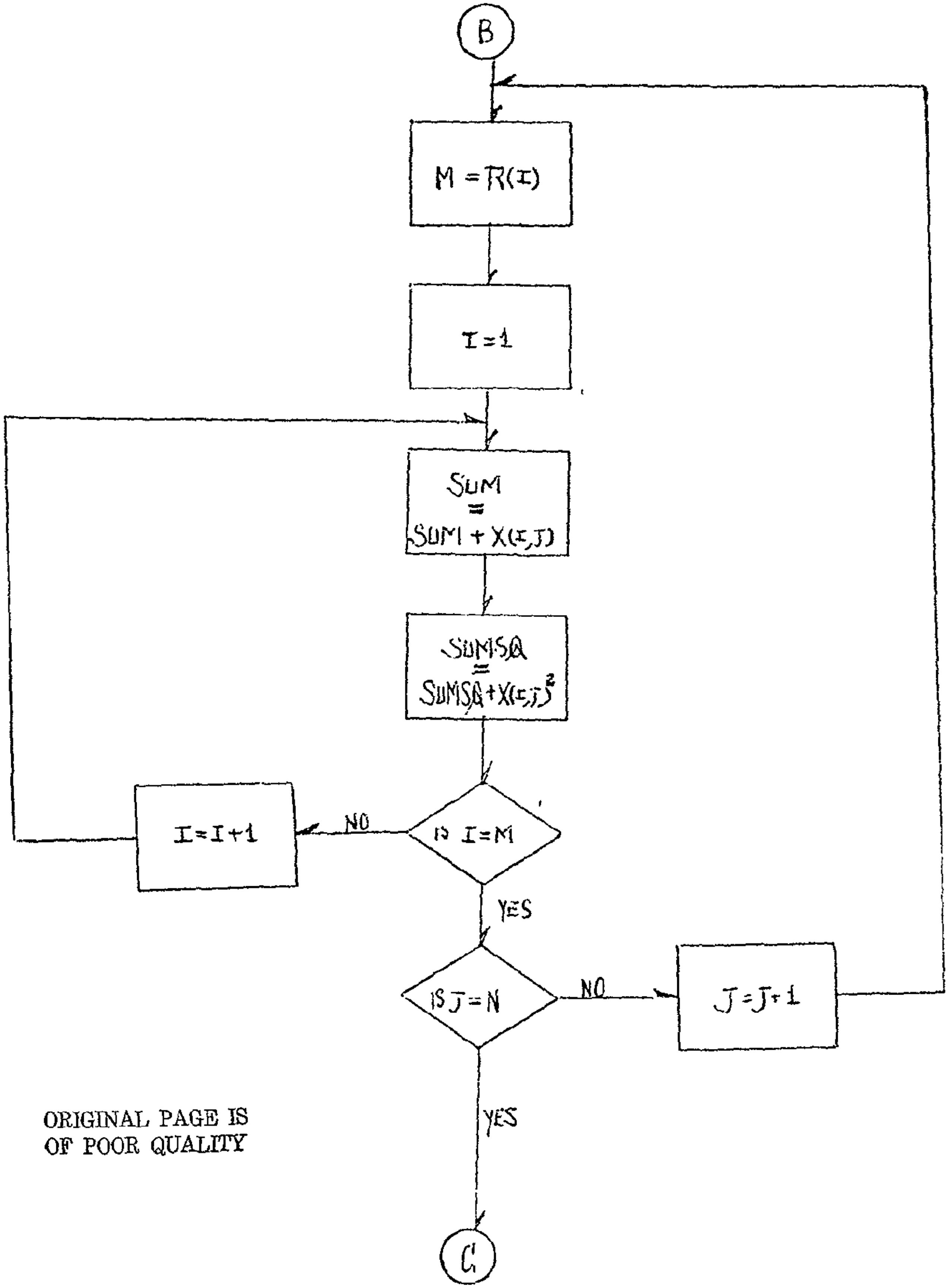
APPENDIX C

TABLE OF CONTENTS

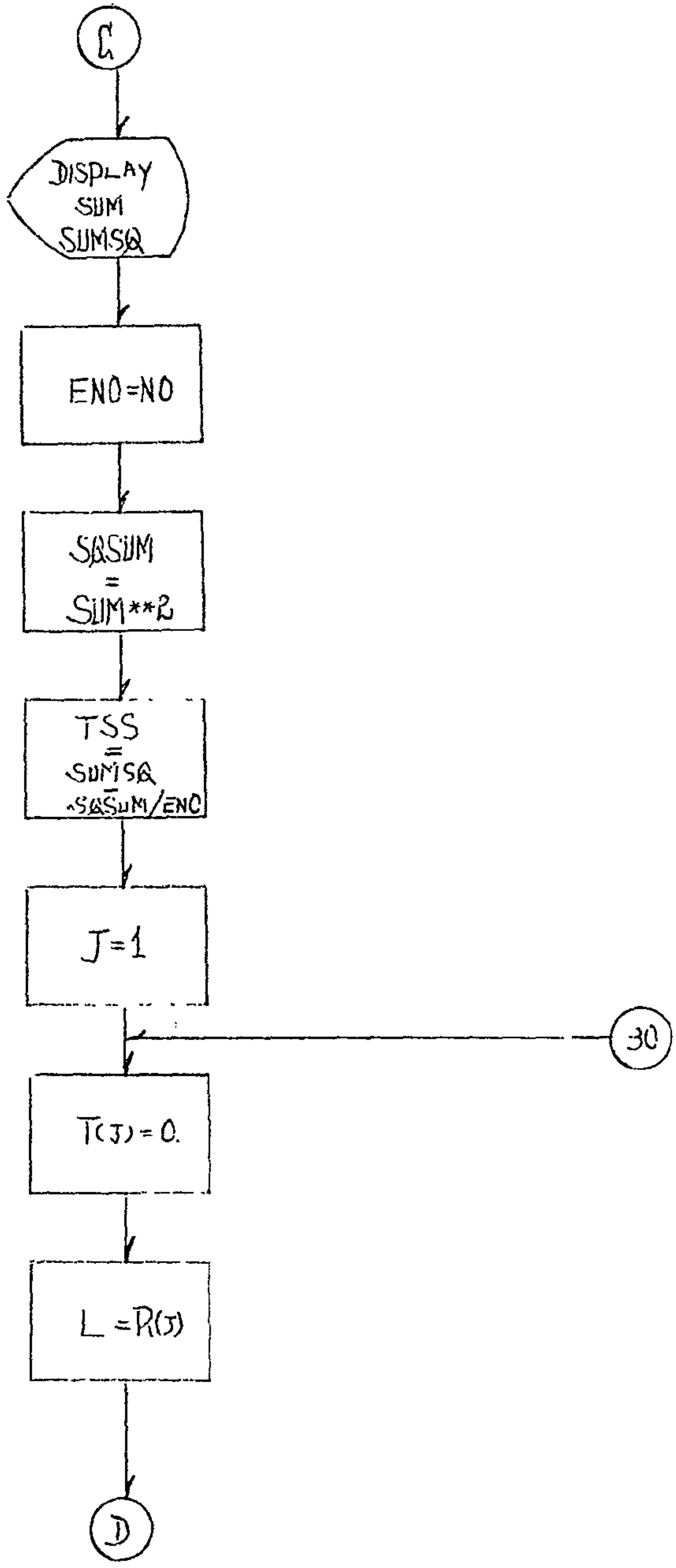
THE ANALYSIS OF VARIANCE

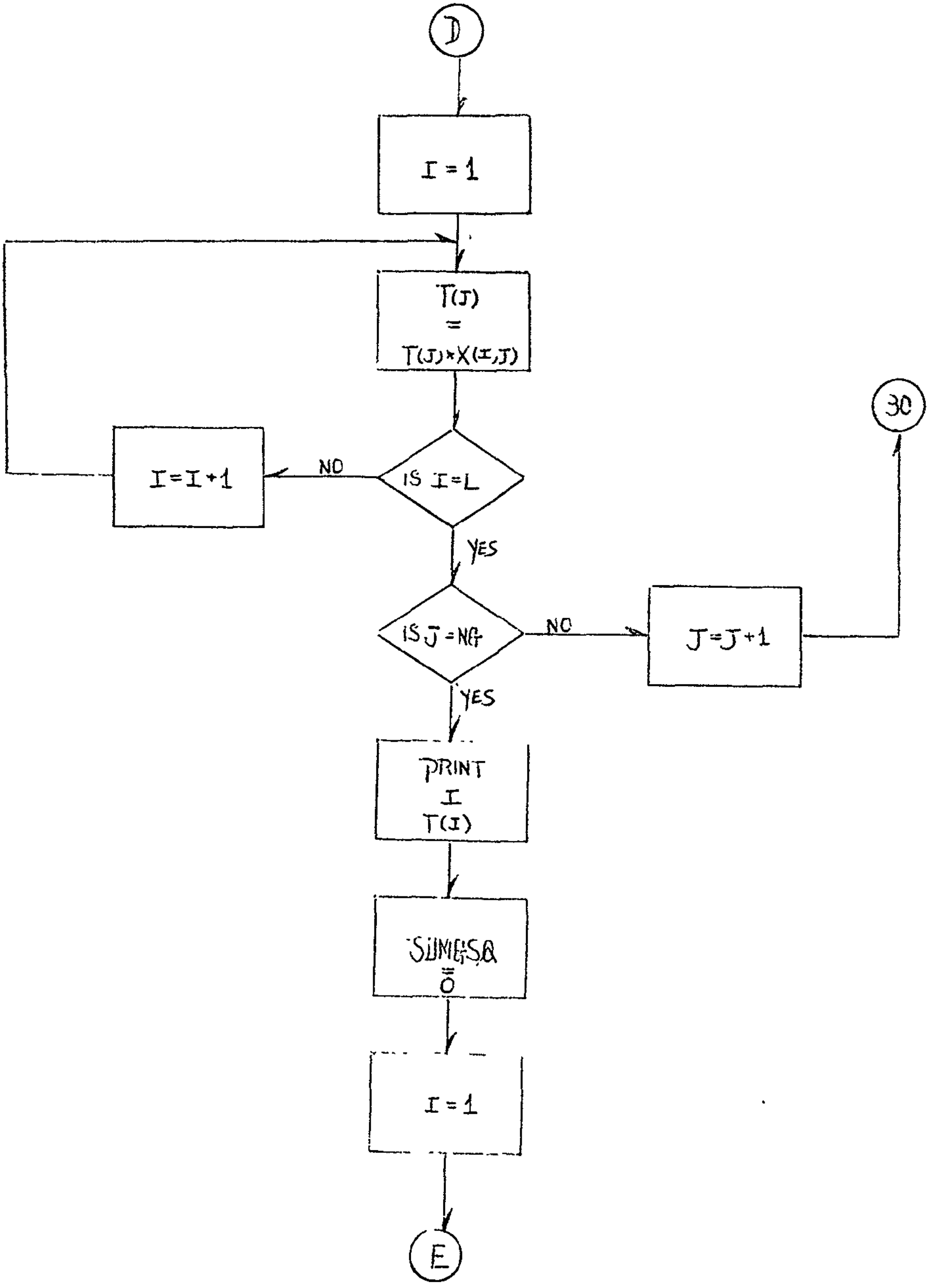


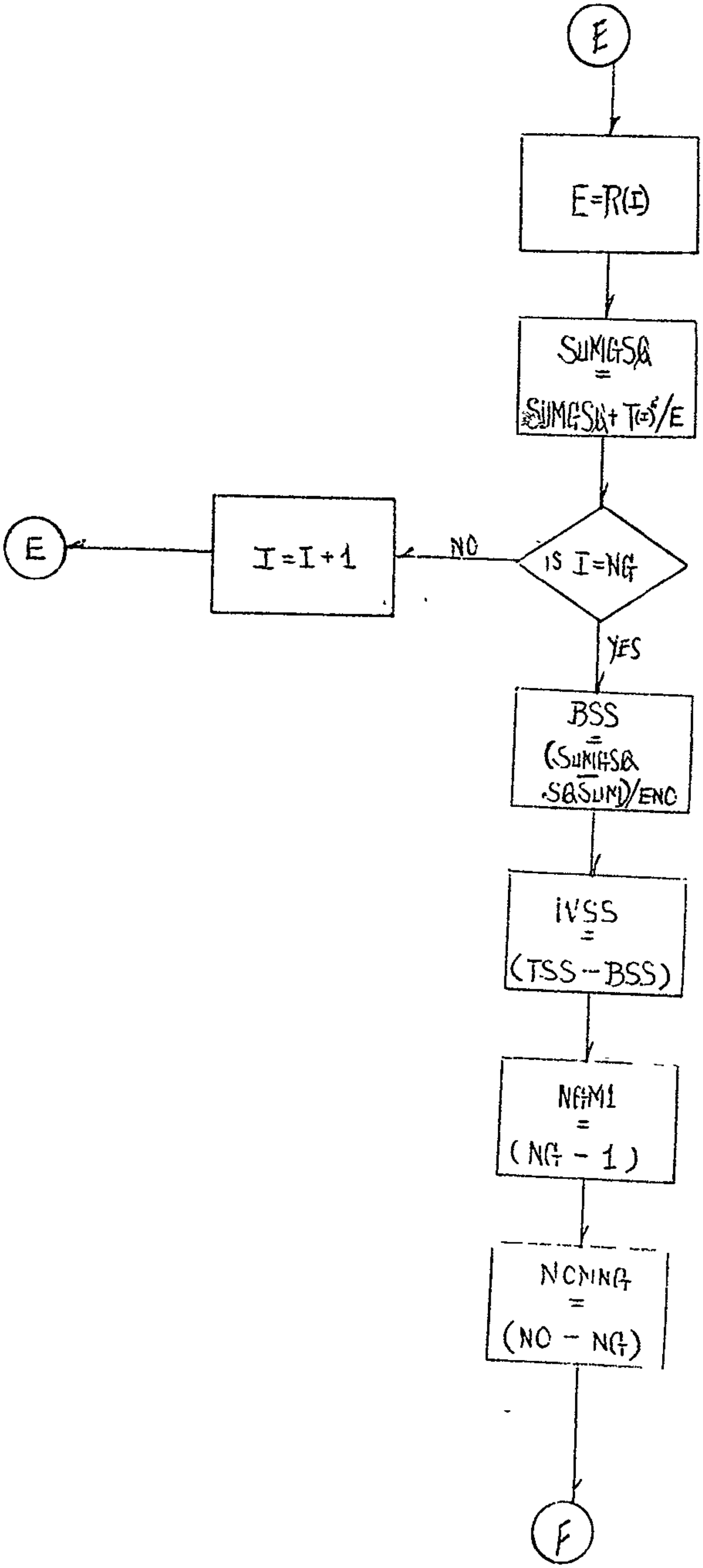

A
READ(X(I,J),J=1,N)
IS I=M
NO
I=I+1
YES
HEADING
SUM=0.0
SUMS(J)=0.
J=1
A
B



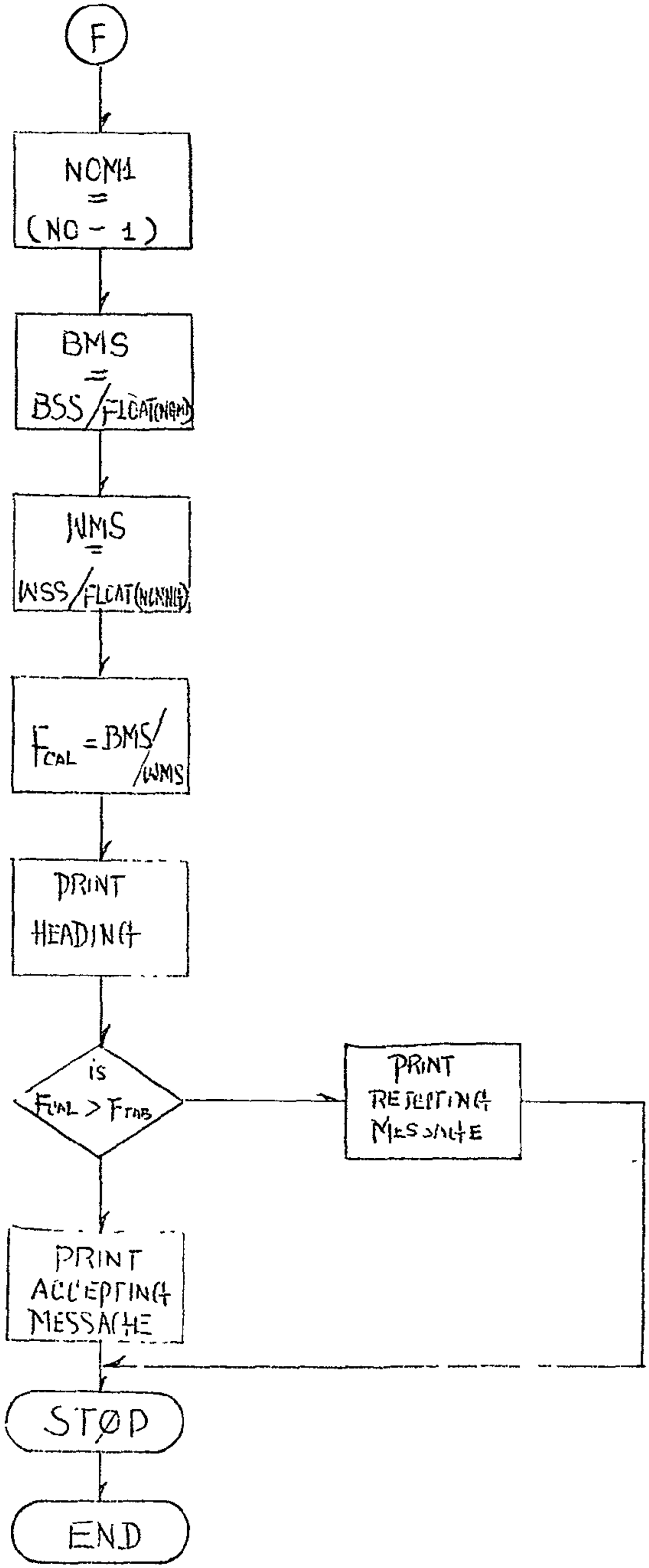
ORIGINAL PAGE IS
OF POOR QUALITY


C
DISPLAY SUM SUMSQ
ENO=NO
SQSUM = SUM**2
TSS = SUMSQ -SQSUM/ENO
J=1
30
T(J) = 0.
L = R(J)
D


D
I = 1
T(J)
=
T(J)*X(I,J)
NO
I=I+1
IS I=L
YES
30
IS J=NG
NO
J=J+1
YES
PRINT
I
T(I)
SUMSQ
=
O
I = 1
E



ORIGINAL PAGE IS
OF POOR QUALITY


F
NOM1 = (NO - 1)
BMS = BSS / FLOAT(NOM1)
WMS = WSS / FLOAT(NO*(NO-1))
F_CAL = BMS / WMS
PRINT HEADING
is F_CAL > F_TAB
PRINT REJECTING MESSAGE
PRINT ACCEPTING MESSAGE
STØP
END

```
COMPILER OPTIONS - NAME=  MAIN,OPT=00,LINECNT=55,SIZE=0000K,
                   SOURCE,EBCDIC,NOLIST,NODECK,LOAD,MAP,NOEDIT,ID,XREF
C         ****************************************
C         *********** THE AOV ANALYSIS  ***********
C         ***********        BY         ***********
C         ***********   BUDDY H JEUN    ***********
C         ****************************************
          REAL X(100,100),T(100),G(100)
          INTEGER R(100)
          FTAB=6.93
          R(1)=12
          R(2)=12
          R(3)=12
          M=12
          N=3
          NG=3
          NO=0
          DO 100 I=1,NG
          NO=NO+R(I)
      100 CONTINUE
          DO 22 I=1,M
          READ(5,10)(X(I,J),J=1,N)
       10 FORMAT(3(F5.2,1X))
       22 CONTINUE
          WRITE(6,98)
       98 FORMAT('1',59X,'TA-LIEN(#54662)'/
         @43X,'LOCKHEED',5X,'U.S.AIR FORCE',5X,'HONG KONG ROYAL'/
         @43X,46('-'))
          DO 11 I=1,M
          WRITE(6,9)(X(I,J),J=1,N)
        9 FORMAT(43X,F10.2,5X,F12.2,5X,F13.3)
       11 CONTINUE
          SUM=0.0
          SUMSQ=0.0
          DO 200 J=1,NG
          M=R(J)
          DO 200 I=1,M
          SUM=SUM+X(I,J)
          SUMSQ=SUMSQ+X(I,J)**2
      200 CONTINUE
          WRITE (6,105) SUM,SUMSQ
      105 FORMAT(20X,'SUM=',F10.2,2X,'SUMSQ=',F10.2//)
C         NO IS THE # OF OBSERVATIONS
C         NG IS THE # OF GROUP
          ENO=NO
          SQSUM=SUM**2
          TSS=(SUMSQ-SQSUM/ENO)
C         TSS IS THE TOTAL SUM SQ OF OBSERVATIONS
          DO 300 J=1,NG
          T(J)=0.0
          L=R(J)
          DO 300 I=1,L
          T(J)=T(J)+X(I,J)
```

```
ISN 0043        300 CONTINUE
ISN 0044            DO 12 I=1,NG
ISN 0045            WRITE(6,106)I,T(I)
ISN 0046        106 FORMAT(20X,'SUM OF GROUP(',I3,') IS ',F10.2/)
ISN 0047         12 CONTINUE
ISN 0048            SUMGSQ=0.0
ISN 0049            DO 400 I=1 ,NG
ISN 0050            E=R(I)
ISN 0051            SUMGSQ=SUMGSQ+T(I)**2/E
ISN 0052        400 CONTINUE
ISN 0053            BSS=(SUMGSQ-SQSUM/ENO)
              C     BSS IS THE SUMSQ BETWEEN GROUP
ISN 0054            WSS=TSS-BSS
ISN 0055            NGM1=NG-1
              C     NGM1 IS THE DEGREE OF FREEDOM FOR THE WITHIN THE GROUP
ISN 0056            NOMNG=NO-NG
              C     NOMNG IS THE DEGREE OF FREEDOM FOR WITHIN THE GROUP
ISN 0057            NOM1=NO-1
              C     NOM1 IS THE DEGREE OF FREEDOM FOT THE TOTAL OBSERVATIONS
ISN 0058            BMS=BSS/FLOAT(NGM1)
ISN 0059            WMS=WSS/FLOAT(NOMNG)
ISN 0060            FCAL=BMS/WMS
ISN 0061            WRITE(6,20)
ISN 0062         20 FORMAT (55X,'ANALYSIS OF VARIANCE'/
                   +50X,'DEGREE OF ',7X,'SUM OF '/
                   +26X,'SOURCE OF VARIATION',5X,'FREEDOM',10X,'SQUARE',5X,
                   +'MEAN SQUARE',5X,'F RATIO'/
                   +26X,75('_')/)
ISN 0063            WRITE(6,21)NGM1,BSS,BMS,
                   +NOMNG,WSS,WMS,FCAL,
                   +NOM1,TSS
ISN 0064         21 FORMAT(25X,'BETWEEN GROUP',12X,I3,9X,F13.3,5X,F10.3/
                   +25X,'WITHIN GROUPS',12X,I3,9X,F13.3,5X,F10.3,5X,F10.3/
                   +25X,'TOTAL',20X,I3,9X,F13.3/
                   +25X,77('_')/////)
ISN 0065            IF(FCAL.GE.FTAB) GO TO 101
ISN 0067            WRITE(6,23)
ISN 0068         23 FORMAT(30X,'SINCE FCAL<FTAB,SO ACCEPT THE HYPOTHESE')
ISN 0069            GO TO 600
ISN 0070        101 WRITE(6,24)
ISN 0071         24 FORMAT(30X,'SINCE FCAL>FTAB,SO REJECT THE HYPOTHESE')
ISN 0072        600 STOP
ISN 0073            END
```