

ศูนย์บริการเอกสารวิจัย



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Concentrated animal food

CH PROGRAMME NO. 54
(STUDY OF MATERIAL DETERIORATION)

sponsored by

ADVANCED RESEARCH PROJECTS AGENCY (ARPA), U.S. DEPARTMENT OF DEFENSE

conducted by

APPLIED SCIENTIFIC RESEARCH CORPORATION OF THAILAND
under U.S. Army Contract DAJB 29-70-C-0086

with the cooperation of

MILITARY RESEARCH AND DEVELOPMENT CENTER (MRDC)

PRESERVED FOOD SERIES

REPORT NO. 2
CONCENTRATED ANIMAL FOOD

BY

KAEW NUALCHAWEE
WILLIAM G. PREWETT
PAKORN PAKARNSEREE

ENVIRONMENTAL AND ECOLOGICAL RESEARCH INSTITUTE

ASRCT, BANGKOK 1974
not for publication

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F O R E W O R D

The work reported herein is part of a research programme called "Exposure Testing", or "Study of Material Deterioration". This is a second report in a series of seven which, according to the test plan, are scheduled to be issued at seven monthly interval. The programme is sponsored by OSD/ARPA under ARPA contract number DAJB 29-70-C-0086 and modification number DAJB 29-70-C-0086-P00003. The establishment of the exposure testing facilities and performing of the programme by the Applied Scientific Research Corporation of Thailand is done in cooperation with the Military Research and Development Center (MRDC). Readers are referred, for a more detailed discourse on cooperation and collaboration with other Armed Forces Organizations in the previous reports of the same project.

CONCENTRATED ANIMAL FOOD

By Kaew Nualchawee,* William Prewett,* and Pakorn Pakarnseree*

SUMMARY

A number of concentrated animal food samples were supplied, by Charoen Phokphan Feed Mill Co. Ltd., through the Military Research and Development Center (MRDC) of the Supreme Command Headquarters, to the Exposure Testing Project for use as test specimens. The liaison personnel for MRDC were Col. Adulsuckdi Mitrabhuckdi, Maj. Sripan Vichapan, and Maj. Howard S. De Witt. The purpose of the test is to study the shelf life of the concentrated animal food. The animal food in two different types of container and in five different formulae, were placed on the wooden floors of the wooden huts, built to simulate field depots. The two wooden huts are located in the clear site, and at the jungle site. There is one wooden building, fitted with an air-conditioner to serve as a control room, located near the two aforementioned huts. Therefore conditions for exposure are storage in the clear site, storage in the jungle site, and storage in the control room.

Tests were performed on the animal food for changes in weight, visible changes, microbiological changes, and changes in chemical composition occurring during exposure.

Changes in weight were positive in most cases except in some cases of samples stored in the control room which were negative. Visible changes of containers and the food itself varied widely with the kind of container and conditions of exposure. Most plastic containers suffered from ants and rodents as well as from breakage of seams (creases) due to inadequacy of sealing procedure. They also suffered breakage in the course of handling and transportation. In not very many cases did laminated paper/plastic containers show any defect.

Many cases, especially samples from the jungle site showed mold growth which could be seen through plastic containers. This could also be confirmed by the temperature of the containers which were warm to the touch. Results from microbiological study showed an increasing quantity of microorganisms in the animal food, especially on ones exposed in the jungle site depot. Results of chemical analysis indicates very small degrees of deviation from the results of the first withdrawal. The free fatty acid test showed very little change from the results of the first withdrawal.

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INTRODUCTION

In rural areas, communication and transportation can be accomplished on foot and by use of animals. Roads and other means of transportation may not be possible because of many difficulties especially funding problem. Therefore animals such as horses, asses, and mules are allowed to serve the mentioned purpose. In order to keep the animals in good working conditions, and for better service, they should be fed with reasonable nutritional food. Realizing this fact the Military Research and Development Center (MRDC) has contracted a local firm to produce animal food for that purpose. In order to understand the rate of deterioration of this food or its shelf life, MRDC asked ASRCT, through its Environmental and Ecological Research Institute, to undertake exposure tests on the animal food. To do this the project has set up different conditions for exposure, i.e. a shelter in the cleared site, a shelter in the jungle site, and an air-conditioned room.

This report presents the results of tests carried out before exposure and after the second withdrawal. Samples of the second withdrawal were exposed from 12 May - 12 August 1972.

MATERIALS AND METHODS OF EXPOSURE

The concentrated animal food samples received for test specimens comprise five (5) formulae, each contained in both sealed plastic bags, and sewed laminated paper/plastic bags. Details of composition of any one formula are presented below:

Composition of food	Formula 1	Formula 2	Formula 3	Formula 4	Formula 5
Paddy rice, ground	+	+	+	+	+
Corn, ground	+	+	+	+	-
Rice bran	+	+	+	+	+
Soybean meal	+	+	+	+	-
Peanut meal	-	-	+	-	-
Fish meal	-	+	-	-	-
Dicalcium phosphate	+	+	+	+	-
Limestone	+	+	+	+	-
Salt	+	+	+	+	+
Mollasses	+	+	+	+	-
Fat	-	-	-	+	-
Premix	+	+	+	+	-
Ground bone (steamed)	-	-	-	-	+

+ = present in composition.

- = absent in composition.

Premix consists of vitamins B2, B12, B6, A, D3, and antibiotic.

Containers. Two kinds of container were used in packaging, they were:

- sewed laminated paper/plastic bags (4-ply paper and 1-ply inner most plastic)
- sealed plastic bags.

Plastic bags were not accepted to be good enough containers for many disadvantages.

Environmental conditions for exposure

1. In the depot, cleared site.
2. In the depot, jungle site.
3. In the control room (air-conditioned room).

Readers are referred to Report No. 1 for a layout diagram showing the mode of exposure of the samples.

Withdrawal programme. 2-3-4-5-6-7 and 8 months after start of exposure (7 withdrawals). The scheduled programme is as follows:

Exposure date: 13 May 1972

<u>Withdrawal number</u>	<u>Withdrawal date</u>
1	12 July 1972
2	12 August 1972
3	12 September 1972
4	12 October 1972
5	12 November 1972
6	12 December 1972
7	12 January 1973

METHODS OF TESTS AND RESULTS

The concentrated animal food samples withdrawn from the exposure site were tested and analysed as follows:

Study of microorganisms, which comprised counting and test of different types of microorganism i.e. mold, aerobic bacteria, anaerobic bacteria, and coliform organisms.

Visual observation of food containers and changes in physical appearance of food.

Study of weight changes.

Chemical analysis, to confirm composition of food and to test for deterioration of mineral and nutritional value of food after storage for a certain period of time under different environmental conditions.

RESULTS

(i) Weight changes

Animal food samples were weighed before exposure and after exposure so that weight changes during exposure period could be determined. The majority of the samples weighed between 1000-1100 g, only small number of samples weighed lower than 1000 g or higher than 1100 g. Weight changes of food samples are tabulated below in Table 1.

TABLE 1. WEIGHT CHANGES

Code number	Description	Original weight (g) (28 Apr. 72)	Final weight (g) (15 Aug. 72)	Weight changes (g)
9-1-1-0-bB ₁	Formula 1, laminated paper/plastic bag, control room, second withdrawal, replicate number 1	1070.8	1077.3	+6.5
9-1-1-0-bB ₂	Formula 1, laminated paper/plastic bag, control room, second withdrawal, replicate number 2	1116.2	1124.2	+8.0
9-1-1-0-bB ₃	Formula 1, laminated paper/plastic bag, control room, second withdrawal, replicate number 3	1127.0	1134.7	+7.7
9-1-1-0-bB ₄	Formula 1, laminated paper/plastic bag, control room, second withdrawal, replicate number 4	1121.0	1131.1	+10.1
9-1-1-0-bB _X	Formula 1, laminated paper/plastic bag, control room, second withdrawal, replicate number X	1118.9	1127.2	+8.3
9-1-1-I-bB ₁	Formula 1, laminated paper/plastic bag, in depot, clear site, second withdrawal, replicate number 1	1065.2	1082.7	+17.5
9-1-1-I-bB ₂	Formula 1, laminated paper/plastic bag, in depot, clear site, second withdrawal, replicate number 2	1101.2	1119.3	+18.1
9-1-1-I-bB ₃	Formula 1, laminated paper/plastic bag, in depot, clear site, second withdrawal, replicate number 3	1125.4	1145.1	+19.7
9-1-1-I-bB ₄	Formula 1, laminated paper/plastic bag, in depot, clear site, second withdrawal, replicate number 4	1106.6	1123.8	+17.2
9-1-1-I-bB _X	Formula 1, laminated paper/plastic bag, in depot, clear site, second withdrawal, replicate number X	1131.0	1147.7	+16.7
		(1 May 72)		
9-1-1-II-bB ₁	Formula 1, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number 1	1117.6	1132.2	+14.6
9-1-1-II-bB ₂	Formula 1, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number 2	1091.9	1109.1	+7.2
9-1-1-II-bB ₃	Formula 1, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number 3	1053.4	1071.3	+17.9
9-1-k-II-bB ₄	Formula 1, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number 4	1126.2	1145.1	+18.9
9-1-1-II-bB _X	Formula 1, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number X	1118.8	1139.3	+20.5

TABLE 1. (continued)

Code number	Description	Original weight (g) (1 May 72)	Final weight (g) (15 Aug. 72)	Weight changes (g)
9-1-2-0-bB ₁	Formula 1, plastic bag, control room second withdrawal, replicate number 1	1065.3	1064.5	-0.8
9-1-2-0-bB ₂	Formula 1, plastic bag, control room, second withdrawal, replicate number 2	1089.0	1092.9	+3.9
9-1-2-0-bB ₃	Formula 1, plastic bag, control room, second withdrawal, replicate number 3	1104.1	1103.2	-0.9
9-1-2-0-bB ₄	Formula 1, plastic bag, control room, second withdrawal, replicate number 4	1068.0	1070.6	+2.6
9-1-2-0-bB _X	Formula 1, plastic bag, control room, second withdrawal, replicate number X	1146.7	1149.0	+2.3
9-1-2-I-bB ₁	Formula 1, plastic bag, in depot, cleared site, second withdrawal, replicate number 1	1092.2	1100.8	+8.6
9-1-2-I-bB ₂	Formula 1, plastic bag, in depot, cleared site, second withdrawal, replicate number 2	1087.9	1091.3	+3.4
9-1-2-I-bB ₃	Formula 1, plastic bag, in depot, cleared site, second withdrawal, replicate number 3	1080.1	1083.8	+3.7
9-1-2-I-bB ₄	Formula 1, plastic bag, in depot, cleared site, second withdrawal, replicate number 4	1096.9	1105.4	+8.5
9-1-2-I-bB _X	Formula 1, plastic bag, in depot, cleared site, second withdrawal, replicate number X	1096.9	1102.0	+5.1
9-1-2-II-bB ₁	Formula 1, plastic bag, in depot, jungle site, second withdrawal, replicate number 1	1072.3	1082.5	+10.2
9-1-2-II-bB ₂	Formula 1, plastic bag, in depot, jungle site, second withdrawal, replicate number 2	1035.2	1036.2	+1.0
9-1-2-II-bB ₃	Formula 1, plastic bag, in depot, jungle site, second withdrawal, replicate number 3	1092.1	1101.7	+9.6
9-1-2-II-bB ₄	Formula 1, plastic bag, in depot, jungle site, second withdrawal, replicate number 4	1094.7	1026.3	-68.4
9-1-2-II-bB _X	Formula 1, plastic bag, in depot, jungle site, second withdrawal, replicate number X	1089.6	1097.8	+8.2

TABLE 1. (continued)

Code number	Description	Original weight (g) (1 May 72)	Final weight (g) (15 Aug. 72)	Weight changes (g)
9-5-1-0-bB ₁	Formula 5, laminated paper/plastic bag, control room, second withdrawal, replicate number 1	1129.9	1127.8	-2.1
9-5-1-0-bB ₂	Formula 5, laminated paper/plastic bag, control room, second withdrawal, replicate number 2	1727.0	1725.0	-2.0
9-5-1-0-bB ₃	Formula 5, laminated paper/plastic bag, control room, second withdrawal, replicate number 3	1133.1	1127.5	-5.6
9-5-1-0-bB ₄	Formula 5, laminated paper/plastic bag, control room, second withdrawal, replicate number 4	1116.4	1111.8	-4.6
9-5-1-0-bB _X	Formula 5, laminated paper/plastic bag, control room, second withdrawal, replicate number X	1111.9	1110.2	-1.7
9-5-1-I-bB ₁	Formula 5, laminated paper/plastic bag, in depot, cleared site, second withdrawal, replicate number 1	1096.2	1109.1	+12.9
9-5-1-I-bB ₂	Formula 5, laminated paper/plastic bag, in depot, cleared site, second withdrawal, replicate number 2	1101.3	1111.1	+9.8
9-5-1-I-bB ₃	Formula 5, laminated paper/plastic bag, in depot, cleared site, second withdrawal, replicate number 3	1110.4	1120.9	+10.5
9-5-1-I-bB ₄	Formula 5, laminated paper/plastic bag, in depot, cleared site, second withdrawal, replicate number 4	1092.0	1101.8	+9.8
9-5-1-I-bB _X	Formula 5, laminated paper/plastic bag, in depot, cleared site, second withdrawal, replicate number X	1123.8	1132.0	+8.2
9-5-1-II-bB ₁	Formula 5, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number 1	1076.2	1085.7	+9.5
9-5-1-II-bB ₂	Formula 5, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number 2	1105.7	1111.9	+6.2
9-5-1-II-bB ₃	Formula 5, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number 3	1088.5	1100.3	+11.8
9-5-1-II-bB ₄	Formula 5, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number 4	1080.5	1090.7	+10.2
9-5-1-II-bB _X	Formula 5, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number X	1117.1	1134.0	+16.9

TABLE 1. (continued)

Code number	Description	Original weight (g) (1 May 72)	Final weight (g) (15 Aug. 72)	Weight changes (g)
9-5-2-0-bB ₁	Formula 5, plastic bag, control room second withdrawal, replicate number 1	1103.9	1108.0	-0.9
9-5-2-0-bB ₂	Formula 5, plastic bag, control room second withdrawal, replicate number 2	1054.7	1054.0	-0.7
9-5-2-0-bB ₃	Formula 5, plastic bag, control room, second withdrawal, replicate number 3	1100.5	1099.8	-0.7
9-5-2-0-bB ₄	Formula 5, plastic bag, control room, second withdrawal, replicate number 4	1078.6	1077.4	-1.2
9-5-2-0-bB _X	Formula 5, plastic bag, control room, second withdrawal, replicate number X	1124.3	1124.0	-0.3
9-5-2-I-bB ₁	Formula 5, plastic bag, in depot, cleared site, second withdrawal, replicate number 1	1097.9	1107.8	+9.9
9-5-2-I-bB ₂	Formula 5, plastic bag, in depot, cleared site, second withdrawal, replicate number 2	1085.7	1091.0	+5.3
9-5-2-I-bB ₃	Formula 5, plastic bag, in depot, cleared site, second withdrawal, replicate number 3	1102.8	1108.0	+5.2
9-5-2-I-bB ₄	Formula 5, plastic bag, in depot, cleared site, second withdrawal, replicate number 4	975.2	980.0	+4.8
9-5-2-I-bB _X	Formula 5, plastic bag, in depot, cleared site, second withdrawal, replicate number X	1122.2	1131.8	+9.6
9-5-2-II-bB ₁	Formula 5, in depot, jungle site, second withdrawal, replicate number 1	1070.7	1081.1	+10.4
9-5-2-II-bB ₂	Formula 5, in depot, jungle site, second withdrawal, replicate number 2	1097.1	1104.0	+6.9
9-5-2-II-bB ₃	Formula 5, in depot, jungle site, second withdrawal, replicate number 3	1109.1	1111.5	+2.4
9-5-2-II-bB ₄	Formula 5, in depot, jungle site, second withdrawal, replicate number 4	1102.8	1109.2	+6.4
9-5-2-II-bB _X	Formula 5, in depot, jungle site, second withdrawal, replicate number X	1083.0	1086.7	+3.7

(ii) Visual observation

Before and during the exposure period until the withdrawal date, visual observation of food samples was made to see if deterioration had taken place in food containers and foodstuff itself. The following table shows the results of observation:

TABLE 2. VISUAL OBSERVATION

Code number	Description	Defect of package	
		Before exposure	After exposure
9-1-1-0-bB _X	Formula 1, laminated paper/plastic bag, control room, second withdrawal, replicate number X	No defect	Container in good condition, pellets looked normal, insect infestation
9-1-1-I-bB _X	Formula 1, laminated paper/plastic bag, in depot, cleared site, second withdrawal, replicate number X	No defect	Container in good condition, pellets looked less compact, mold and insect infestation
9-1-1-II-bB _X	Formula 1, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number X	No defect	Broken seal, mold and insect infestation
9-5-1-0-bB _X	Formula 5, laminated paper/plastic bag, control room, second withdrawal, replicate number X	Bad stitching caused imperfect package	Broken seal, pellets looked normal, insect infestation
9-5-1-I-bB _X	Formula 5, laminated paper/plastic bag, in depot, cleared site, second withdrawal, replicate number X	No defect	Container in good condition, mold and insect infestation
9-5-1-II-bB _X	Formula 5, laminated paper/plastic bag, in depot, jungle site, second withdrawal, replicate number X	No defect	Container in good condition, pellets looked less compact, mold and insect infestation

(iii) Microbiological observation

Microbiological observation was made at the first withdrawal of the samples; selected samples were tested for microorganisms of which results are shown in the following table:

TABLE 3. MICROBIOLOGICAL DATA

Code number	Description	Aerobic count (colonies per g)	Mold count (colonies per g)	Anaerobic test	Coliform test
9-1-1-0-bB _X	Formula 1, laminated paper/ plastic bag, in control room, second withdrawal	3×10^4	2×10^2	-	-
9-1-1-I-bB _X	Formula 1, laminated paper/ plastic bag, in depot, cleared site, second withdrawal	1×10^4	24×10^4	-	-
9-1-1-II-bB _X ^{1/}	Formula 1, laminated paper/ plastic bag, in depot, jungle site, second withdrawal	11×10^4	27×10^4	-	-
9-5-1-0-bB _X	Formula 5, laminated paper/ plastic bag, in control room, second withdrawal	7×10^4	2×10^4	-	-
9-5-1-I-bB _X ^{1/}	Formula 5, laminated paper/ plastic bag, in depot, cleared site, second withdrawal	8×10^4	70×10^4	-	-
9-5-1-II-bB _X ^{1/}	Formula 5, laminated paper/ plastic bag, in depot, jungle site, second withdrawal	11×10^4	175×10^4	-	-

^{1/} Yellow mold present.

(iv) Chemical analysis

Before and during the exposure period until the second withdrawal date, chemical analysis was made to compare the composition with the figures given by the manufacturer and to determine the rate of deterioration of the composition of food samples. The following table shows the results of analysis.

TABLE 4. CHEMICAL ANALYSIS

Sample type Exposure condition	Formula 1			Formula 5		
	Control room	Depot cleared	Depot jungle	Control room	Depot cleared	Depot jungle
% H ₂ O	10.04	11.58	10.73	9.93	10.83	12.41
% Ca	1.13	1.23	1.13	4.15	4.18	4.06
% P	0.63	0.65	0.68	1.00	1.13	1.00
% Free fatty acid	3.95	5.78	3.80	4.93	5.42	4.72
% Fat	4.61	3.36	4.36	4.79	3.92	2.30
% Ash	9.64	9.39	9.55	15.93	15.78	15.76
% Fibre	5.90	7.74	5.58	6.34	6.38	8.53
% Protein	14.96	15.02	14.54	9.98	9.51	9.35
% CHO	54.85	52.91	55.24	53.03	53.58	51.65
Net energy (kcal/kg)	3200	3000	3200	3000	2900	2600

(v) Meteorological data

Graphical presentation of the observed meteorological parameters during the period 12 May - 12 August 1972 is tabulated as follows.

Quantities reported are:

1. Cleared site out of doors:
 - 1.1 Daily rainfall, in mm.
 - 1.2 Daily sunshine duration, in hour.
 - 1.3 Daily relative humidity, in per cent of maximum and minimum.
 - 1.4 Daily temperature, in degree Fahrenheit for maximum and minimum.
2. Cleared site in the depot:
 - 2.1 Daily relative humidity, in per cent of maximum and minimum.
 - 2.2 Daily temperature, in degree Fahrenheit for maximum and minimum.
3. Jungle site out of doors:
 - 3.1 Daily rainfall, in mm.
 - 3.2 Daily relative humidity in per cent of maximum and minimum.
 - 3.3 Daily temperature, in degree Fahrenheit for maximum and minimum.
4. Jungle site in the depot:
 - 4.1 Daily relative humidity, in per cent of maximum and minimum.
 - 4.2 Daily temperature, in degree Fahrenheit for maximum and minimum.

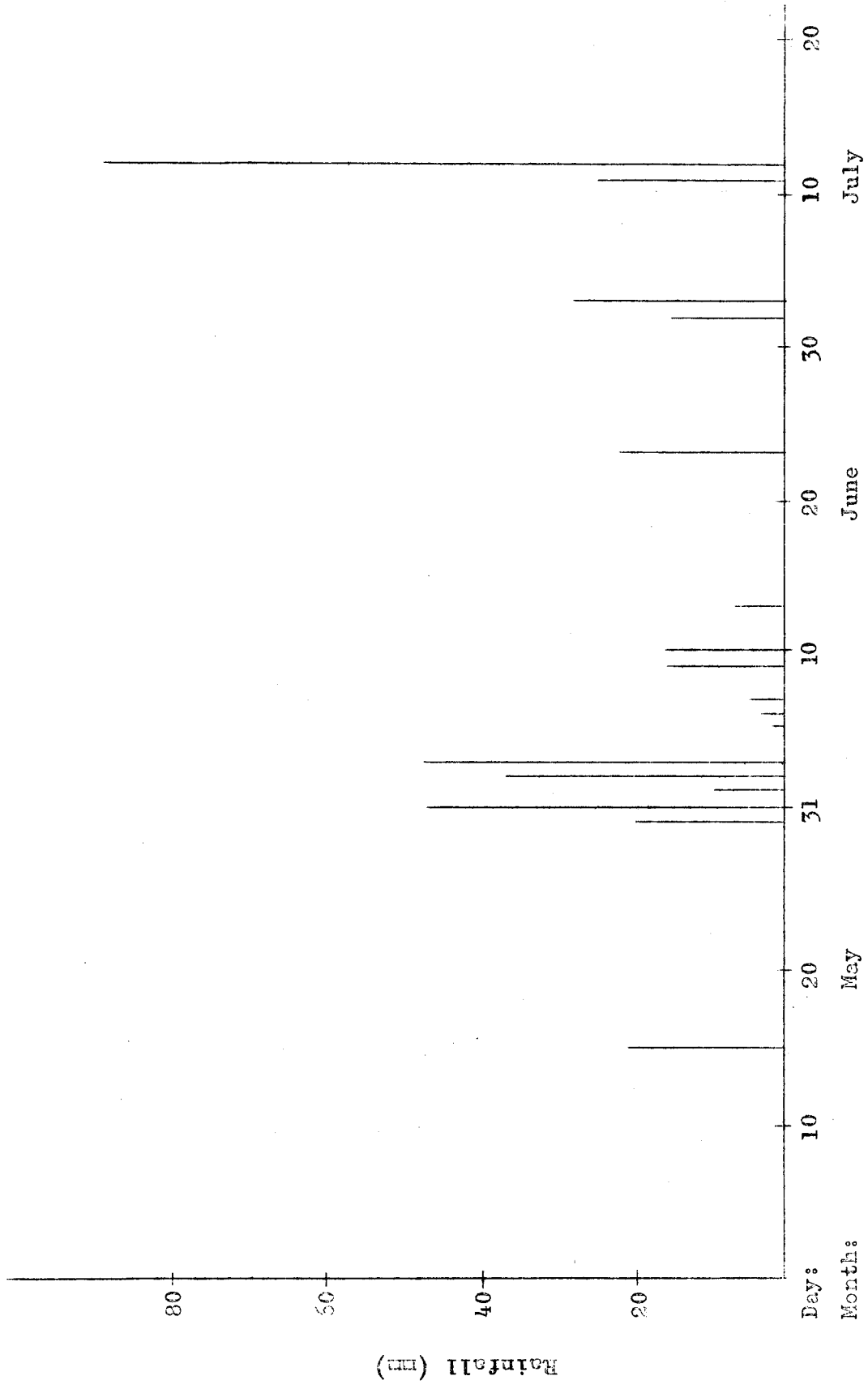


Figure 1. Graph showing daily rainfall recorded at cleared site during the period 1 May - 16 July, 1972.

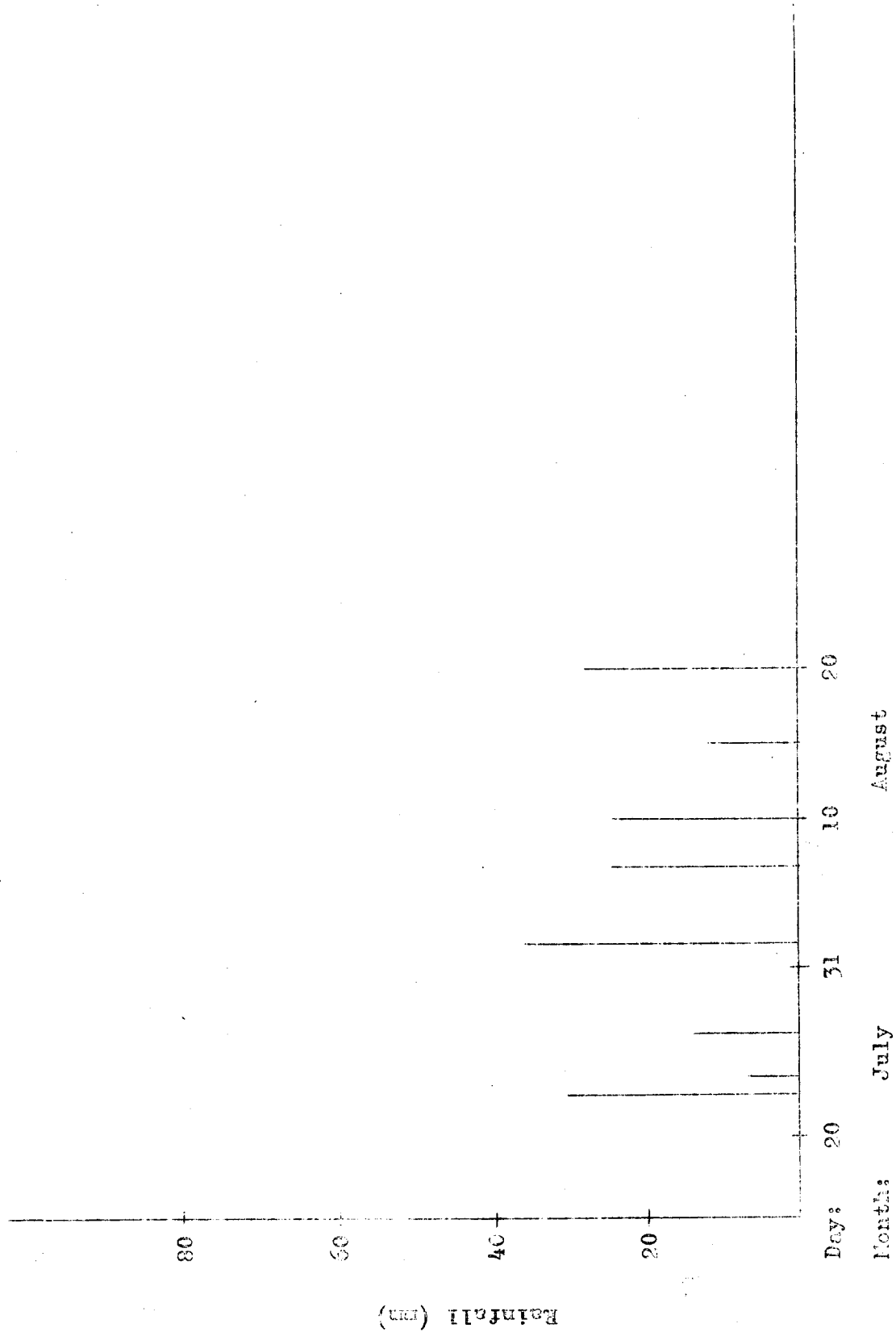


Figure 2. Graph showing daily rainfall recorded at cleared site out of doors during the period 15 July - 20 August, 1972.

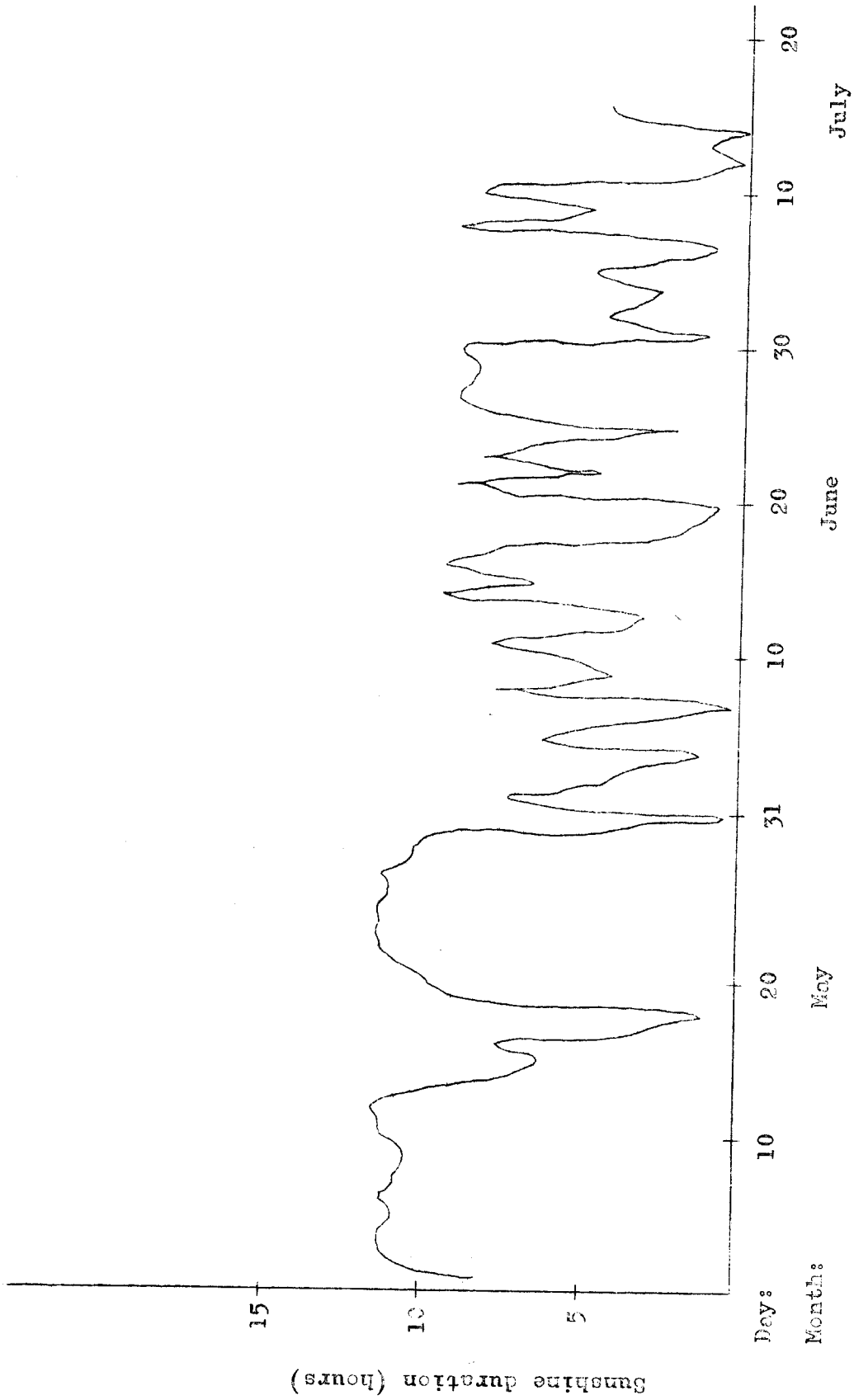


Figure 3. Graph showing daily sunshine duration recorded at cleared site during the period 1 May - 16 July, 1972.

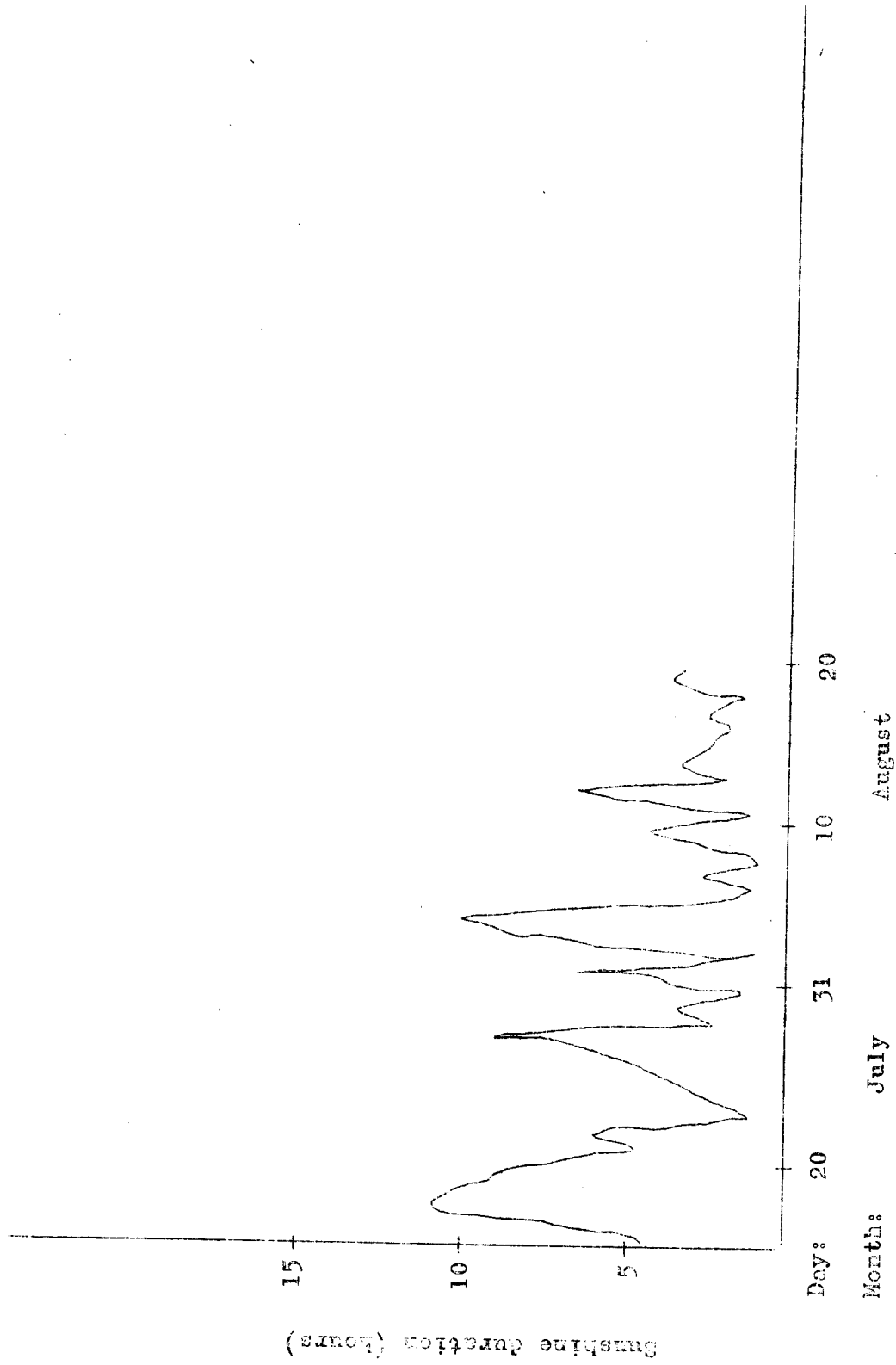


Figure 4. Graph showing daily sunshine duration recorded at cleared site during the period July - 20 August, 1972.

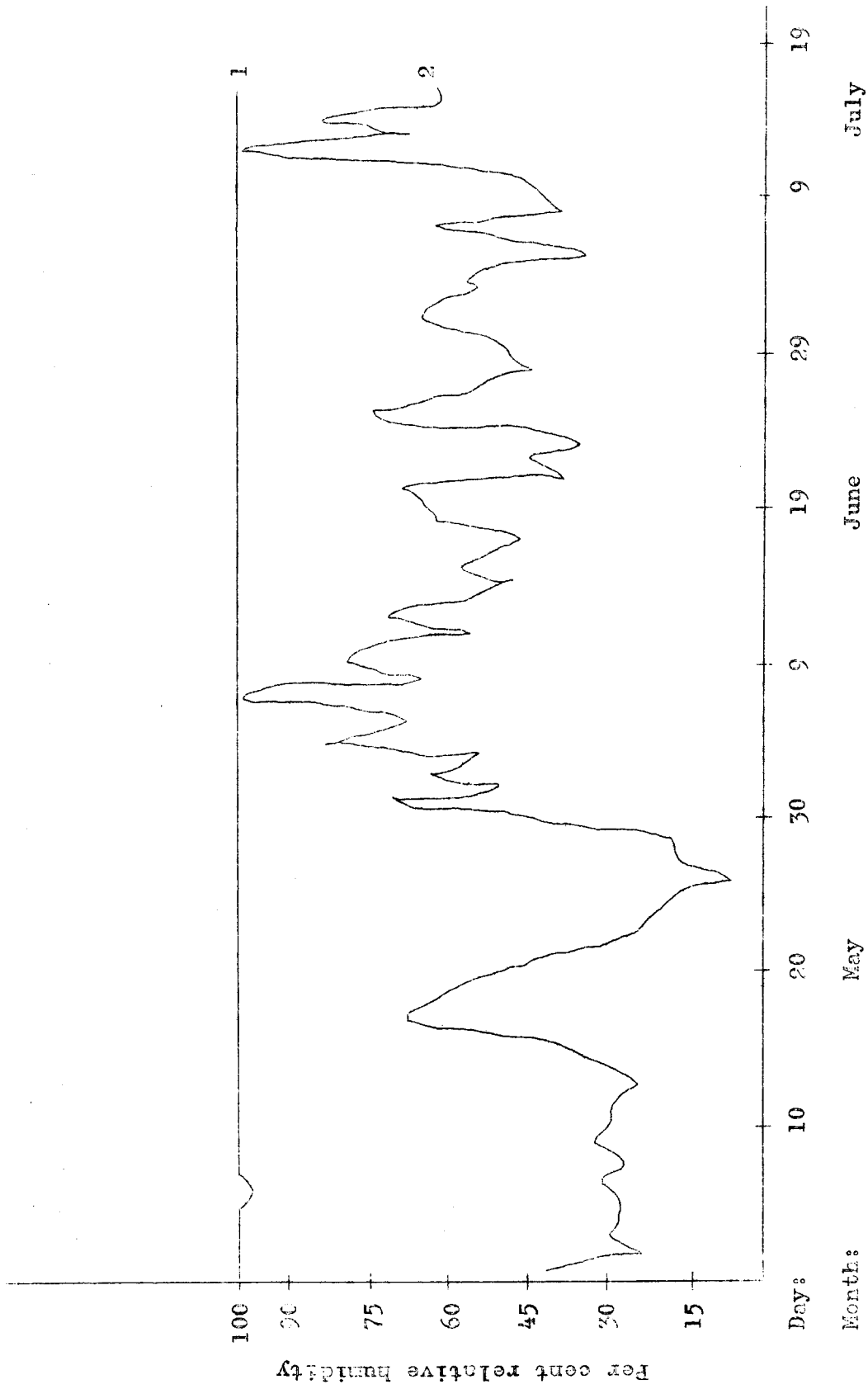


Figure 5. Graph showing daily relative humidity at the cleared site out of doors during the period 1 May - 6 July, 1972.

- 1. Maximum relative humidity.
- 2. Minimum relative humidity.

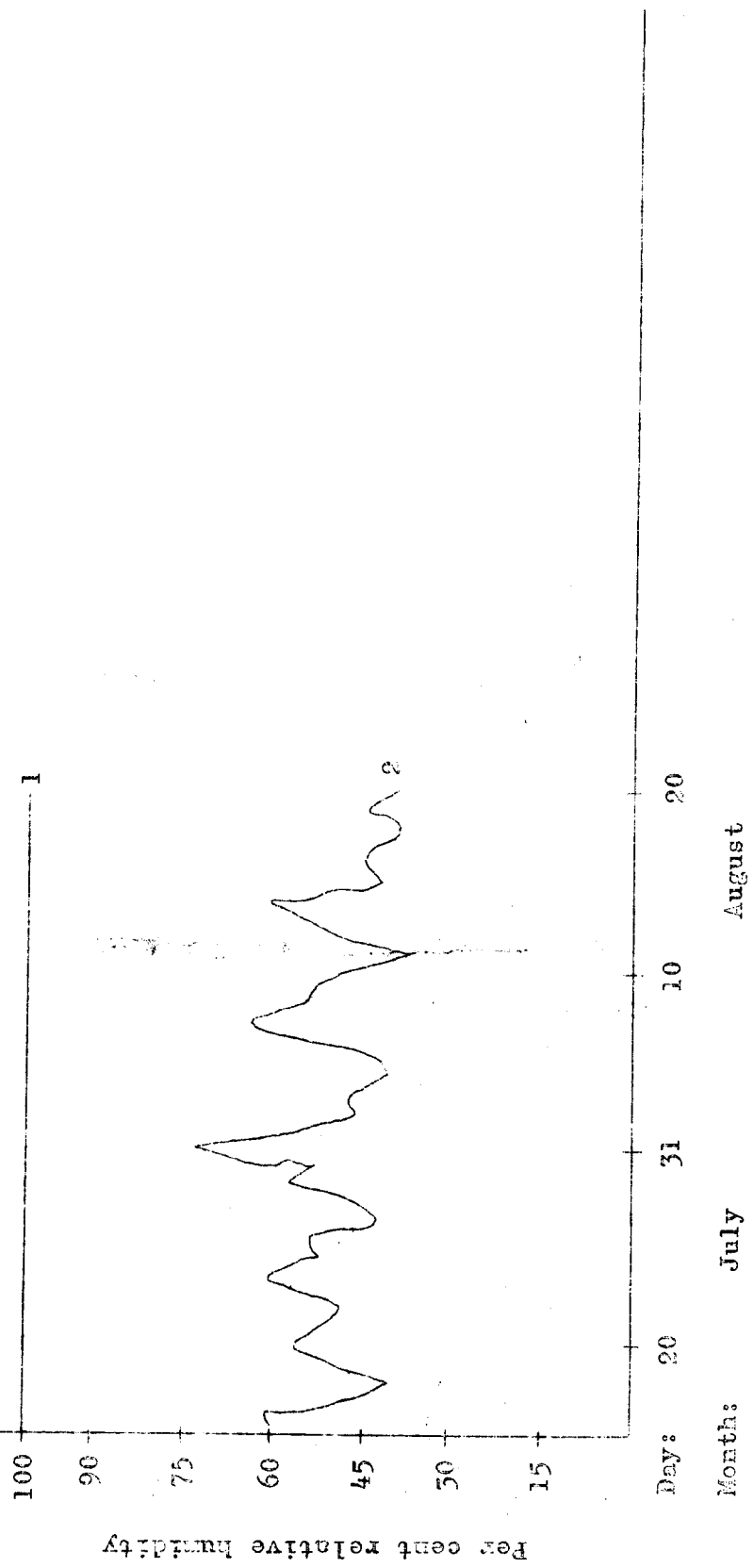


Figure 6. Graph showing daily relative humidity at the cleared site out of doors during the period 15 July - 20 August, 1972.

- 1. Maximum relative humidity.
- 2. Minimum relative humidity.

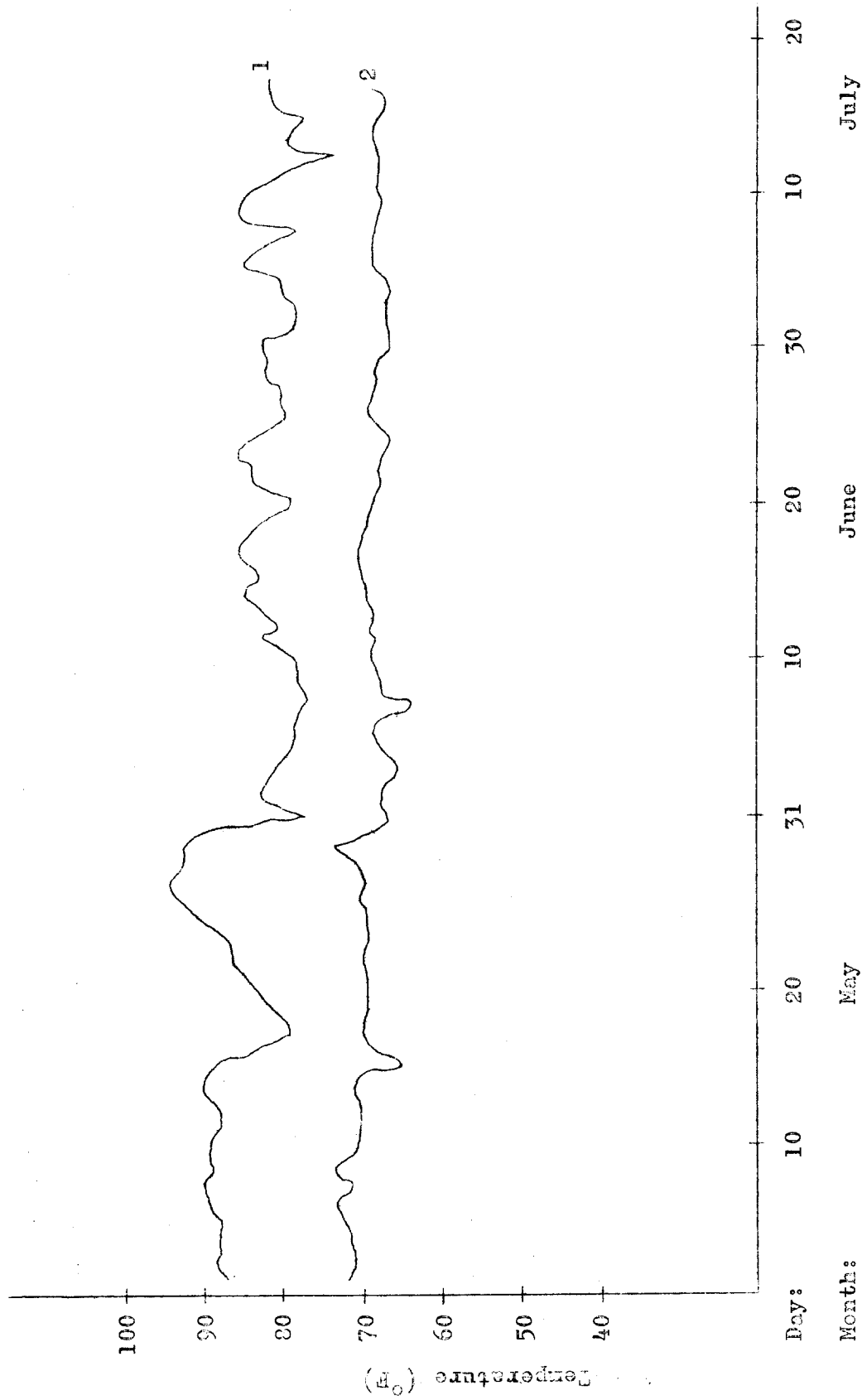


Figure 7. Graph showing daily temperature at the cleared site out of doors during the period 1 May - 16 July, 1972.

- 1. Maximum temperature.
- 2. Minimum temperature.

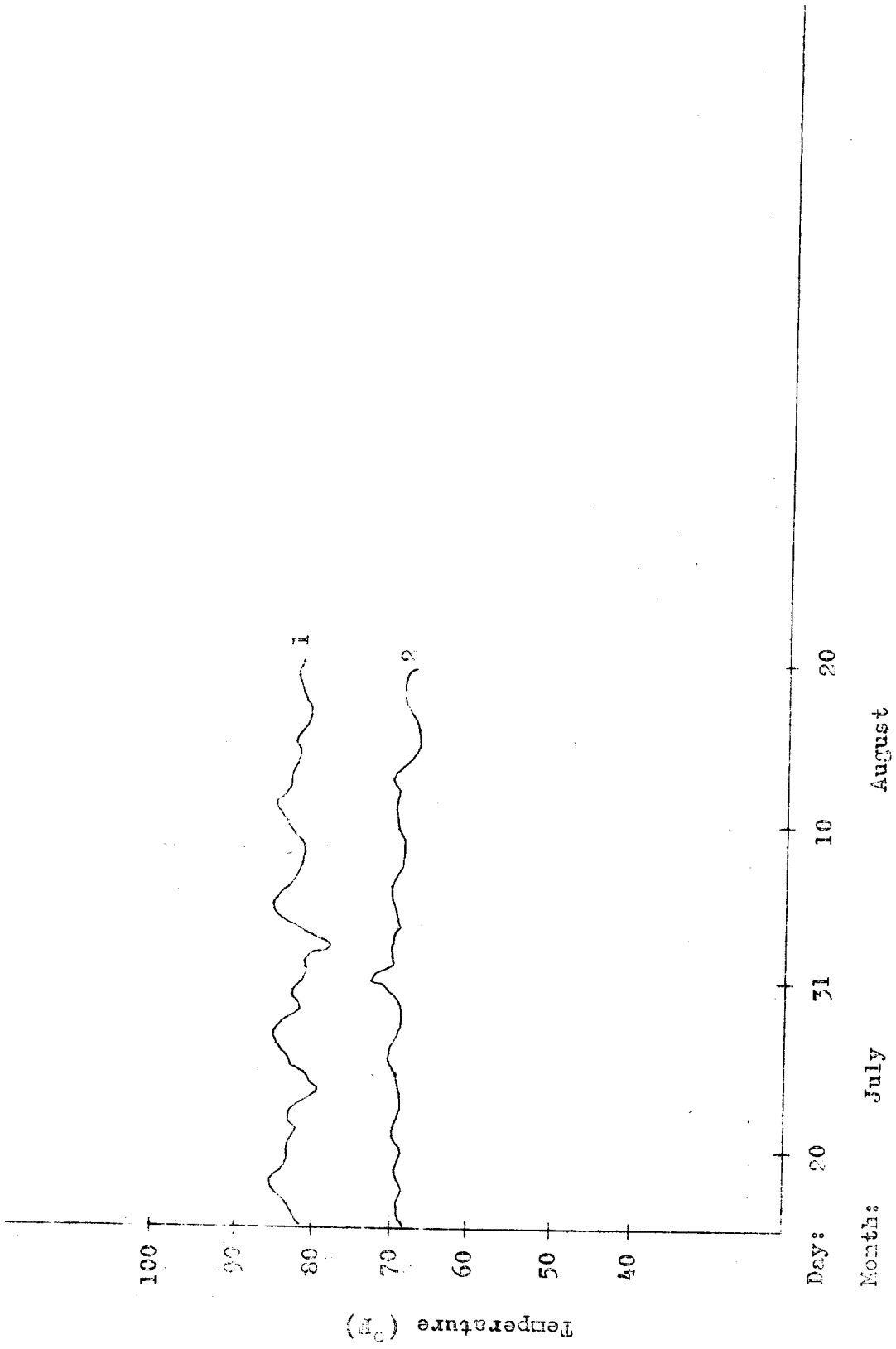


Figure 8. Graph showing daily temperature at the cleared site out of doors during the period 15 July - 20 August, 1972.

- 1. Maximum temperature.
- 2. Minimum temperature.

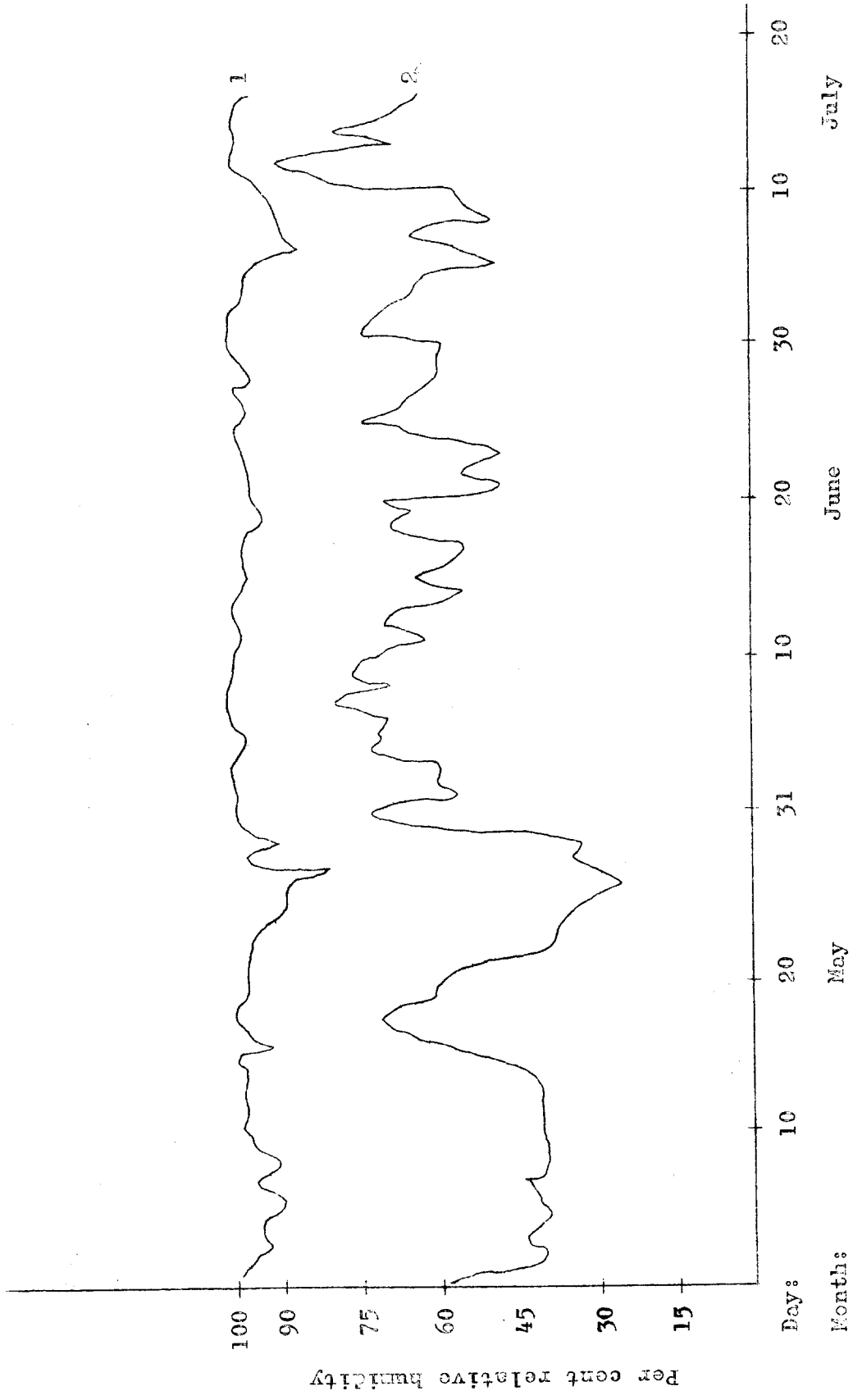


Figure 9. Graph showing daily relative humidity at the cleared site in the depot during the period 1 May - 16 July, 1972.

- 1. Maximum relative humidity.
- 2. Minimum relative humidity.

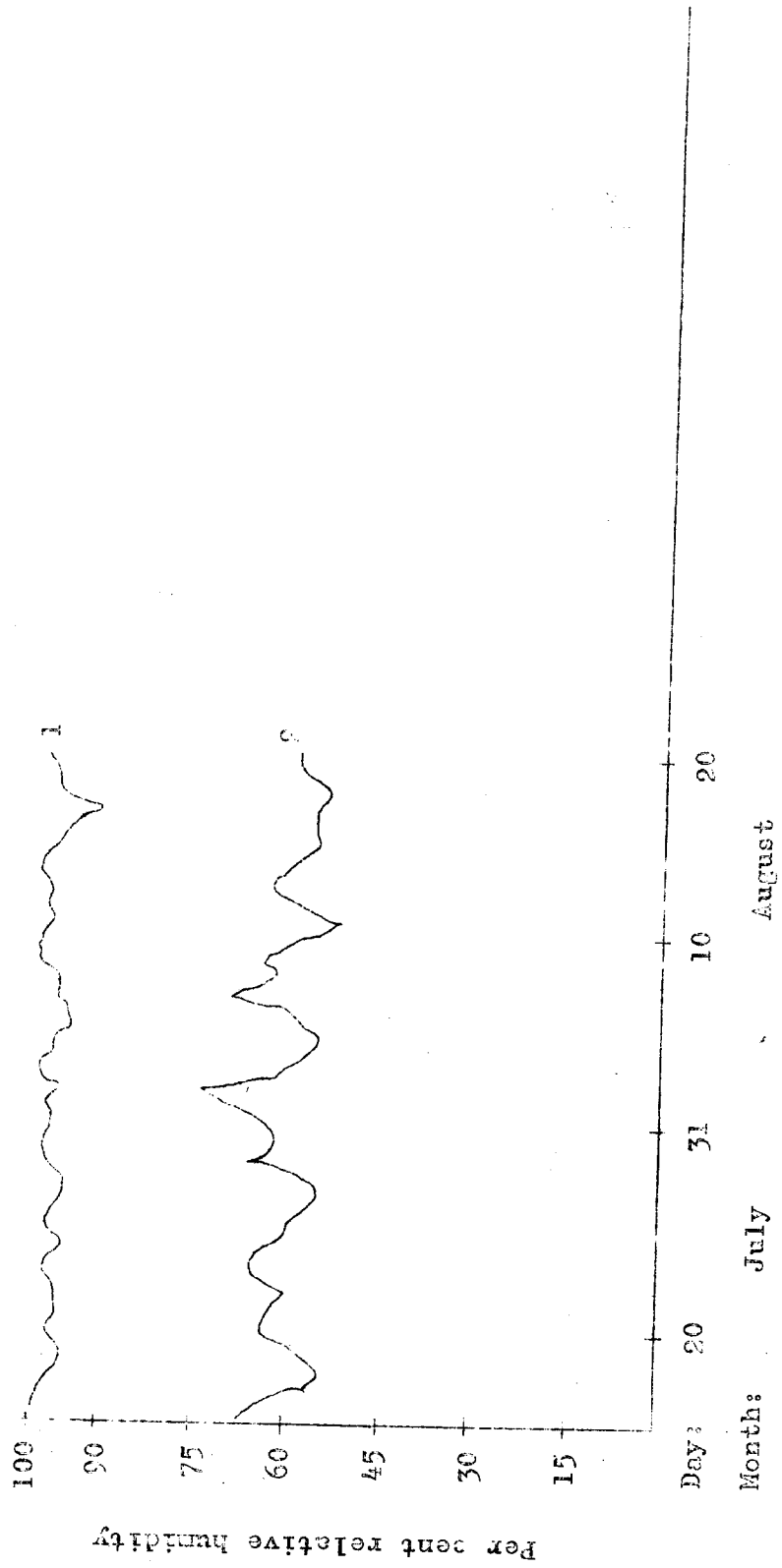


Figure 10. Graph showing daily relative humidity at the cleared site in the depot during the period 15 July - 20 August, 1978.

- 1. Maximum relative humidity.
- 2. Minimum relative humidity.

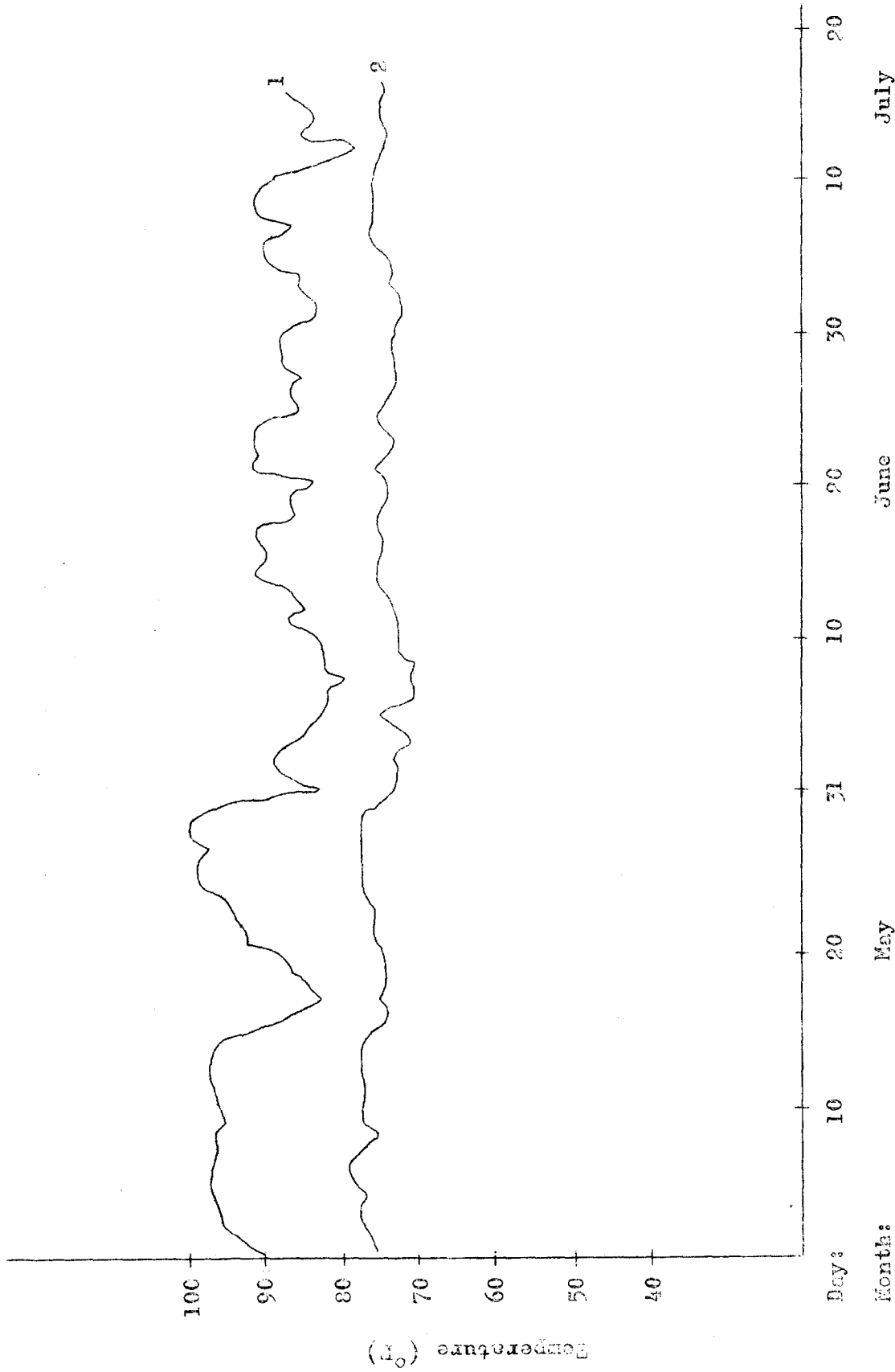


Figure 11. Graph showing daily temperature at the cleared site in the depot during the period 1 May - 16 July, 1972.

- 1. Maximum temperature.
- 2. Minimum temperature.

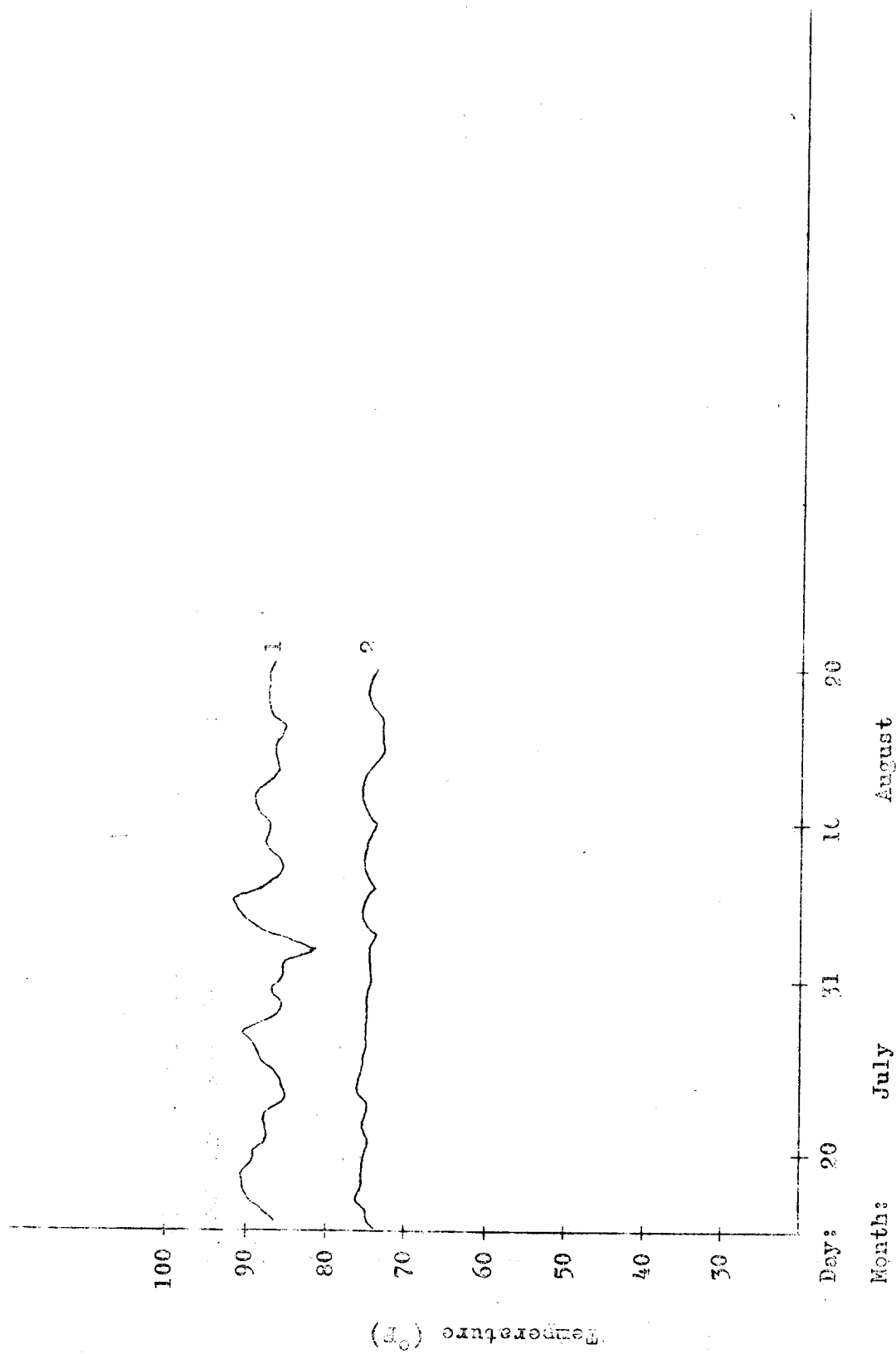


Figure 12. Graph showing daily temperature at the cleared site in the depot during the period 15 July - 20 August, 1972.

- 1. Maximum temperature.
- 2. Minimum temperature.

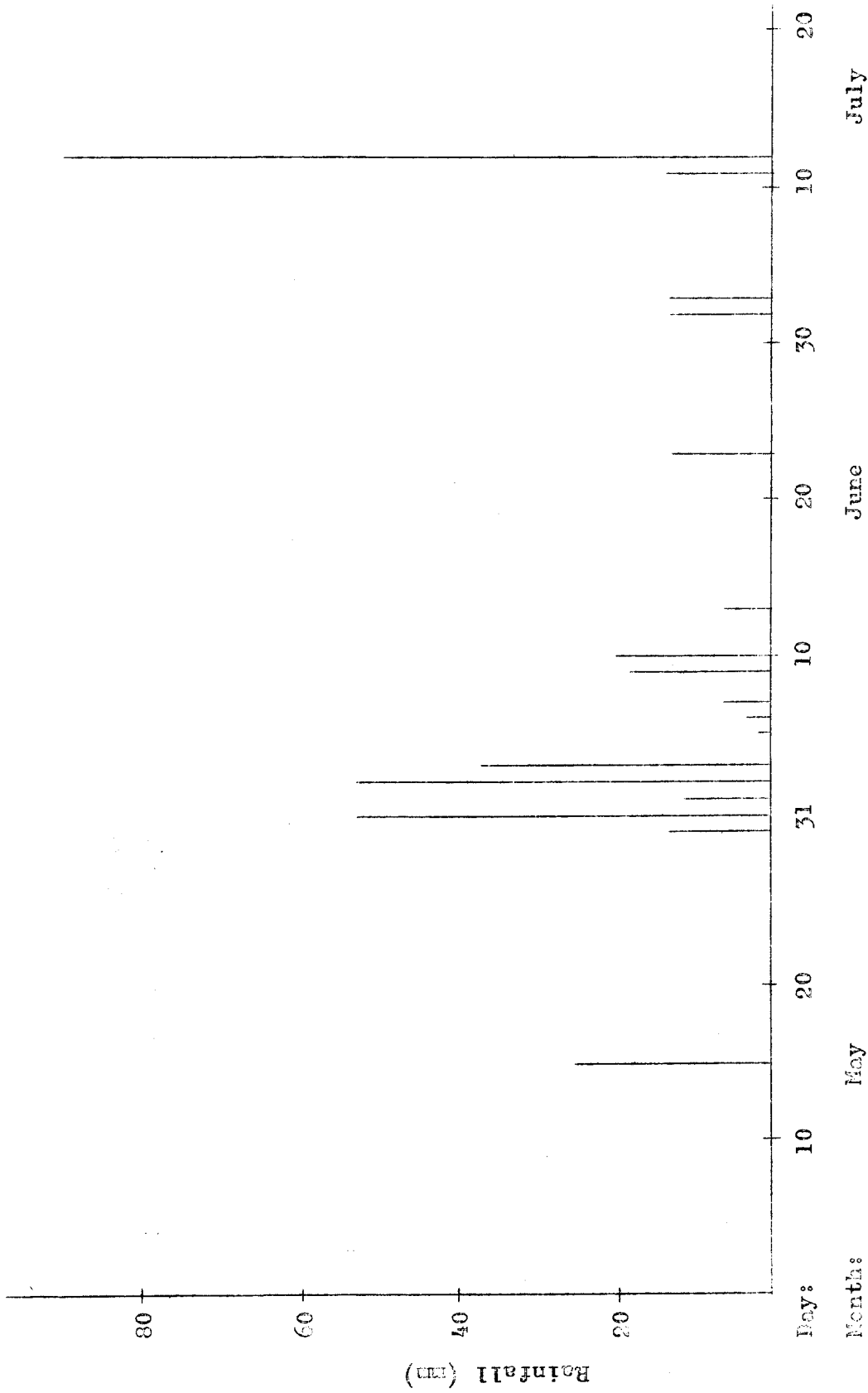


Figure 13. Graph showing daily rainfall recorded at the jungle site during the period 1 May - 16 July, 1972.

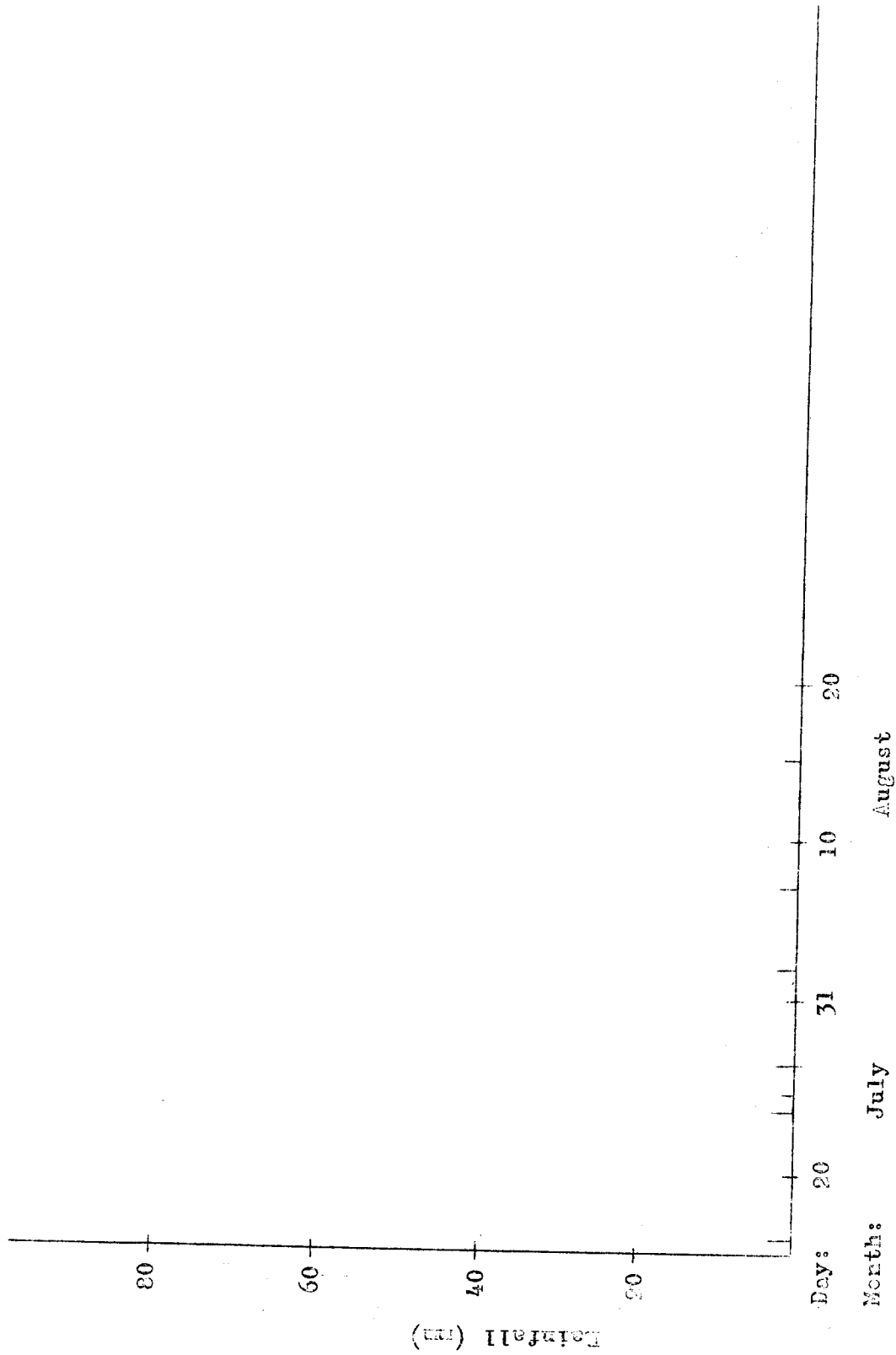


Figure 14. Graph showing daily rainfall recorded at the jungle site during the period 15 July - 20 August, 1972.

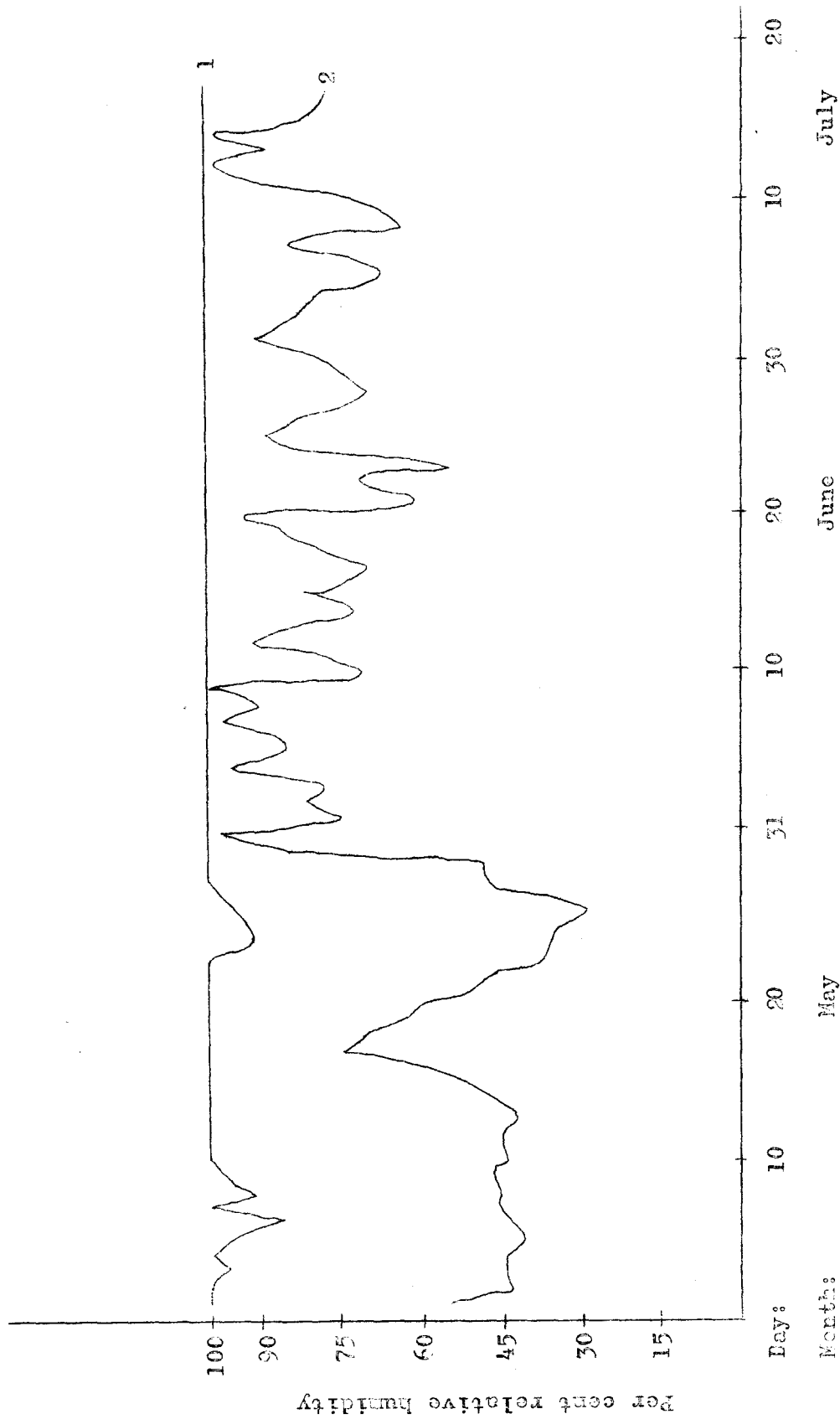


Figure 15. Graph showing daily relative humidity at the jungle site out of doors during the period 1 May - 16 July, 1972.

- 1. Maximum relative humidity.
- 2. Minimum relative humidity.

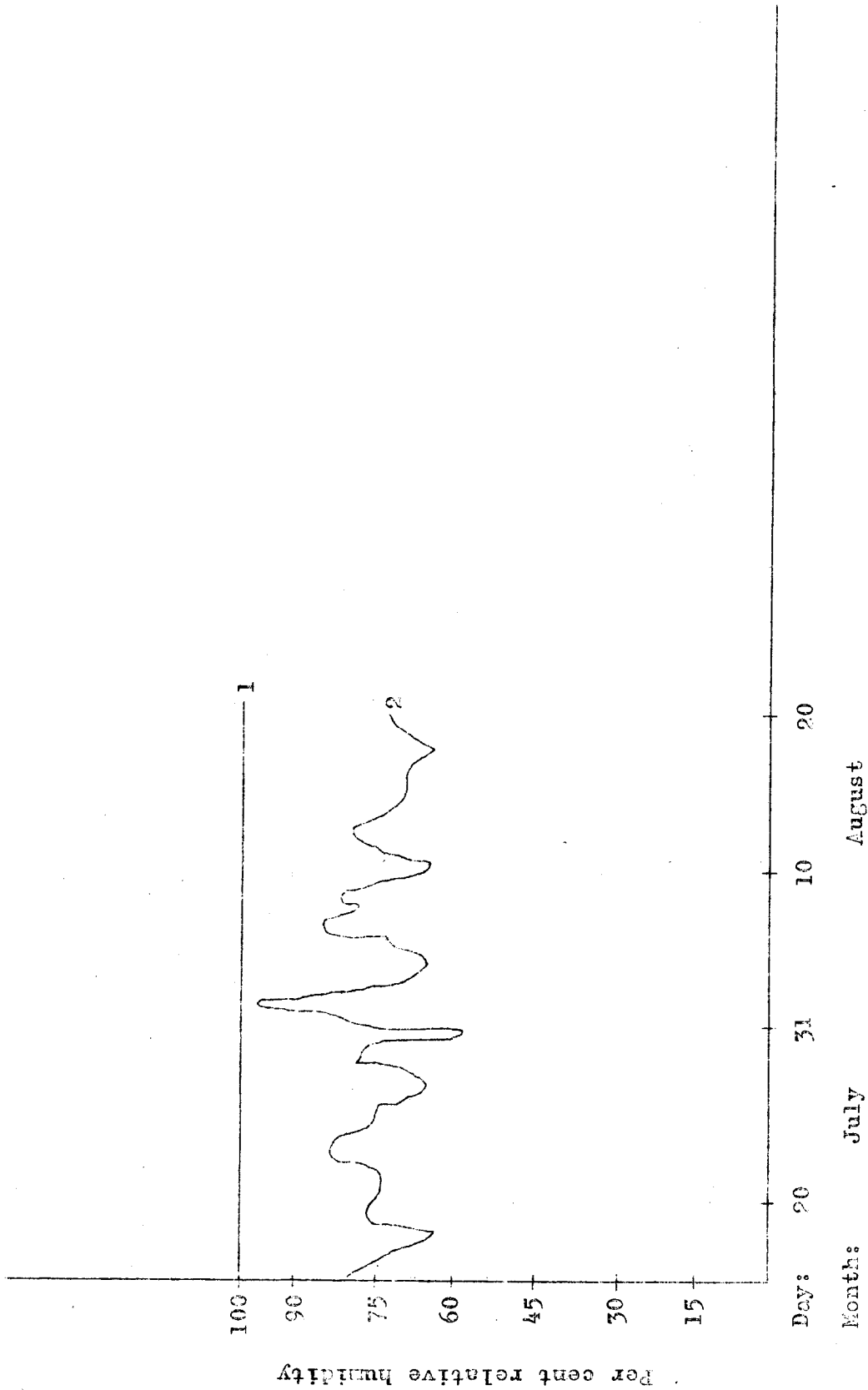


Figure 16. Graph showing daily relative humidity at the jungle site out of doors during the period 15 July - 20 August, 1972.

1. Maximum relative humidity.
2. Minimum relative humidity.

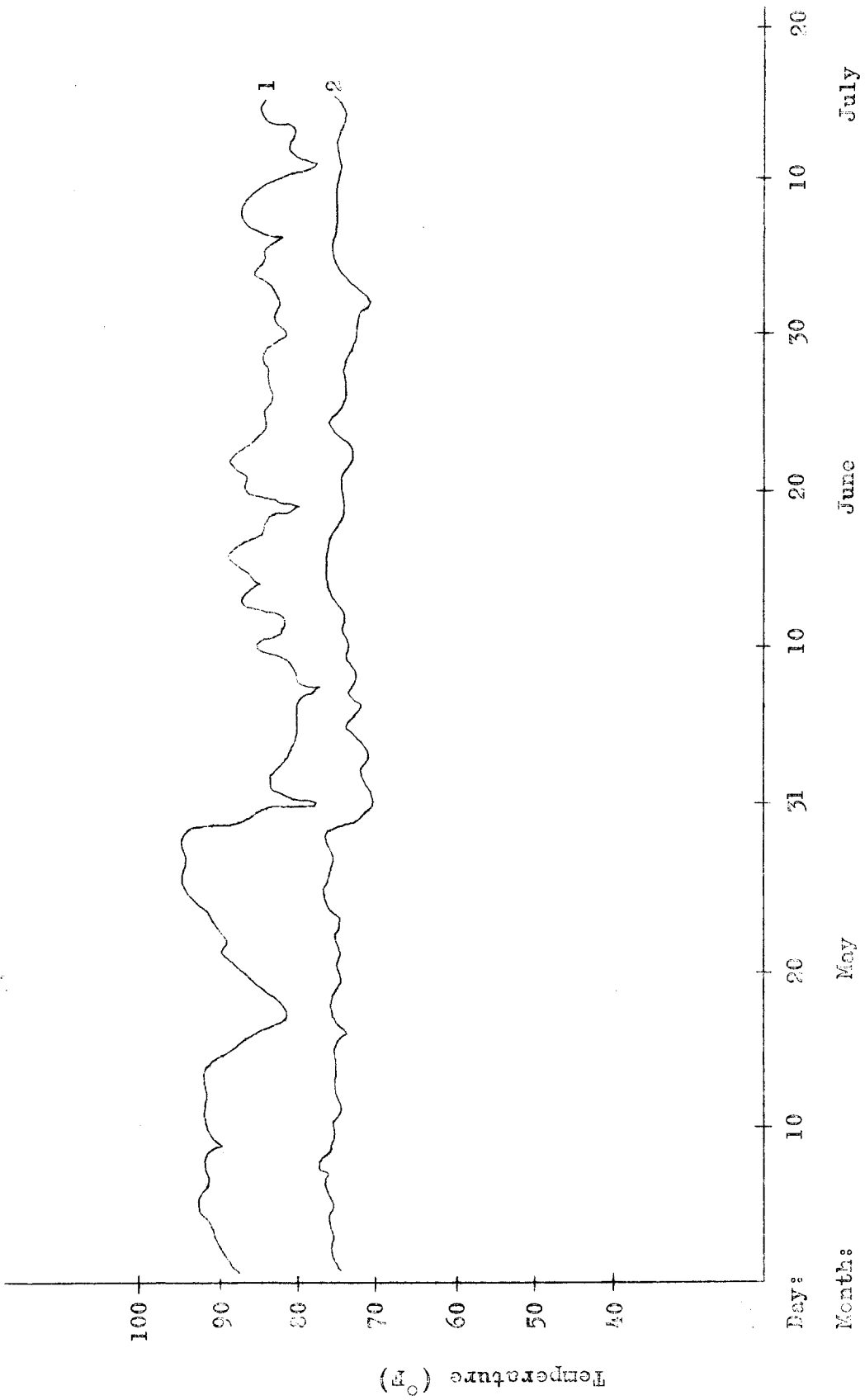


Figure 17. Graph showing daily temperature at the jungle site out of doors during the period 1 May - 16 July, 1972.

- 1. Maximum temperature.
- 2. Minimum temperature.

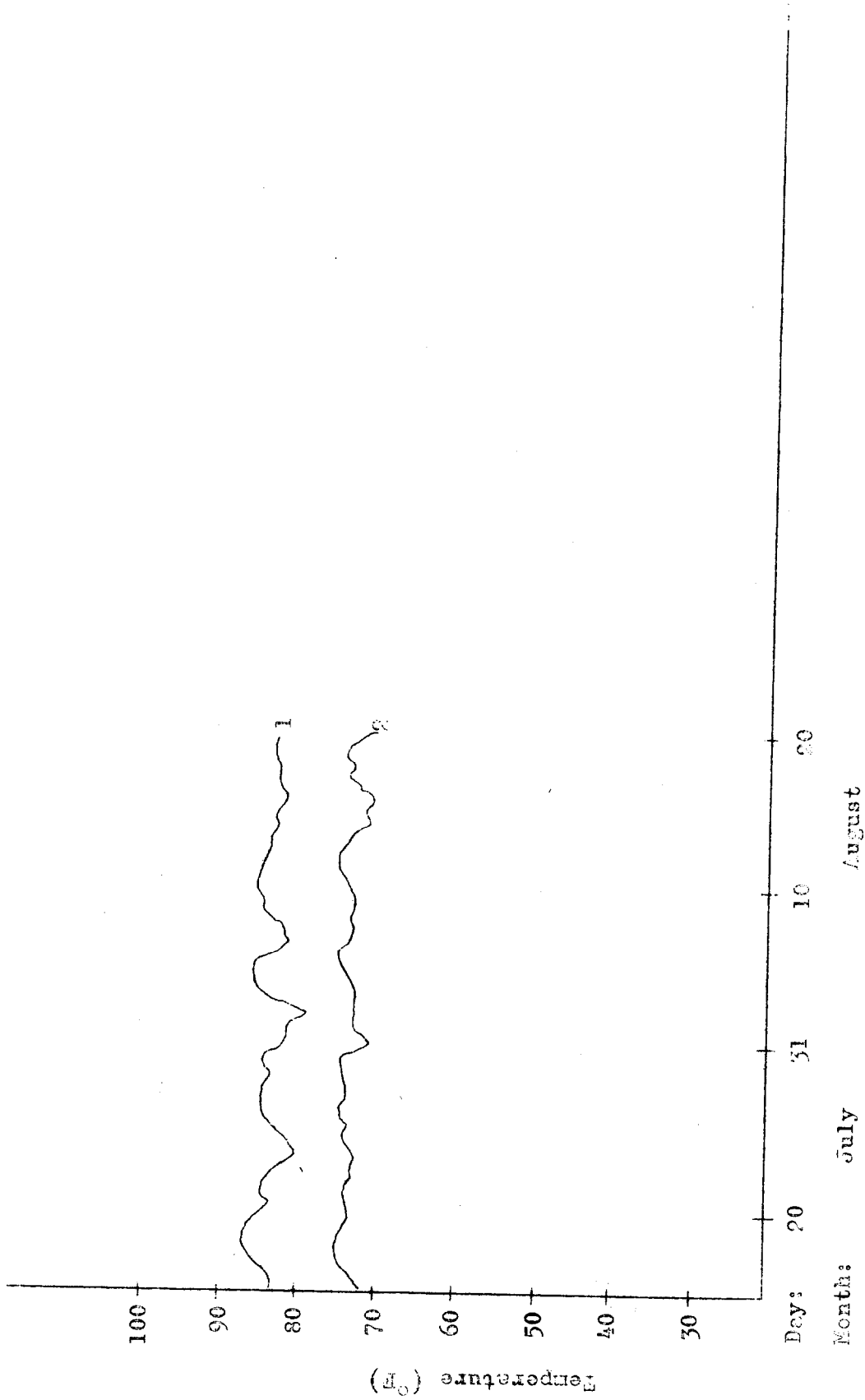


Figure 18. Graph showing daily temperature at the jungle site out of doors during the period 15 July - 20 August, 1972.

- 1. Maximum temperature.
- 2. Minimum temperature.

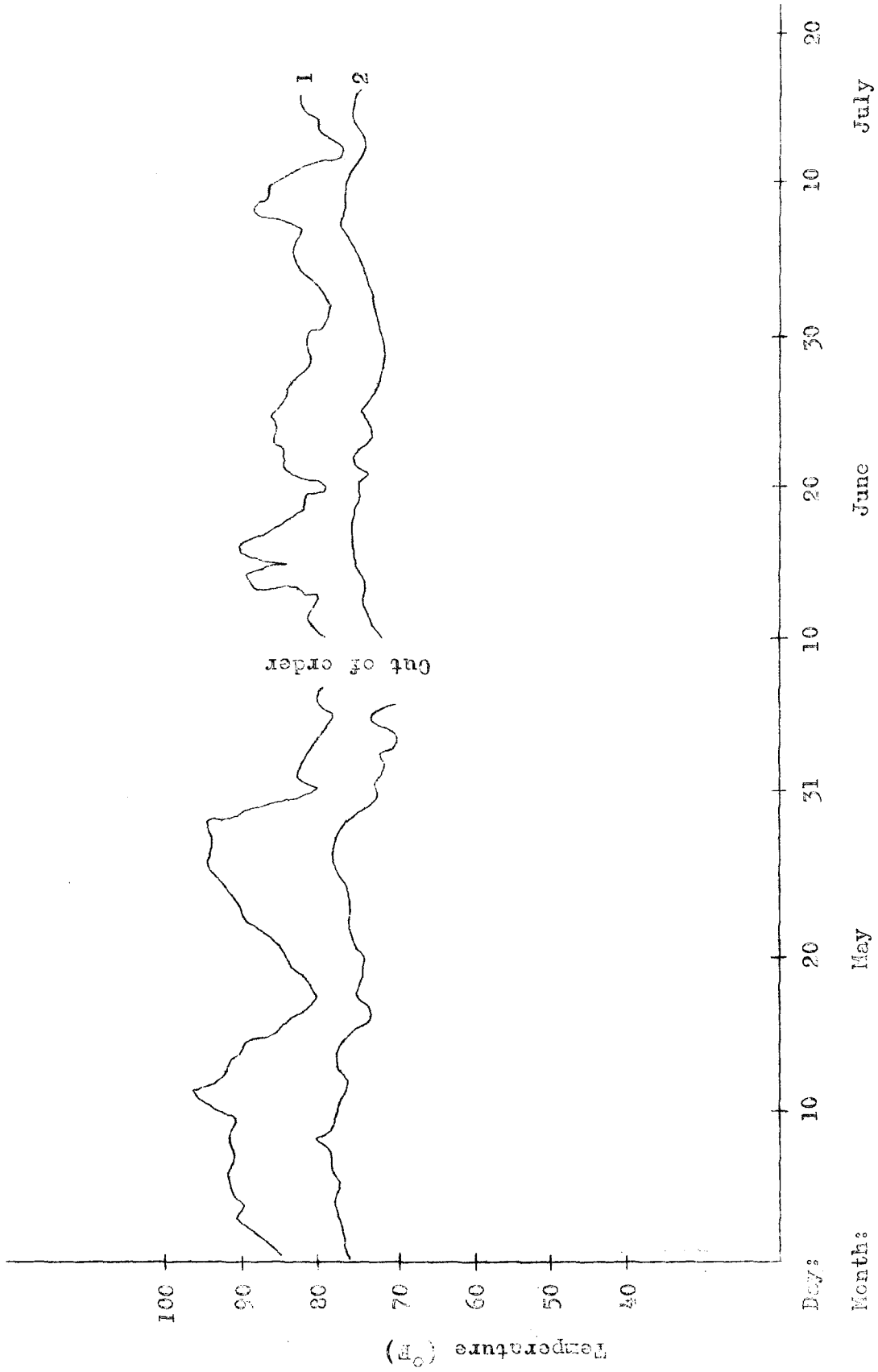


Figure 19. Graph showing daily temperature at the jungle site in the depot during the period 1 May - 16 July, 1972.

- 1. Maximum temperature.
- 2. Minimum temperature.

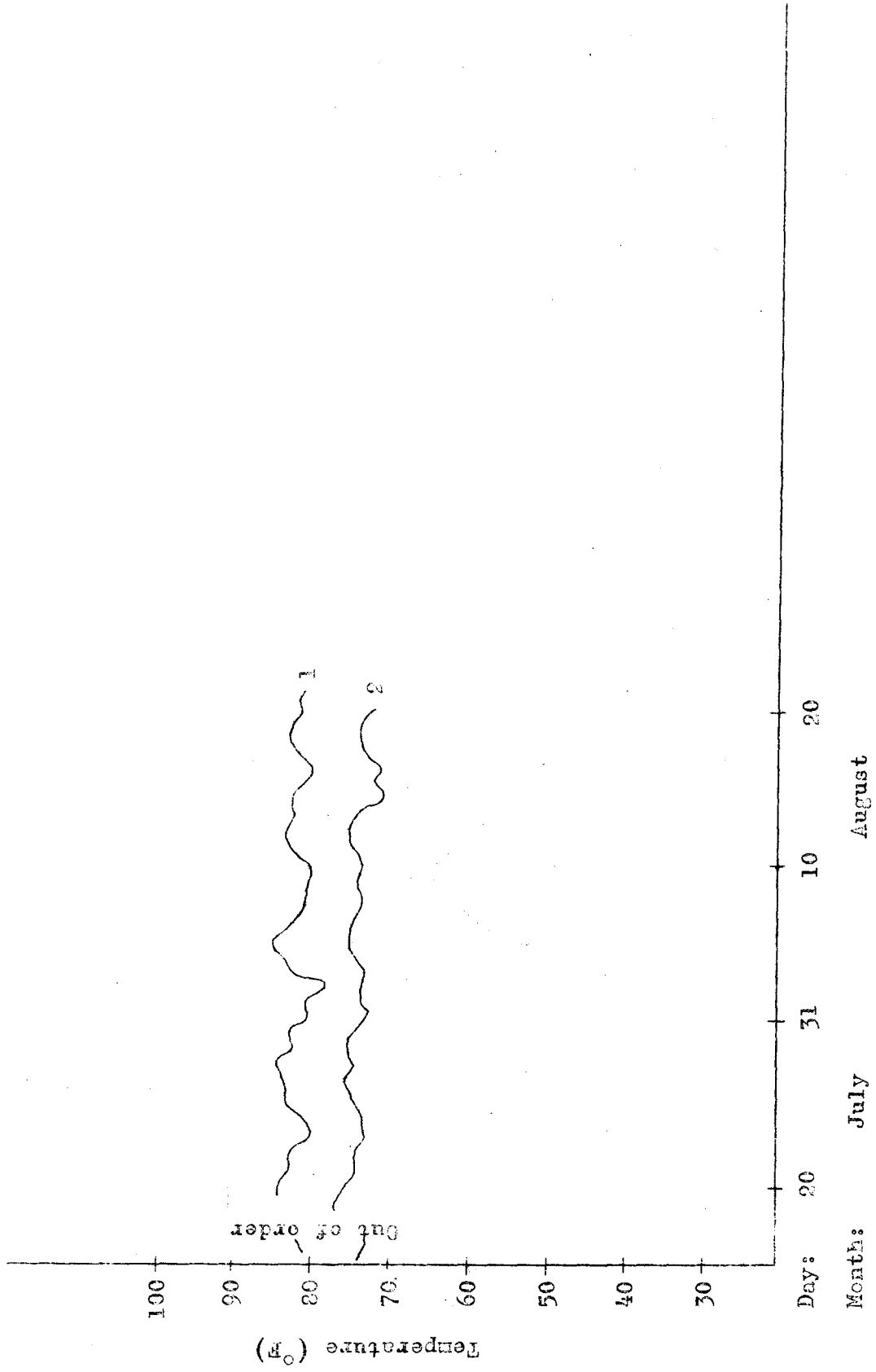


Figure 20. Graph showing daily temperature at the jungle site in the depot during the period 15 July - 20 August, 1972.

- 1. Maximum temperature.
- 2. Minimum temperature.

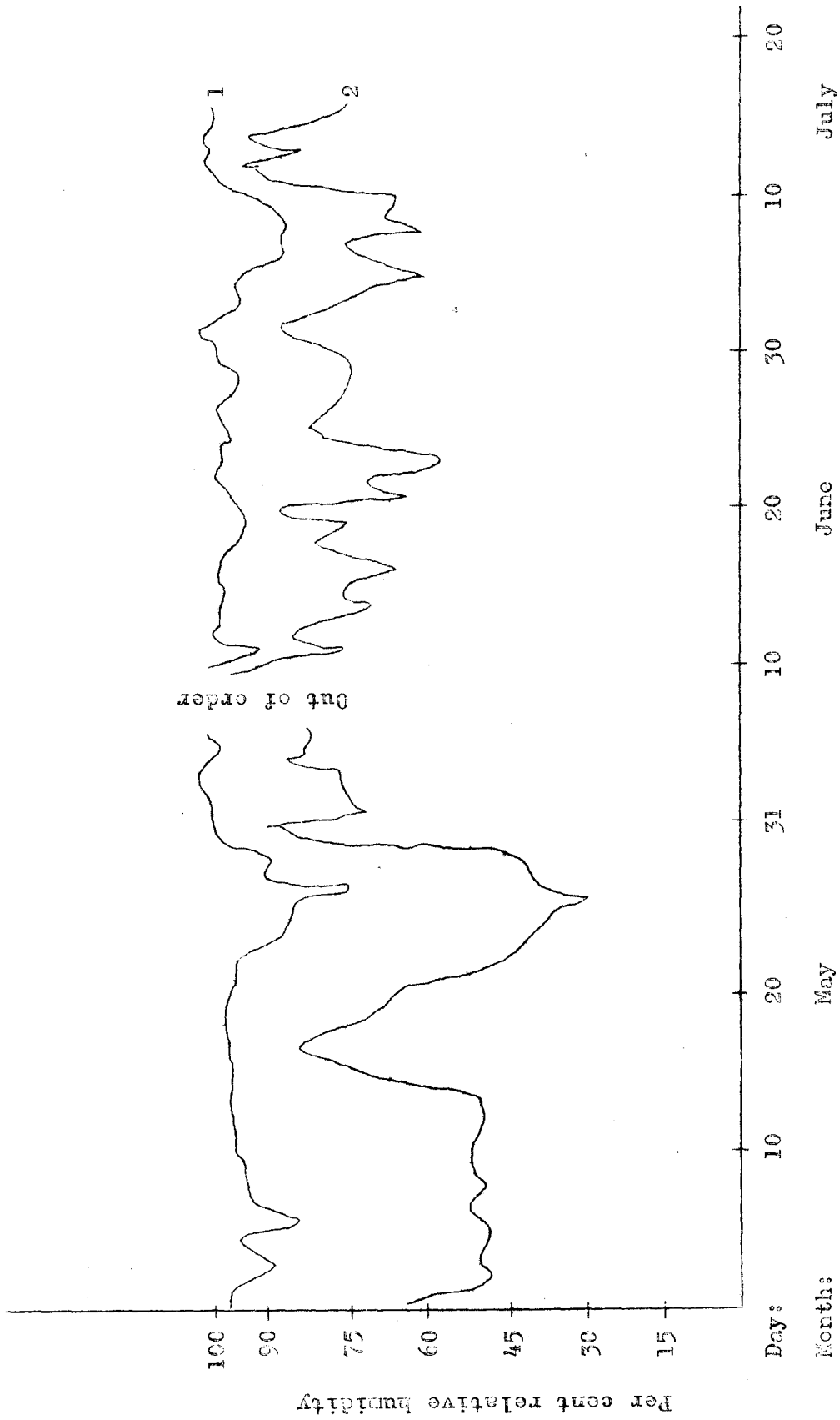


Figure 21. Graph showing daily relative humidity at the jungle site in the depot during the period 1 May - 16 July, 1972.

- 1. Maximum relative humidity.
- 2. Minimum relative humidity.

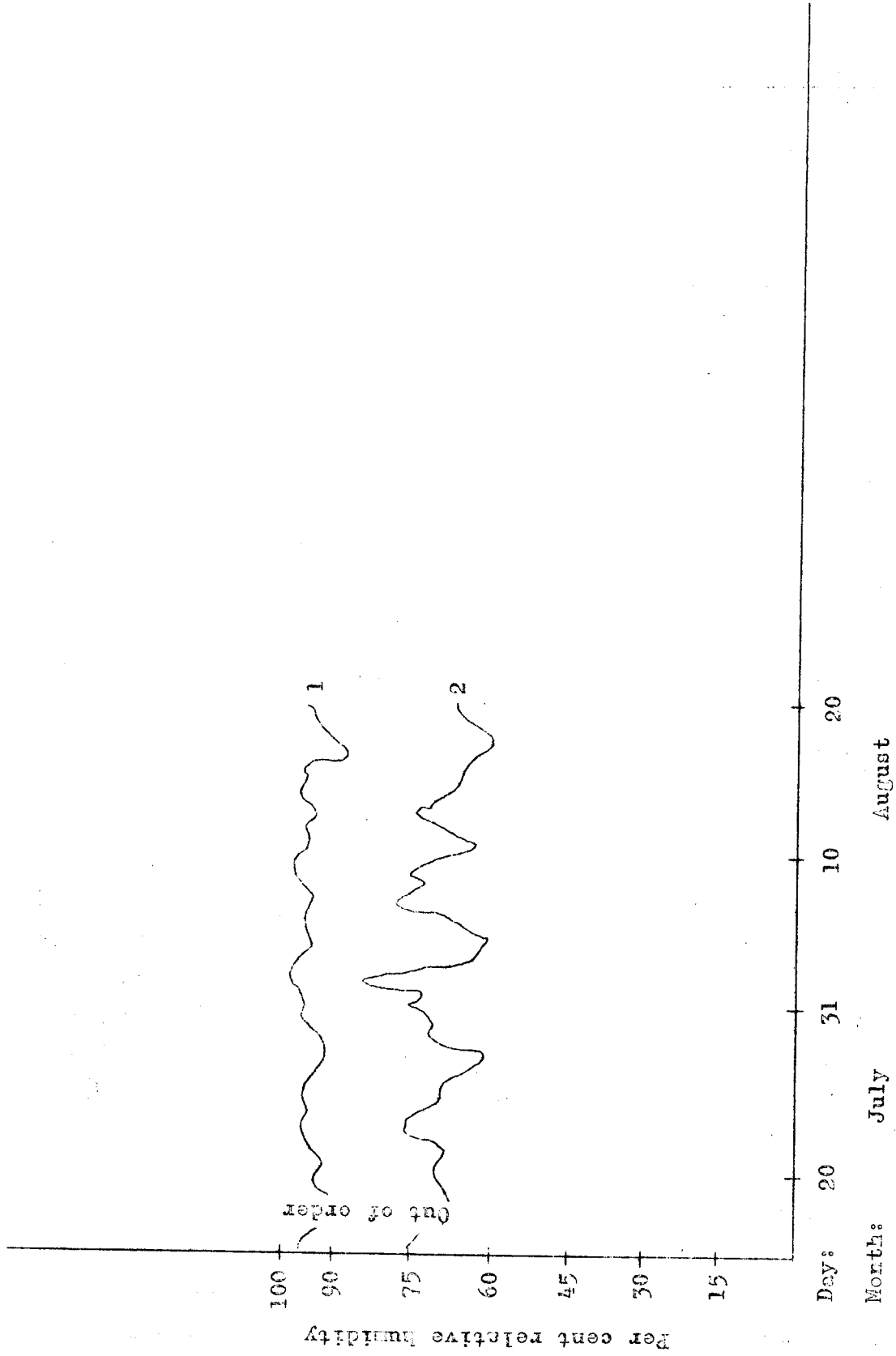


Figure 22. Graph showing daily relative humidity at the jungle site in the depot during the period 15 July - 20 August, 1972.

- 1. Maximum relative humidity.
- 2. Minimum relative humidity.

DISCUSSION

Discussion of visual observation and weight changes

Because of the inadequacy of the quality of plastic containers, they were eliminated because of the reasons stated in the Report No. 1 (in Thai). Visual observation was, therefore, made only on the laboratory test samples in sewed laminated paper/plastic containers. External condition of the laminated paper/plastic containers remained the same at the time of observation (at second withdrawal). Only one case reported to have had broken seal because of mice. Further examination into the foodstuff itself revealed that most of the foods were affected by mold and insect^{*}, eventhough pellets looked normal. In some case, yellow mold was visible in addition to common blue-green mold in foodstuff. The observed, beetle type, insects were in mature stage so that they could readily fly when they got off the confinement. The insects are believed to have originated from within the animal food itself.

Observation for weight changes was made on all formulas 1 and 5 in the sewed laminated paper/plastic containers that belong to the second withdrawal (12 August 1972). The results of observation revealed that there were three different modes of weight changes. The ones in the control room showed decrease in weight, while those in the depot in the cleared site, and in the depot in the jungle site showed increase in weight. The ones in jungle site depot showed larger weight increase than those in the cleared site depot. This could be accounted for by hygroscopic property of animal food pellets which absorb water vapour prevailing in the immediate vicinity. Meteorological observation showed that relative humidity in the depot in the jungle site was higher than that in the cleared site depot which was higher than that in the control room. Observation of mold growth revealed that degree of severity ranged from samples in the jungle site depot, cleared site depot to the control room. Therefore it can be said here that humidity plays a key role in deterioration of animal food.

* Insect infestation in foodstuff believed to be of beetle type, with hard-brown wings.

Discussion of microbiological observation

Animal food samples were withdrawn from storage conditions on 12 August 1972, and microbiological tests on them were made on 21 August 1972. Only few selected test samples were tested for microorganisms. The results do not show appreciably change in aerobic bacteria and mold population. Anaerobic and coliform tests were negative in all test samples. Because of the yellow mold manifested on sample numbers 9-1-1-II-bBx and 9-5-1-I-bBz, the Microbiology Unit paid special attention to the matter by preparing Martin's agar plates and exposed them at the storage on site, and brought them back to ASRCT for further tests and study. The results of tests showed no yellow mold in all storage site. The Microbiology Unit concluded that the yellow mold could have come from within the animal food.

There is some evidence to show that changes in microbiological populations correlated with site of "exposure". It was obvious that varying degree of severity of mold and bacteria ranged from jungle site, cleared site to control room.

Discussion of meteorological data

The period between the exposure time and the second withdrawal falls in the rainy season. It was unseasonally, however, dry and intermittently rain this year. Although rainfall does not directly affect the food samples stored under shelter in depot but the available humidity outside the depot affects the humidity in the depot. The relative humidity rose to high levels each night, through most of the period, even in the absence of rainfall. Temperatures in the depots were generally high and steady. It is notable that, although on most nights the humidity out of doors reaches 100%, it usually did not do so in the depots. This should be a significant aspect of the protection of deterioration by the depots.

Discussion of chemical analysis

Chemical analysis of test samples was made firstly to compare the composition with the figures given by the manufacturer and secondly to determine the rate of deterioration of composition of food samples.

Results revealed that changes in composition were not appreciably high, although the tendency of changes was observed to be decreasing. Changes in nutritional value of food during this period should not affect animals to which the foods are given.

CONCLUSION

Observation showed that animal food samples, especially those exposed in the depot in the jungle site were moldy. The ones that were affected the least were those stored in the control room. This could be accounted for by higher humidity in the jungle that got into the containers and thereby caused increase in weight and mold growth. Toxicity test of mold was not undertaken due to lack of staff time and work involved. Although tests for coliform and anaerobic bacteria were negative, the foods which manifested mold might not be fit for animals, but it was difficult to confirm without toxication test and animal feeding trial.

Insect infestation in the animal foods which is believed to have originated from within the package, indicated that the manufacturing process was not completely free from contamination.

Results of chemical analysis of composition and rate of deterioration does not show any obvious changes in composition and nutritional value of food samples. Up to the second withdrawal food nutritional value is still acceptable. Results of free fatty acid showed only little changes. Except mold manifestation problem, the animal food samples were otherwise acceptable up to the second withdrawal.

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