Chapter V

RESULTS AND DISCUSSION

In this chapter, the result from the experiment in Appendix G 7/7 and that from the theoretical calculation which is calculated by using a computer program given in Appendix H are compared as follows :

(1) Time response as shown in Figure 5.1

(2) Phase plane characteristic as shown in Figure 5.2

Figure 5.1 shows that :

(1) The time characteristic obtained from the experiment shows a small deviation from the calculated one. This might be because of the use of the approximate characteristic of the relay in stead of the actual one.

(2) The value of T_{max} from the experiment is less than that from the calculation by approximately $2.4^{\circ}C$. The value of T_{min} from the experiment is greater than that from the calculation by approximately $0.8^{\circ}C$.

(3) The controlled temperature from the experiment differs from that from the calculation by $0.8^{\circ}C$ (or 0.61 per cent) for the controlled temperature of $131.5^{\circ}C$.
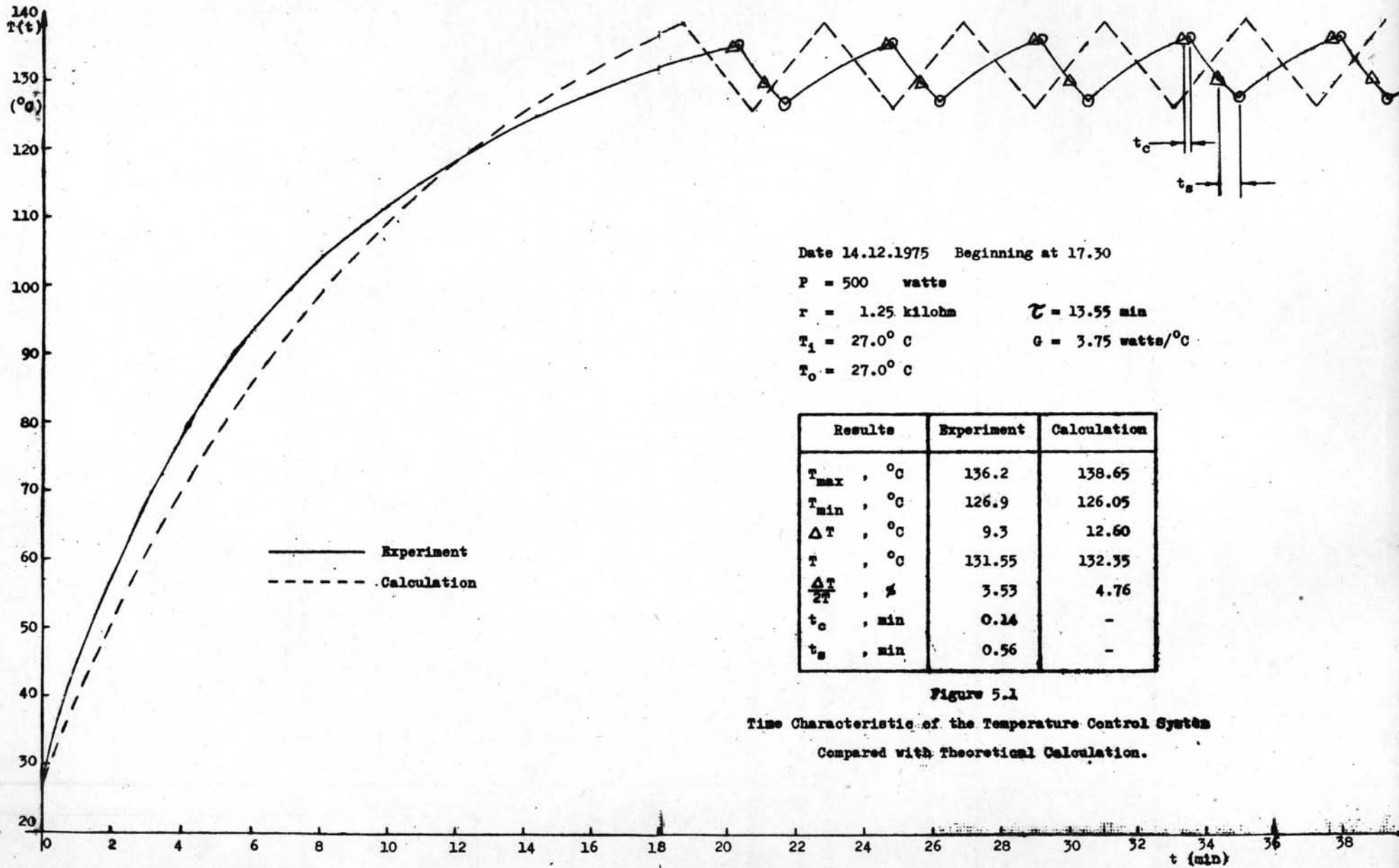
Date 14.12.1975   Beginning at 17.30

P = 500   watts

r = 1.25 kilohm τ = 13.55 min

T_i = 27.0° C   G = 3.75 watts/°C

T_o = 27.0° C

Results		Experiment	Calculation
T_{max}	°C	136.2	138.65
T_{min}	°C	126.9	126.05
ΔT	°C	9.3	12.60
$\bar{T}$	°C	131.55	132.35
$\frac{\Delta T}{2\bar{T}}$	%	3.53	4.76
t_c	min	0.14	–
t_s	min	0.56	–

Figure 5.1

Time Characteristic of the Temperature Control System
Compared with Theoretical Calculation.

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(4) The temperature fluctuation $\frac{\triangle T}{2T}$ from the experiment
is less than that from the calculation by
approximately 1.2 per cent.

(5) From the experiment, the dead time during the
open-time of the relay t_c and that during the
closed-time of the relay t_s are not equal; and
t_c is much smaller than t_s .

Figure 5.2 shows that :

(1) The slope of phase trajectory from the calculation
(by using eqns. 2.13 and 2.17) is similar to that
from the experiment (calculated from eqns. 2.16
and 2.19), because the slopes of both trajectories
are constant.

(2) The limit cycle of the system is composed of four
straight-lines.

Figures 5.3 and 5.4, from experimental results in
Appendix D, show that the temperature fluctuation increases
rapidly at higher controlled temperature.

Figure 5.5, from experimental results in Appendix D,
the controlled temperature varies inversely with the reference
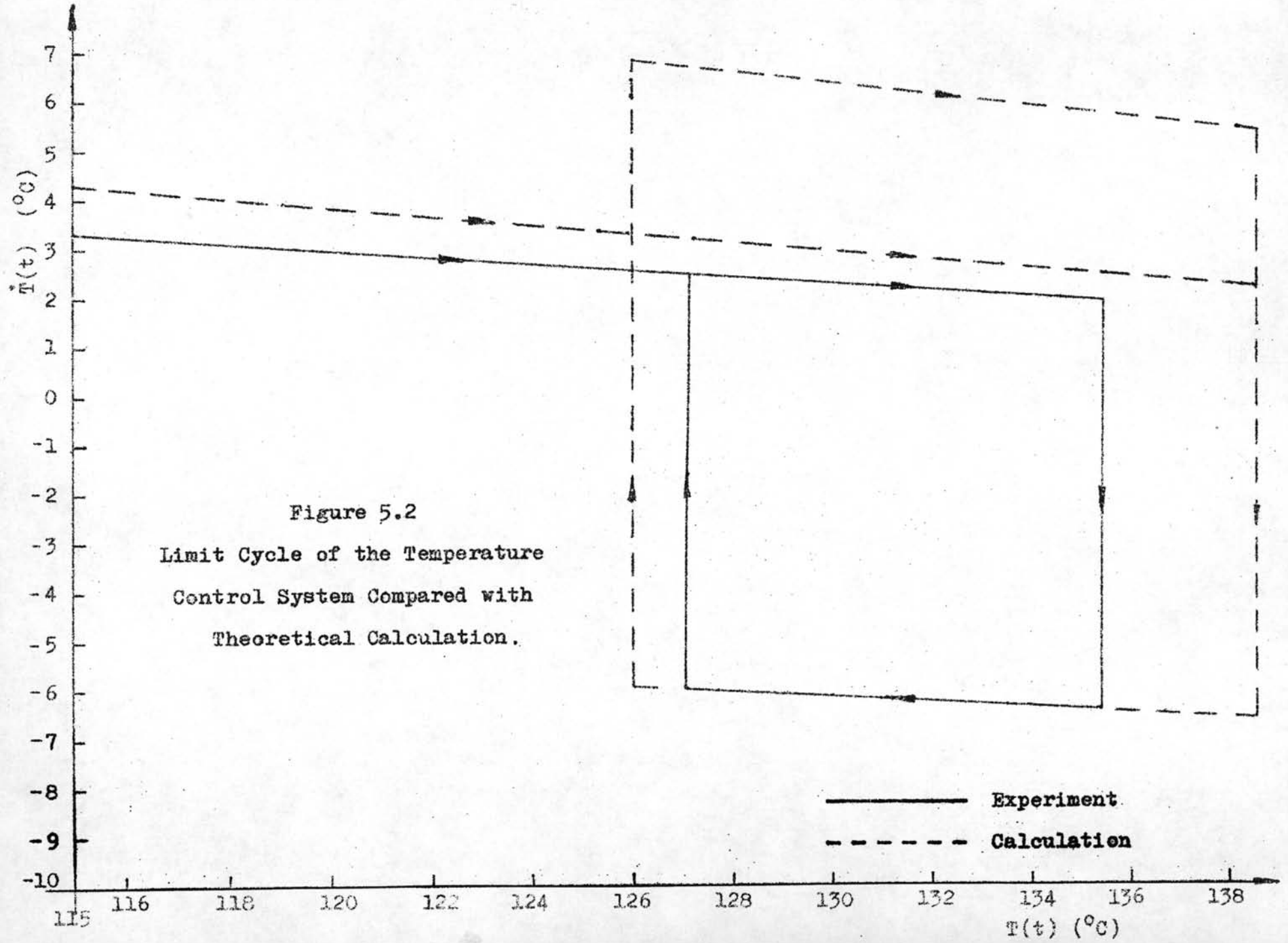bridge resistance.

Figure 5.2

Limit Cycle of the Temperature

Control System Compared with

Theoretical Calculation.

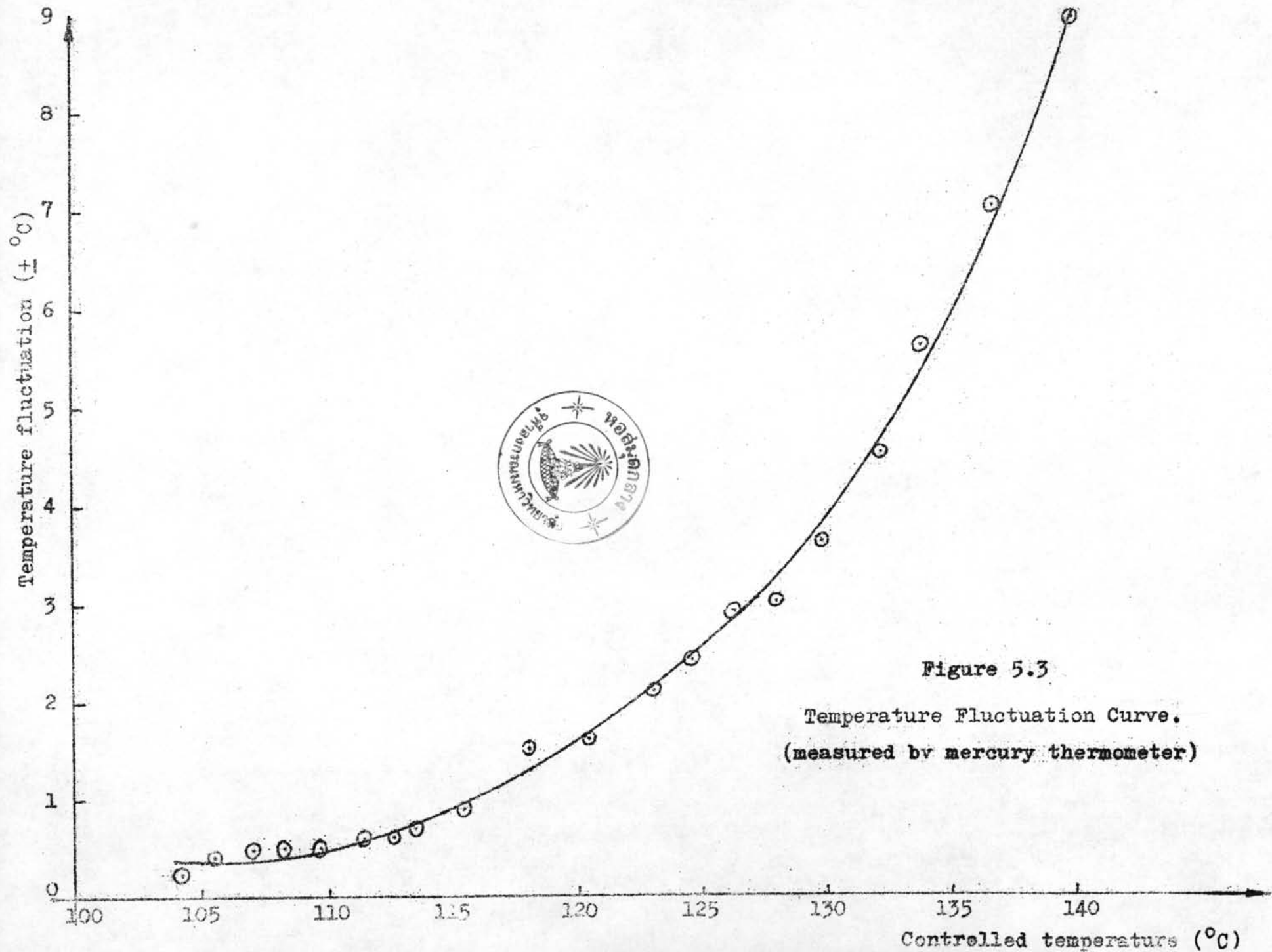——————————— Experiment

— — — — — — — Calculation

Figure 5.3

Temperature Fluctuation Curve.
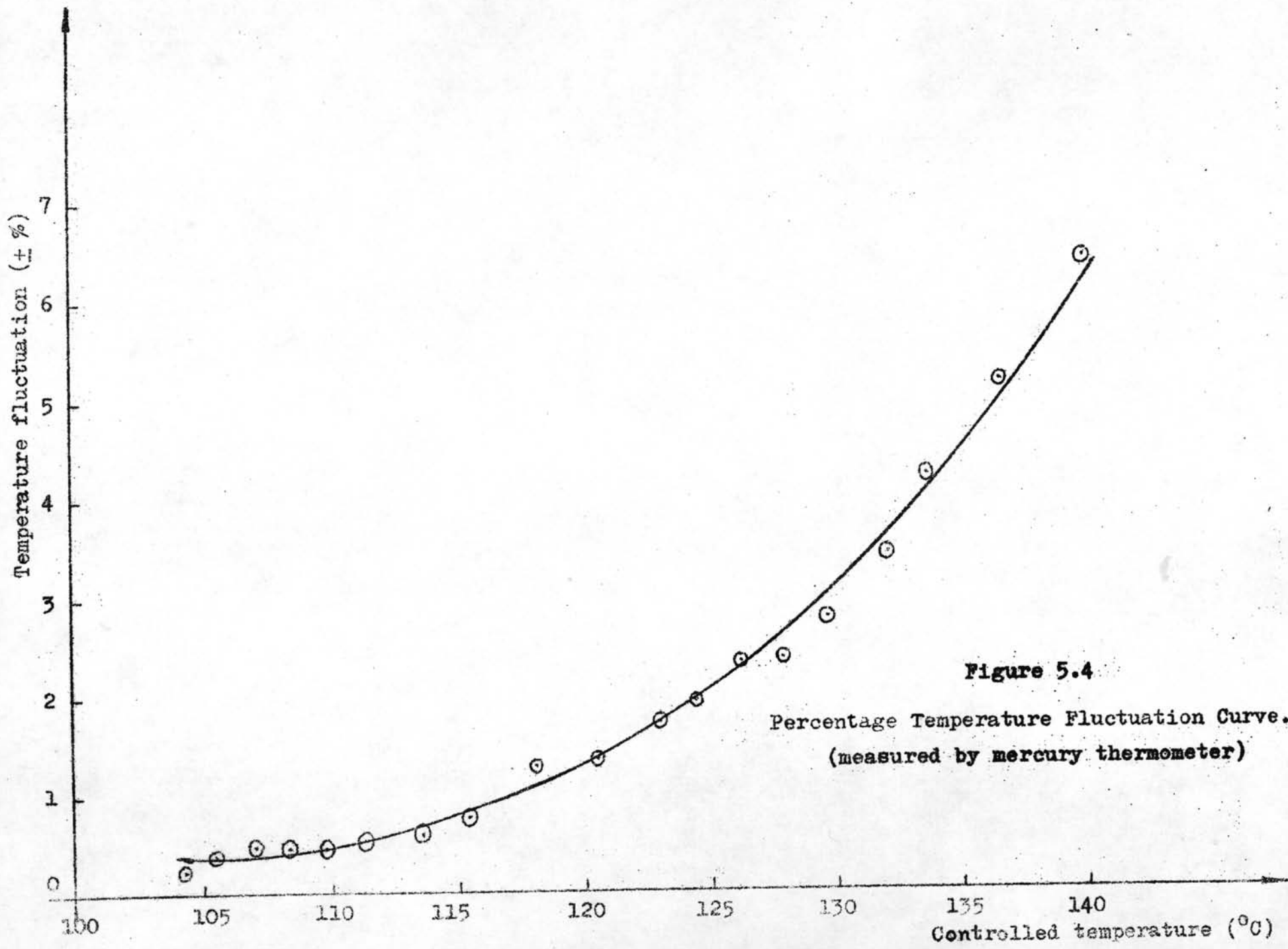
(measured by mercury thermometer)

Figure 5.4

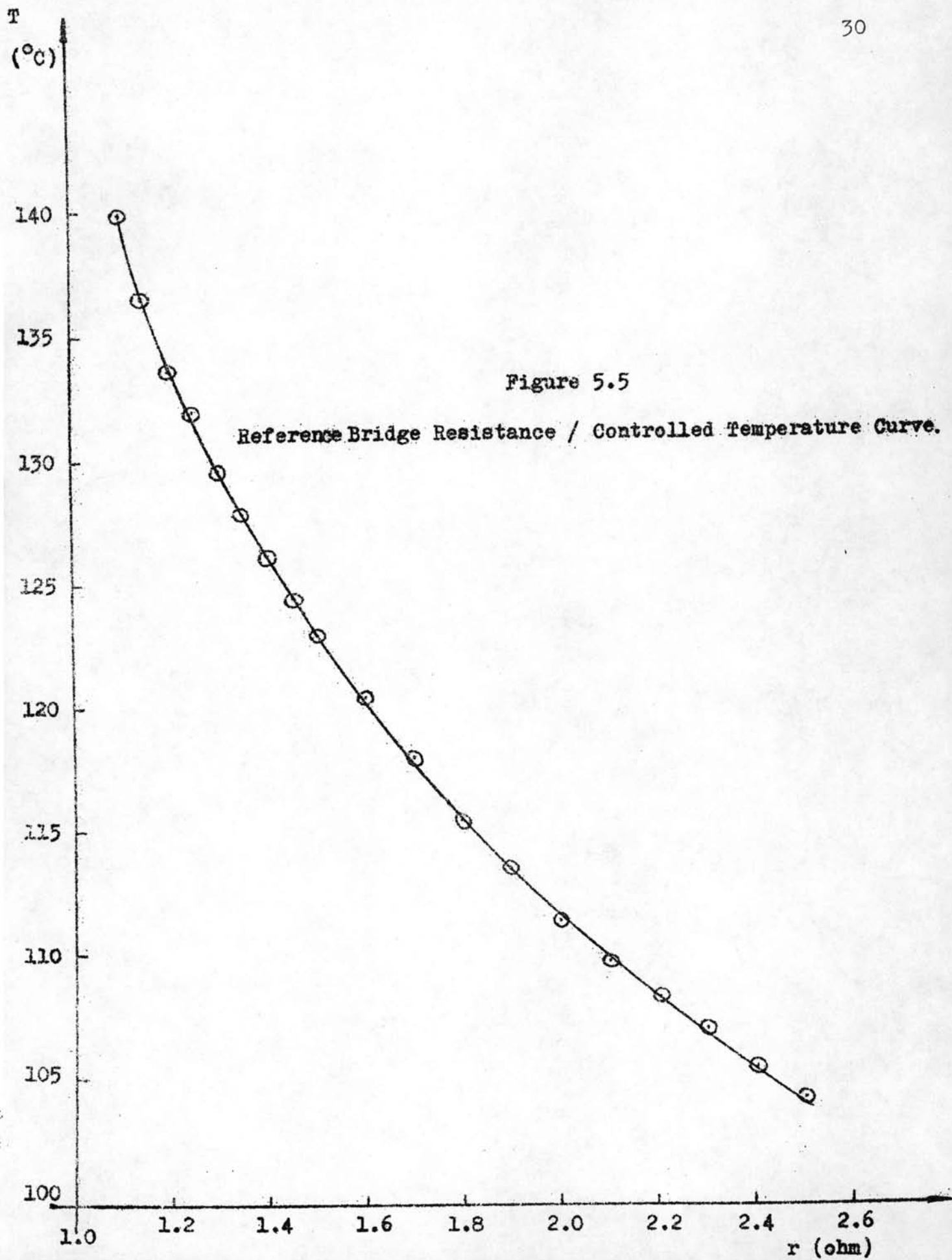Percentage Temperature Fluctuation Curve.
(measured by mercury thermometer)

Figure 5.5

Reference Bridge Resistance / Controlled Temperature Curve.