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Biological Effects of Locally Applied Microwaves on the Thyroid Gland of Dogs*

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by

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ABSTRACT

Studies of thyroid gland function during localized 2450 MHz CW microwave exposure were conducted. Some alteration in the secretion of thyroxine, the major thyroid hormone, was evidenced. The data suggest that the observed effects were of thermal origin.

SUMMARY

Alterations in the function of the neuroendocrine system of man and animals exposed to microwaves have been reported with increasing frequency in recent years (1). These reports suggest that a specific part of the neuroendocrine system, the hypothalamic-hypophysial-thyroid (HHT) axis, whose main responsibility is the control of the body's metabolism,may be sensitive to perturbation following microwave exposure. Several mechanisms have been proposed to explain the observed changes in thyroid function (direct CNS, thermal or nonthermal stimulation, alteration of internal temperature gradients within the brain or other parts of the body, peripheral nerve stimulation). However, since the exposure conditions are either not known, as in the cases of thyroid dysfunction in humans reported in the Soviet Union (2), or consisted of whole body irradiation, as in most animal experiments (3, 4), the focus of action ~~of micro~~-

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conclusion is Temp in the Portion which determines degree of effect is not warranted

1. did not do studies at diff temp looking at same hormone

2. in 4A why 2°C diff RT to LT thyroid before exposure

3. in 3B both gland show effect on T4 even tho only one is heated but in 4B only the unheated thyroid shows effect which is in opposite direction to 3B

4. The mag in 3 B grossly diff from that in 4B

5. In ~~3B~~ 4 even tho temp goes back soon after MW shut off the T_4 takes much longer if ever

of microwaves on a particular part of the HHT axis cannot be specified.

The HHT axis consists of three levels of organization (hypothalamus, pituitary gland, thyroid gland) whose final output function, the secretion of thyroid hormones by the thyroid gland, is controlled by the balance of hormonal signals in the direction: secreted thyroid hormones → hypothalamus, → pituitary. In addition, this balance is modified by direct neural inputs from higher brain centers and peripheral nerves. A simplified block diagram indicating each level of organization and the known feedback and control pathways is shown in Figure 1.

In order to study the effects of microwaves on the thyroid gland, a series of localized microwave exposures were undertaken in the anesthetized dog. One thyroid gland was exposed with a dielectrically loaded waveguide applicator (2" x 1") at 2450 MHz, while the other gland was used as a control. Blood was collected directly from the caudal thyroid veins. The plasma concentration of thyroxine, the major thyroid hormone,secreted by the gland, was measured by radioimmunoassay (5). The temperatures of both glands were measured continuously during each experiment using a YSI511 thermistor near the unexposed gland and a liquid crystal fiber optic (LCFO) temperature probe near the exposed gland (6). The LCFO temperature probe was obtained through the cooperation of Dr. C.C. Johnson and Dr. Thomas Rozzell. The microwave power directed to the exposed gland was measured using the microwave transmission system shown in Figure 2. Some experiments were conducted following administration of 10 I.U. of thyroid stimulating hormone (TSH).

Figure 3a shows the recorded temperatures during an experiment in which the left thyroid gland was locally exposed with microwaves with a measured net forward power of 3 watts. The temperature of the left gland increased

3°C to approximately 39°C. The thyroxine release rate (TRR) was calculated using the following formula(7):

$$TRR = (T4_V - T4_A)\ (F)\ (H)$$

TRR - thyroxine release rate (ng T4/min)

$T4_V$ - thyroid vein thyroxine concentration (µg T4/ml plasma)

$T4_A$ - femoral artery thyroxine concentration (µg T4/ml plasma)

F - thyroid vein blood flow (ml/min)

H - hematocrit (plasma/whole blood)

This formula takes into consideration any change in blood flow which otherwise might mask or enhance an actual change in the secretory function of the gland. Figure 3b shows a slight elevation of TRR for the microwave heated gland.

Figure 4a shows the recorded temperatures during another experiment in which TSH was administered prior to localized microwave exposure. The left gland showed a significant rise in temperature to approximately 42°C, while the temperature of the right gland remained between 36°C and 37°C. The TRR of the right gland increased during the experiment, a normal response of a thyroid gland to TSH (8). The left gland which was heated with 5 watts of microwave power showed an irregular response during exposure. The TRR of both glands were parallel after the microwave power was turned off.

These results and those obtained from six similar experiments indicate that the secretory output of the thyroid gland can be altered by microwave exposure. However, the temperature of the exposed gland seems to be the factor which determines the degree of effect.

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FIGURE (1)

HHT AXIS ORGANIZATION

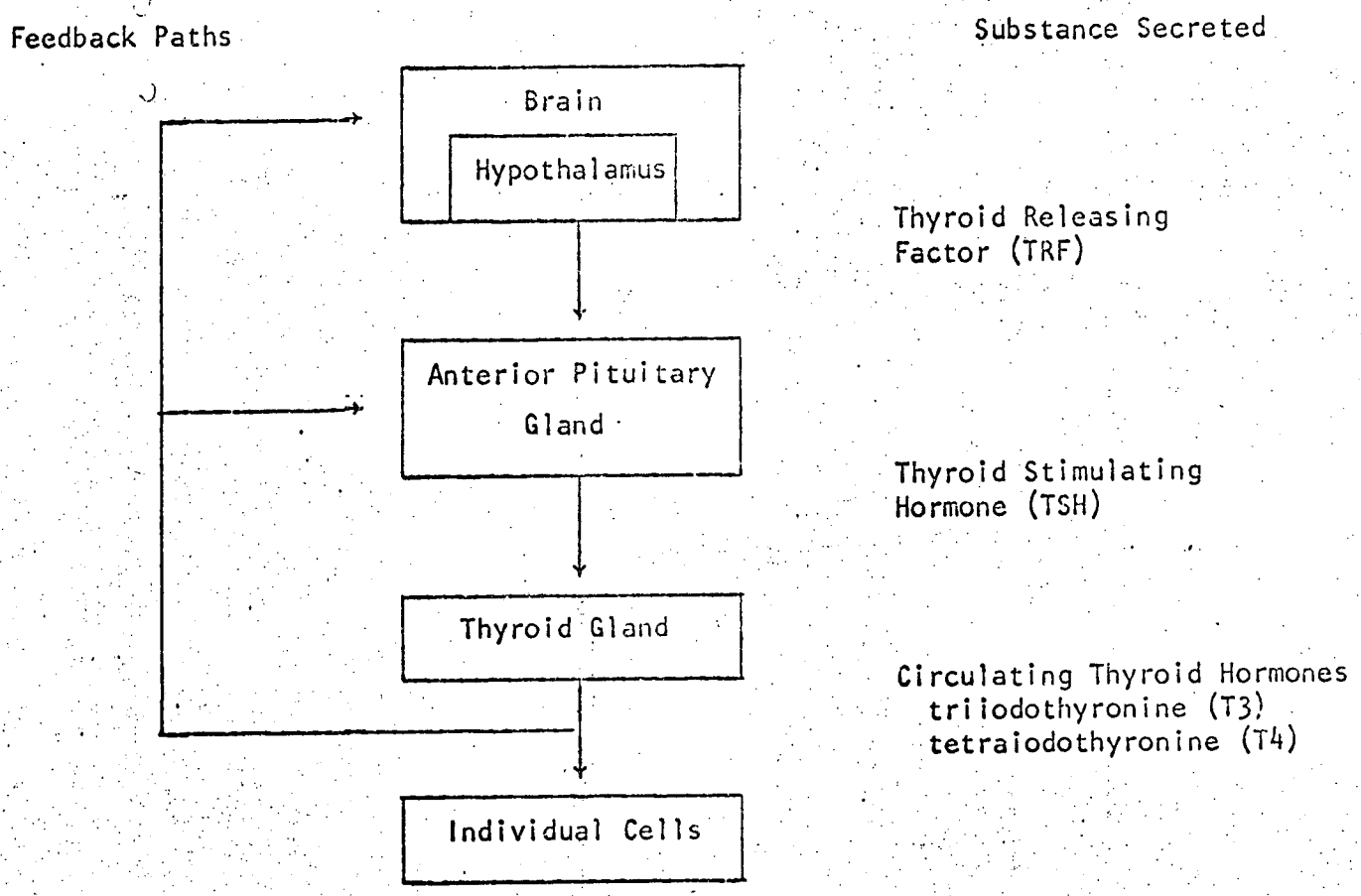
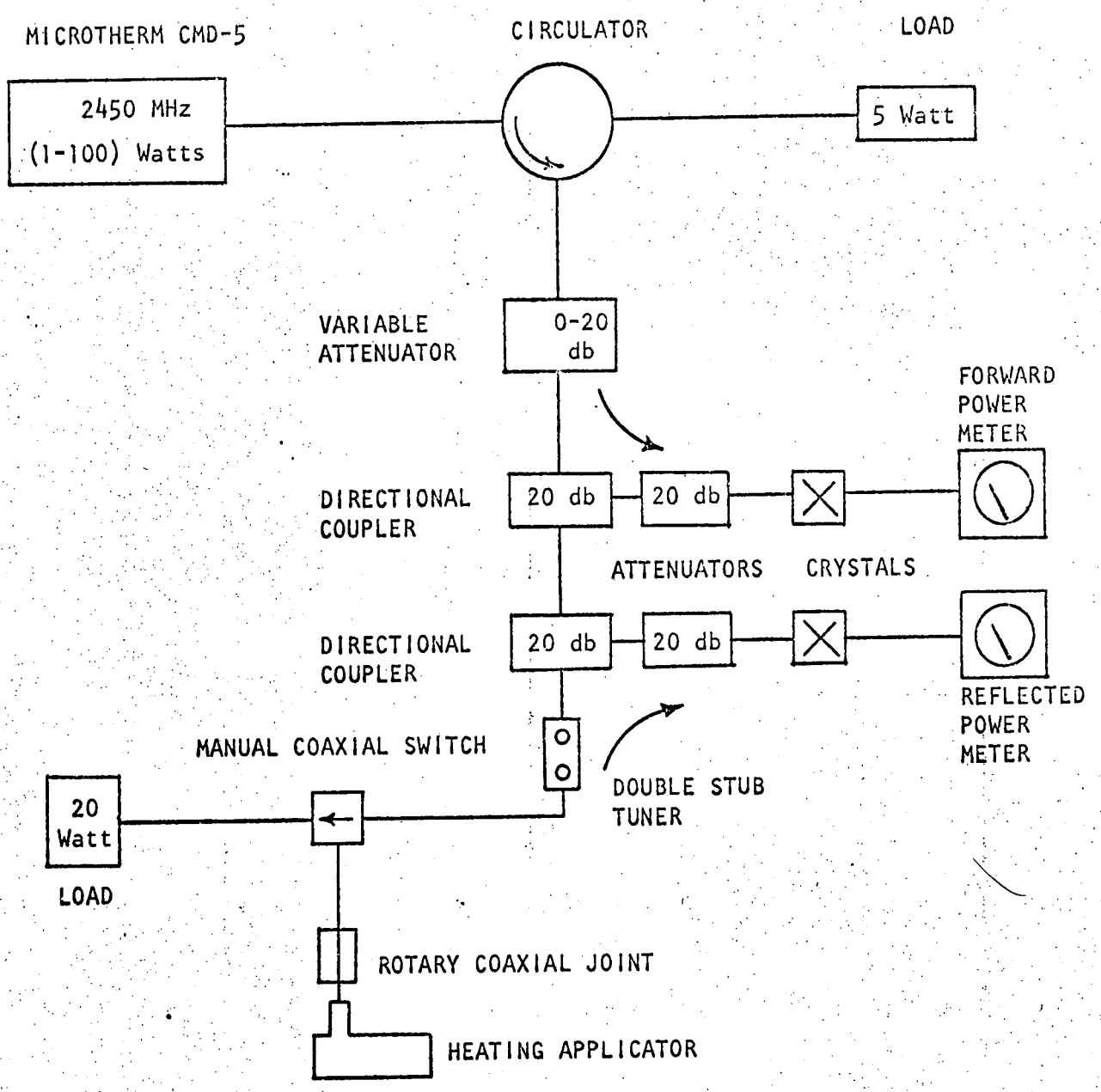


Figure 2



MICROWAVE TRANSMISSION SYSTEM

Figure 3a

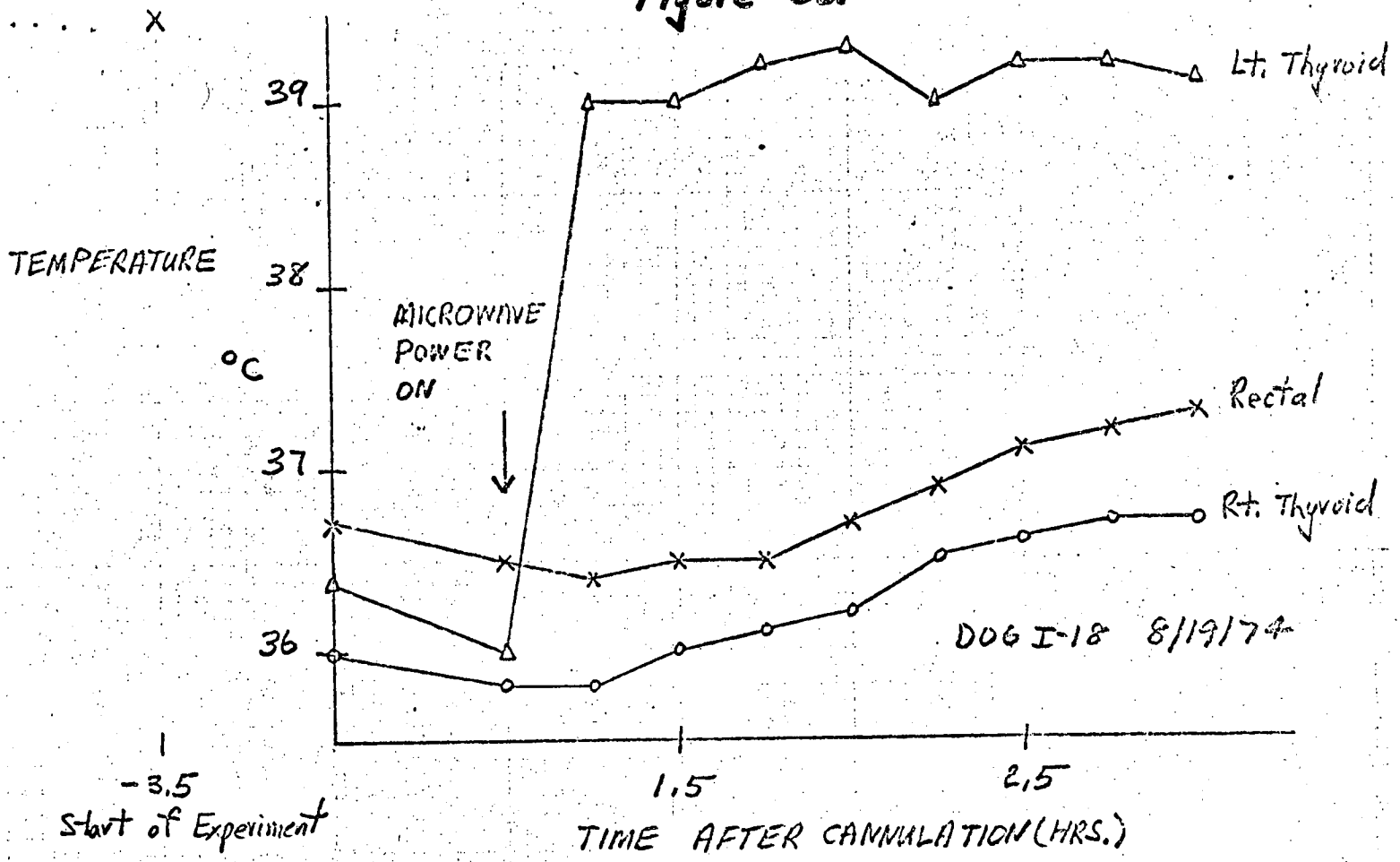
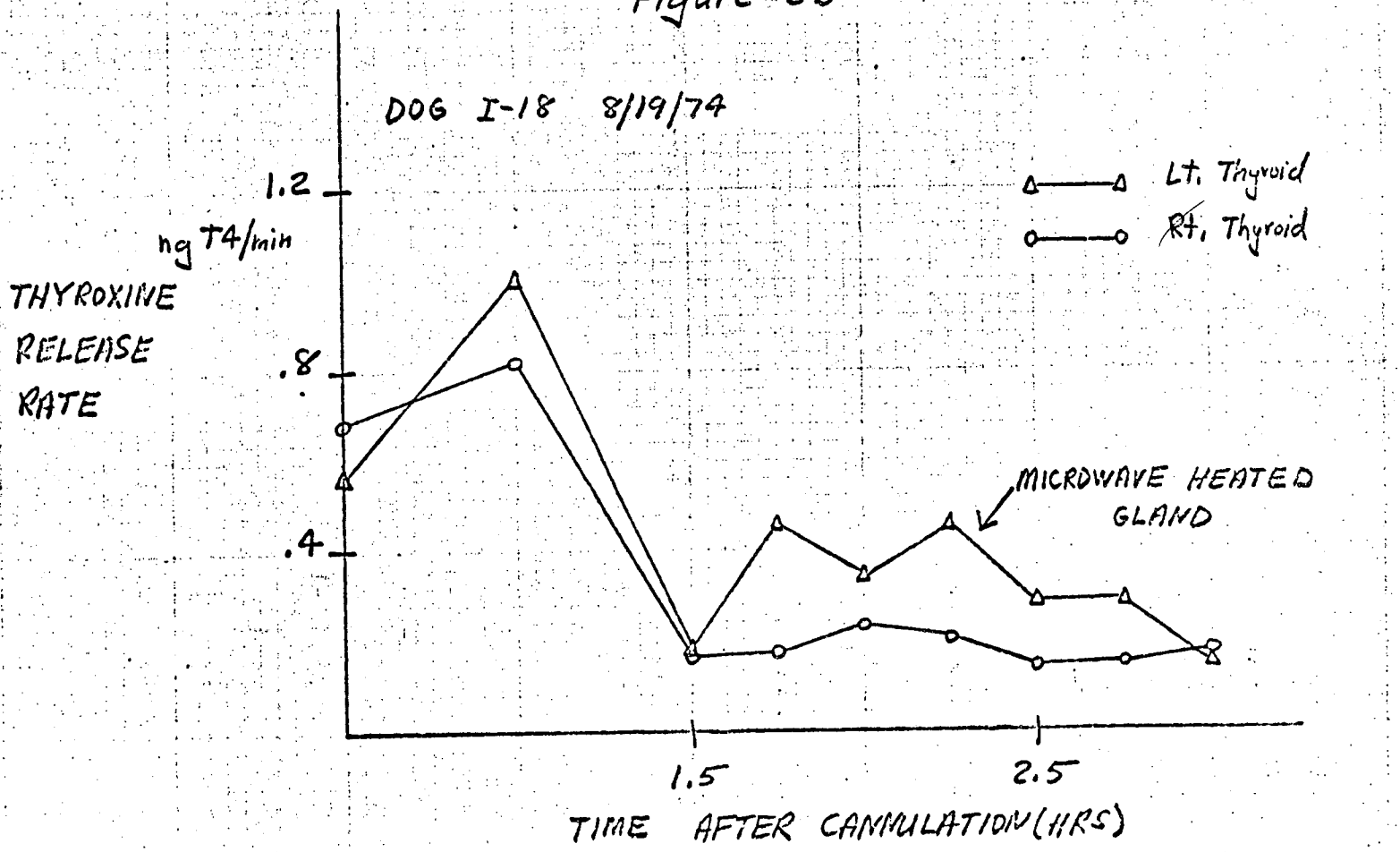


Figure 3b



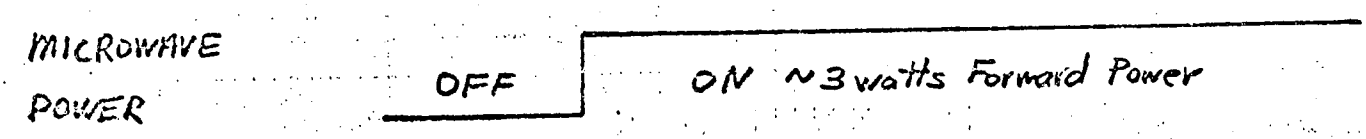


Figure 4a

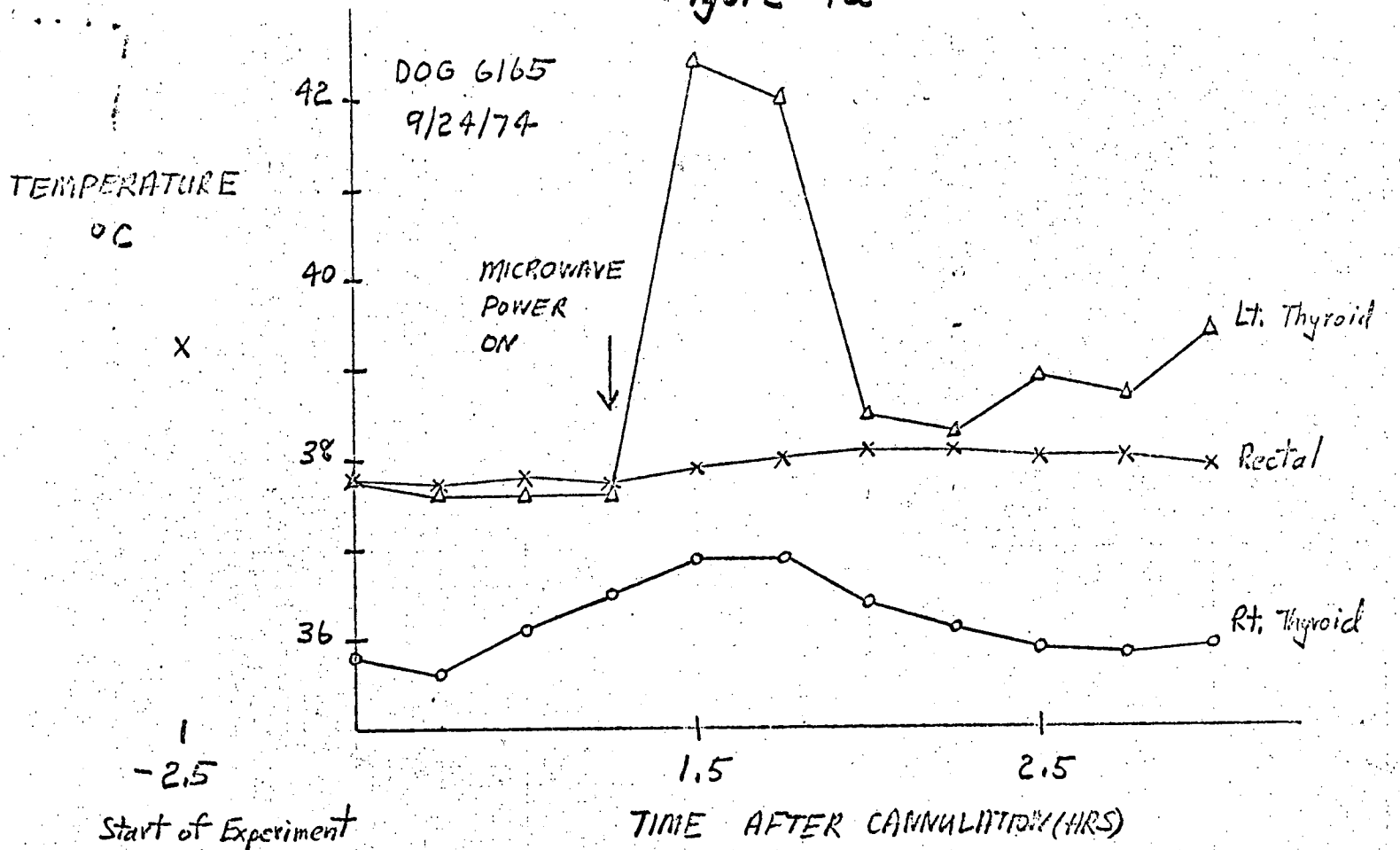


Figure 4b