THE UNIVERSITY OF MANITOBA

THE METABOLIC EFFECTS OF TRANSCENDENTAL MEDITATION

by

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ABBREVIATIONS AND SYMBOLS

BMR	- Basal metabolic rate.
SMR	- Standardised metabolic rate is metabolic rate taking into account age, sex, weight and lean body mass.
SMR^{o}	- Standardised metabolic rate corrected for time of day.
ΔCO_2	- Change in carbon dioxide.
$\dot{V}$	- Ventilation rate (l/min).
$\dot{V}_{CO_2}$	- Rate of carbon dioxide production.
$\dot{V}_D$	- Dead space ventilation rate (L/min).
$\dot{V}_A$	- Alveolar ventilation rate (L/min).
F_{ACO_2}	- Fraction of alveolar carbon dioxide.
f	- Frequency.
P_{ACO_2}	- Partial pressure of alveolar carbon dioxide.
PCO_2	- Partial pressure of carbon dioxide.
mmHg	- Millimeters of mercury.

ABSTRACT

It is now accepted that mental states alter physiological function. The technique of Transcendental Meditation (TM) has been reported to produce a substantial decrease in oxygen consumption during short test periods (Wallace, Benson and Wilson, Am. J. Physiol. 221, 795). We have repeated these experiments using a method designed to reduce interference with the subject's respiration. Seventy-four experiments were run on 15 experienced meditators and a similar series of 41 experiments was made with 14 control subjects. In each case nasal air velocities were measured using heated thermistors, and nasal air was analysed continuously for pCO_2. Each experiment was divided into 3 sections. During the first 20 minutes both groups were instructed to read; during the second period of 20 minutes meditators meditated while the control group sat comfortably and relaxed with closed eyes; during the final 20 minutes both groups were instructed to read. Mean minute volume ($\dot{V}$), minute CO_2 production ($\dot{V}_{CO_2}$), as well as respiratory frequency were computed for each experimental section. Meditation was associated with decreases of 1.5 ± .2 liters/min and 55 ± 8 ml/min in $\dot{V}$ and $\dot{V}_{CO_2}$ respectively (means and S.E. of the means), with no significant change in respiratory frequency. These changes are in the same order of size but slightly larger than those previously reported. However, the tests with non-meditating subjects unexpectedly produced similar results ($\Delta\dot{V}$ 1.3 ± .2 liters/min; $\Delta\dot{V}_{CO_2}$ 59 ± 10 ml/min). We conclude that under the conditions of our experiments, the decrease in metabolic rate achieved by our meditating subjects was not necessarily related to the practice of the technique.

ACKNOWLEDGEMENTS

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TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

1. INTRODUCTION

Various forms of meditation have to date been investigated to examine the practitioner's ability to voluntarily control autonomic functions (Rao, 1968; Vakil, 1950; Wenger and Bagchi, 1961; Wenger, Bagchi, and Anand, 1961; Kasamatsu and Hirai, 1966; Anand, Chhina, and Singh, 1961). Transcendental meditation (TM) (Maharishi Mahesh Yogi, 1966, 1969) has received particular attention in recent years because experimental evidence has indicated that by this technique, which is easily learned and is regularly practiced by many thousands of people in Canada, changes can be produced in a number of physiologic parameters (Allison, 1970; Wallace, 1971). Wallace (1970) reports a mean decrease in oxygen consumption of 45 cm^3/min. during the meditation period as compared to the control period. The extent of the fall in oxygen consumption may have been underestimated due to the invasion of the meditational state by equipment such as a face mask or mouth-piece and nose-clip, by measuring blood pressure and by the presence of a catheter for taking arterial blood samples. If these experimental conditions masked a much greater drop in oxygen consumption than was recorded, our understanding of basal metabolism and the management of common diseases might be affected (Lancet, 1972*). It was therefore felt to be of value to measure the changes in oxygen consumption which accompany TM by a method which would permit meditation to be as free as possible from experimental restrictions. Energy expenditure is usually measured from the amount of oxygen consumed by the body. The rate of energy expenditure depends on a variety of factors and for this reason metabolic rate, for the purpose of

*See editorial The Lancet, May 13, 1972.

comparison, is usually measured under standard conditions, which include being in a quiet room, following at least half an hours rest in the morning, 12 or more hours after eating. Under these conditions, the rate of energy expenditure is known as the basal metabolic rate (BMR). Because standard conditions are required for comparative purposes, an understanding of the factors affecting BMR is essential.

Energy metabolism refers to the chemical processes occurring within the tissues, the integration of which results in the maintenance of body temperature, in growth, in the supply of energy for vital processes and muscular activity. In the absence of growth or physical activity, the energy released in the body eventually appears as heat and the rate of heat production provides an accurate means of measuring basal metabolic rate (calorimetry). The most commonly used method of measurement of overall energy balance in man is indirect calorimetry in which heat production is calculated from the oxygen consumed or carbon-dioxide produced during a given period of time, taking into account the thermal equivalent of a particular respiratory quotient. A portable apparatus of the open-circuit type which enabled the determination of respiratory exchange in humans under a variety of situations was introduced by Nathan Zuntz in 1893, and by 1906, Magnus-Levy, a student of Zuntz, had described basal metabolism as the "energy exchange by which the normal functions of the organs may be maintained when under conditions of the greatest possible relaxation". The well known relationship between surface area and basal metabolism in normal humans stems from the work of F.G. Benedict on "post absorptive metabolism" and that of

DuBois and Rubner in attempting to establish a standard of metabolism. The total heat production of individuals of different size will vary, but the rate of heat production per square meter of surface area in fasting, resting subjects is fairly constant, in the order of 1134 to 1112 Calories in a 24 hour period when age and sex have been taken into consideration. The surface area can be determined by one of several methods. The DuBois and DuBois height-weight formula,

$A = W^{0.425} \times H^{0.725} \times 71.84$ (a constant) where

A = surface area in square centimeters

W = Weight in kilograms

H = Height in centimeters,

and the "linear method" of calculating surface area are most commonly used. In the linear method the body is divided into 7 regions; head, arms, hands, trunk, thighs, legs and feet. Each area is estimated by measuring the length and circumference, multiplying and correcting each part by means of factors, then adding for total surface area.

The development of accurate methods of human indirect calorimetry paved the way for investigation of the factors affecting metabolic rate. These are mainly diet, specific dynamic action (SDA) of food, exercise, hormones, fever, climate, season, and sympathetic stimulation. DuBois (1954) has reviewed the studies which to that date investigate the factors affecting metabolism.

1.1. Factors Affecting Resting Metabolism

1.1.1. Variation due to testing methods

Results in testing basal metabolism can vary 10 - 20% if, as recommended by Boothby et al., (1952), initial readings are not used but rather duplicate readings are repeated on successive days until the second reading does not differ from the first of the day by more than 5%. Roberts and Reid (1952) found that 70% of their subjects had initial readings 10 - 20% lower than their basal readings when tests were repeated in this way. They feel that these lower readings are a result of familiarization with the equipment since they are consistent for each age group. Vogelius (1945) recommended a training period as well, since 20% of his group of subjects aged 7 - 18 years, had difficulty adapting to the testing procedure. He also tested 9 boys, first following a sitting rest period and then following a 4 day hospital bed rest period and found no difference in their basal metabolic rate. Young et al., (1943) observed all academic years over a 4 year period at women's colleges in a study of the effect of selection on the mean metabolism and the variability of basal metabolism. In some instances tests were made on successive days, and in others, 3 tests per morning were made. Indications were that since variations within observations on the same day were small, only one observation per day is necessary. Since variance between days was significant in some individuals and highly significant in others, they concluded that observations on more than one day are necessary to establish a basal metabolic rate.

1.1.2. Seasons and climate

Environmental temperature change accompanying the seasons was found to be a significant factor affecting basal metabolic rate Pittman et al., (1946) in a study of college women in 5 midwestern states over the period of a year. Thompson and Kight (1963) in a study of men and women over the same period of time, found the basal metabolism of women in the summer to be 8.2 percent below that in the winter. In men the seasonal difference was 3.5%.

1.1.3. Race

Race as a variable factor in basal metabolism has not gained support. Rodahl (1952) found Eskimos tested much higher than their white counterparts but when the diet of both groups was kept the same for 4 days, the basal metabolic rates of both groups reached the same levels indicating a dietary rather than racial difference. Quiring (1951) investigated West Indian negroes and New Orleans negroes and found the average heat production rate per square meter of calculated surface area in each group fell within the limits established as normal for the white population of the area.

1.1.4. Age and sex

The B. M. R. declines with age and is slightly lower for females. At age 2 years the average heat production per square meter per hour for females is 52 kilocalories and by age 60 has declined to 32 kilocalories. In males the drop is from 57 to 35 kilocalories per square meter of surface area per hour. Krag and Kountz (1950) exposed subjects between the ages of 57 and 91 years and controls between 22 - 36 years to 5 - 15°C for periods up to 2 hours. Both groups increased their basal oxygen consumption but the older age group were less able to maintain their body temperature in cold environments. This may have been due to an impaired mechanism for prevention of heat loss or due as well to limited further increase in heat production. The same investigators (1952) studied similar younger and older age groups at temperatures from 38 - 45°C. After 60 minutes of exposure, the young group consumed 1290 ccs of oxygen above basal levels and the older group 923 ccs above basal levels. There was a slightly greater mean increase in the young when the rate per square meter of surface per 1.0°C rise in temperature was calculated.

1.1.5. Exercise

Strenuous exercise causes an increase as much as 20 to 50 times the normal resting heat production of the body. Short bursts of maximal contraction of any single muscle liberates 1000 times its resting heat so that any muscle contraction affects metabolic rate. Bahnson et al., (1949) showed that an increase in oxygen consumption occurs with passive limb movements almost equivalent to active unresisted exercise at the same rate. The increase during passive movements is thought to be due to activation of stretch receptors which reflexly increase muscle tone since the oxygen consumption increase did not occur when the blood supply was intact and the nerve supply was not but did occur with an intact nerve supply and an occluded blood supply. In an extensive study of recovery curves of CO_2 elimination and O_2 consumption after moderate exercise Berg (1947) found that gaseous exchange returned to pre-exercise resting levels within 10 minutes but in any age group the more physically fit tended to require less time to return to pre-exercise levels. The work of Crescitelli and Taylor (1944) examines blood and urine lactate in a group of young men in various states of fitness in response to 15 minutes submaximal treadmill walking at 100 meters/ min. on a 15% grade. Blood lactate rose rapidly at the beginning of exercise, reached a peak and then declined along a curve in which the rate of decrease is a function of the time after cessation of exercise. 60 - 90 minutes were required for blood lactate levels to return to pre-exercise levels in the fit and unfit categories. Less fit individuals appeared to give a significantly greater lactate response to the exercise than fit individuals.

1.1.6. Specific dynamic action

After food is absorbed the metabolic activities of the body are stimulated and heat production increases. The increase in energy output of an individual following ingestion of the food needed to maintain basal conditions is termed the specific dynamic action of food (S. D. A.) and varies with the type and amount of food taken; for proteins it is about 30% of the basal metabolism, and for fats and carbohydrates about 5%. The heat production begins to rise within an hour of eating and remains above the basal level for several hours. The results of Buskirk et al., (1957) show a 12% total increase in basal metabolism when fasting individuals were measured at 4 hour intervals throughout the day. Peak rates of oxygen consumption associated with S. D. A. in the resting subject can amount to 1.5 to 2.0 times basal rates of oxygen consumption. After a small (1000 cal.), high-protein meal, the maximum rate of extra calorie production (Glickman et al., 1948) is 33 cal. per hour, deoreasing in about 6 hours to 12 calories per hour. The total effect of S. D. A. of a high protein meal is considered to continue for 16 hours and a high carbohydrate meal for 12 hours.

1.1.7. Endocrine effects

Means (1951) in his review of the integrative action of the endocrine system observed that the endocrine glands are in balance with one another. Removing one of them or giving an excess of one of the hormones will unbalance the whole system. Although a number of these hormones influence energy metabolism, the effect is one of interrelationship with the other hormones and particularly with those of a normally functioning thyroid gland. Thyroxin affects the basic metabolism of most body tissues. The basal metabolic rate can increase as much as 100% when large quantities of thyroxin are secreted and complete lack of thyroid secretion can cause a drop of 50% in basal metabolism. Thyroid hormone is necessary for cell protein anabolism and catabolism and therefore necessary for growth. Growth hormone is not effective in the absence of thyroxin. In normal rats (Hoch, 1965 a, b) growth hormone has been found to increase normal metabolic rate by 60% and in obese women (Bray, 1969) growth hormone raised the metabolic rate 10 - 20%. The calorigenic action of glucagon does not occur in thyroidectomized rats. A maximum effect of 50% increase of the B. M. R. was found to be linearly related to the dose (Davidson et al., 1960), with a reduction in effect apparent as environmental temperature was decreased (Holloway and Stevenson, 1964). The effect of both adrenalin and glucagon is greatly reduced following adrenalectomy, but it is gradually recovered and even potentiated by treating the rats with cortisone suggesting the adrenal cortex plays a role in respiratory metabolism (Swanson, 1956). The adrenalglucocorticoids increase the metabolic rate of patients with hypothyroidism

(Beierwaltes et al., 1950). Adrenalectomy of the previously thyroidectomized rats decreases metabolic rate by 20% while administering cortical extracts restores the metabolic rate to hypothyroid levels (Hoffman et al., 1948) without showing an increase in I^{131} uptake (Beierwaltes, 1950).

1.1.8. Sleep

Metabolic rate decreases during sleep and the amount of decrease reported varies between 10 - 20%. The reason for this variation is explained by the experimental work of Brebbia (1965) in which he relates oxygen consumption with electroencephalographic (E. E. G.) stage of sleep. He found the highest rate of consumption during Stage I Rapid Eye Movement (R. E. M.) sleep, but the rate of oxygen consumption was greater during periods of wakefulness than in any stage of sleep. While differences in rate of oxygen consumption paralleled the level of sleep as defined by E. E. G., the differences were small though statistically significant. Early morning $\dot{V}O_2$ values prior to wakening (Buskirk et al., 1965) range from 0 - 15% less than the basal values measured thirty minutes later. Robin et al., 1958 reported a mean decrease of 2.15 l/min. in total ventilation, 1.66 l/min. in alveolar ventilation, 57 ml/min. in O_2 consumption, and 79 ml/min. in CO_2 production during sleep after 1 hour of sleep.

1.1.9. Hypnosis

Jana (1965) found the metabolic rate of subjects during sleep lowered from 7 - 10% of basal waking values but the metabolic rate during hypnosis in which sleep was suggested did not change from waking basal values. Dynes (1947) in his study of sleep and hypnosis indicated also that there is no destinctive difference between E. E. G. tracings of cortical activity in hypnosis or in the normal waking state and that the cortical electrical activity of a person in a hypnotic trance bears no resemblance to E.E.G. tracings of a sleeping person. Schneck (1963) comments on the conflicting reports of the effects of neutral hypnosis on B.M.R., pointing out that the inconsistencies found may be related to problems in method. The first essential in testing the effect of hypnosis is a completely relaxed control baseline and the second is to be certain the subject has not fallen asleep when the hypnotic effects are measured. He cites von Eiff (1950) as reporting a 7% decrease in B.M.R. during hypnosis. Goldwyn (1930) found the B.M.R. reduced from .6 - 8.3%, an average of 3.88%, in subjects under hypnotic suggestion tending to produce physical and mental inactivity.

1.1.10. Meditation

Voluntary control of metabolic rate was demonstrated by a practitioner of Yoga on two separate occasions (Anand, 1961). Shri Romanand Yogi remained in an airtight box for 8 hours and again for 10 hours. During the 10 hour experiment his O_2 consumption averaged 13.3 l/hr. as opposed to a basal rate of 19.5 l/hr . before the experiment. Wallace et al.,(1970, 1971) suggest a type of hypometabolic state in an experiment in which 15 subjects acting as their own controls during Transcendental Meditation (TM) were able to reduce oxygen consumption by 17% from a sitting, resting level. Carbon-dioxide production and respiration frequency were also reduced though the arterial partial pressures of CO_2 and O_2 showed no significant change during meditation. The mean blood lactate concentration decreased during meditation and continued to decrease for a post meditation period. This decrease in blood lactate is consistent with findings (Levander et al., 1972) of increased forearm blood flow on days when TM was practised, suggesting a decrease in arteriolar sympathetic activity.

2. METHODS

2.1 General Principle

Seventy-four experiments were run on 15 meditators, 14 males and 1 female with experience ranging from 1 month to 6 years. The ages of the meditating subjects ranged from 18-28 years. They were chosen by a teacher of transcendental meditation on the basis of their willingness to participate in the study.

Fourty-four experiments were run on 14 control subjects, 8 males, 6 females aged 21-47 years. These subjects were chosen from hospital, university personnel and students. Four were physical education staff members; 3 were physiotherapists, 4 were university students and 3 university staff members.

Each experiment was divided into 3 sections: a control period (the first experimental period), a period of meditation or relaxation in the case of the control subjects (the second experimental period) and a second control period (third experimental period). The subject was provided with a stopwatch and instructed to note the exact length of each period. In this way interruption was avoided after the subject had entered the isolated booth in which the experiments were carried out. It was suggested that each experimental session extend over a minimum of sixty minutes divided into 3 periods of equal length. However, it was impressed on each subject that he would not be interrupted until he left the booth. The meditation and control periods varied in length from 15 to 25 minutes. During the first experimental period the subjects were asked to read, during the second experimental period meditators meditated and control subjects sat comfortably relaxed with eyes closed, during the third experimental period all subjects were again asked to read. During each experiment nasal air velocities from both nostrils were measured using two hot thermistor spirometers and in 15 experiments nasal air was measured continuously for % end tidal CO_2 with an infra red analyser (Capnograph).

2.2. Method of Calculating CO_2 Output

Given the available data it was possible to calculate minute CO_2 outputs as follows:

All CO_2 in expired air is assumed to be produced in body metabolism. The assumed V_{CO_2} is thus equal to $F_{ACO_2} \times \dot{V}A = \dot{V}_{CO_2}$.

The A_{CO_2} can be measured from the estimation of the end tidal CO_2 and $\dot{V}_A = \dot{V}-\dot{V}_D$. Collier et al, (1955) found that analysis of end tidal CO_2 with an infra red analyser gave calculated arterial pCO_2's with a mean deviation of only .9 mmHg from the measured values over a range from 15 to 40 mmHg. They also found that measurable contamination of the end tidal sample with deadspace air began to occur when the tidal volume fell to below 350-400 ml in subjects showing a constant $\dot{V}_{CO_2}$. Only rarely did the tidal volume of our subjects fall into this range, and it will be shown (section 4.3.1.) that omission of experiments where this occurred from the pooled results does not affect the conclusions to be drawn from the data.

Following the work of Radford (1955) we have taken the deadspace volume to equal weight in pounds.

Therefore: $\dot{V} = \dot{V}_A + \dot{V}_D$

$= \dot{V}_A + (f \times \text{wt in lbs})$

and $\dot{V}_{CO_2} = F_{ACO_2}\ (\dot{V}-\dot{V}_D)$

$\approx .05\ [\dot{V} - (f \times \text{deadspace})]$

In only 15 experiments was end tidal CO_2 tested. In the remaining experiments 5% end tidal CO_2 was assumed. (See Results, 3.2.2.)

2.3. The Hot Thermistor Flowmeter

The circuit used for controlling the temperature of the thermistors was devised by Mr. H. Spencer (Fig. 1). The 2 microbead thermistors (STC μ23) used (one for each nostril) were maintained by the circuit at 200°C. The response of an individual thermistor in the circuit to air flow is shown in Figure 2. The response of the circuit is a power function of the velocity and was linearised as described below.

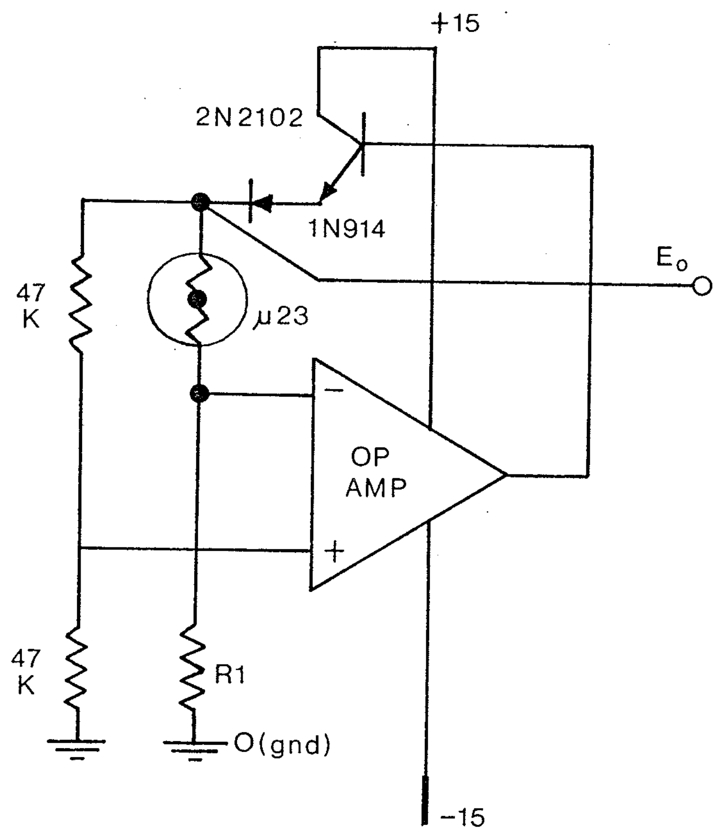
2.4. Linearisation and Recording

A schematic diagram of the experimental arrangement (Fig. 3) shows the two thermistors at extreme left. The thermistor circuits described above are labelled 'f', and the outputs of these (eo) are linearised using operational amplifiers (Nexus) by forming the function.

$$[\text{Antilog}\ \ (\log_{eo}) \div \beta]$$

(That this is a linear function of air flow is shown in the next section.)

The two linearised outputs were then summed and the analog "total velocity" signal was fed into a voltage controlled oscillator (VCO) set to generate 10 μsec pulses at a rate determined by the



THERMISTOR SPIROMETER

Figure 1. Circuit for controlling the temperature of the thermistors. R1 is equal to the resistance of the thermistor bead at 200^{0}C (approximately 50Ω).

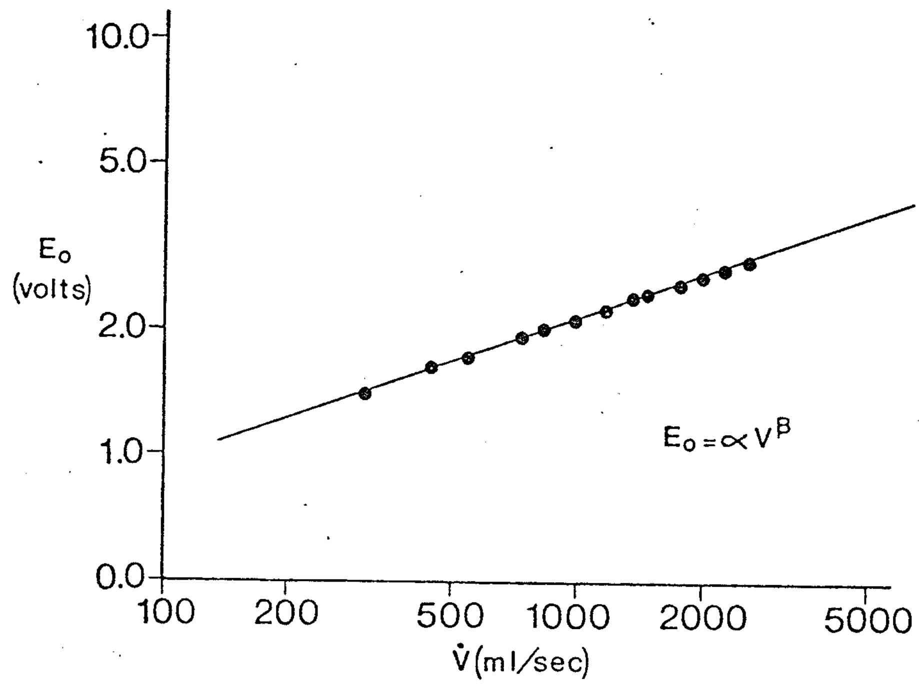


Figure 2. Individual thermistor circuit response to air flow.

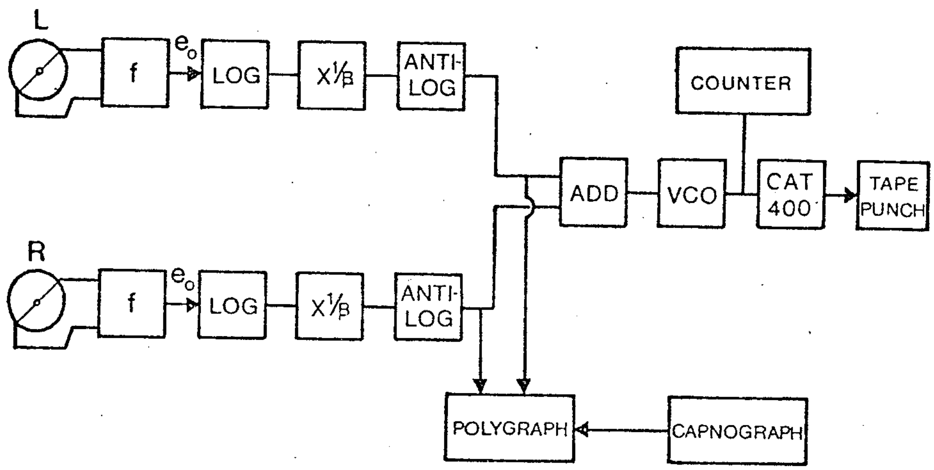


Figure 3. Schematic diagram of experimental set-up. 'L' - Left thermistor, 'R' - Right thermistor, 'f' - thermistor circuit.

input voltage. The pulses generated by the VCO were accumulated over successive 1 minute periods in consecutive addresses of CAT400 computer of Average Transients. These data were later transferred to punched paper tape for subsequent computer analysis. The outputs of the antilog elements and the output of the capnograph (in the experiments where it was used) were recorded on a Gilson ink writing recorder at a paper speed of 1 mm/sec.

The computer was used to subtract the baseline (zero air velocity) count from the data, to find the mean minute volume in the first and second experimental periods and to plot the data in standard format on a Calcomp plotter.

2.5. Calibrations

The thermistor probes were calibrated at intervals throughout the duration of the experiments (February to July, 1973) by a number of different methods.

(a) In line calibrations between a gas cylinder and Collins respirometer.

Figure 4 shows that the sensitivity of the sensors did not change with an increasing air flow rate.

(b) This method used a human subject with a nose clip breathing through a two way valve. On one side of the valve the probes were connected (usually in parallel), while the other side was attached to the Collins respirometer. The subject was allowed to breathe in from the respirometer and out through the sensors or vice versa for about 1 minute. The air speed through the sensors could be voluntarily controlled by the subject as he watched the output which was displayed

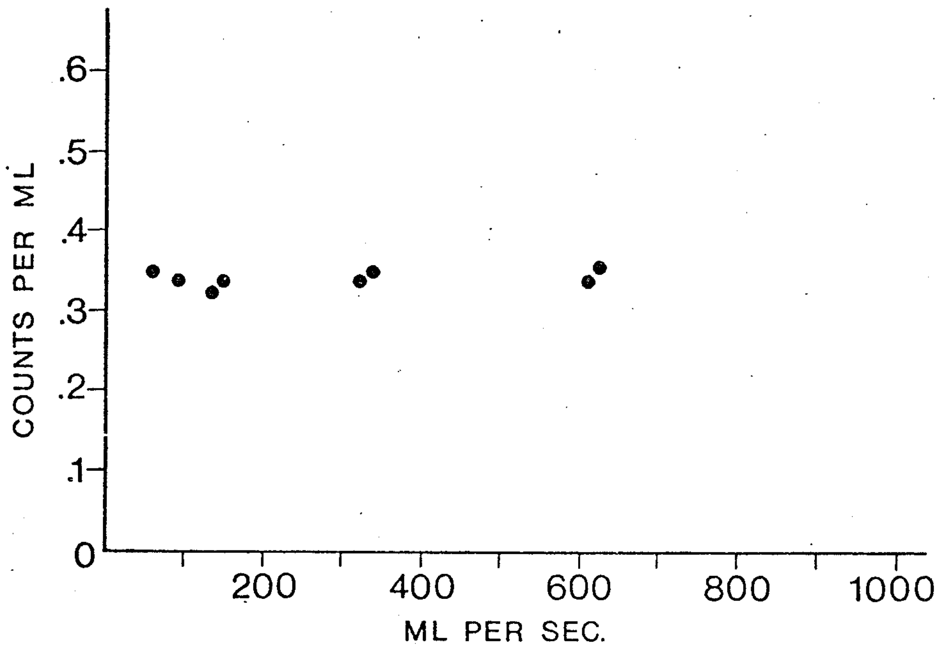


Figure 4. Calibration (12.3.73) shows no change in sensor sensitivity with an increasing rate of air flow.

on a CRT. The results of these calibrations are as follows:

In-flow through the sensor .396 ct/ml ± .008 S.E. of the mean.

Out-flow through the sensor .354 ct/ml ± .006 S.E. of the mean.

The small increase in sensitivity accompanying inward flow could be removed by adding 1 cm long cardboard extensors. The majority of experiments reported were carried out with these extensors.

(c) Flowmeter calibrations

In these calibrations a Fischer Flowmeter measured the oxygen flow rate before passing through a sensor. The results obtained in this way for the two sensors separately are shown in Fig. 5. The solid line shows the predicted relationship from the results of method 'a'.

It will be seen that the results of these different methods of calibration carried out at different times during the project agree very well. In the computer calculation of minute volume, the sensor sensitivity is taken as .35 ct/ml ATPS.

(d) Closed Circuit Spirometer Tests

After completion of the usual experimental procedure, in six cases, subjects were tested with a closed circuit Collins spirometer using a mouth piece and nose clip (Table 1). The CO_2 and minute volume were calculated over a 10 minute test period. The larger minute volume in every case is thought to be due to mouth breathing and the subjects response to the resistance of the equipment.

The agreement between the calculated and measured CO_2 output is acceptable, especially since the two estimates were obtained at least an hour apart.

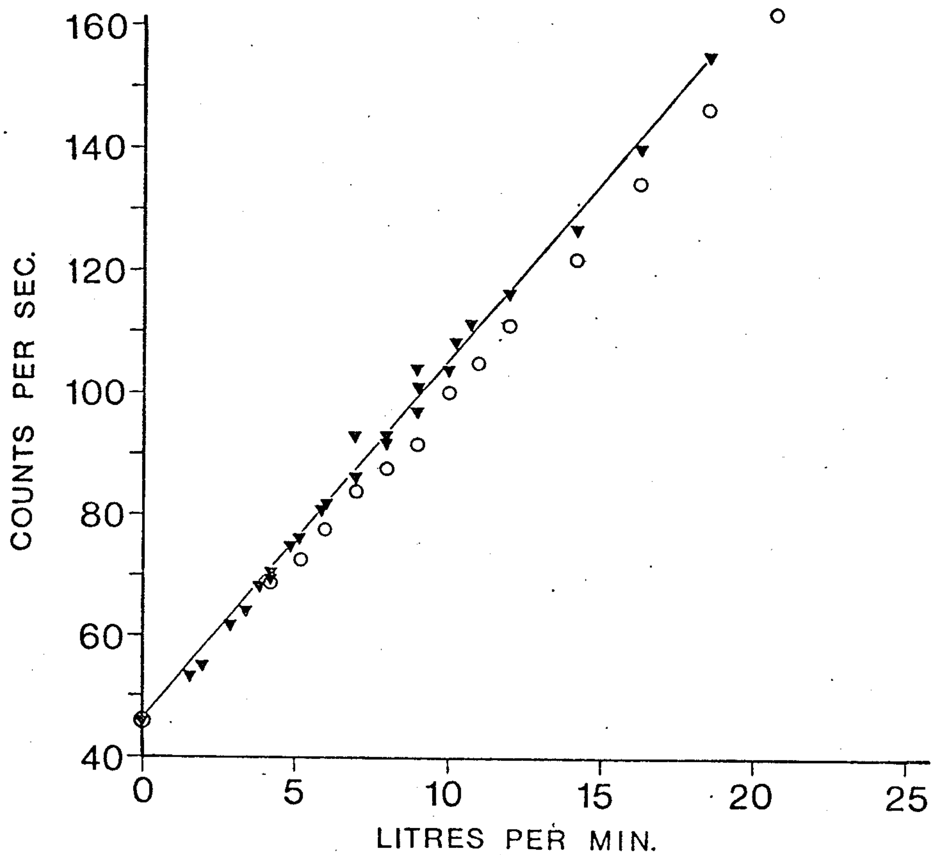


Figure 5. Counts per second are plotted against rate of air flow for left and right o sensors (15 May 1973). The line indicates the predicted line from figure 4.

Table 1. Comparison of minute volumes using thermistors and a spirometer.

Subject and Run No.		1st experimental period min. vol.	1st experimental period CO_2	spirometer min. vol.	spirometer CO_2
5	1	5,831	176	9,200	204
13	1	7,427	264	12,300	230
7	5	7,207	251	11,000	209
2	4	9,175	336	12,800	308
3	3	7,270	228	7,650	211
6	5	6,307	210	8,660	232
	Means:	7,203	244	10,268	232

2.6. Stored Data and Statistics

All meditating subjects but 1 were tested 5 times and all control subjects but 1 were tested 3 times. After each run, mean minute volume, breathing frequency and rate of CO_2 production and extra data from a questionnaire (Appendix 1) were stored on magnetic disk in the IBM360 using the APL language. A printout of the complete files for meditating and control subjects is shown in Appendix 2.

This method of storage and the use of APL made it easy to perform single descriptive and comparative statistics on the data.

3. RESULTS

3.1. First Experimental Period

(a) Meditating Subjects

For 73 experiments with 15 meditators the average CO_2 production in the first experimental period was calculated as 311.5 ± 28 S.E. of the mean ml/min (ATPS). A BMR for each subject was assumed from tables (Passmore 1966, R.Q. taken as .85) which give the average BMR for the general population. These tables take into account weight, lean body mass, age and sex. An approximate correction for these factors was therefore made by expressing the calculated CO_2 output as a fraction of the 'basal' CO_2 output obtained from the tables. The mean 'standardised' metabolic rate (SMR) found in this way was 1.38 ± .05 (S.E. of the mean, n = 73). A linear multiple regression analysis showed that of the factors recorded (Appendix 1) only "time of day" was significantly correlated with SMR at the 5% level (r = .21). The "time since last meditated" and "time since the last meal" were also correlated with "time of day" and the multiple regression coefficient was not improved by inclusion of these factors. It was possible to correct for the effect of "time of day" on SMR by the use of the multiple regression equation:

$SMR^o = SMR - .03 \times$ "time of day",

After applying this correction,

$SMR^o = .96 \pm .04$ S.E. of the mean

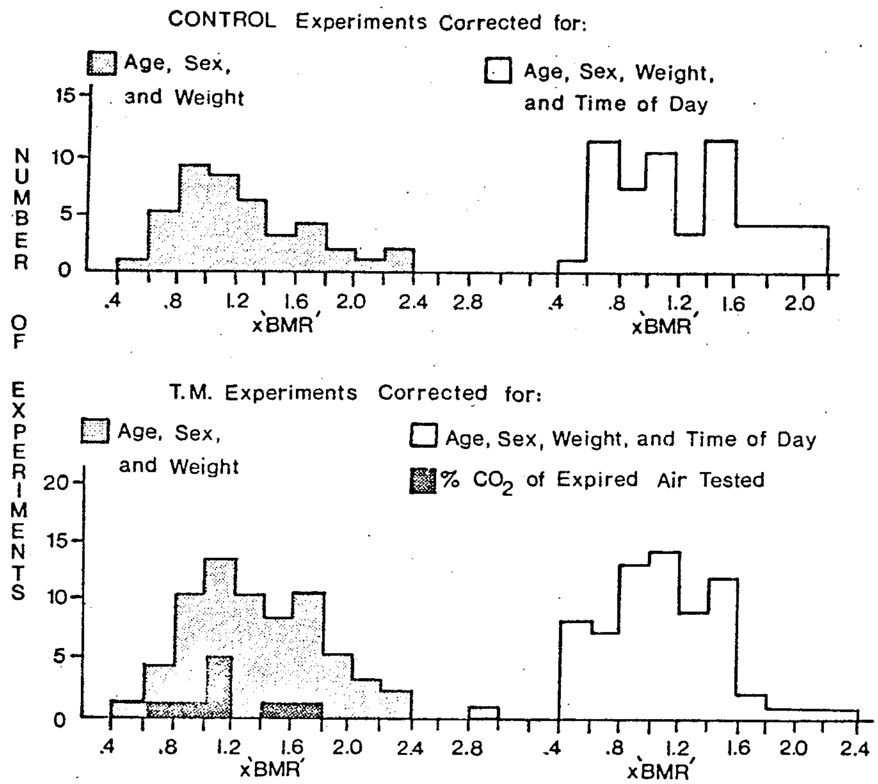


Figure 6. Shows the effect of correcting the metabolic rate of meditating and control subjects for the effect of "Time of Day". The black inset in the T.M. experiments represents those for which end tidal CO_2 was tested.

This correction must be considered arbitrary since the very considerable scatter doubtless indicates many uncontrolled factors were in operation in these experiments (Fig. 6).

(b) Non-meditators

The corresponding results of the first experimental period measurements in 41 experiments with control subjects were:

$\dot{V}_{CO_2}$ = 289 ± 15 ml/min S.E. of mean

SMR = 1.26 ± .07 S.E. of mean

SMR^{o} = 0.97 ± .16 S.E. of mean

The SMR values for meditators and controls were not significantly different at the 5% level. The increase in SMR found with time of day can be accounted for by the cumulated SDA and diurnal effects described by Glickman et al (1948) and Buskirk et al (1957).

3.2. Source of Error

3.2.1. Of course the process of dividing by an average BMR will itself introduce some scatter into calculated SMRs. According to Robertson and Reid (1952) the SD of distribution of the population BMRs about the mean is approximately 7% of the mean.

3.2.2. Another source of error is the assumption for most subjects of an end tidal CO_2 value of 5%. From the normal range of variation of 2% in P_{ACO_2} given by Rahn (1954), this can be taken as negligible.

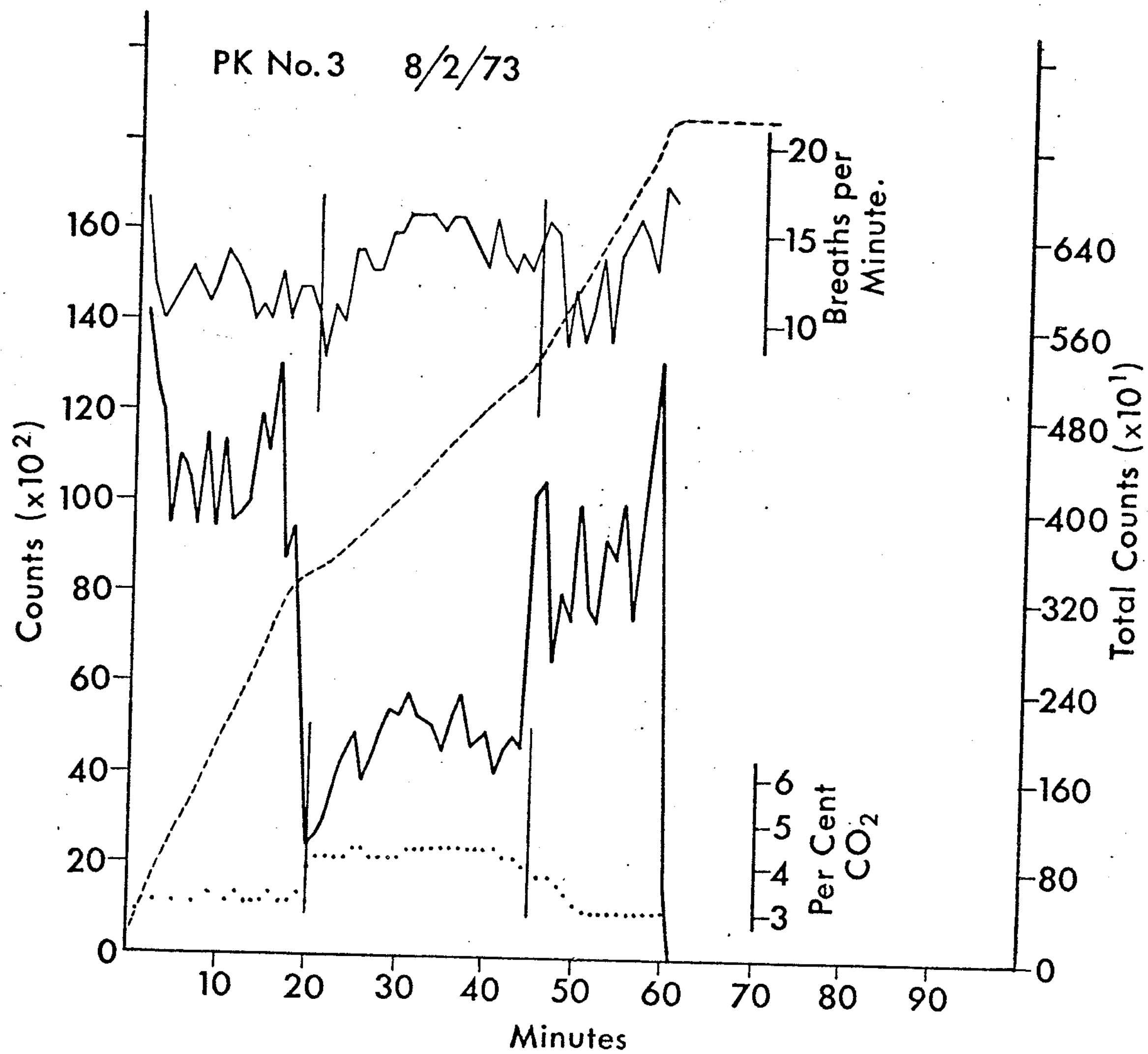


Figure 7. Record of an experiment with a meditating subject.

Top trace - Breathing frequency.

Middle trace - Minute volume (arbit units).

Lower row of dots - % CO_2 (end-expired).

Diagonal line - Accumulated total ventilation (arbit units).

Vertical line - Beginning and end of meditation.

This is only true if the end tidal CO_2 is equal to the alveolar CO_2 concentration. That this is not always the case is shown by the example of PK, one of the meditating subjects whose end tidal pCO_2 was consistently lower than normal during the first experimental period and increased significantly during meditation (Fig. 7). If we assume the end tidal CO_2 to be 5% for this subject, then we seriously overestimate the metabolic rate.

3.2.3. Muscular exertion is considered to be a major factor in determining the level of metabolism for a period up to 1 hour following exercise (Crescitelli and Taylor 1944). The effect of recent exercise was not allowed for in our experiments and could be the cause of some of the variation in metabolic rate found between the subjects and amongst individual tests.

3.3. Comparison of the results with resting metabolism figures in the literature.

The mean SMR for all our subjects in the first experimental periods of all runs is 1.34. Since the SMR measurements were made while our subjects were sitting resting, it is not appropriate to compare $\dot{V}_{CO_2}$ with that of subjects in the supine position required for BMR measurements. This point has often been overlooked by other workers (e.g. Wallace 1970). Some data for sitting subjects are given by Passmore, Thompson and Warnock (1952) from which it appears that sitting comfortably under conditions similar to those in our experiments, raises metabolic rate from BMR to about 1.5 times basal. In view of this, a t-test was carried out on the pooled data for the first experimental period given the null hypothesis that SMR is not significantly different from 1.5. Our mean SMR was found to be significantly less at the 1% confidence level. The reason for this difference is not clear.

3.4. Second Experimental Period

The change in SMR from first experimental period to the second in meditating subjects was from 1.38 ± .05 to 1.09 ± .05 (means and S.E. of means). The change in the control group was from 1.26 ± .07 to 1.02 ± .07 (means and S.E. of the means). The difference between the two groups was not significant at the 5% level. In both groups the metabolic rate of the second experimental period correlated significantly with that of the first period at the .1% level (Fig. 8 and 9).

3.4.1. Mean respiration rates for meditating and control subjects were reduced by .8 ± .1 and 1.73 ± .1 breaths/min (means and S.E. of the means) respectively during the second experimental period. Since these changes in respiration rates are very small (6-10%), the observed mean decrease in minute volume of 1463 ± 151 (S.E. of the mean) cc must be accounted for by a decrease in tidal volume.

3.4.2. The metabolic rate increased in 4 experiments in meditating subjects during the second experimental period. In 2 experiments the metabolic rate remained the same, and in the remaining experiments there was decrease (Fig. 8). The equivalent data for the control subjects shows similar results in Figure 9. The correlation of the metabolic rates of the first and second experimental period are significant at the .1% level. There was no significant difference found between the 15 results in which end tidal CO_2 was tested and the results in which 5% end tidal CO_2 was assumed.

3.5. <u>Possible Factors Affecting the Differences Between the First and Second Experimental Period.</u>

A record was kept of factors which might have an effect on the ΔMR and $\Delta\dot{V}$ during the second experimental period. The following of these factors were analysed.

1. Time Since Last Meal
2. Time of Day
3. Time Since Last Meditation
4. Regularity of Meditation
5. Effect of Falling Asleep
6. Subjective Evaluation

3.5.1. <u>Effect of Time Since Last Meal</u>

The time since last meal was not significantly correlated with either $\Delta\dot{V}$ or ΔSMR between the first and second experimental period in the control or meditating subjects.

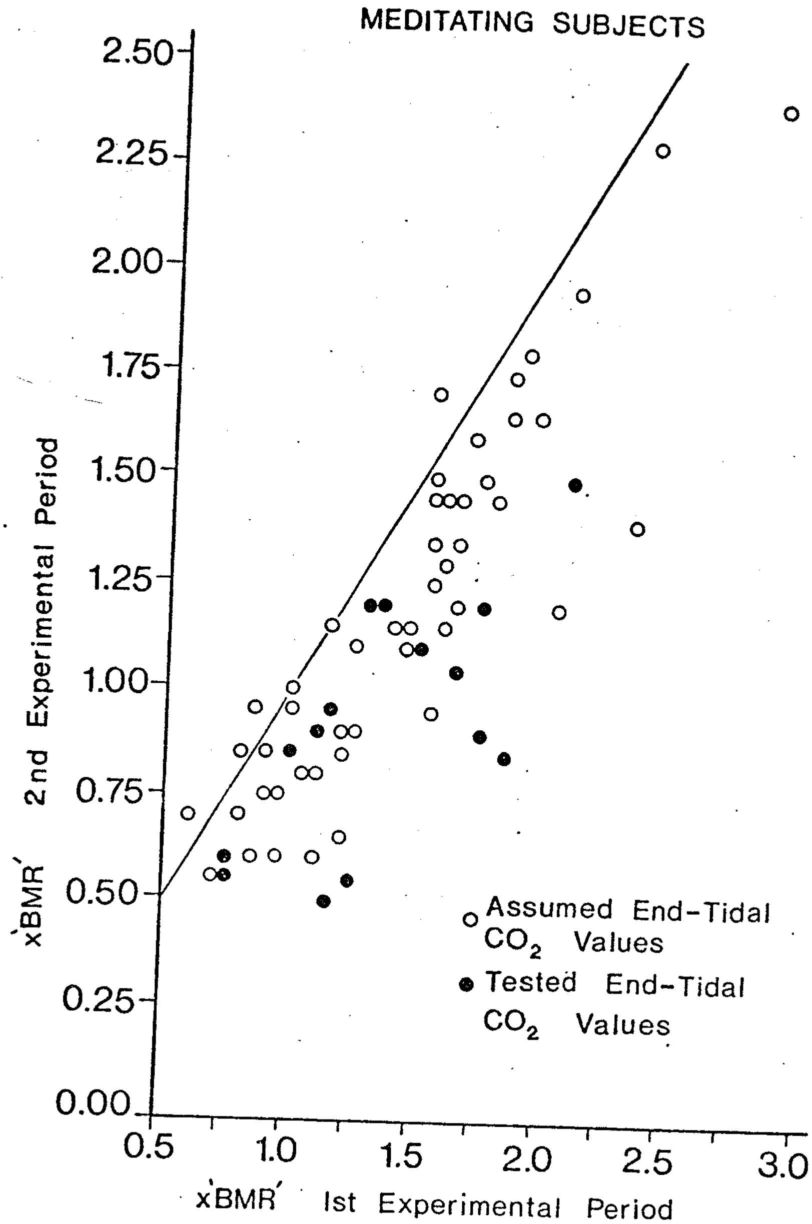


Figure 8. The MR of meditating subjects in the second experimental period is plotted against their MR in the first experimental period. The filled dots represent the experiments in which end tidal CO_2 was tested. The diagonal line is the line of identity.

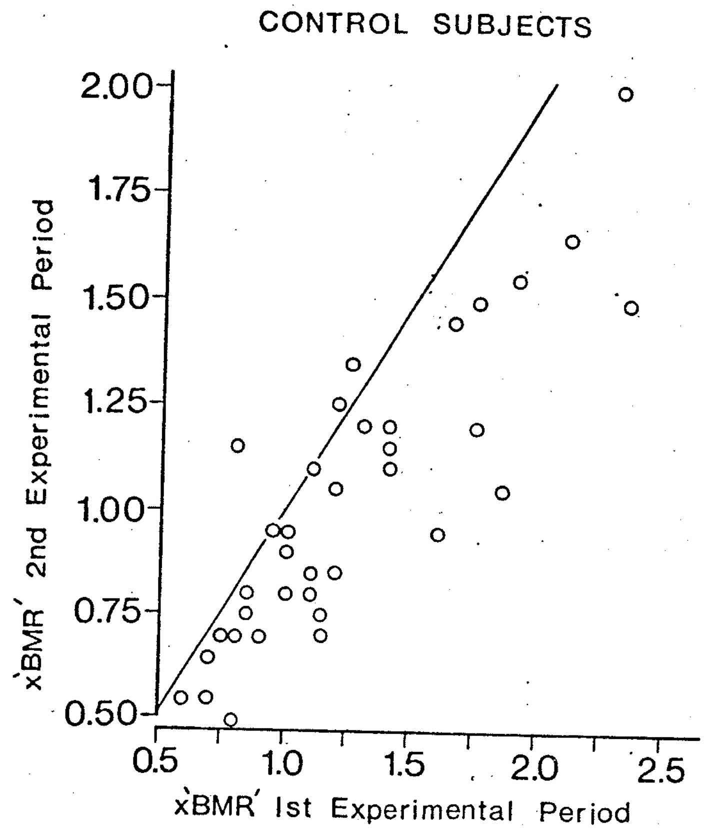


Figure 9. The MR of control subjects in the second experimental period is plotted against their MR in the first experimental period. The diagonal line is the line of identity.

3.5.2. Effect of Time of Day

Time of day was found not to have an effect on either $\Delta\dot{V}$ or ΔSMR from the first to the second experimental period in the control or meditating subjects.

3.5.3. Effect of Time Since Last Meditation

This was found not to correlate with either $\Delta\dot{V}$ or ΔSMR between the first and second experimental period.

3.5.4. Effect of Regularity of Meditation

Since the subjects tested meditated regularly, it was not possible to evaluate $\Delta\dot{V}$ or ΔSMR due to regularity of meditation.

3.5.5. Effect of Falling Asleep

One subject fell asleep in 4 experiments, 2 subjects fell asleep in 3 experiments, and 1 subject fell asleep in 1 experiment. The $\Delta\dot{V}$ during these runs was 77 cc/min. The mean $\Delta\dot{V}$ of the remaining 9 runs of the same subject was not significantly different at 88 cc/min.

3.5.6. Subjective Evaluations

The $\Delta\dot{V}$ and SMR in the 50 tests during which subjects stated that "meditation went normally as at home" was 800 ± 5 cc and .7 ± .3 times basal (means and S.E. of means) respectively. The $\Delta\dot{V}$ and SMR in 23 tests during which meditation did not go normally was 780 ± 2 cc and .6 ± .3 times basal (means and S.E. of the means) respectively. There was no correlation between the subjective assessment of an experiment and the $\Delta\dot{V}$ or SMR.

3.6. Third Experimental Period

The mean SMR in the third experimental period was 1.24 ± .05 (S.E. of the mean) for the meditating group and 1.17 ± .07 (S.E. of the mean) for the control group. Again the means of the two groups were found not to be significantly different in this period.

3.7. Further Statistical Analysis

The differences between meditating and control subjects in the second experimental period were tested by a t-test. The question arises whether a more discriminating test would show a significant difference between these two groups of subjects. A 2-way analysis of variance was therefore carried out. Once again no significant difference was seen between meditating and control subjects, while variability between individual subjects and between experimental periods were significant (Table 2).

Source of Variation	Degree of Freedom	Sum of Squares	Estimate of Variance	F	Significance
A. Between Experimental Periods	2	1.14	.57	5.66	<1%
B. Between Meditators and Non-meditators	1	.009	.009	.08	>5%
A.B.	2	.016	.008	.08	>5%
Residual	78	7.86	.101	---	---

Table 2: Analysis of Variance.

4. DISCUSSION OF RESULTS

The changes which occurred during the second experimental period were:

1. a decrease in SMR
2. a decrease in minute ventilation
3. an increase end tidal CO_2

4.1. Decrease in SMR

The mean change in SMR during the second experimental period represents a 20% fall in CO_2 production for meditating subjects which is comparable to a 17% decrease reported by Wallace et al (1971). The results of the control subjects were not significantly different suggesting the ΔMR is due to factors other than the practice of T.M. According to our results the mean MR did not fall below basal during the second experimental period. (Our figure of 1.3 x basal rate for sitting resting subjects is comparable to the 1.5 x basal rate found by Passmore et al (1952) for subjects under similar conditions.) However, in some meditating subjects the CO_2 production decreased by consistently large amounts in each experiment (e.g., C.W. 30%,56%,56%, 35% and 58%) in others it varied (e.g., P.K. 28%,50%,40%,10%,40%) and in still others the change was relatively small (e.g., M.C. 30%,3%, 10%,12%,3%). The following results show a similar variability in ΔSMR occurred in experiments with control subjects:

M.T. 20%,30%,20%

W.J.D. 36%,20%,30% (increase)

D.W.R. 10%,6%,14%

4.1.1. How Factors Affecting Resting Metabolism May Have Contributed to the Variability in the Change in SMR

In the Introduction factors affecting metabolic rate are discussed. Some of these factors may have contributed to the variability found in the change in SMR which occurred in the second experimental period:

(a) Training effect
(b) Exercise
(c) Specific dynamic action
(d) Endocrine
(e) Sleep
(f) Hypnosis

(a) The training effect, familiarisation with equipment and procedure, described by Roberts and Reid (1952) was not evident in the successive runs of our subjects by producing a greater decrease in MR in the second experimental period. However this may have been masked by the effect of the other factors on the change in SMR.

(b) Moderate exercise causes an increase in CO_2 production above the resting rate but gaseous exchange returns to pre-exercise levels within 10 minutes (Berg 1947). Variation of the amount of exercise just prior to the testing period could have introduced variability into the change in MR which occurred in the second experimental period.

(c) Although SDA has an effect on MR, (Glickman 1948) it did not affect the change which occurred in the second experimental period since 'time since the last meal' was not significantly correlated with ΔSMR (section 3.5.1.).

(d) Variability of results could have been influenced in individual subjects suffering from the hyper- or hypo-thyroidism, particularly if the conditions of stress prior to the test period varied. Means (1951) states that secretion of large amounts of thyroxin can increase BMR up to 100%.

(e) The effect of falling asleep on the variability of the results was discussed earlier in relation to those subjects who fell asleep during an experimental session (section 3.5.5.). Although MR reportedly decreases between 10-20% after several hours of sleep, in our experiments falling asleep did not affect the change in MR which occurred during the second experimental period.

(f) A form of self-hypnosis may have been practised by some control subjects, contributing to their decrease in MR and may possibly have contributed to the variability in the changes which occurred.

4.2. Decrease in Minute Ventilation

Allison (1970) reported a decrease in breathing frequency during TM to half the resting rate in 1 subject, and gave indirect evidence that a comparable increase in tidal volume did not occur. The mean decrease in breathing frequency in our experiments was only .8 ± 1 breaths per min. (S.E. of the mean). The mean decrease of 1463 ± 151 cc (S.E. of the mean) seen in minute ventilation must have been due therefore to a decrease in tidal volume. In one of our subjects the breathing frequency during the second experimental period did decrease by 50% (Fig. 10), but the fact that minute ventilation

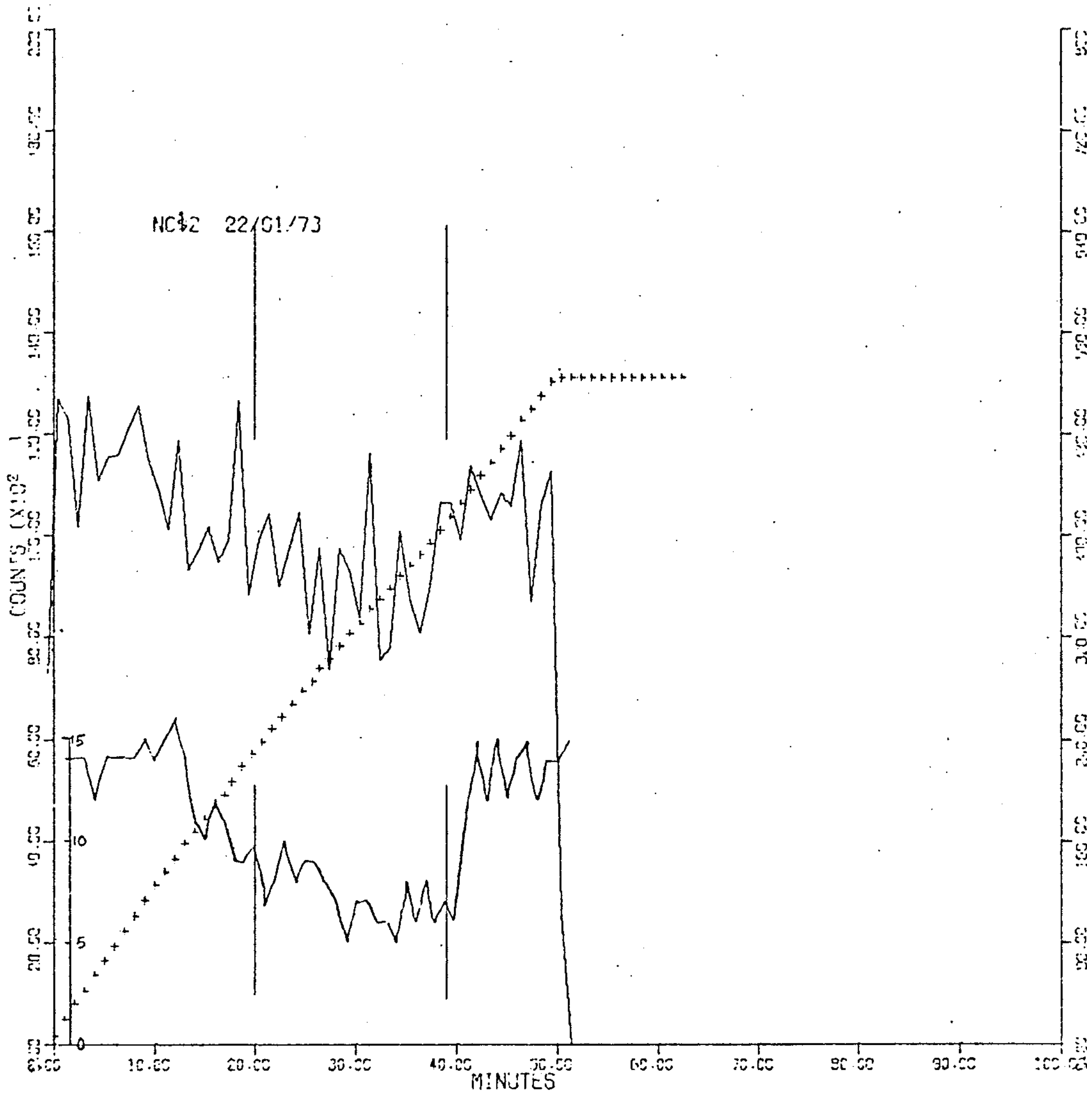


Figure 10. Experimental record of a meditating subject showing a 50% decrease in breathing frequency (lower trace).

Top trace - Minute volume (arbit units).

Diagonal line - Accumulated total ventilation.

Vertical lines - Beginning and end of meditation.

did not decrease by the same amount indicates that a compensatory increase in tidal volume occurred.

4.3. CO_2 Concentration

One subject in the 15 experiments in which end tidal CO_2 was tested showed an increase of 35% during meditation (Fig. 7). In the remaining experiments an increase of 3-4% occurred. This is consistent with the assumption of Allison (1970) and the findings of Wallace (1971) that there was no significant build up during meditation. In neither of the above experiments was there evidence of overbreathing after meditation.

4.3.1. An alternative explanation of the changes seen in the second experimental period is that hypoventilation occurred, without any necessary changes in $\dot{V}_{CO_2}$. The mean change in minute volume was almost completely accounted for by a fall in tidal volume (section 3.4.1.). Collier et al (1955), have indicated that at tidal volumes less than 350 ml in adult subjects, end tidal CO_2 may be lower than P_{ACO_2}. If this were the case, our method of calculating $\dot{V}_{CO_2}$ would give values that are too low. However, the mean tidal volumes of meditating and control subjects were 564.6 and 531.6 ml respectively, in the first experimental period. In the second experimental period, the mean tidal volumes for meditating and control subjects were 485 and 498 ml respectively. When the runs of 4 meditating subjects whose mean tidal volume in the second experimental period were below 350 ml were discarded, the % decrease in calculated CO_2 production in the second experimental period changed from 79.2 ± 2 to 81.5 ± 1.7 ml (means and

S.E. of means). Similarly discarding the runs of 3 control subjects changed the % decrease in CO_2 output in that period from 82.8 ± 2.5 to 81 ± 2.3 ml (means and S.E. of means). Alveolar hypoventilation does not appear to have affected the mean change in SMR in these experiments.

4.4. The Metabolic Effects of T.M.

The metabolic effects of T.M. have not been established.

4.4.1. The decrease in CO_2 production during the practice of T.M. is not correlated with the length of time the subject has been practicing the technique nor with his subjective feeling of having had a successful (beneficial?) period of meditation. Along with the control subjects equivalent ΔCO_2 production, this suggests that the 20% change in SMR found is related to sitting relaxed with eyes closed. How can we account for the 20% change in both meditating and control subjects? A decrease in brain metabolism can be ruled out as the major cause since the brain contributes 15% of the total body metabolism at rest. Over half of the metabolism of the resting subject is due to thoracic and abdominal organs and the balance is contributed by skin and muscle. It would be possible to account for the observed change in CO_2 production in terms of skeletal muscle activity following muscular relaxation. In connection with the possible role of brain metabolism, additional experiments with a second group of control subjects sitting relaxed performing a mental task would clarify this area.

4.4.2. Wallace et al (1971) found a mean decrease in blood lactate from the beginning of the experiment to midway through the postcontrol period. The concentration decreased from 11.4 mg/100 ml in the precontrol period to 8.0 mg/100 ml during meditation. To determine whether this change in lactate concentration is peculiar to the practice of T.M. it would be necessary to test meditating and control subjects from basal conditions since the effects of recent exercise could, according to Crescitelli and Taylor (1944) have an effect on blood lactate results for 90 minutes postexercise. Wallace et al, did in fact find a steady decline in lactate concentration throughout their experiments.

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APPENDIX 1

```
      PROGRAM FRED
      COMMON IDATA(400)
      COMMON T(102),J(102),JS(102),BC,BD
      COMMON LABEL(4),NAMON(3),NAMTO(6),NOTE(7),IIN,IOUT,NUM
      REAL J,JS
      IOUT=0
      DO 99 L6=1,50
C **********MAX NUMBER OF TAPES/RUN IS SET HERE AT 50
C **********THE LAST DATA CARD READ BY TMCALC SETS IOUT=999
C **********AND RETURNS CONTROL TO FRED TO STOP EXECUTION
      CALL TMCALC
      IF(IOUT.EQ.999) STOP
      CALL PLOTZ
   99 CONTINUE
      STOP
      END
COMMON
BLANK $040F
```

```
      SUBROUTINE PLOTZ                                          OCT18.72.
C****    THIS SUBPROGRAM ACCEPTS DATA FORM TMCALC (IN COMMON)
C****    AND MAKES THE TM GRAPHS,SCALING THE ORDINATES
C****    BUT NOT THE ABSCISSA (SET AT 100 MINUTES)
      COMMON IDATA(400)
      COMMON T(102),J(102),JS(102),BC,BD
      COMMON LABEL(4),NAMON(3),NAMTO(6),NOTE(7),IIN,IOUT,NUM
      REAL J,JS
      S1=IIN/10.
      S2=IOUT/10.
      S3=S1+.5
      S4=S2+.5
      M=NUM+1
      MM=NUM+2
      T(M)=0.
      T(MM)=10.
      CALL PLOT(5.0,-11.0,-3)
C      DEFINES LOGICAL ORIGIN
      CALL PLOT(0.,0.7,-3)
C         BOTH Y AXES ARE SCALED /ABSCISSA IS FIXED AT 100MIN
      CALL SCALE(J,10.,NUM,1)
      CALL SCALE(JS,10.,NUM,1)
      CALL AXIS(0.,0.,LABEL,-7,10.,0.,0.,10.)
      CALL AXIS(0.,0.,NAMON,6,10.,90.,J(M),J(MM))
      CALL AXIS(10.,0.,NAMTO,-12,10.,90.,JS(M),JS(MM))
      CALL SYMBOL(1.,8.,.14,NOTE,0.,14)
C         VERTICAL LINES MARK START AND END OF TM PERIOD
      CALL SYMBOL(S1,1.5,2.1,45,0.,-1)
      CALL SYMBOL(S1,7.0,2.1,45,0.,-1)
      CALL SYMBOL(S2,7.0,2.1,45,0.,-1)
      CALL SYMBOL(S2,1.5,2.1,45,0.,-1)
      CALL LINE(T,JS,NUM,1,-1,4)
      CALL LINE(T,J,NUM,1,0,0)
      CALL PLOT(11.,0.,999)
      RETURN
      END
COMMON
BLANK $040F
```

OCT 18.72

```
      SUBROUTINE TMCALC
C*************
C*************
C*************
C  A LITTLE PROGRAMME TO HANDLF THE TM CALCULATIONS
C
C
      COMMON IDATA(400)
      COMMON T(102),J(102),JS(102),BC,BD
      COMMON LABEL(4),NAMON(3),NAMTO(6),NOTE(7),IIN,IOUT,NUM
C
C       PLOTTER WILL NOT ACCEPT INTEGER ARRAYS
      REAL J,JS
    6 FORMAT(20X,12HNUMBER COUNT,I6,10X,10HZERO COUNT,I6/)
    7 FORMAT(20X,12HERROR COUNT ,I6/)
    8 FORMAT(20X,12HERROR CODE  ,I6/)
   11 FORMAT(F4.2,4I4)
   13 FORMAT(10X,F6.1,4X,F6.0,4X,F6.0)
   15 FORMAT(4A2,3A2,6A2,I3)
   16 FORMAT(7A2)
   17 FORMAT(10X,4A2,5X,3A2,5X,6A2/)
   18 FORMAT(//10X,17HREGRESSION OUTPUT/
     710X,6HSLOPE=,F8.3,10HINTERCEPT=,F8.3,11HCORR.COEFF=,
     7F8.5,9HRSQUARED=F8.5/)
      IRD=1
      IPR=3
      ICOUNT=0
      IERCNT=0
      IERR=0
C*************
C       AXIS TITLES FOR PLOTTER AND STOP CODE IF NEEDED
      READ(IRD,15) LABEL,NAMON,NAMTO,NEND
      IF(NEND.EQ.999) GO TO 44
C*************
C       EXPERIMENT PARAMETER CARD
      READ(IRD,11) TIME,IGO,IZRO,IIN,IOUT
C*************
C       SUBJECT NAME AND DATE
      READ(IRD,16)NOTE
C*************
C       READ THE TAPE
      CALL RDPTP (ICOUNT,IERCNT,IERR)
      WRITE(IPR,6) ICOUNT,IGO
      WRITE(IPR,7) IERCNT
      WRITE(IPR,8) IERR
      WRITE(IPR,17) LABEL,NAMON,NAMTO
C
      DO 10 K=1,ICOUNT
      IF(K.LE.IGO) GO TO 12
      I=K-IGO
C
C       MAX ARRAY LENGTH IS SET AT 100
      IF(I.GT.100) GO TO 72
C
      NUM=I
      J(I)=IDATA(K)-IZRO
```

```
      IF(J(I).LT.0) J(I)=0
      T(I)=TIME*(I-1)
      KK=J(I)/100.+.5
      IF(I.EQ.1) JS(I)=KK
      IF(I.GT.1) JS(I)=JS(I-1)+KK
      WRITE(IPR,13)T(I),J(I),JS(I)
   12 CONTINUE
   10 CONTINUE
   72 CONTINUE
C
C        A SIMPLE LINEAR REGRESSION ROUTINE
C        RETURNING A,B,R AND R-SQUARED
C        FOR THE FIRST (CONTROL) PERIOD AND THE TM PERIOD
      KNOT=0
      JA=1
      JI=IIN
  723 CONTINUE
      SX=0.
      SY=0.
      SXSQ=0.
      SYSQ=0.
      SXY=0.
      NQM=0
      KNOT=KNOT+1
      DO 204 JAI=JA,JI
      XC=T(JAI)
      PQ=JS(JAI)
      SX=SX+XC
      SY=SY+PQ
      SXSQ=SXSQ+XC*XC
      SYSQ=SYSQ+PQ*PQ
      SXY=SXY+XC*PQ
      NQM=NQM+1
      COVXY=SXY-((SX*SY)/NQM)
      VARX=SXSQ-((SX*SX)/NQM)
      VARY=SYSQ-((SY*SY)/NQM)
      BC=COVXY/VARX
      AC=(SY-(BC*SX))/NQM
      RC=COVXY/(SQRT(VARX*VARY))
      RSQ=RC*RC
  204 CONTINUE
      WRITE(IPR,18)BC,AC,RC,RSQ
      IF(KNOT.EQ.1) BD=BC
      IF(KNOT.GT.1) GO TO 300
      JA=IIN
      JI=IOUT
C        NOW GO BACK FOR THE REST
      GO TO 723
  300 CONTINUE
C      NOW FOR THE PLOTTING
      RETURN
C
C
C
   44 IOUT=999
C      ON RETURN TO FRED THIS STOPS EXECUTION

PROGRAM LENGTH 5030D

EXTERNALS
Q8QFLT Q8QFIX FLOT   Q8QINI Q8QX   Q8QEND RDPTP
FLOAT  SQRT


 *U
*****     ACCOUNTING INFORMATION     SEQUENCE NO.     50     DATE 18/ 10/ 72     START
*****     ACCOUNTING INFORMATION     SEQUENCE NO.     50     DATE 18/ 10/ 72     START
*****     ACCOUNTING INFORMATION     SEQUENCE NO.     50     DATE 18/ 10/ 72     START
*****     ACCOUNTING INFORMATION     SEQUENCE NO.     50     DATE 18/ 10/ 72     START
*****     ACCOUNTING INFORMATION     SEQUENCE NO.     50     DATE 18/ 10/ 72     START
*****     ACCOUNTING INFORMATION     SEQUENCE NO.     50     DATE 18/ 10/ 72     START
```

APPENDIX 2

SUBJECT QUESTIONNAIRE

DATE: ______________________ RUN NO.: __________

1. Name: ______________________________________

2. Age: _______________________________________

3. Time of experiment: __________ a.m. __________ p.m.

4. How long have you been meditating? ______ years ______ months

5. Has meditation been regular? ______ yes ______ no

6. When did you last meditate? ____________________ date
   ________ a.m. ________ p.m.

7. When did you last eat? ____________________ date
   ________ a.m. ________ p.m.

8. Do you smoke? ______ yes ______ no

9. Have you any known respiratory ailments? ______ yes ______ no

10. Did you feel in any way restricted by experimental conditions?
    ______ yes ______ no

11. Did you fall asleep during meditation? ______ yes ______ no

12. Did you feel that meditation went normally as at home? ____yes ____no

APPENDIX 3

INTERPRETATION OF DATA COLUMNS

1. Mean minute volume during 1st experimental period.

2. Mean minute volume during 2nd experimental period.

3. Mean minute volume during 3rd experimental period.

4-6. Breathing frequencies during the 3 experimental periods.

7-9. Mean % end tidal CO_2 during the 3 experimental periods.

10. Time of day (24 hour clock).

11. Time since last meditation (hours).

12. Has meditation been regular? Yes = 1, No = 0

13. Hours since last ate.

14. Fell asleep? Yes = 1, No = 0

15. Was meditation normal as at home? Yes = 1, No = 0

16-18. CO_2 production during the 3 experimental periods.

19-21. X BMR during the 3 experimental periods.

22. ΔCO_2 production in second experimental period expressed as % of the CO_2 produced in the first period.

23. MR of first experimental corrected for 'time of day'.

24. '1' signifies the runs in which end tidal CO_2 of 5% was assumed.

25. Blank column.

```
ILLINOIS
SUBJECT:  1      RUN:  1
DATA:  7330  5003  7293  16  14  16  5.5  5.9  5.2  18  10  1  8  0  0  286  206  286  1.5  1.00  1.5
  72  0.96  0  10
SUBJECT:  1      RUN:  2
DATA:  5876  4558  4862  13  15.5  16  5.3  5.5  5.2  9  16  1  14  0  0  204  155  159  1.07  0.81
  0.63  76  0.8  0  10
SUBJECT:  1      RUN:  3
DATA:  4862  3545  4862  16.5  14  15  5.4  5.9  5.2  10  18  1  15  0  0  162  116  165  0.85  0.61
  0.86  72  0.55  0  10
SUBJECT:  1      RUN:  4
DATA:  7007  5747  7857  16  15  16.5  5.7  5.7  5.2  9  15  1  15  0  0  331  231  312  1.74  1.21
  1.64  70  1.47  0  10
SUBJECT:  2      RUN:  1
DATA:  13246  9220  10000  9.5  14.5  11.5  4.09  4.9  4.4  17  7  1  5  0  0  485  348  366  2.12  1.52
  1.6  72  1.61  0  10
SUBJECT:  2      RUN:  2
DATA:  13749  6302  11298  12  14  13.5  3.5  4.7  3.5  18  8  1  6  0  1  420  200  326  1.84  0.87
  1.42  48  1.3  0  10
SUBJECT:  2      RUN:  3
DATA:  11230  7622  7285  13.5  14  12.5  5  5  5  16  6  1  2  1  1  463  279  273  2.03  1.22  1.19
  69  1.55  1  10
SUBJECT:  2      RUN:  4
DATA:  9175  8684  6000  12  13.5  12.5  5  5  5  13  24  1  14  1  1  371  336  209  1.62  1.47  0.91
  91  1.23  1  10
SUBJECT:  2      RUN:  5
DATA:  9184  6292  8714  14.5  14  15  5  5  5  17  11  1  5  1  1  354  213  326  1.55  0.93  1.42
  69  1.04  1  10
SUBJECT:  3      RUN:  1
DATA:  5349  3896  5454  15  13  15  5  5.3  4.94  15  8  1  4  0  0  173  120  176  0.85  0.59  0.87
  69  0.4  0  10
SUBJECT:  3      RUN:  2
DATA:  6944  3709  6298  15  13  14  5  5.3  4.94  14  6  1  6  0  1  253  110  224  1.25  0.54  1.1
  43  0.83  0  10
SUBJECT:  3      RUN:  3
DATA:  7272  3974  6428  15.5  14  14.5  5  5.3  4.94  14  6  1  5  0  1  266  117  228  1.31  0.57
  1.12  44  0.89  0  10
SUBJECT:  3      RUN:  4
DATA:  5827  4190  4857  16.5  14  15  5  5  5  16  9  1  4  0  1  188  122  149  0.93  0.6  0.73  65
  0.45  1  10
SUBJECT:  3      RUN:  5
DATA:  6660  3660  6071  16  13.5  15  5  5  5  14  4  1  4  0  1  233  93  209  1.15  0.48  1.03  42
  0.73  1  10
SUBJECT:  4      RUN:  1
DATA:  8311  6883  7272  18.5  16.5  17  5.1  4.8  4.8  16  7  1  7  0  1  282  211  226  1.2  0.9  0.96
  75  0.72  0  10
SUBJECT:  4      RUN:  2
DATA:  10649  6623  9090  16.5  14.5  16.5  5.1  4.8  4.8  16  7  1  0 ...
```

```
SUBJECT:  3      RUN:  4
DATA:  5827  4190  4857  16.5  14  15  5  5  5  16  9  1  4  0  1  188  122  149  0.93  0.6  0.73  65
  0.45  1  10
SUBJECT:  3      RUN:  5
DATA:  6660  3660  6071  16  13.5  15  5  5  5  14  4  1  4  0  1  233  98  209  1.15  0.48  1.03  42
  0.73  1  10
SUBJECT:  4      RUN:  1
DATA:  8311  6883  7272  18.5  16.5  17  5.1  4.8  4.8  16  7  1  7  0  1  282  211  226  1.2  0.9  0.96
  75  0.72  0  10
SUBJECT:  4      RUN:  2
DATA:  10640  6623  9090  16.5  14.5  16.5  5.1  4.8  4.8  16  7  1  2  0  1  416  213  317  1.77  0.91
  1.35  51  1.29  0  10
SUBJECT:  4      RUN:  3
DATA:  7291  6815  8000  16.5  15.5  15.5  5  5  5  14  4  1  3  0  1  240  224  283  1.02  0.95  1.2
  93  0.6  1  10
SUBJECT:  4      RUN:  4
DATA:  6021  6134  5857  15.5  14.5  15  5  5  5  16  7  1  6  0  1  184  197  180  0.78  0.84  0.76
  107  0.3  1  10
SUBJECT:  4      RUN:  5
DATA:  7598  6535  8571  16  15  16  5  5  5  16  7  1  4  0  1  259  214  308  1.1  0.91  1.31  83
  0.62  1  10
SUBJECT:  5      RUN:  1
DATA:  5831  5557  6428  17.5  16  18  5  5  5  17  16  1  7  0  1  176  172  202  0.89  0.87  1.03
  98  0.38  1  10
SUBJECT:  5      RUN:  2
DATA:  4761  4878  6142  17.5  16  16.5  5  5  5  15  4  1  3  0  1  122  138  198  0.62  0.7  1.01
  113  0.17  1  10
SUBJECT:  5      RUN:  3
DATA:  5530  4198  5142  19  15.5  16.5  5  5  5  14  4  1  18  0  1  151  107  148  0.77  0.54  0.75
  71  0.35  1  10
SUBJECT:  5      RUN:  4
DATA:  8221  8675  8857  15.5  15  15.5  5  5  5  15  5  1  3  0  1  308  334  340  1.57  1.7  1.73
  108  1.12  1  10
SUBJECT:  5      RUN:  5
DATA:  5428  4285  5571  20  15.5  16  5  5  5  13  12  1  2  0  1  139  111  172  0.7  0.56  0.87  80
  0.31  1  10
SUBJECT:  6      RUN:  1
DATA:  8557  7131  7142  13.5  13  13.5  5  5  5  14  9  1  3  1  1  323  255  252  1.46  1.15  1.14
  79  1.04  1  10
SUBJECT:  6      RUN:  2
DATA:  6515  5802  6857  13.5  13  12  5  5  5  14  7  1  8  0  1  221  189  249  1  0.85  1.13  86
  0.56  1  10
SUBJECT:  6      RUN:  3
DATA:  8761  6981  7142  14.5  14  14  5  5  5  13  8  1  7  1  0  325  240  248  1.47  1.09  1.12  74
```

```
SUBJECT:  5     RUN:  5
DATA:  5428  4285  5571  20  15.5  16  5  5  5  13  12  1  2  0  1  139  111  172  0.7  0.56  0.87  80
  0.31  1  10
SUBJECT:  6     RUN:  1
DATA:  8557  7131  7142  13.5  13  13.5  5  5  5  14  9  1  3  1  1  323  255  252  1.46  1.15  1.14
  73  1.04  1  10
SUBJECT:  6     RUN:  2
DATA:  6515  5802  6857  13.5  13  12  5  5  5  14  7  1  8  0  1  221  189  249  -1  0.85  1.13  86
  0.58  1  10
SUBJECT:  6     RUN:  3
DATA:  8761  6981  7142  14.5  14  14  5  5  5  13  8  1  7  1  0  325  240  248  1.47  1.09  1.12  74
  1.08  1  10
SUBJECT:  6     RUN:  4
DATA:  9514  8118  8500  14.5  14  14.5  5  5  5  11  16  1  2  0  1  363  297  312  1.65  1.35  1.41
  82  1.32  1  10
SUBJECT:  6     RUN:  5
DATA:  6307  5467  5714  13.5  13.5  13  5  5  5  10  14  1  14  1  1  210  168  184  0.95  0.76  0.83
  80  0.65  1  10
SUBJECT:  7     RUN:  1
DATA:  7032  4547  6857  15  13.5  15  5  5  5  9  13  1  4  0  1  241  126  230  1.11  0.58  1.06  52
  0.84  1  10
SUBJECT:  7     RUN:  2
DATA:  5954  6250  7000  15  13.5  15  5  5  5  9  13  1  14  0  1  185  211  237  0.85  0.97  1.09
  114  0.58  1  10
SUBJECT:  7     RUN:  3
DATA:  9131  8722  8285  15.5  15.5  14.5  5  5  5  10  3  1  2  0  1  340  319  305  1.57  1.47  1.41
  94  1.27  1  10
SUBJECT:  7     RUN:  4
DATA:  9614  9084  6857  14.5  14.5  14  5  5  5  9  13  1  14  0  1  371  345  237  1.71  1.59  1.09
  53  1.44  1  10
SUBJECT:  7     RUN:  5
DATA:  7207  7337  7428  14.5  15  14.5  5  5  5  9  13  1  11  0  1  251  254  262  1.16  1.17  1.21
  101  0.89  1  10
SUBJECT:  8     RUN:  1
DATA:  9268  8270  7792  17  16.5  16  5  4.9  4.9  16  8  1  4  0  1  335  283  264  1.39  1.17  1.1
  84  0.91  0  10
SUBJECT:  8     RUN:  2
DATA:  8392  7622  6883  15.5  15  15  5.4  5.3  5.4  15  6  1  6  0  0  327  284  250  1.36  1.18  1.04
  87  0.91  0  10
SUBJECT:  8     RUN:  3
DATA:  10965  9310  8571  16.5  14.5  14.5  5  5  5  17  9  1  4  0  0  424  356  319  1.76  1.48  1.32
  84  1.25  1  10
SUBJECT:  8     RUN:  4
DATA:  11607  10407  11285  17.5  16.5  17  5  5.5  17  8  1  7  0  1  449  396  436  1.87  1.65  1.81
```

SUBJECT: 8 RUN: 2
DATA: 8392 7622 6883 15.5 15 15 5.4 5.3 5.4 15 6 1 6 0 0 327 284 250 1.36 1.18 1.04
87 0.91 0 10
SUBJECT: 8 RUN: 3
DATA: 10965 9310 8571 16.5 14.5 14.5 5 5 5 17 9 1 4 0 0 424 356 319 1.76 1.48 1.32
84 1.25 1 10
SUBJECT: 8 RUN: 4
DATA: 11607 10407 11285 17.5 16.5 17 5 5 5 17 8 1 7 0 1 449 396 436 1.87 1.65 1.81
88 1.36 1 10
SUBJECT: 9 RUN: 1
DATA: 9784 6976 8571 17 14.5 16 5.2 4.9 4.6 15 7 1 3 0 0 380 238 287 1.66 1.04 1.25
63 1.21 0 10
SUBJECT: 9 RUN: 2
DATA: 7545 5964 7012 15.5 14.5 15.5 5.1 5.1 4.8 15 7 1 3 0 1 270 196 228 1.18 0.85
1 73 0.73 0 10
SUBJECT: 9 RUN: 3
DATA: 6428 5508 3642 15 13.5 15 5 5 5 15 6 1 4 0 0 212 177 73 0.92 0.77 0.32 83
0.47 1 10
SUBJECT: 9 RUN: 4
DATA: 9285 8142 9000 15.5 13.5 15.5 5 5 5 14 5 1 3 0 1 351 309 337 1.53 1.35 1.47
88 1.11 1 10
SUBJECT: 9 RUN: 5
DATA: 12998 8482 10428 16 15 15 5 5 5 11 24 1 2 0 0 533 315 412 2.33 1.38 1.8 59
2 1 10
SUBJECT: 10 RUN: 1
DATA: 9498 7142 8000 13 12.5 13.5 5 5 5 18 7 1 3 0 0 383 269 305 1.62 1.13 1.29
79 1.08 1 10
SUBJECT: 10 RUN: 2
DATA: 10757 10297 10714 14 13 14 5 5 5 16 5 1 4 0 0 440 423 437 1.86 1.79 1.85
96 1.38 1 10
SUBJECT: 10 RUN: 3
DATA: 11142 9792 10000 13.5 13.5 14 5 5 5 17 7 1 5 0 0 462 395 402 1.95 1.67 1.7
85 1.44 1 10
SUBJECT: 10 RUN: 4
DATA: 9615 8554 9071 13.5 12.5 13.5 5 5 5 17 7 1 5 0 1 386 340 359 1.63 1.44 1.52
88 1.12 1 10
SUBJECT: 10 RUN: 5
DATA: 13052 12680 11428 12.5 12.5 12.5 5 5 5 11 12 1 12 0 0 565 546 483 2.39 2.31
2.04 97 2.06 1 10
SUBJECT: 11 RUN: 1
DATA: 12864 11290 12000 16.5 12 15.5 5 5 5 17 8 1 6 0 1 515 471 479 2.12 1.94 1.97
91 1.61 1 10
SUBJECT: 11 RUN: 2
DATA: 9600 7848 9714 18 14 17.5 5 5 5 16 7 1 4 0 1 [illegible]

```
SUBJICT:  10      RUN:  4
DATA:  9615  8554  9071  13.5  12.5  13.5  5  5  5  17  7  1  5  0  1  386  340  359  1.63  1.44  1.52
  88  1.12  0  10
SUBJICT:  10      RUN:  5
DATA:  13052  12680  11428  12.5  12.5  12.5  5  5  5  11  12  1  12  0  0  565  546  483  2.39  2.31
  2.04  97  2.06  0  10
SUBJICT:  11      RUN:  1
DATA:  12864  11290  12000  16.5  12  15.5  5  5  5  17  8  1  6  0  1  515  471  479  2.12  1.94  1.97
  91  1.61  0  10
SUBJICT:  11      RUN:  2
DATA:  9600  7848  9714  18  14  17.5  5  5  5  15  7  1  4  0  1  340  283  350  1.4  1.16  1.44  83
  0.95  0  10
SUBJICT:  11      RUN:  3
DATA:  10644  8045  9857  17  15  17.5  5  5  5  17  7  1  6  0  1  400  286  357  1.65  1.18  1.47
  72  1.14  0  10
SUBJICT:  11      RUN:  4
DATA:  9024  6631  8142  19.5  15  18  5  5  5  14  4  1  4  0  1  300  215  267  1.23  0.88  1.1  72
  0.81  0  10
SUBJICT:  11      RUN:  5
DATA:  17025  14140  17142  18.5  15.5  18.5  5  5  5  17  7  1  7  0  1  707  586  713  2.92  2.42
  2.94  83  2.41  0  10
SUBJICT:  12      RUN:  1
DATA:  7207  6308  6857  15.5  15.5  13.5  5  5  5  15  7  1  12  0  0  231  186  230  1.01  0.81  1
  81  8  9  10
SUBJICT:  12      RUN:  2
DATA:  7522  6422  6714  14.5  14  11  5  5  5  15  7  1  4  0  0  255  204  244  1.11  0.89  1.07  80
  0.66  0  10
SUBJICT:  12      RUN:  3
DATA:  7995  7941  8857  14  17.5  15.5  5  5  5  15  7  1  3  1  0  283  251  314  1.24  1.1  1.37
  89  0.79  0  10
SUBJICT:  12      RUN:  4
DATA:  6367  6035  8714  15.5  16.5  16.5  5  5  5  9  13  1  18  0  1  189  164  298  0.82  0.71  1.3
  87  0.55  0  10
SUBJICT:  12      RUN:  5
DATA:  8524  7104  8000  17  17.5  17  5  5  5  9  13  1  14  0  1  285  209  258  1.25  0.91  1.13
  73  0.98  0  10
SUBJICT:  13      RUN:  1
DATA:  7427  7187  7571  16  15.5  14  5  5  5  15  6  1  5  0  1  264  256  285  1.17  1.14  1.27  97
  0.72  0  10
SUBJICT:  13      RUN:  2
DATA:  10245  8654  10071  16.5  15.5  15  5  5  5  16  7  1  3  1  0  402  329  403  1.79  1.46  1.79
  82  1.31  0  10
SUBJICT:  13      RUN:  3
```

```
SUBJECT:  12      RUN:  5
 DATA:  8524  7104  8000  17  17.5  17  5  5  5  9  13  1  14  0  1  285  200  258  1.25  0.91  1.13
  73  0.98  1  10
SUBJECT:  13      RUN:  1
 DATA:  7427  7187  7571  16  15.5  14  5  5  5  15  6  1  5  0  1  264  256  285  1.17  1.14  1.27  97
  0.72  1  10
SUBJECT:  13      RUN:  2
 DATA:  10245  8654  10071  16.5  15.5  15  5  5  5  16  7  1  3  1  0  402  329  403  1.79  1.46  1.79
  82  1.31  1  10
SUBJECT:  13      RUN:  3
 DATA:  8368  7084  7714  16  15  13.5  5  5  5  15  6  1  4  0  1  312  254  295  1.39  1.13  1.31  81
  0.94  1  10
SUBJECT:  13      RUN:  4
 DATA:  8368  7084  7571  16  13.5  13.5  5  5  5  15  6  1  4  0  1  312  264  288  1.39  1.17  1.28
  85  0.94  1  10
SUBJECT:  13      RUN:  5
 DATA:  5884  6224  7142  10  13  9.5  5  5  5  11  3  1  12  0  1  227  224  293  1.01  1  1.3  99  0.68
  1  10
SUBJECT:  14      RUN:  1
 DATA:  4830  4234  3357  11  12  10.5  5  5  5  15  6  1  5  0  0  164  127  94  0.75  0.58  0.43  77
  0.3  1  10
SUBJECT:  14      RUN:  2
 DATA:  6714  5944  6000  12.5  13  12  5  5  5  17  7  1  5  0  0  248  206  216  1.14  0.95  1  83
  0.63  1  10
SUBJECT:  14      RUN:  3
 DATA:  8322  7257  6571  12  13  12  5  5  5  15  6  1  5  0  1  332  271  244  1.53  1.25  1.12  82
  1.06  1  10
SUBJECT:  14      RUN:  4
 DATA:  7078  5737  6571  12.5  13.5  12.5  5  5  5  17  6  1  5  0  0  266  192  241  1.23  0.88  1.11
  72  0.72  1  10
SUBJECT:  14      RUN:  5
 DATA:  7152  6911  7285  10.5  12.5  11  5  5  5  15  4  1  3  0  1  284  258  287  1.31  1.19  1.32
  91  0.86  1  10
SUBJECT:  15      RUN:  1
 DATA:  9743  8165  8571  17  15  17  5  5  5  11  16  1  15  0  1  368  303  300  1.6  1.31  1.34  82
  1.27  1  10
SUBJECT:  15      RUN:  2
 DATA:  11035  10430  8571  18  17  17  5  5  5  10  16  1  14  0  1  428  405  300  1.86  1.76  1.34
  95  1.53  1  10
SUBJECT:  15      RUN:  3
 DATA:  7752  5262  5714  16  17  17.5  5  5  5  10  14  1  14  0  1  275  145  163  1.19  0.63  0.7
  53  0.89  1  10
SUBJECT:  15      RUN:  4
 DATA:  9595  9403  10000  18  17.5  18.5  5  5  5  10  14  1  14
```

```
SUBJECT:  15     RUN:  1
 DATA:  9748  8165  8571  17  15  17  5  5  5  11  16  1  15  0  1  368  303  300  1.6  1.31  1.34  82
   1.27  1  10
 SUBJECT:  15     RUN:  2
 DATA:  11035  10400  8571  18  17  17  5  5  5  10  16  1  14  0  1  428  405  300  1.06  1.76  1.34
   05  1.56  1  10
 SUBJECT:  15     RUN:  3
 DATA:  7752  5282  5714  16  17  17.5  5  5  5  10  14  1  14  0  1  275  145  163  1.19  0.63  0.7
   53  0.89  1  10
 SUBJECT:  15     RUN:  4
 DATA:  9595  9408  10000  18  17.5  18.5  5  5  5  10  14  1  14  0  1  353  347  370  1.53  1.5  1.6
   38  1.23  1  10
 SUBJECT:  15     RUN:  5
 DATA:  3354  3435  5142  20.5  19  19.5  5  5  5  10  14  1  14  0  1  124  38  120  0.53  0.16  0.52
   31  0.23  1  10
EN L
      )CL LI I
CL LA I WS
      )CO I' /IC S LIACOH∆ IATA
SA/ IL  15.08.09  07/19/ B
      S LIACOI I
              v
              ∆ IATA
    ICH-MLLITATO IS
/ ALJ L  LLIO I
```

```
NCI-ILLITATO 13
SUBJECT: 1    RUN: 1
DATA: 6811 5755 6753 15 14 16 5.2 5.2 5.2 17 0 0 5 0 0 260 211 251 1.42 1.15 1.37
  81 0.91 9 10
SUBJECT: 1    RUN: 2
DATA: 5357 4464 5714 13.5 11.5 13 5 5 5 14 0 0 2 0 0 216 154 207 1.18 0.84 1.13
  71 0.76 9 10
SUBJECT: 1    RUN: 3
DATA: 5371 4387 5142 14.5 11.5 15 5 5 5 14 0 0 2 0 0 181 150 167 0.99 0.82 0.91
  83 0.57 9 10
SUBJECT: 2    RUN: 1
DATA: 12498 9192 11571 19 19 15 5 5 5 10 0 0 2 0 0 425 260 421 1.58 0.97 1.57 61
  1.28 9 10
SUBJECT: 2    RUN: 2
DATA: 10415 7725 10000 20 19 18.5 5 5 5 10 0 0 1 0 0 310 186 305 1.15 0.69 1.13
  69 0.85 9 10
SUBJECT: 2    RUN: 3
DATA: 13321 10292 11142 19 18.5 16 5 5 5 9 0 0 1 0 0 466 320 389 1.73 1.19 1.45
  63 1.46 9 10
SUBJECT: 3    RUN: 1
DATA: 5251 3661 4928 13.5 10.5 12 5 5 5 12 0 0 17 0 0 165 107 160 0.78 0.5 0.76
  65 0.42 9 10
SUBJECT: 3    RUN: 2
DATA: 5955 4611 6857 15 11 11 5 5 5 12 0 0 17 0 0 190 151 263 0.9 0.71 1.25 79
  0.54 9 10
SUBJECT: 3    RUN: 3
DATA: 5425 4781 5142 13 10.5 11.5 5 5 5 12 0 0 17 0 0 178 163 174 0.84 0.77 0.82
  92 0.48 9 10
SUBJECT: 4    RUN: 1
DATA: 5324 4340 5142 11.5 9.5 12 5 5 5 9 0 0 16 0 0 199 161 187 0.99 0.8 0.93 81
  0.72 9 10
SUBJECT: 4    RUN: 2
DATA: 5305 4470 5857 11 7.5 10 5 5 5 9 0 0 13 0 0 201 180 234 1 0.9 1.17 90 0.73
  9 10
SUBJECT: 4    RUN: 3
DATA: 6252 6482 6928 10.5 9.5 12 5 5 5 9 0 0 13 0 0 251 269 276 1.25 1.34 1.38
  107 0.98 9 10
SUBJECT: 5    RUN: 1
DATA: 11540 9857 10285 14 12 12.5 5 5 5 11 0 0 4 1 0 452 386 403 1.73 1.48 1.55
  85 1.4 9 10
SUBJECT: 5    RUN: 2
DATA: 9468 8030 8420 12 12.5 9.5 5 5 5 12 0 0 2 0 0 366 290 336 1.4 1.11 1.29 79
  1.04 9 10
SUBJECT: 5    RUN: 3
```

```
SUBJECT: 4    RUN: 3
 DATA: 6252 6482 6928 10.5 9.5 12 5 5 5 9 0 0 13 0 0 251 269 276 1.25 1.34 1.38
  107 0.98 9 10
SUBJECT: 5    RUN: 1
 DATA: 11540 9857 10285 14 12 12.5 5 5 5 11 0 0 4 1 0 452 386 403 1.73 1.48 1.55
  85 1.4 9 10
SUBJECT: 5    RUN: 2
 DATA: 9468 8030 8428 12 12.5 9.5 5 5 5 12 0 0 2 0 0 366 290 336 1.4 1.11 1.29 79
  1.04 9 10
SUBJECT: 5    RUN: 3
 DATA: 13912 12355 14285 10.5 11.5 8.5 5 5 5 12 0 0 18 0 0 602 515 638 2.31 1.98
  2.45 86 1.95 9 10
SUBJECT: 6    RUN: 1
 DATA: 7330 6922 7142 15.5 13.5 16.5 5 5 5 9 0 0 1 0 0 244 239 226 0.97 0.95 0.9
  98 0.7 9 10
SUBJECT: 6    RUN: 2
 DATA: 6282 4997 5571 17.5 14 18 5 5 5 9 0 0 1 0 0 175 139 136 0.7 0.55 0.54 79
  0.43 9 10
SUBJECT: 6    RUN: 3
 DATA: 9608 8361 7571 16.5 14.5 15.5 5 5 5 9 0 0 1 0 0 350 303 256 1.4 1.21 1.02
  87 1.13 9 10
SUBJECT: 7    RUN: 1
 DATA: 4574 3917 4285 16.5 13.5 15.5 5 5 5 11 0 0 3 0 0 117 104 109 0.59 0.53 0.55
  89 0.26 9 10
SUBJECT: 7    RUN: 2
 DATA: 5345 6510 5857 15.5 14 15.5 5 5 5 11 0 0 3 0 0 162 231 188 0.82 1.17 0.95
  143 0.49 9 10
SUBJECT: 7    RUN: 3
 DATA: 6561 5137 5571 16.5 14 15.5 5 5 5 11 0 0 3 0 0 216 162 173 1.1 0.82 0.88
  75 0.77 9 10
SUBJECT: 8    RUN: 1
 DATA: 12665 8111 10428 17.5 15.5 19 5 5 5 9 0 0 1 0 0 480 269 355 1.84 1.03 1.36
  56 1.57 9 10
SUBJECT: 8    RUN: 2
 DATA: 15392 10664 13142 18.5 16.5 17 5 5 5 9 0 0 9 0 0 607 388 508 2.33 1.49 1.95
  64 2.06 9 10
SUBJECT: 9    RUN: 1
 DATA: 5207 4959 5714 17.5 17 17.5 5 5 5 11 0 0 3 0 0 144 135 170 0.77 0.72 0.91
  34 0.44 9 10
SUBJECT: 9    RUN: 2
 DATA: 6501 6285 5714 17.5 16 17.5 5 5 5 9 0 0 1 0 0 209 208 170 1.12 1.11 0.91
  100 0.85 9 10
SUBJECT: 9    RUN: 3
 DATA: 6735 4997 5142 19 17 18 5 5 5 12 0 0 4 0 0 211 [illegible]
```

```
SUBJECT:  3   RUN:  2
DATA:  15332  10664  13142  18.5  16.5  17  5  5  5  9  0  0  9  0  0  607  388  508  2.33  1.40  1.95
  64  2.06  9  10
SUBJECT:  9   RUN:  1
DATA:  5207  4950  5714  17.5  17  17.5  5  5  5  11  0  0  3  0  0  144  135  170  0.77  0.72  0.91
  94  0.44  9  10
SUBJECT:  9   RUN:  2
DATA:  6501  6285  5714  17.5  16  17.5  5  5  5  9  0  0  1  0  0  209  208  170  1.12  1.11  0.91
  100  0.85  9  10
SUBJECT:  9   RUN:  3
DATA:  6735  4007  5142  19  17  18  5  5  5  12  0  0  4  0  0  211  137  138  1.13  0.73  0.74  65
  0.77  9  10
SUBJECT:  10   RUN:  1
DATA:  8720  7454  10000  13  10.5  14.5  5  5  5  11  0  0  1  0  0  354  307  400  1.66  1.44  1.92
  87  1.33  9  10
SUBJECT:  10   RUN:  2
DATA:  10787  8744  8857  14  13  12.5  5  5  5  10  0  0  2  0  0  451  355  364  2.12  1.67  1.71
  73  1.82  9  10
SUBJECT:  10   RUN:  3
DATA:  6744  6611  6285  13.5  10  12  5  5  5  11  0  0  2  0  0  252  268  239  1.18  1.26  1.12  106
  0.85  9  10
SUBJECT:  11   RUN:  1
DATA:  8731  7421  8714  15.5  15  17.5  5  5  5  13  0  0  4  0  0  343  281  330  1.88  1.54  1.81
  82  1.40  9  10
SUBJECT:  11   RUN:  2
DATA:  6578  5704  6285  17.5  15.5  17.5  5  5  5  12  0  0  4  0  0  223  192  209  1.22  1.05  1.14
  86  0.36  9  10
SUBJECT:  11   RUN:  3
DATA:  6912  6428  7428  18  17.5  17.5  5  5  5  12  0  0  4  0  0  237  216  266  1.3  1.18  1.46
  91  0.94  9  10
SUBJECT:  12   RUN:  1
DATA:  7025  5314  6857  15.5  12  15.5  5  5  5  10  0  0  2  0  0  242  181  234  1.11  0.83  1.07
  75  0.61  9  10
SUBJECT:  12   RUN:  2
DATA:  5871  5332  5500  15  13  15.5  5  5  5  10  0  0  1  0  0  188  175  166  0.86  0.8  0.76  93
  0.56  9  10
SUBJECT:  12   RUN:  3
DATA:  5405  4952  4142  16  14.5  16  5  5  5  10  0  0  1  0  0  158  146  95  0.72  0.66  0.43  92
  0.42  9  10
SUBJECT:  13   RUN:  1
DATA:  9150  8061  8571  16.5  14  15  5  5  5  9  0  0  2  1  0  238  217  229  0.79  0.72  0.76  91
  0.52  9  10
SUBJECT:  13   RUN:  2
DATA:  6898  6557  5928  15  13.5  10.5  5  5  5  15  0  0  20  0  0  232  226  217  1  0.97  0.93  97
```

```
SUBJECT:  12     RUN:  2
DATA:  5871  5332  5500  15  13  15.5  5  5  5  10  0  0  1  0  0  188  175  166  0.86  0.8  0.76  93
  0.56  9  10
SUBJECT:  12     RUN:  3
DATA:  5405  4952  4142  16  14.5  16  5  5  5  10  0  0  1  0  0  158  146  95  0.72  0.66  0.43  92
  0.42  9  10
SUBJECT:  13     RUN:  1
DATA:  9150  8061  8571  16.5  14  15  5  5  5  9  0  0  2  1  0  238  217  229  0.79  0.72  0.76  91
  0.52  9  10
SUBJECT:  13     RUN:  2
DATA:  6898  6557  5928  15  13.5  10.5  5  5  5  15  0  0  20  0  0  232  226  217  1  0.97  0.93  97
  0.55  9  10
SUBJECT:  13     RUN:  3
DATA:  9608  8361  7571  16.5  14.5  15.5  5  5  5  9  0  0  1  0  0  350  303  256  1.4  1.21  1.02
  87  1.13  9  10
SUBJECT:  14     RUN:  1
DATA:  12498  9192  11571  19  19  15  5  5  5  10  0  0  2  0  0  425  260  421  1.58  0.97  1.57  61
  1.28  9  10
SUBJECT:  14     RUN:  2
DATA:  10415  7725  10000  20  19  18.5  5  5  5  10  0  0  1  0  0  310  186  305  1.15  0.69  1.13
  60  0.85  9  10
SUBJECT:  14     RUN:  3
DATA:  13321  10292  11142  19  18.5  16  5  5  5  10  0  0  1  0  0  466  320  389  1.73  1.19  1.45
  69  1.43  9  10

)CO IY VI
```