METHYL CHLORIDE:

DEVELOPMENT OF A BIOLOGIC STANDARD FOR THE

INDUSTRIAL WORKER BY BREATH ANALYSIS

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Blood and breath analyses were used to evaluate methyl chloride (74873) exposure in humans. Adults of both sexes were exposed repetitively on a daily basis to methyl chloride gas in concentrations of 0, 20, 100, and 150 parts per million for 1, 3 and 7.5 hours. Physiological responses were monitored, and blood and alveolar air samples were analyzed for methyl chloride concentrations. Physiological, neurological, behavioral, clinical and medical studies revealed no deleterious effects of the methyl chloride exposures. Three male and one female subject had elevated blood and breath methyl chloride concentrations, while these values for the remaining seven male and eight female subjects were not altered by the exposures. The authors conclude that some individuals are more sensitive to methyl chloride exposure, and recommended that breath monitoring can be used to identify exposed employees with higher body burden of the chemical. They suggest that the physically stressed workers may be adversely affected by repeated exposures to the recommended time weighted average concentration (unreported).

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SYNOPSIS - ABSTRACT

Adults of both sexes were exposed repetitively on a daily basis to methyl chloride gas in air concentrations of 0, 20, 100 and 150 ppm for periods of 1, 3, and 7-1/2 hours in a controlled-environment chamber for two purposes: 1) to develop a practical "biologic" test which would indicate the magnitude of an industrial exposure, and 2) to monitor the physiological responses of healthy adults to different vapor concentrations and durations of exposure. These studies were designed to simulate the types of exposure encountered in the industrial setting and consisted of both steady, nonfluctuating concentrations of the gas in air, as well as widely fluctuating concentrations.

Physiological, neurological, behavioral, clinical, and medical studies revealed no deleterious effects of the methyl chloride exposures during these studies.

Blood and breath analyses revealed that the subjects breathing an atmosphere contaminated with methyl chloride gas could be divided into two groups; a minority of subjects had methyl chloride blood and breath levels two to six times higher in concentration than did seven of ten male and eight of nine female subjects. This important phenomena should encourage the use of breath monitoring to identify the employee who consistently carries a higher body burden of methyl chloride upon exposure to this gas. Although we found no deleterious responses in any of our subjects at any magnitude of exposure that could be attributed to methyl chloride, it is possible that the physically stressed worker, may be adversely affected by repeated exposures to the recommended time-weighted average (TWA) concentration.

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INTRODUCTION

Methyl chloride is a gas at normal room temperature and atmospheric pressure (boiling point: -24.2° C). Because of this physical property, it has been used as a refrigerant, as an expanding agent for plastic foams, and as a propellant solvent for aerosol products. It has also been used in industry as a dewaxing solvent, a methylating agent, and a catalyst solvent in synthetic rubber production. Its use as a refrigerant has decreased to being almost non-existent in the United States, partly because of the availability of the fluorocarbons, but mainly because of several deaths in households where leaks occurred in the refrigerating units[1,2]. It can be used without symptoms of illness as a foam blowing agent in industrial situations if the exposure is minimized[3]. No report of deleterious effects due to its use as a propellant is known to the authors; however, with the problems that the fluorocarbons are presently experiencing, the use of methyl chloride as a propellant may increase and problems may arise.

The Threshold Limit Value (TLV) for methyl chloride was established by the American Conference of Industrial Hygienists in 1959 at 100 ppm, where it remains today. Although some investigators assumed that methyl chloride was metabolized to methanol and then to formic acid, these metabolites could not be confirmed in animals[4] or humans[5]. Therefore there has been no "biologic" monitor proposed for its industrial use or for consumer over-exposure.

This study evaluated the potential use of blood or breath analysis as a monitor of exposure, and evaluated human responses to exposures that might occur in industrial situations.

EXPERIMENTAL

Healthy adults of both sexes were exposed to known concentrations of methyl chloride gas in a controlled-environment chamber. These studies were designed to simulate the type of exposures encountered in the industrial setting and consisted of both steady, non-fluctuating concentrations as well as widely fluctuating concentrations of methyl chloride.

Exposure Schedule:

The exposure sequence is presented in Table I. The sequence was initiated with male subjects who were exposed to concentrations of methyl chloride gas in air (v/v) of 0, 20, 100, and 150 ppm for periods of 1, 3, or 7-1/2 hr. The female subjects were exposed to 0 and 100 ppm for identical periods of time. The concentrations of methyl chloride in the controlled-environment chamber were not permitted to fluctuate widely except during the exposure of male subjects in Week 5 when the wide fluctuation experiment was performed. The female subject exposure sequence occurred subsequent to the exposure of male subjects and duplicated Week 2 for males.

The widely fluctuating concentrations of methyl chloride during Week 5 of exposure of male subjects was attained by varying the concentration in the chamber from 50 to 100 to 150 ppm during equal periods of time. The sequence of the up and down concentrations was designed so that the last 15 min of exposure for all subjects was to a concentration of 100 ppm methyl chloride (see Figure 1).

Subjects:

The subjects were selected from the Caucasian, middle-class, working population of the Milwaukee metropolitan area. They were recruited for this study by a private employment agency. Each subject who completed the study received $2.50/hr spent at the laboratory, plus overtime, with a 3-hr minimum payment for the Saturday morning medical surveillance check. After the objectives of the study and the nature of the procedures to be used were fully explained to them, all subjects signed an informed consent form, a copy of which is attached as Appendix I.

Eleven healthy males volunteered for this study. Two volunteers dropped out of the study after the first two contol days (0 ppm methyl chloride) and thus were not exposed to the chemical. Of the 9 volunteer subjects remaining, 4 were assigned to Group I (7-1/2-hr exposure), 3 to Group II (3-hr exposure), and 2 to Group III (1-hr exposure). In addition to the subjects who dropped out of the study during the 0-ppm exposures, three subjects dropped out after the exposures to methyl chloride began. Two new volunteers joined Group III during Week 3. The ages of the exposed subjects ranged from 19 to 34 years (mean: 24), height from 163 to 194 cm (mean: 177), and their weight from 59.7 to 95.4 kg (mean: 75.5).

The ages of the 9 participating females ranged from 19 to 36 years (mean: 24), their height from 161 to 170 cm (mean: 164), and their weight from 50.1 to 77.2 kg (mean: 62.3). None of the subjects was obese. One additional female volunteered but dropped out of the study after the first day (0 ppm methyl chloride). The division of subjects

into Groups I, II, and III was 4, 3, and 2, respectively.

All subjects were cautioned to abstain from the use of drugs and to limit their use of alcohol to very moderate amounts. Subjects who were smokers were not allowed to smoke during their stay in the controlled-environment chamber. Subjects who underwent behavioral testing (3-hr and 7-1/2-hr males) were asked to refrain from consuming any caffeine prior to the end of each day's study (1 hr post exposure).

Most of the subjects had no other wage-earning job during the time of the study, and none experienced any exposure to methyl chloride outside of the laboratory.

Controlled-Environment Chamber:

All exposures to methyl chloride were conducted in a controlled-environment chamber 20 x 20 x 8 ft in size, which was adjoined by a 3 x 5 x 8 ft toilet facility and a 7 x 7-1/2 x 8 ft room shielded against electromagnetic radiation. Both the toilet facility and the shielded room were ventilated by air from the chamber. This three-room complex had its own independent air handling system and all outside doors were self-sealing when closed. Air flow through the complex was approximately 1500 cu ft/min and approximately 25% of this flow was exhausted causing a slight negative pressure within the complex at all times. Air temperature was maintained at 72-74° F while relative humidity ranged between 45-55%. The methyl chloride was introduced by metering the gas into the chamber's circulating air using a GILMONT, size no. 12, glass and TEFLON flowmeter.

Analysis of Chamber Atmosphere:

The methyl chloride gas used to contaminate the chamber atmosphere was obtained from MATHESON SCIENTIFIC in liquid phase in a size 1J pressurized cylinder. The gas was analyzed in our laboratory for purity by gas chromatography and infrared spectroscopy.

Standards were prepared by filling saran bags with room air pumped in sequence through a charcoal column, a wet test meter, a Drierite column, and a type N all-service gas mask cannister. After filling a bag with a known amount of clean, dry air, a calculated amount of methyl chloride was injected into the bag using a gas syringe (Precision Sampling Corp.). Calibration of analytical devices was accomplished by attaching the saran bag standard to the necessary probe within the chamber. At least three standards were analyzed prior to allowing subjects to enter the chamber each day and then standards were analyzed at approximately 2-hr intervals throughout the day.

Two completely independent systems were used to monitor the chamber atmosphere. In both cases, air was withdrawn from the chamber through a 1/4" I.D. polyethylene tube at approximately 7 ℓ/min, through or past the analytical device, to a small diaphragm pump which discharged back into the chamber.

A gas chromatograph (GC) was used as the primary monitoring and chamber concentration control device. The Varian Aerograph Model 940 GC was equipped with a stainless steel column, 1/8" x 18", packed with Poropak Q, and operated at 115° C. Nitrogen was used as the carrier gas to a hydrogen flame detector operated at 335-340° C. An automatic device injected a sample of chamber air into the GC every 70 sec.

Output of the GC was connected to a strip-chart recorder. Peak-height values read manually were entered into a PDP-12 (DEC) computer and transformed into concentrations based on the standards that had been analyzed during the day. Time-weighted average exposure concentrations for each group of subjects were calculated by the computer based upon the methyl chloride concentrations during their time in the chamber.

A Wilks MIRAN-I Infrared Analyzer was used as the secondary monitoring device. The 20-m cell was operated at 9.2, 9.5, or 20 m path-length and the absorption band at 3.35 μ with a 2-mm slit was used. Voltage output of the MIRAN-I was connected to a strip-chart recorder, and a voltage proportional to the pen position of that recorder was conducted to the analog-to-digital input of the computer. The computer sampled pen position voltage each sec, averaged those voltages every 30 sec, recorded the average on magnetic tape, and, using the best fit inverse regression line based on standards, wrote on a CRT the concentration over that 30-sec interval and the cumulative or time-weighted average concentration since the beginning of the run.

Medical Surveillance:

Each subject was given a comprehensive medical examination prior to the study and after the last exposure day of the study. These examinations included a complete history and physical examination with the following laboratory studies: complete blood count, complete panel of clinical chemistries (23 values plus 2 calculated), and a 12-lead electrocardiogram (EKG). A complete blood count and the panel of clinical chemistries were repeated at least once per week during the weekly

exposures. Prior to each day's exposure the subjects were given a brief medical examination which included blood pressure, temperature, subjective signs or symptoms, and urinalysis (Labstix^{R}, Ames). During the time that they were in the environmental chamber, each subject's EKG (lead-II) was continuously monitored by telemetry and recorded at hourly intervals. The subjects were under continual surveillance by medical personnel while they were in the study.

Breath Sample Collection and Analysis:

Alveolar breath samples were obtained daily from each subject prior to entry into the environmental chamber, immediately upon exit from the chamber, and at the following times after exiting the chamber (post exposure): 15 and 30 min; 1, 2, and 3 hr. These samples were each collected in 5-ℓ saran bags. The pre-exposure sample from the following morning represented the 15-1/2-, 20-, or 22-hr post exposure (baseline) sample for Group I, II, or III, respectively. Alveolar breath samples were obtained by expelling a breath (which had been held for at least 20 sec) into the saran bag and stoppering the bag securely. Sampling of the breath in the bag was accomplished by puncturing with a syringe needle. All samples, except the 2- and 3-hr post exposure samples, were analyzed the same day that they were obtained. The 2- and 3-hr post exposure samples were collected by the subjects after leaving the laboratory, and thus were analyzed the following day.

A Varian Aerograph Model 900 gas chromatograph (GC) equipped with a hydrogen flame ionization detector was used to determine methyl chloride in the breath samples. The GC was fitted with a stainless steel column,

5 ft x 1/8 inch, packed with Poropak Q, 60/80 mesh. The column was preconditioned at 220° C overnight prior to use. The operating conditions of the GC were as follows: carrier gas (nitrogen) flow rate of 60 ml/min; column temperature of 110° C; injection port, 190° C; and detector, 240° C. Both hydrogen and air flow were kept at 20 psig. The sample size was usually 1 ml. Standards at 3 concentrations to bracket the unknown levels were prepared with clean air as diluent. A single injection from the saran bags was used because of the reproducibility of the analysis. The concentration of methyl chloride in the unknowns was obtained by direct comparison of peak heights to the standards. The minimal amount of methyl chloride detectable in breath by this method was 0.05 ppm with an accuracy of ± 0.1 ppm.

Blood Sampling and Methyl Chloride Analysis:

Blood samples were withdrawn from an antecubital vein of each subject on Days 1 and 4 of each exposure week. The blood samples were obtained pre-exposure, immediately pre-exit from the chamber, and 15 and 30 min post exposure by 5-ml Vacutainer (B-D). Analysis of methyl chloride was carried out by the indirect headspace technique. After equilibration at room temperature for at least 1 hr, 1 ml of the headspace air was withdrawn and injected into a gas chromatograph. Samples were analyzed the same day that they were obtained.

A Varian Aerograph Model 2700 Moduline^{R} gas chromatograph (GC) equipped with a hydrogen flame ionization detector was used to determine the methyl chloride levels in the blood. The GC was fitted with a stainless steel column 3-1/2 ft x 1/8 inch, packed with 25% Apiezon L on Chromosorb W, 45/60 mesh. The column was preconditioned at 200° C

overnight prior to its use. Throughout the analysis for methyl chloride in blood, the column was baked at 200° C when it was not in use. The operating conditions of the GC were: carrier gas (nitrogen) flow rate of 45 ml per min; column temperature, 120° C; injection port, 235° C; and detector, 250° C. A calibration curve prepared from at least 3 concentrations of methyl chloride in air was prepared daily. Samples were injected in duplicate and the concentration of methyl chloride in the headspace air above the blood was obtained directly from the calibration curve. Concentrations were normalized to 5 ml of blood in each sample. The detectable limit of methyl chloride by this method was 0.05 ppm while the accuracy was ± 0.1 ppm.

Blood Carboxyhemoglobin:

At least once per week while exposed to methyl chloride, blood samples from Group I male subjects and all female subjects were analyzed for carboxyhemoglobin saturation using two IL CO-Oximeters.

Analysis for Methyl Alcohol in Urine as a Potential Metabolite:

All subjects collected 24-hr urine samples on Mondays and Thursdays of each week. The samples were collected in iced jars, and an aliquot of each urine was analyzed for methanol by the gas chromatographic technique using a Poropak Q column.

Neurological Studies:

Within 5 min of entry into the environmental chamber on each exposure day, and within 10 min prior to exit, each subject performed a

modified Romberg and heel-to-toe equilibrium test which was videotaped for later inspection if necessary. The test consisted of standing upon each leg singly with arms at the side for a minimum of 3 sec, and walking heel-to-toe in a straight line for approximately 5 ft. This was first done with the eyes open and then repeated with the eyes shut.

Spontaneous electroencephalograms (EEG) and visual evoked responses (VER) were recorded 4 times each on Monday, Wednesday, and Friday on Group I (7-1/2-hr) subjects. Recordings were normally made once during the first hr and 3 times after the fifth hr of exposure. A complete description and illustration of the EEG-VER monitoring system is found in a previous publication[6] from this laboratory. Gold-plated silver disk electrodes were oriented on the scalp according to a modified 10-20 International Electrode System[7]. GRASS EEG paste was used to secure the electrodes to the scalp. An 8-channel GRASS polygraph fitted with EEG amplifiers was utilized for recording. EEG activity was recorded for 15-sec before, during, and 15-30 sec after acquisition of the VER. The EEG recordings were analyzed by visual examination.

The VER was recorded from the electrode at the inion, referred to the left ear. An EEG channel was used to amplify the VER, and the output was fed to an on-line averaging computer (Nuclear Chicago, 7100). The VER was triggered by a strobe flash (3 μsec) at the rate of 1 per sec for 100 sec. The strobe was operated to deliver 18 million beam candles at 1 m from the subject's eyes, which were closed throughout the period of strobe flashing. Analysis time was 250 msec. Flash delay from the synchronizing pulse which initiated the computer sweep was 25 msec. The computer averaged the response to the 100 flashes and the

resultant VER was recorded on an X-Y plotter for analysis.

It has been shown that VER amplitude can be altered by varying the levels of attention, cortical desynchronization, and sleep[8-10]. Accordingly, standardized conditions were used throughout each exposure day, specifically immediately preceding the actual recordings. After entering the booth, the subject was always allowed 3-5 min to achieve a relaxed state, and then immediately prior to initiating the strobe flash, in an attempt to standardize "attention", the subject clapped his hands 5 times slowly and forcibly.

The most prominent and reproducible portions of the VER complex are the 3rd, 4th, and 5th waves (designation by Gastaut)[6,9,11]. Our analysis was thus restricted to these waves. Wave 3 was identified as proceeding in a positive direction 80-120 msec after initiation of the strobe flash. Waves 4 and 5 were the succeeding negative and positive segments of the VER. Our analysis involved 1) measuring the amplitude of these waves and 2) measuring whether changes had occurred in latency and wave form of the VER complex. The 0-ppm data was compared with the methyl chloride exposure data at the three levels of exposure for male Group I subjects and one level for female Group I subjects.

Before and after each recording session the equipment was calibrated as a system. Ten μv square waves, 100 msec in duration, were fed into the amplifiers, averaged over 100 trials, and recorded.

Cardio-Pulmonary Function Studies:

Minute ventilation was measured under 0-ppm conditions before, during, and after the methyl chloride exposures and on the 2nd and 4th

days of each week of exposure to methyl chloride. Measurements were made while in the sitting position during the last one-half hour of exposure for Groups II and III and during the 5th hr for Group I. The expiration port of a breathing valve was connected via corrugated tubing (1 inch I.D.) to a 13 ℓ spirometer (W.E. Collins). After approximately 5 min breathing on the valve, ventilation was collected for 3-4 min and the average minute volume over this time period was tabulated.

Measurements designed to evaluate functional integrity of pulmonary airways, alveolar-capillary gas exchange, and regulation of pulmonary ventilation and heart rate were made on male Group I subjects only.

Three maximum and partial forced expiratory maneuvers were performed by each male Group I subject under resting conditions between the 5th and 6th exposure hours on 3 days of 0-ppm conditions and on the final day of exposure at 20 ppm, 100 ppm, and 100 ppm fluctuating. The components of the system employed in these measurements were: a) in series a mouthpiece, a flexible tube, a heated Fleisch No. 3 pneumotachograph, and a water spirometer, and b) the essentials of a computer system for analysis, i.e. a PDP-12 mini-computer, oscilloscope, teletype, etc. Initially, under control conditions, each subject's vital capacity (VC) and functional residual capacity (FRC) were determined on the water spirometer. For the actual maneuver, the subject in sequence: a) breathed quietly on the system for 3 or 4 breaths, b) inspired to his 70% VC mark on the spirometer (based on FRC), c) expired maximally, d) inspired maximally, and finally, e) expired maximally. Step-by-step software analysis of the acquired flow-time data included: a) integration to determine volumes, b) generation of flow-volume curves, and

c) calculation and printout of such variables as total expiratory volumes (VC), volume expired in one second (FEV_1), and flow rates at 40% and 25% of vital capacity for both the maximum and partial expiration. It is important to note that in our system, because expired flow rate was dependent on lung volume, necessary adjustments were made so that all flow rate determinations were at the same absolute lung volume.

Metabolic, pulmonary, cardiac, and hematologic parameters were measured on Group I male subjects at rest and during two levels of dynamic muscular exercise between the 5th and 7th hours of exposure on Day 4 of each week (Day 2 of Week 6). The exercise was performed on a bicycle ergometer for 11 consecutive min, 6 min at 350 KPM followed by 5 min at 750 KPM.

The essential components of the expired gas collection and measurement system were a breathing valve, corrugated tubing, a Parkinson-Cowan gas meter, a 150-ℓ Douglas bag, and a Hewlitt-Packard recorder. Minute ventilation and tidal volume were quantitated using the gas meter and recorder. Expired gas was collected in the Douglas bag for 1 min at rest and 1 min at each exercise intensity (between 4.5 and 5.5, and 9.5 and 10.5 min of exercise). Fifty ml of this mixed expired air was stored in a glass syringe and subsequently analyzed for $[CO_2]$ and $[O_2]$ using a Quintron gas chromatograph. Pulmonary ventilation, $[CO_2]$, and $[O_2]$ were used to calculate metabolic rate, respiratory quotient, and alveolar ventilation.

For sampling of blood, a 21-gauge needle was placed in a superficial dorsal hand vein. The needle was attached to a tubing stopcock arrangement which during non-sampling periods was filled with heparinized saline. For 5 min prior to sampling, the entire hand was heated

to approximately 42° C. This procedure sufficiently "arterialized" the venous blood so that P_{CO_2} and pH were virtually identical to arterial[12]. Three to 5 ml of blood were sampled over the 1-min period of expired air collection. The blood was analyzed within 15 min for P_{CO_2} and pH with the Radiometer electrode arrangement.

Alveolar-capillary gas exchange was assessed by the single breath carbon monoxide diffusion technique[13] (D_LCO). Measurements were made twice on each subject at rest and after 5.5 and 10.5 min of exercise. The previously described computerized system was used to calculate inspired, residual, and total lung volume and D_LCO. Neon was used as the inert gas to measure residual volume. Neon and CO concentrations in the collected alveolar sample were analyzed using a Quintron chromatograph.

Heart rate was measured using the Biotel 170 ECG patient telemetry system developed by Spacelabs, Inc. (Chatworth, California). Heart rate was measured during the 30-sec interval preceding initiation of the exercise and over the final 15-sec interval of each exercise period (350 and 750 KPM).

Systolic and diastolic blood pressure were measured by the auscultatory method. Measurements were made at rest and after 4 and 9 minutes of exercise.

Cognitive Testing:

A battery of cognitive tests were performed in a group situation by the male Group I and II subjects on days 1, 3, and 5 of each week. The testing was carried out 3 and 2 hr after the start of exposure for the

7-1/2 and 3-hr groups, respectively. The subjects were trained to a performance plateau before these tests were used during exposures to methyl chloride.

The subjects sat in comfortable chairs at individual carrels to perform the cognitive tests. The subjects were not permitted to talk or have access to watches, food, soft drinks, radios, etc. during the testing. All instructional commands were made from outside of the chamber via an intercom system. The tests, in order of performance, are described below.

Ten- and Thirty-Second Time Estimation Test: Each subject, upon the verbal signal "ready, begin", depressed a hand-held, silent, push-button micro-switch for an interval of time he estimated to be 10 seconds. This was repeated two additional times, and then three 30-second estimates were made. The micro-switches were connected to the PDP-12 Digital computer which measured the time intervals. This test took approximately 3 min to perform.

Marquette Time Estimation Test: This test consisted of a series of nine tone stimuli followed by nine light stimuli of approximately 1, 3, and 5 sec duration presented in a random sequence but always with three stimuli of each time interval. At the termination of each stimulus, the subject depressed the push-button for that interval of time he estimated to be equal in length to the original auditory or light stimulus. A detailed description of the test and the instrumentation used to carry it out has been described by Stewart, et al[14]. This test took approximately 7 min to perform.

Coordination Test: This test was the Flanagan Aptitude Classification Tests, 7A, Coordination, published by Science Research Associates, Inc., 259 East Erie Street, Chicago, Illinois. This test asked the subject to rapidly follow a spiral pathway with a pencil. The subject was allowed 40 sec to complete each of 6 spirals. The first 2 were considered practice and the last 4 were scored and totaled. The total score depended upon the longest distance attained in each spiral minus the number of times the sides of the spiral pathway were touched with the pencil. This test took approximately 5 min to perform.

Arithmetic Test: This test, which measured the subject's ability to work with numbers, was divided into 2 parts. The first part, lasting 5 min, consisted of simple addition and subtraction problems while the second part, lasting 3 min, consisted of multiplication and division. The maximum score attainable if all answers were correct was 140; however, no subject completed the tests in the allotted time. In order to minimize memorization of answers, 10 randomly generated problem tests were used.

Inspection Test: This test was a measure of the subject's ability to spot the number "3" in rows of random numbers on an 8-1/2" x 11" page. The subject was asked to scan each row, beginning at the top of the page, and slash out with a red pencil each "3" encountered. The subject was given 2 min to strike out as many as possible. No subject ever finished the entire page. A subject's score was the total number of "3's" struck. Six differing pages with random numbers were utilized so that no subject received an identical number sheet on successive tests.

Electrically Evoked Electromyograms:

The electrically elicited monosynaptic reflex of the gastrocnemius muscle was obtained from Group I male and female subjects 3 times a day during the 2-3 days of 0 ppm conditions and during the first, third, and fifth days of exposure at the various concentrations of methyl chloride. This reflex is commonly called the "H response" and it is elicited by an electric shock to the muscle spindle afferents (Ia) in the tibial nerve at the popliteal fossa (Figure 2). As shown by the schema in Figure 3, the Ia spindle afferents synapse with alpha motorneurons which when activated elicit a contraction of the muscle (gastrocnemius).

For both delivery of the stimulus and recording of the compound action potential, small silver disk electrodes were taped to the prepared skin of the left leg. The stimulus was a 0.1 msec square-wave pulse (American Electronics Lab; stimular, model 104A) delivered to the posterior tibial nerve at the popliteal fossa. The anode was placed on the posterior aspect of the ipsilateral thigh. One recording electrode was placed on the midline of the posterior aspect of the leg approximately 20 cm from the calcaneus. The other was placed over the belly of the muscle approximately 5 cm proximal and 3 cm lateral to the first. The ground was placed lateral to the popliteal fossa. Indelible ink was used to mark the electrode sites. The electrodes were placed prior to initiation of exposure, and generally, with the aid of an elasticated net bandage (Surgifix) placed over the leg, they remained in place throughout the day.

While obtaining the reflex, the subject lay prone on a well grounded cot. After connecting the electrodes, electrical stimuli were delivered at 20-sec intervals at increasing intensity until the reflex

action potential (amplified by low level Tektronix preamplifier, model FM 122) became evident on the oscilloscope (Tektronix, type RM504). This stimulus intensity was then repeated with the shutter of a camera (Beattier-Coleman Oscillotron II, mounted on oscilloscope) open so that a permanent record could be obtained of the compound action potential.

Our analysis of the EMG's was restricted to visual examination and measurement of stimulus to response latency. Statistical treatment of the latency measurements included a paired t-test to determine whether changes occurred within each particular day and analysis of variance and group t-test for detection of potential changes between 0 ppm and methyl chloride exposure conditions.

Subjective Responses:

Each subject was asked to note on an individualized form any subjective responses occurring during the exposure in the chamber or during the first 3 hr post exposure. The form contained rows for noting headache, nausea, dizziness, abdominal pain, eye, nose, throat irritation, other, and odor, and columns for the "immediate", "1/2-hr", and hourly periods of time thereafter. The adjectives "mild, moderate, and strong" appeared on the sheet as cue words, and the phrase "only abnormalities recorded" was prominently typed at the bottom. The home telephone numbers of each of the Department physicians appeared on the form and the subjects were encouraged to phone if they became ill while away from the laboratory.

Retention of Methyl Chloride in Breath Containers:

Two types of breath containers were studied, the glass tube with screw-on plastic caps at each end[15], and the approximately 5-ℓ saran film bag. The latter was used exclusively for breath sampling in the study of breath decay curves for methyl chloride. To study retention in the two types of containers, 30 tubes and 6 bags were filled, 5 tubes alternated with 1 bag, with a diaphragm pump over a 30-min period while the controlled-environment chamber concentration was held constant at 49 ppm (± 1.35, n = 27). Ten tubes, selected at random from the thirty, were analyzed for methyl chloride within 2 hr (0 time). Five tubes were packaged, taken to Colorado, and returned by airmail. Five tubes from the remainder were analyzed at 24 hr, 48 hr, and at 120 hr when the airmailed tubes had been returned. Each time that tubes were assayed, the saran film bags were reassayed and a mylar film tape placed over the needle puncture. Bags and tubes, except for the airmailed tubes, were stored at room temperature during the study.

RESULTS

Exposure Schedule:

The exposure schedule for volunteer male subjects was designed so that control (0 ppm methyl chloride) exposures were carried out prior to, in the midst of, and at the end of the actual exposures to this chemical gas. As shown in Table I, these control days occurred on days 4 and 5 of Week 1, prior to any methyl chloride exposure; days 4 and 5 of Week 4, six days after the last previous exposure to methyl chloride, 20 ppm; and on day 3 of Week 6, the day following an exposure to 150 ppm methyl chloride gas. Because Groups I and II male subjects were to be given behavioral tests which required several training sessions, these sessions were carried out on days 1, 2, and 3 of Week 1. The two control days for volunteer female subjects were scheduled two days prior to and again after the five consecutive days of exposure to methyl chloride gas.

A five-consecutive-days-per-week exposure to a steady 100 ppm concentration of methyl chloride for 7-1/2, 3, or 1 hr per day was carried out with male subjects during Week 2. Similarly, they were exposed to a fluctuating (50 to 150 ppm) time-weighted average (TWA) concentration of 100 ppm during Week 5. The exposure of female subjects to a steady 100 ppm concentration of methyl chloride duplicated the Week 2 exposures of male subjects. The male subjects were also exposed to a TWA concentration of 20 ppm for four consecutive days, Week 3, and 150 ppm for two consecutive days, Week 6. This schedule provided the required data utilizing the fewest number of exposure days.

Subjects:

Retaining the optimum ten subjects for each study with methyl chloride proved impossible. Table I shows the number of subjects in each group on a daily basis. Although each study was begun with four subjects in Group II (3-hr exposure), three of the male subjects and one female dropped out before each respective study was completed. There was also a dropout of a male subject in Group III (1-hr exposure); however, two male subjects were added during the study as training for any tests was not necessary in this group. All subjects who dropped out did so voluntarily because of personal reasons, or were asked to discontinue testing because of their inability to meet the requirements of the study. In cases of the latter, over-indulgence of alcohol was the usual problem.

Attendance of Group I subjects, male and female, was excellent, as was their cooperation in carrying out their assigned tasks.

Controlled-Environment Chamber:

All subjects were sedentary during their stay in the controlled-environment chamber except for the brief period of exercise during pulmonary function testing of Group I, males, one day per week. The subjects generally watched television, chatted, or played cards during the periods that they were not personally involved in a testing procedure. All Group I subjects ate their lunches in the chamber. Each period of exposure, 7-1/2, 3, or 1 hr, was continuous each day. The large size of the environmental chamber (20 x 20 x 8 ft) allowed complete freedom of movement and comfort for all subjects.

Due to leaky ductwork in the air handling system of the chamber, some methyl chloride contamination of the air in the subject lounge occurred. The subjects stayed in this lounge for approximately one-half hour before and one hour after daily exposure in the environmental chamber. Random samples from the subject lounge, obtained and analyzed during an exposure, measured 0.5 ppm methyl chloride during a 20-ppm chamber exposure; 1.4, 2.3, and 3.0 ppm during a 100-ppm; and 4.2 ppm during a 150-ppm exposure. Although these values represent a very small percentage of the chamber concentration, as a precaution, all subjects gave their pre-exposure breath samples in the uncontaminated foyer immediately upon entry to the building.

Analysis of the Chamber Atmosphere:

A slight interference by water vapor in the chamber atmosphere at the analytical infrared wavelength for methyl chloride prevented use of the infrared analyzer as the primary controlling device for the concentration of methyl chloride gas in the controlled-environment chamber. However, the gas chromatograph system, presenting a peak every 80 seconds, but no time-weighted average concentration until the peak heights were measured and entered into the computer, provided good control of the methyl chloride gas concentration as shown in Table I. The time-weighted average concentrations were always within ten percent of the goal for the day, and were usually within five percent.

Though the infrared analyzer system could not be used for primary control of the chamber atmosphere, it was an effective system for assuring that the concentration prior to subject entry was correct, and

that no gross excursion of concentration occurred while subjects were in the chamber.

Medical Surveillance:

Comprehensive medical examinations revealed that all subjects were in good health prior to and after the study. The attached forms (History - Appendix II, Physical Examination - Appendix III) were used and are retained in each subjects' confidential personal file. Daily medical surveillance by a physician, daily check of temperature and blood pressure, weekly blood clinical chemistries and complete blood counts, daily urinalysis, and continual monitoring of EKG's (lead II) while subjects were in the controlled-environment chamber, revealed no unusual abnormalities that could be attributed to the exposures to methyl chloride. No female became pregnant while a subject in the study.

Breath Analysis:

The results of the daily methyl chloride in breath analyses for male subjects are given in Tables II through XVIII. It became rapidly apparent upon calculating means of the values from Groups II and III that one subject from each group had much higher breath levels of methyl chloride, especially from immediately to one-hr post exposure, than did the other subject or subjects. This is exemplified in Tables III and V by the large range in values. In those groups that included a "high-breath-level" responder, a second table of means was prepared omitting the results from that responder. The latter groups (omitting the "high-breath-level" responders) were labeled II-b or III-b, while the total

group means were labeled II-a or III-a. A similar format was followed for Tables XIX through XXIII which summarize the breath levels by weeks for the male subjects. Tables XXIV through XXVIII list the results of breath analysis for female subjects. Interestingly, only one of the nine female subjects was found to be a "high-breath-level" responder, and she was found in Group II. Therefore there are the two tables for Group II females as already described for the Groups II and III males.

Attention is also drawn to the fact that throughout these methyl chloride breath concentration tables, the values for "baseline" are those from the initial breath samples for that day, given in the foyer of the building before entering the laboratory area. Leaky or uncorked bags, or occasional masked peaks, invalidated approximately 10 percent of the breath values. The masked peaks in the chromatograms were felt by the analyst to be due to ethanol because they occurred exclusively on sample bags taken home.

Methyl Chloride in Blood:

Tables XXIX through XXXIV list the individual methyl chloride in blood values obtained for each subject on Days 1 and 4 of each methyl chloride exposure week. Perusal of the data reported from the laboratory indicates the difficulty of measuring methyl chloride accurately at the lowest levels of exposure (20 ppm), and at all time periods except the pre-exit sample. Blood levels drop very rapidly post exposure, even after a 7-1/2-hr exposure to 150 ppm.

It was of great interest to follow the blood levels of the three male subjects (numbers 267, 274, and 276) and one female subject (number

282) who had grossly exaggerated levels of methyl chloride in their breath upon exit from the chamber. Not surprisingly, these subjects had three to five-fold higher blood concentrations of methyl chloride than did their peers. This situation continued at 15 and 30 min post exposure, and possibly even until the next morning. Unfortunately, two of these four subjects had poor attendance and multiple data points were not obtained.

Blood Carboxyhemoglobin:

Tables XXXV through XXXVIII list the blood carboxyhemoglobin percent saturation values for individual subjects. Values for pre-exposure (baseline), pre-exit, and 30 min post exposure revealed no indication of conversion of methyl chloride to carbon monoxide in the body as is the case with methylene chloride[16].

Urinary Analysis for Methyl Alcohol:

Analysis of 24-hr urine collections for methyl alcohol revealed no discernable amounts of methyl alcohol in any sample.

Neurological Studies:

No significant neurological abnormalities occurred during the exposures of these subjects to methyl chloride. Equilibrium as measured subjectively on a daily basis by the modified Romberg and heel-to-toe tests remained normal after 7-1/2, 3, or 1 hour of exposure. One Group III subject had difficulty performing the tests after his one hour of exposure to 100 ppm methyl chloride on Day 3 of Week 2. This was

interpreted to be a spurious result as the loss of equilibrium was not repeated at this concentration or at 150 ppm.

All visual analyses of EEG recordings during exposures to methyl chloride appeared normal. Figures 4 to 7 and 8 to 11 show representative tracings of the EEGs of the four male and four female subjects, respectively. Included are tracings from the 0 ppm days and the days of highest exposure to methyl chloride. Likewise, there was no visible difference nor was there significant measurable difference in the VER tracings of these subjects. Figures 12 to 19 show the VER tracings obtained during several control days while Figures 20 to 27 show representative tracings for comparative purposes at the various levels of methyl chloride exposure.

Cardio-Pulmonary Function Studies:

Pulmonary Ventilation. The individual values of pulmonary ventilation are presented in Table XXXIX. There were some spurious values from each individual, probably reflecting an altered emotional state, but in general, the values were consistent from day-to-day. The difference between male and female subjects reflects the lower metabolic rates of the females. The values are in the range expected from subjects in the seated position[17].

Maximum and Partial Expiratory Volumes and Flow Rates. Expiratory volume and flow rates have traditionally been used to detect certain pulmonary diseases. Recently it has been shown that probably the most sensitive index of acutely induced airway disease is expiratory flow rate (at low lung volumes) after inspiring to approximately three-fourths

of total lung volume[18]. Expiratory flow-volume curves can be constructed for expirations following both a maximum and a partial inspiration, and typical examples of these curves are presented in Figures 28 and 29. The calculated mean expiratory volumes and flow rates at various points in the expiration for all four Group I male subjects are tabulated in Table XL. There was no significant change in any of the parameters during exposure to methyl chloride. Because lung volumes and expiratory flow rates are dependent on such factors as respiratory muscle power, lung and chest wall elasticity, and bronchomotor tone, we conclude that methyl chloride exposure had no major effect on pulmonary mechanics. The trial to trial variability in each parameter was calculated and is presented in Table XLI. For all parameters, variability was three percent or less, and there was no significant difference between trials ($p > 0.5$).

Metabolic Rate, Pulmonary, Cardiac, and Hematologic Data. Cardiovascular-pulmonary function is sensitive to changes in metabolic rate and state of anxiety or emotion. The effect of the latter is markedly reduced during muscular exercise. Accordingly, in evaluating whether a treatment such as methyl chloride exposure altered cardiovascular-pulmonary function, it was helpful to relate each function to metabolic rate during both resting and exercise conditions (Figures 30 through 35). When evaluated in this manner, most of the functions remained within normal limits throughout the study[19,20]. The possible exceptions were arterial pH and P_{CO_2} (Figure 32). There was a slight respiratory acidosis during exercise on some of the days of methyl chloride exposure. This trend was most evident during exposure at 100

ppm, fluctuating. A tendency toward alveolar hypoventilation was also evident on this day which would induce respiratory acidosis. Trial to trial variability was checked for Pa_{CO_2}, arterial pH, and $D_{L_{CO}}$ at rest. There was no significant difference between 20 paired samples for each parameter. Variability (mean difference/grand mean x 100) ranged from 0.3% (arterial pH) to 2.6% ($D_{L_{CO}}$).

Cognitive Testing:

Extensive data accumulated from the battery of cognitive tests given to Group I and II male subjects on Days 1, 3, and 5 of each week. The daily means (± one standard deviation, S.D.) of the test results versus the day performed, along with bar graphs showing the concentration of methyl chloride, were graphed for rapid visual assessment. Figures 36 through 45 contain the data for Group I subjects while Figures 46 through 55 are for Group II subjects. In order to assess the significance of the exposure to methyl chloride on test results, analysis of variance for the Group I scores were made for the parameters measured in each test. There were insufficient test subjects in Group II to make such an assessment feasible. Results of the analysis of variance are shown in Tables XLII through LII. Significant variance ($p < 0.05$), other than that attributed to learning (linear day trend) and people, was noted only in the effect of methyl chloride exposure upon the Marquette test, Estimate/Stimulus, light stimulus only (Table XLVII). Figure 56 shows the test performance means (± S.D.) versus exposure level on the last day of exposure at each exposure level (first day only for 150 ppm level). The mean performance scores do show an inverse

relationship with exposure level, from an over-estimate at control levels to an under-estimate at each methyl chloride exposure level. Interestingly, this effect was not seen for the sound stimulus. Neither were the Group II (3-hr exposure) subjects affected by methyl chloride for either the light or sound stimulus. It is therefore assumed that this change in estimating the length of the light stimulus is probably a spurious occurrence.

Electrically Evoked Electromyograms:

Electrically evoked electromyograms (EMGs) were obtained on both male and female subjects exposed to methyl chloride for 7-1/2 hr daily. The testing was carried out within 1 hr after exposure began, at 3-4 hr of elapsed time, and again at 6-1/2 to 7-1/2 hr, on Days 1, 3, and 5 of each week. Visual comparative examination of control and exposure EMGs revealed no change in the configuration or stimulus-to-response latency for any subject as a result of exposure to methyl chloride. Figure 57, which shows randomly selected EMGs of one male subject at three different time periods while exposed to either 0 ppm or 100 ppm methyl chloride, demonstrates the extreme stability of the response. Latency measurements, as shown in mean and standard-error-of-the-mean analyses in Table LIII, revealed no significant within-day or methyl chloride exposure effect for either males or females.

Subjective Responses:

There were a minimum number of subjective responses noted during exposures to methyl chloride (see Table LIV), and there was no difference

in percent responding with complaints between control days and exposure to 20, 100, or 150 ppm, males, or 100 ppm, females. Although a notation of a mild odor was entered occasionally on the subjective response forms, this occurred as frequently during 0 ppm conditions as during 100 or 150 ppm levels. Several subjects developed colds, including mild throat irritation, but by the physician's judgment the incidence was no greater than normal for this season of the year.

Retention of Methyl Chloride in Breath Containers:

The results of the study to ascertain the retention of methyl chloride in two types of breath containers are shown in Table LV. The saran bags were excellent in retaining the methyl chloride for the first 24 hr as shown at the bottom of the table. At 48 hr, one had leaked severely, as noted by complete deflation, as had another at 120 hr. Individual assay results also were spread considerably at these two times post-filling, even though the averages were close to the zero-time average. It is more difficult to determine when and if a glass tube has leaked, the criteria being an assay value one-half, or less, than that expected. This occurred only in the tubes that were airmailed, where the reduced outside pressure at the heights flown by aircraft no doubt partially evacuated some of the tubes. The tubes appear to be relatively stable in methyl chloride content for the first 24 hr; however, a gradual decline in concentration was already apparent at this time. At 120 hr, the five tubes retained an average of 87% of the zero-time saran bag average.

DISCUSSION

Methyl chloride has three physical properties that increase its potential for hazard to workers' health; it is a gas at room temperature, it is colorless, and its odor is undetectable at concentrations in air that may be injurious to health. Despite these hazardous properties, only one report could be found in the literature of the past ten years describing serious intoxication of workers other than due to refrigeration leakages. This 1974 report by Scharnweber, et al[21], relates six cases of chronic overexposure in a plastic foam plant where methyl chloride was used as a blowing agent. The intoxicated workers were believed to have been exposed to an eight-hour time-weighted average concentration in air of from 265 to 300 ppm for several weeks. Behavioral and neurological symptoms of an insidious nature predominated, with slight elevation in blood pressure in three cases. All workers recovered from the overexposures with the exception of one individual who still exhibited symptoms of tremor and increased nervousness three months after hospitalization. Other recently reported cases of methyl chloride intoxication[22,23,24] have all occurred in Eastern European countries as a result of leaking refrigeration charged with methyl chloride as a refrigerant. This use has been abandoned in the U.S., and therefore a potential hazard has been removed.

Repko, et al[25] evaluated the behavioral and neurological performance of a large group of workers in several industrial plants of a company using methyl chloride as a blowing agent for foam manufacture. They found a significant correlation between increasing levels of methyl

chloride exposure and decrements in amount of hand tremor (increased) and performance of the two-digit math test. There was no correlation with electroencephalographic changes. Unfortunately, the two methods of exposure analysis used did not give acceptably agreeing results causing some question as to actual exposure conditions on the test days. Between group comparisons were marred by the significantly lower age of the control group. Methyl chloride in breath proved to be an insensitive indicator of methyl chloride exposure. A significant correlation of performance decrement was found with decreasing urine pH. However, the meaning of this correlation is unknown because diets were uncontrolled, and there have been no laboratory studies to confirm a direct relationship between increasing methyl chloride exposure and decreasing pH or urinary acidity.

Behavioral, neurological, and electromyographic testing of subjects in this study exposed to 20, 100, or 150 ppm methyl chloride in air for 7-1/2 hr per day resulted in no significant decrements in performance. One significant change in performance was correlated with increasing methyl chloride concentration in air; male subjects changed from overestimating the length of a light stimulus during control conditions to underestimating it with increasing methyl chloride concentration (see Figure 56). However, this change did not occur with the sound stimulus or with 3-hr subjects, and is therefore believed to have been spurious and to have no significance regarding performance in the work place. There was no decrement in performance on the arithmetic tasks performed by these subjects; however, they were not a part of a multiple-task testing regimen as employed by Repko, et al[25]. Hand tremor was not

tested in the subjects in this investigation. However, hand tremor would not be expected to be induced under the few days of exposure used. In summary, we did not find any significant behavioral changes in these subjects similar to those found by Repko, et al, in methyl chloride exposed workers.

Regarding urine pH, a rough pH measure of the morning urine sample was made daily using the dip indicator technique. The results did not reveal any increasing acidity with increased methyl chloride concentration, though no exact pH measurements were made and therefore the dip technique may not have been sensitive enough to reveal any relationship. No methyl alcohol was found in the urines as a metabolite of methyl chloride.

The most interesting results of this study occurred in the analyses of breath and blood samples. The mean daily alveolar post exposure breath concentrations from four 7-1/2-hr subjects during the week of exposure to 100 ppm steady are shown in Figures 58 and 59 for male and female subjects, respectively. The mean breath concentrations, at 35 to 50 ppm upon exit from the chamber, dropped very rapidly so that by 60 min post exposure the concentrations were in the range of 1 to 4 ppm. At 2 and 3 hr post exposure they were in a range of questionable accuracy, below 1 ppm. None of the other chlorinated hydrocarbons studied in this series, methylene chloride, 1,1,1-trichloroethane, perchloroethylene, or trichloroethylene, dropped to such low levels so rapidly. As would be expected from such a rapid disappearance from the breath, there was no cumulation effect on successive days of the week.

Figure 60 demonstrates the mean breath decay curves for the four male subjects exposed to three concentrations of methyl chloride for

7-1/2 hr per day and the four female subjects exposed to 100 ppm only. The dashed line represents mean values from the female subjects. It is evident that though the concentration of methyl chloride in the sample taken at exit from the chamber (zero time) correlated directly with exposure concentration, subsequent samples were more difficult to differentiate as to exposure concentration, except those from the 20 ppm exposures which were significantly lower. From these results it is evident that breath analysis decay curves that would differentiate exposures of 100 and 150 ppm were not obtained. Therefore it is not possible, as it is with other chlorinated hydrocarbons studied, to assess the magnitude of a methyl chloride exposure by analyzing post exposure alveolar breath samples.

As noted in the Results section, four subjects in the 3- and 1-hr exposure groups consistently had much higher concentrations of methyl chloride in their alveolar breath samples after identical exposures than did their peers. The high responders were arbitrarily labeled type B, while the normal responders were labeled type A. Table LVI compares individual type B subject's alveolar breath values to those of type A at zero time, while Table LVII gives similar data obtained at 1 hr post exposure. Mean alveolar breath concentrations of type B subjects were elevated from 60 to 110% over mean values for type A subjects at zero time, and were three to six fold higher at 1 hr post exposure. A similar phenomenon had been observed but unconfirmed in 1962[26] when two of six male subjects exposed to approximately 100 ppm methyl chloride for 6-1/2 hr had similarly elevated post exposure breath levels. Those two subjects were added to Table LVII as type B subjects 5 and 6. The similarity of

breath concentrations to the present type B and type A subjects is striking.

Breath analysis points were plotted for the varying lengths of exposure to 100 ppm methyl chloride for both type A and B subjects as shown in Figure 61. This figure demonstrates another unique feature of the methyl chloride breath analysis decay curves, i.e., one cannot differentiate between 1-, 3-, and/or 7-1/2-hr exposures of type A subjects. In addition, the figure demonstrates that there was no overlap of the value from type A and type B subjects at 15, 30, and 60 min post exposure. At 120 and 180 min post exposure values from all subjects tended to converge.

The comparison of methyl chloride venous blood concentrations (indirect headspace method) at the end of 1- or 3-hr exposures of types A and B subjects is demonstrated in Figure 62. Blood levels by this method were also much higher in type B subjects, although one could argue that this could have been due to a difference in solubility since the headspace technique was used. The higher blood levels in type B subjects continued through the 15 and 30 min post exposure sampling periods. These results indicate that the higher post exposure breath levels of type B subjects are a direct result of higher blood levels.

Unfortunately, the fate of methyl chloride in the human body is still unknown. It was thought to be metabolized to methanol and hydrochloric acid[27]; however, we were unable to detect any methanol in the urine of our subjects confirming a previous report[5]. It more likely is conjugated with sulfhydryl groups in the liver and excreted as a mercapturic acid, or it may be oxidized to formaldehyde, which would

rapidly be further oxidized to formic acid and excreted. The reason for the difference in blood and breath levels in our subjects could not be associated with differences in weight, body build, or blood lipids. It may be theorized that the difference was related to glutathione content of the liver which is known to be depleted with starvation. However, the consistency of the increased response would negate this theory.

The question arises as to which of the two types of persons may be more susceptible to the central nervous system effects noted with chronic overexposure to methyl chloride[21]. As previously noted, these effects are insidious, and can occur long after blood and breath levels are below measurable concentrations. From this standpoint, the person who exhibits the lower blood and breath levels, and who therefore assumedly is metabolizing more of the compound to the toxic metabolite, may be more susceptible. On the other hand, the type of person who exhibits higher blood and breath levels may be more susceptible to acute overexposure, assuming methyl chloride per se is the cause of any acute effects. And of course the third possibility exists that any toxic effects are due to a minor metabolite that is produced only upon exposure to much higher levels of methyl chloride.

It is our recommendation that additional studies be carried out to attempt to determine whether the type A and B responders exist, and in what ratio, in industrial situations where methyl chloride exposures occur. Furthermore, additional studies should be carried out to attempt to define the metabolite(s) of methyl chloride. And finally, the effect of exercise on both types of subjects should be determined.

In conclusion, this study did not reveal any deleterious, measurable effects of the sedentary exposure of male or female subjects to 100 ppm methyl chloride for up to 7-1/2 hr per day for five consecutive days. It did reveal that a small number of subjects, four of twenty, exhibited much higher blood and breath levels of methyl chloride than did there peers. This finding and its significance in the work place needs additional study.

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TABLE I

METHYL CHLORIDE EXPOSURE SCHEDULE

ACTUAL TIME-WEIGHTED AVERAGE CH_3Cl CONCENTRATION, PPM

			GROUP I, 7-1/2 HR			GROUP II, 3 HR			GROUP III, 1 HR		
WEEK	DAY OF WEEK	DESIRED CONC. PPM	NUMBER OF SUBJECTS	MEAN	±S.D.	NUMBER OF SUBJECTS	MEAN	±S.D.	NUMBER OF SUBJECTS	MEAN	±S.D
					MALE						
1	4	0	4	0		4	0		2	0	
	5	0	3	0		4	0		2	0	
	1	100	4	98	3	3	100	2	2	100	2
	2	100	3	93	5	4	93	2	2	96	1
2	3	100	4	97	5	3	98	3	2	92	5
	4	100	4	93	4	2	94	4	2	90	2
	5	100	4	92	3	2	93	3	2	92	1
	1	20	4	20	<1	1	20	<1	3	20	<1
	2	20	4	18	<1	1	18	<1	3	18	1
3	3	20	4	19	1	2	20	<1	3	21	<1
	4	20	4	20	<1	2	20	<1	3	20	<1
4	4	0	4	0		1	0		1	0	
	5	0	4	0		1	0		3	0	
	1	100f	4	95	40	1	95	42	3	99	41
	2	100f	4	97	39	0			3	92	37
5	3	100f	4	98	38	0			3	98	36
	4	100f	4	104	43	1	105	43	1	105	43
	5	100f	4	97	39	1	100	40	3	92	34
	1	150	4	148	4	1	150	3	2	143	5
6	2	150	4	149	6	1	150	4	1	155	4
	3	0	4	0		1	0		1	0	
					FEMALE						
1	5	0	4	0		4	0		2	0	
	1	100	4	99	4	3	99	4	2	95	2
2	2	100	4	100	4	3	101	5	2	99	3
	3	100	4	98	3	3	99	3	2	100	3
	4	100	4	99	3	3	102	2	2	96	3
	5	100	4	99	4	3	100	3	2	97	4
3	1	0	4	0		3	0		2	0	2

TABLE II

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 7-1/2 Hours - Chamber Concentration: 100 ppm

GROUP I

	Time	Mean (in ppm)	Range (in ppm)	± Standard Deviation	Number of Subjects
Day 1:	1 min., post exit	47.25	39.00 - 55.00	6.55	4
	15 " " "	3.40	2.00 - 4.20	0.99	4
	30 " " "	1.95	1.80 - 2.00	0.10	4
	1 hour " "	1.23	1.00 1.80	0.39	4
	2 " " "	0.30	0.30	0	3
	3 " " "	0.20	0.20	0	2
	Baseline	0.30	0 - 0.60	0.30	3
Day 2:	1 min., post exit	45.50	44.00 - 47.50	1.80	3
	15 " " "	3.83	3.30 - 4.20	0.47	3
	30 " " "	2.27	2.00 - 2.40	0.23	3
	1 hour " "	1.63	1.40 - 1.75	0.20	3
	2 " " "	0.90	0.90	0	3
	3 " " "	0.60	0.60	0	2
	Baseline	0.30	0.30	0	4
Day 3:	1 min., post exit	42.00	28.00 - 50.00	10.46	4
	15 " " "	3.50	3.00 - 4.00	0.44	4
	30 " " "	2.33	1.80 - 3.60	0.86	4
	1 hour " "	1.20	0.90 - 1.50	0.25	4
	2 " " "	0.50	0.50	0	3
	3 " " "	0.33	0.25 - 0.50	0.14	3
	Baseline	0.23	0.20 - 0.25	0.29	4
Day 4:	1 min., post exit	40.50	32.00 - 48.00	7.72	4
	15 " " "	3.10	2.40 - 3.60	0.50	4
	30 " " "	1.80	1.60 - 2.00	0.23	4
	1 " " "	1.00	0.80 - 1.20	0.23	4
	2 " " "	0.40	0.30 - 0.50	0.08	4
	3 " " "	0.30	0.20 - 0.50	0.14	4
	Baseline	0.20	0.20	0	3
Day 5:	1 min., post exit	46.63	39.00 - 52.50	6.49	4
	15 " " "	3.15	2.60 - 3.60	0.44	4
	30 " " "	1.85	1.60 - 2.10	0.29	4
	1 hour " "	0.95	0.80 - 1.00	0.10	4
	2 " " "	0.40	0.40	0	2
	3 " " "	0.33	0.25 - 0.40	0.08	4
	Baseline	0.22	0.15 - 0.40	0.16	3

TABLE III

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 3 Hours - Chamber Concentration: 100 ppm

GROUP II-a

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	49.67	35.00 - 74.00	21.22	3
	15 " " "	6.80	1.90 - 16.50	8.40	3
	30 " " "	4.78	1.80 - 10.75	5.17	3
	1 hour " "	3.47	1.00 - 8.00	3.93	3
	2 " " "	0.67	0.60 - 0.70	0.06	3
	3 " " "	0.40	0.30 - 0.60	0.17	3
	Baseline	0.45	0.00 - 0.70	0.31	4
Day 2:	1 min., post exit	50.63	39.00 - 74.00	15.82	4
	15 " " "	6.48	3.00 - 15.60	6.10	4
	30 " " "	4.60	2.00 - 12.00	4.94	4
	1 hour " "	4.03	1.90 - 10.00	3.99	4
	2 " " "	1.48	0.90 - 1.80	0.43	4
	3 " " "	0.73	0.30 - 1.10	0.35	4
	Baseline	0.38	0.30 - 0.45	0.11	2
Day 3:	1 min., post exit	53.00	38.00 - 74.00	18.74	3
	15 " " "	8.83	2.40 - 18.60	8.60	3
	30 " " "	6.00	2.10 - 13.50	6.50	3
	1 hour " "	4.30	1.80 - 9.30	4.33	3
	2 " " "	1.10	0.40 - 1.60	0.62	3
	3 " " "	0.45	0.30 - 0.60	0.21	2
	Baseline	0.70	0.40 - 1.0	0.42	2
Day 4:	1 min., post exit	49.5	35.00 - 64.00	20.51	2
	15 " " "	11.6	3.20 - 20.00	11.88	2
	30 " " "	6.95	2.40 - 11.50	6.44	2
	1 " " "	5.60	2.00 - 9.20	5.09	2
	2 " " "	0.65	0.30 - 1.00	0.50	2
	3 " " "	0.60	0.6		1
	Baseline	0.40	0.4	0	2
Day 5:	1 min., post exit	51.00	37.00 - 65.00	19.80	2
	15 " " "	10.20	3.40 - 17.00	9.62	2
	30 " " "	6.50	2.00 - 11.00	6.36	2
	1 hour " "	4.50	1.80 - 7.20	3.82	2
	2 " " "	0.50	0.5	0	1
	3 " " "	0.40	0.4	0	2
	Baseline				

TABLE IV

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 3 Hours - Chamber Concentration: 100 ppm

GROUP II-b

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	37.50	35.00 - 40.00	3.54	2
	15 " " "	1.95	1.90 - 2.00	0.07	2
	30 " " "	1.80	1.80	0	2
	1 hour " "	1.20	1.00 - 1.40	0.28	2
	2 " " "	0.65	0.60 - 0.70	0.70	2
	3 " " "	0.45	0.30 - 0.60	0.21	2
	Baseline	0.38	0 - 0.60	0.32	3
Day 2:	1 min., post exit	42.83	39.00 - 45.00	3.33	3
	15 " " "	3.43	3.00 - 4.00	0.51	3
	30 " " "	2.13	2.00 - 2.40	0.23	3
	1 hour " "	2.03	1.90 - 2.20	0.15	3
	2 " " "	1.37	0.90 - 1.80	0.45	3
	3 " " "	0.68	0.30 - 1.10	0.40	3
	Baseline	0.30	0.30	--	1
Day 3:	1 min., post exit	42.50	38.00 - 47.00	6.36	2
	15 " " "	3.95	2.40 - 5.50	2.19	2
	30 " " "	2.25	2.10 - 2.40	0.21	2
	1 hour " "	1.80	1.80	0	2
	2 " " "	1.30	1.30	--	1
	3 " " "	0.60	0.60	--	1
	Baseline	0.40	0.40	--	1
Day 4:	1 min., post exit	35.00	35.00	--	1
	15 " " "	3.20	3.20	--	1
	30 " " "	2.40	2.40	--	1
	1 " " "	2.00	2.00	--	1
	2 " " "	0.30	0.30	--	1
	3 " " "	--	--	--	1
	Baseline	0.40	0.40	--	1
Day 5:	1 min., post exit	37.00	37.00	--	1
	15 " " "	3.40	3.40	--	1
	30 " " "	2.00	2.00	--	1
	1 hour " "	1.80	1.80	--	1
	2 " " "	0.50	0.50	--	1
	3 " " "	0.40	0.40	--	1
	Baseline	--	--	--	--

TABLE V

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 1 Hour - Chamber Concentration: 100 ppm

GROUP III-a

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	54.00	38.00 - 70.00	22.63	2
	15 " " "	9.55	3.10 - 16.00	9.12	2
	30 " " "	6.38	2.00 - 10.75	6.19	2
	1 hour " "	5.00	2.00 - 8.00	4.24	2
	2 " " "	0.48	0.40 - 0.55	0.11	2
	3 " " "	0.20	0.20	0	2
	Baseline	0.55	0.40 - 0.70	0.21	2
Day 2:	1 min., post exit	51.00	30.00 - 72.00	29.70	2
	15 " " "	9.40	3.20 - 15.60	8.77	2
	30 " " "	6.10	2.20 - 10.00	5.52	2
	1 hour " "	4.20	1.60 - 6.80	3.68	2
	2 " " "	1.20	0.60 - 1.80	0.85	2
	3 " " "	0.85	0.60 - 1.10	0.35	2
	Baseline	0.38	0.30 - 0.45	0.11	2
Day 3:	1 min., post exit	55.00	33.00 - 77.00	31.11	2
	15 " " "	8.85	2.70 - 15.00	8.70	2
	30 " " "	6.80	2.00 - 11.60	6.79	2
	1 hour " "	4.05	1.50 - 6.60	3.61	2
	2 " " "	0.55	0.50 - 0.60	0.71	2
	3 " " "	0.33	0.25 - 0.40	0.11	2
	Baseline	0.25	0.25	0	2
Day 4:	1 min., post exit	50.25	31.50 - 69.00	26.52	2
	15 " " "	9.40	2.80 - 16.00	9.33	2
	30 " " "	7.65	2.80 - 12.50	6.86	2
	1 " " "	3.00	2.20 - 3.80	1.13	2
	2 " " "	1.40	0.80 - 2.00	0.85	2
	3 " " "	0.30	0.30	0	2
	Baseline	0.20	--	--	1
Day 5:	1 min., post exit	49.50	34.00 - 65.00	21.92	2
	15 " " "	8.50	2.60 - 14.40	8.34	2
	30 " " "	6.00	2.00 - 10.00	5.66	2
	1 hour " "	4.00	2.00 - 6.00	2.83	2
	2 " " "	0.75	0.40 - 1.10	0.50	2
	3 " " "	0.60	0	--	1
	Baseline				

TABLE VI

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 1 Hour - Chamber Concentration: 100 ppm

GROUP III-b

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	38.00	38.00	--	1
	15 " " "	3.10	3.10	--	1
	30 " " "	2.00	2.00	--	1
	1 hour " "	2.00	2.00	--	1
	2 " " "	0.40	0.40	--	1
	3 " " "	0.20	0.20	--	1
	Baseline	0.70	0.70	--	1
Day 2:	1 min., post exit	30.00	30.00	--	1
	15 " " "	3.20	3.20	--	1
	30 " " "	2.20	2.20	--	1
	1 hour " "	1.60	1.60	--	1
	2 " " "	0.60	0.60	--	1
	3 " " "	0.60	0.60	--	1
	Baseline	0.45	0.45	--	1
Day 3:	1 min., post exit	33.00	33.00	--	1
	15 " " "	2.70	2.70	--	1
	30 " " "	2.00	2.00	--	1
	1 hour " "	1.50	1.50	--	1
	2 " " "	0.50	0.50	--	1
	3 " " "	0.40	0.40	--	1
	Baseline	0.25	0.25	--	1
Day 4:	1 min., post exit	31.50	31.50	--	1
	15 " " "	2.80	2.80	--	1
	30 " " "	2.80	2.80	--	1
	1 " " "	2.20	2.20	--	1
	2 " " "	0.80	0.80	--	1
	3 " " "	0.30	0.30	--	1
	Baseline	0.20	0.20	--	1
Day 5:	1 min., post exit	34.00	34.00	--	1
	15 " " "	2.60	2.60	--	1
	30 " " "	2.00	2.00	--	1
	1 hour " "	2.00	2.00	--	1
	2 " " "	0.40	0.40	--	1
	3 " " "	--	--	--	--
	Baseline	0.10	0.10	--	1

TABLE VII

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 7-1/2 - Chamber Concentration: 20 ppm

GROUP I

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	8.68	8.10 - 9.40	0.54	4
	15 " " "	0.58	0.45 - 0.70	0.14	4
	30 " " "	0.41	0.30 - 0.45	0.08	4
	1 hour " "	0.23	0.20 - 0.30	0.05	4
	2 " " "	0.08	0.05 - 0.10	0.03	4
	3 " " "	>0.05	>0.05	0	4
	Baseline	0	0	0	4
Day 2:	1 min., post exit	8.73	7.60 - 10.90	1.56	4
	15 " " "	0.66	0.55 - 0.80	0.11	4
	30 " " "	0.39	0.30 - 0.50	0.10	4
	1 hour " "	0.21	0.15 - 0.30	0.07	4
	2 " " "	0.10	0.05 - 0.20	0.07	4
	3 " " "	0.05	0.05	0	3
	Baseline	0.01	0 - 0.05	0.01	3
Day 3:	1 min., post exit	10.00	9.20 - 10.70	0.65	4
	15 " " "	0.51	0.40 - 0.70	0.14	4
	30 " " "	0.35	0.20 - 0.50	0.13	4
	1 hour " "	0.21	0.15 - 0.30	0.06	4
	2 " " "	0.13	0.10 - 0.20	0.03	3
	3 " " "	0.09	0.05 - 0.10	0.01	4
	Baseline	0.01	0 - 0.05	0.01	4
Day 4:	1 min., post exit	10.85	8.00 - 14.00	2.59	4
	15 " " "	0.70	0.60 - 0.80	0.08	4
	30 " " "	0.33	0.25 - 0.40	0.09	4
	1 " " "	0.25	0.25	0	4
	2 " " "	0.19	0.10 - 0.25	0.06	4
	3 " " "	0.10	0.10	0	3
	Baseline	0	0	0	3
Day 5:	1 min., post exit				
	15 " " "				
	30 " " "				
	1 hour " "		Holiday		
	2 " " "				
	3 " " "				
	Baseline				

TABLE VIII

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 3 Hours - Chamber Concentration: 20 ppm .

GROUP IIb

	Time	Mean (in ppm)	Range (in ppm)	± Standard Deviation	Number of Subjects
Day 1:	1 min., post exit	6.50	6.50	--	1
	15 " " "	0.70	0.70	--	1
	30 " " "	0.30	0.30	--	1
	1 hour " "	0.20	0.20	--	1
	2 " " "	0.05	0.05	--	1
	3 " " "	0.05	0.05	--	1
	Baseline	0	0	--	1
Day 2:	1 min., post exit	8.00	8.00	--	1
	15 " " "	0.50	0.50	--	1
	30 " " "	0.30	0.30	--	1
	1 hour " "	0.30	0.30	--	1
	2 " " "	0.05	0.05	--	1
	3 " " "	--	--	--	--
	Baseline	0	0	--	1
Day 3:	1 min., post exit	7.80	7.80	--	1
	15 " " "	0.50	0.50	--	1
	30 " " "	0.30	0.30	--	1
	1 hour " "	0.30	0.30	--	1
	2 " " "	0.10	0.10	--	1
	3 " " "	0	0	--	1
	Baseline	0	0	--	1
Day 4:	1 min., post exit	9.50	9.50	--	1
	15 " " "	0.70	0.70	--	1
	30 " " "	0.60	0.60	--	1
	1 " " "	0.40	0.40	--	1
	2 " " "	--	--	--	--
	3 " " "	0.10	0.10	--	1
	Baseline	0	0	--	1
Day 5:	1 min., post exit				
	15 " " "				
	30 " " "				
	1 hour " "		Holiday		
	2 " " "				
	3 " " "				
	Baseline				

TABLE IX

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 3 Hours - Chamber Concentration: 20 ppm

GROUP II-a

	Time	Mean (in ppm)	Range (in ppm)	± Standard Deviation	Number of Subjects
Day 1:	1 min., post exit				
	15 " " "				
	30 " " "				
	1 hour " "				
	2 " " "				
	3 " " "				
	Baseline				
Day 2:	1 min., post exit				
	15 " " "				
	30 " " "				
	1 hour " "				
	2 " " "				
	3 " " "				
	Baseline	0	0	0	2
Day 3:	1 min., post exit	11.25	7.80 - 14.70	4.88	2
	15 " " "	1.80	0.50 - 3.10	1.84	2
	30 " " "	1.30	0.30 - 2.30	1.41	2
	1 hour " "	1.10	0.30 - 1.90	1.13	2
	2 " " "	0.60	0.10 - 1.10	0.50	2
	3 " " "	0.40	0 - 0.80	0.40	2
	Baseline	0.15	0 - 0.30	0.15	2
Day 4:	1 min., post exit	13.50	9.50 - 17.50	5.66	2
	15 " " "	2.55	0.70 - 4.40	2.62	2
	30 " " "	2.05	0.60 - 3.50	2.05	2
	1 " " "	0.95	0.40 - 1.50	0.78	2
	2 " " "	1.20	1.20	--	1
	3 " " "	0.55	0.10 - 1.00	0.45	2
	Baseline	0.05	0 - 0.10	0.05	2
Day 5:	1 min., post exit				
	15 " " "				
	30 " " "				
	1 hour " "		Holiday		
	2 " " "				
	3 " " "				
	Baseline				

TABLE X

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 1 Hour - Chamber Concentration: 20 ppm

GROUP III-a

	Time	Mean (in ppm)	Range (in ppm)	± Standard Deviation	Number of Subjects
Day 1:	1 min., post exit	10.57	8.60 - 13.50	2.59	3
	15 " " "	1.40	0.60 - 2.90	1.30	3
	30 " " "	0.97	0.45 - 2.00	0.90	3
	1 hour " "	0.63	0.30 - 1.30	0.58	3
	2 " " "	0.15	0.05 - 0.30	0.13	3
	3 " " "	0.07	0.05 - 0.10	0.03	3
	Baseline	0.02	0 - 0.05	0.02	3
Day 2:	1 min., post exit	8.97	6.00 - 12.9	3.55	3
	15 " " "	1.10	0.50 - 2.20	0.95	3
	30 " " "	0.92	0.35 - 2.00	0.94	3
	1 hour " "	0.62	0.25 - 1.30	0.59	3
	2 " " "	0.32	0.10 - 0.60	0.26	3
	3 " " "	0.12	0.05 - 0.25	0.12	3
	Baseline	0.02	0 - 0.05	0.02	3
Day 3:	1 min., post exit	10.30	8.60 - 13.70	2.90	3
	15 " " "	1.13	0.50 - 2.30	1.01	3
	30 " " "	0.88	0.35 - 1.80	0.80	3
	1 hour " "	0.72	0.30 - 1.50	0.68	3
	2 " " "	0.27	0.20 - 0.40	0.12	3
	3 " " "	0.20	0.10 - 0.30	0.10	3
	Baseline	0.02	0 - 0.05	0.02	3
Day 4:	1 min., post exit	12.70	9.50 - 16.6	3.60	3
	15 " " "	1.53	0.70 - 3.10	1.36	3
	30 " " "	1.10	0.50 - 2.00	0.79	3
	1 " " "	0.63	0.30 - 1.30	0.58	3
	2 " " "	0.42	0.20 - 0.80	0.33	3
	3 " " "	0.30	0.10 - 0.50	0.28	2
	Baseline	0.02	0 - 0.05	0.02	3
Day 5:	1 min., post exit				
	15 " " "				
	30 " " "				
	1 hour " "				
	2 " " "				
	3 " " "				
	Baseline				

Holiday

TABLE XI

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 1 Hour - Chamber Concentration: 20 ppm

GROUP III-b

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	9.10	8.60 - 9.60	0.71	2
	15 " " "	0.65	0.60 - 0.70	0.07	2
	30 " " "	0.45	0.45	0	2
	1 hour " "	0.30	0.30	0	2
	2 " " "	0.08	0.05 - 0.10	0.04	2
	3 " " "	0.05	0.05	0	2
	Baseline	0	0	0	2
Day 2:	1 min., post exit	7.00	6.00 - 8.00	1.41	2
	15 " " "	0.55	0.50 - 0.60	0.07	2
	30 " " "	0.38	0.35 - 0.40	0.04	2
	1 hour " "	0.28	0.25 - 0.30	0.04	2
	2 " " "	0.18	0.10 - 0.25	0.11	2
	3 " " "	0.05	0.05	0	2
	Baseline	0	0	0	2
Day 3:	1 min., post exit	8.60	8.60	0	2
	15 " " "	0.55	0.50 - 0.60	0.07	2
	30 " " "	0.43	0.35 - 0.50	0.11	2
	1 hour " "	0.33	0.30 - 0.35	0.04	2
	2 " " "	0.20	0.20	0	2
	3 " " "	0.15	0.10 - 0.20	0.07	2
	Baseline	0	0	0	2
Day 4:	1 min., post exit	10.75	9.50 - 12.00	1.77	2
	15 " " "	0.75	0.70 - 0.80	0.07	2
	30 " " "	0.65	0.50 - 0.80	0.21	2
	1 " " "	0.30	0.30	0	2
	2 " " "	0.23	0.20 - 0.25	0.04	2
	3 " " "	0.10	0.10	--	1
	Baseline	0	0	0	2
Day 5:	1 min., post exit				
	15 " " "				
	30 " " "				
	1 hour " "		Holiday		
	2 " " "				
	3 " " "				
	Baseline				

TABLE XII

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 7-1/2 Hours - Chamber Concentration; Fluct. 50-150 ppm

GROUP I

	Time	Mean (in ppm)	Range (in ppm)	± Standard Deviation	Number of Subjects
Day 1:	1 min., post exit	50.13	45.00 - 56.50	6.01	4
	15 " " "	3.65	3.00 - 4.00	0.45	4
	30 " " "	2.28	2.10 - 2.40	0.13	4
	1 hour " "	1.18	1.00 - 1.40	0.17	4
	2 " " "	0.73	0.65 - 0.80	0.09	4
	3 " " "	0.43	0.30 - 0.80	0.25	4
	Baseline	0.15	0.15	0	4
Day 2:	1 min., post exit	53.38	40.50 - 62.50	9.24	4
	15 " " "	2.43	1.60 - 3.00	0.59	4
	30 " " "	1.13	0.60 - 1.80	0.51	4
	1 hour " "	0.54	0.45 - 0.60	0.08	4
	2 " " "	0.37	0.25 - 0.50	0.13	3
	3 " " "	0.27	0.20 - 0.40	0.12	3
	Baseline	0.21	0.10 - 0.40	0.14	4
Day 3:	1 min., post exit	47.38	36.00 - 60.00	10.08	4
	15 " " "	1.41	1.15 - 1.55	0.19	4
	30 " " "	0.91	0.70 - 1.05	0.17	4
	1 hour " "	0.30	0.25 - 0.40	0.07	4
	2 " " "	0.27	0.20 - 0.30	0.06	3
	3 " " "	0.20	0.20	0	4
	Baseline	0.13	0.10 - 0.15	0.03	4
Day 4:	1 min., post exit	45.38	41.00 - 53.00	5.28	4
	15 " " "	4.00	2.60 - 4.80	0.96	4
	30 " " "	2.40	1.40 - 2.90	0.71	4
	1 " " "	1.10	0.70 - 1.90	0.54	4
	2 " " "	0.55	0.50 - 0.65	0.09	3
	3 " " "	0.41	0.15 - 0.60	0.19	4
	Baseline	0.23	0.10 - 0.60	0.25	4
Day 5:	1 min., post exit	53.00	51.00 - 58.00	3.37	4
	15 " " "	2.73	1.85 - 3.10	0.59	4
	30 " " "	1.15	0.80 - 1.55	0.32	4
	1 hour " "	0.56	0.30 - 0.80	0.23	4
	2 " " "	0.36	0.25 - 0.60	0.16	4
	3 " " "	0.32	0.25 - 0.40	0.08	4
	Baseline	0.10	0.10	0	4

TABLE XIII

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 3 Hours - Chamber Concentration: Fluct. 50-150 ppm

GROUP II

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	43.00	43.00	--	1
	15 " " "	1.40	1.40	--	1
	30 " " "	1.20	1.20	--	1
	1 hour " "	0.90	0.90	--	1
	2 " " "	0.40	0.40	--	1
	3 " " "	0.30	0.30	--	1
	Baseline	0.20	0.20	--	1
Day 2:	1 min., post exit				
	15 " " "				
	30 " " "				
	1 hour " "		--Subject out sick--		
	2 " " "				
	3 " " "				
	Baseline				
Day 3:	1 min., post exit				
	15 " " "				
	30 " " "				
	1 hour " "		--Subject out sick--		
	2 " " "				
	3 " " "				
	Baseline	0	0	--	1
Day 4:	1 min., post exit	51.50	51.50	--	1
	15 " " "	2.20	2.20	--	1
	30 " " "	1.90	1.90	--	1
	1 " " "	1.40	1.40	--	1
	2 " " "	1.00	1.00	--	1
	3 " " "	0.65	0.65	--	1
	Baseline	0.50	0.50	--	1
Day 5:	1 min., post exit	46.00	46.00	--	1
	15 " " "	3.00	3.00	--	1
	30 " " "	1.00	1.00	--	1
	1 hour " "	--	--	--	1
	2 " " "	0.25	0.25	--	1
	3 " " "	--	--	--	1
	Baseline	0.10	0.10	--	1

TABLE XIV

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 1 Hour - Chamber Concentration: Fluct. 50-150 ppm

GROUP III-a

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	66.33	55.00 - 85.00	16.29	3
	15 " " "	7.23	3.50 - 14.00	5.87	3
	30 " " "	6.27	2.90 - 12.20	5.15	3
	1 hour " "	5.17	3.00 - 9.00	3.33	3
	2 " " "	0.72	0.50 - 1.00	0.26	3
	3 " " "	0.50	0.40 - 0.70	0.17	3
	Baseline	0.17	0.15 - 0.20	0.03	3
Day 2:	1 min., post exit	57.17	43.00 - 81.00	20.76	3
	15 " " "	4.30	0.90 - 10.00	4.97	3
	30 " " "	1.42	0.35 - 2.50	1.08	3
	1 hour " "	1.27	0.30 - 2.50	1.12	3
	2 " " "	0.45	0.30 - 0.60	0.21	3
	3 " " "	0.33	0.30 - 0.35	0.04	3
	Baseline	0.38	0.35 - 0.40	0.03	3
Day 3:	1 min., post exit	50.67	38.00 - 72.00	18.58	3
	15 " " "	4.87	1.20 - 12.00	6.18	3
	30 " " "	3.47	0.80 - 8.80	4.62	3
	1 hour " "	2.07	0.60 - 5.00	2.54	3
	2 " " "	0.30	0.15 - 0.55	0.22	3
	3 " " "	0.22	0.15 - 0.30	0.08	3
	Baseline	0.15	0.15	--	1
Day 4:	1 min., post exit	35.00	35.00	--	1
	15 " " "	2.60	2.60	--	1
	30 " " "	2.60	2.60	--	1
	1 " " "	2.30	2.30	--	1
	2 " " "	0.65	0.65	--	1
	3 " " "	0.30	0.30	--	1
	Baseline	0.30	0.15 - 0.45	0.30	3
Day 5:	1 min., post exit	59.00	46.00 - 78.00	16.82	3
	15 " " "	4.62	1.85 - 10.00	4.66	3
	30 " " "	3.57	1.45 - 7.50	3.41	3
	1 hour " "	2.67	1.30 - 5.25	2.24	3
	2 " " "	0.50	0.50	--	1
	3 " " "	0.40	0.40	--	1
	Baseline	0.10	0.10	--	1

TABLE XV

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 1 Hour - Chamber Concentration: Fluct. 50-150 ppm

GROUP III-b

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	57.00	55.00 - 59.00	2.83	2
	15 " " "	3.85	3.50 - 4.20	0.50	2
	30 " " "	3.30	2.90 - 3.70	0.57	2
	1 hour " "	3.25	3.00 - 3.50	0.35	2
	2 " " "	0.75	0.50 - 1.00	0.35	2
	3 " " "	0.40	0.40	0	2
	Baseline	0.18	0.15 - 0.20	0.04	2
Day 2:	1 min., post exit	45.25	43.00 - 47.50	3.18	2
	15 " " "	1.45	0.90 - 2.00	0.78	2
	30 " " "	0.88	0.35 - 1.40	0.74	2
	1 hour " "	0.65	0.30 - 1.00	0.50	2
	2 " " "	0.30	0.30	0	1
	3 " " "	0.30	0.30	0	1
	Baseline	0.38	0.35 - 0.40	0.04	2
Day 3:	1 min., post exit	40.00	38.00 - 42.00	2.83	2
	15 " " "	1.30	1.20 - 1.40	0.14	2
	30 " " "	0.80	0.80	0	2
	1 hour " "	0.60	0.60	0	2
	2 " " "	0.18	0.15 - 0.20	0.04	2
	3 " " "	0.18	0.15 - 0.20	0.04	2
	Baseline	0.15	0.15	--	1
Day 4:	1 min., post exit	35.00	35.00	--	1
	15 " " "	2.60	2.60	--	1
	30 " " "	2.60	2.60	--	1
	1 " " "	2.30	2.30	--	1
	2 " " "	0.65	0.65	--	1
	3 " " "	0.30	0.30	--	1
	Baseline	0.38	0.30 - 0.45	0.11	2
Day 5:	1 min., post exit	49.50	46.00 - 53.00	4.95	2
	15 " " "	1.93	1.85 - 2.00	0.11	2
	30 " " "	1.60	1.45 - 1.75	0.21	2
	1 hour " "	1.38	1.30 - 1.45	0.11	2
	2 " " "	0.50	0.50	--	1
	3 " " "	0.40	0.40	--	1
	Baseline	0.10	0.10	--	1

TABLE XVI

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 7-1/2 Hours - Chamber Concentration: 150 ppm

GROUP I

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	74.00	66.00 - 82.00	8.00	3
	15 " " "	3.90	2.80 - 4.80	0.92	4
	30 " " "	2.53	1.50 - 3.00	0.69	4
	1 hour " "	1.05	0.60 - 1.70	0.47	4
	2 " " "	0.55	0.50 - 0.60	0.06	4
	3 " " "	0.51	0.35 - 0.60	0.12	4
	Baseline	0.39	0.25 - 0.60	0.16	4
Day 2:	1 min., post exit	76.67	68.00 - 81.00	7.51	3
	15 " " "	5.98	4.20 - 7.00	1.28	4
	30 " " "	3.90	2.20 - 5.00	1.26	4
	1 hour " "	1.66	1.30 - 2.30	0.46	4
	2 " " "	0.85	0.55 - 1.25	0.29	4
	3 " " "	0.66	0.50 - 1.10	0.29	4
	Baseline	0.39	0.35 - 0.50	0.08	4

TABLE XVII

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 3 Hours - Chamber Concentration: 150 ppm

GROUP II

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	60.00	60.00	--	1
	15 " " "	2.50	2.50	--	1
	30 " " "	2.40	2.40	--	1
	1 hour " "	2.00	2.00	--	1
	2 " " "	1.70	1.70	--	1
	3 " " "	1.40	1.40	--	1
	Baseline	1.00	1.00	--	1
Day 2:	1 min., post exit	64.00	64.00	--	1
	15 " " "	2.70	2.70	--	1
	30 " " "	2.30	2.30	--	1
	1 hour " "	2.00	2.00	--	1
	2 " " "	1.35	1.35	--	1
	3 " " "	1.15	1.15	--	1
	Baseline	0.35	0.35	--	1

TABLE XVIII

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 1 Hour - Chamber Concentration: 150 ppm

GROUP III

	Time	Mean (in ppm)	Range (in ppm)	± Standard Deviation	Number of Subjects
Day 1:	1 min., post exit	69.50	63.00 - 76.00	9.19	2
	15 " " "	3.80	3.60 - 4.00	0.28	2
	30 " " "	2.35	2.30 - 2.40	0.07	2
	1 hour " "	1.30	1.30	0	2
	2 " " "	0.50	0.50	--	1
	3 " " "	0.50	0.50	--	1
	Baseline	--	--	--	1
Day 2:	1 min., post exit	60.50	60.50	--	1
	15 " " "	4.00	4.00	--	1
	30 " " "	3.20	3.20	--	1
	1 hour " "	2.30	2.30	--	1
	2 " " "	0.90	0.90	--	1
	3 " " "	0.45	0.45	--	1
	Baseline	0.40	0.40	--	1

TABLE XIX

WEEKLY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 7-1/2 Hours

GROUP I

	Time	Mean (in ppm)	Range (in ppm)	± Standard Deviation	Number of Subjects
Wk. 2:	Chamber Concentration: 100 ppm				
	1 min., post exit	44.32	28.00 - 55.00	7.10	4
	15 " " "	3.37	2.00 - 4.20	0.60	4
	30 " " "	2.03	1.60 - 3.60	0.45	4
	1 hour " "	1.18	0.80 - 1.80	0.32	4
	2 " " "	0.50	0.30 - 0.90	0.22	4
	3 " " "	0.34	0.20 - 0.60	0.15	4
	Baseline	0.25	0 - 0.60	0.13	4
Wk. 3:	Chamber Concentration: 20 ppm				
	1 min., post exit	9.56	7.60 - 14.00	1.69	4
	15 " " "	0.61	0.40 - 0.80	0.13	4
	30 " " "	0.37	0.20 - 0.50	0.10	4
	1 hour " "	0.22	0.15 - 0.30	0.05	4
	2 " " "	0.12	0.05 - 0.25	0.07	4
	3 " " "	0.07	0.05 - 0.10	0.03	4
	Baseline	0.01	0 - 0.10	0.03	4
Wk. 4:	Chamber Concentration: Fluc. 50-150 ppm				
	1 min., post exit	49.85	36.00 - 62.50	7.19	4
	15 " " "	2.84	1.15 - 4.80	1.09	4
	30 " " "	1.57	0.60 - 2.90	0.75	4
	1 hour " "	0.74	0.25 - 1.90	0.43	4
	2 " " "	0.47	0.20 - 0.80	0.20	4
	3 " " "	0.33	0.15 - 0.80	0.17	4
	Baseline	0.16	0.10 - 0.60	0.13	4
Wk. 5:	Chamber Concentration: 150 ppm				
	1 min., post exit	75.33	66.00 - 82.00	7.09	4
	15 " " "	4.94	2.80 - 7.00	1.51	4
	30 " " "	3.21	1.50 - 5.00	1.20	4
	1 hour " "	1.36	0.60 - 2.30	0.54	4
	2 " " "	0.70	0.50 - 1.25	0.25	4
	3 " " "	0.59	0.35 - 1.10	0.22	4
	Baseline	0.39	0.25 - 0.60	0.11	4

TABLE XX

WEEKLY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 3 Hours

GROUP II-a

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Wk. 2:	Chamber Concentration: 100 ppm				
	1 min., post exit	50.82	35.00 - 74.00	15.66	2
	15 " " "	8.31	1.90 - 20.00	7.25	2
	30 " " "	5.55	1.80 - 13.50	4.84	2
	1 hour " "	4.26	1.00 - 10.00	3.53	2
	2 " " "	1.00	0.30 - 1.80	0.53	2
	3 " " "	0.53	0.30 - 1.10	0.26	2
	Baseline	0.46	0 - 1.00	0.25	2
Wk. 3:	Chamber Concentration: 20 ppm				
	1 min., post exit	10.67	6.50 - 17.50	4.41	2
	15 " " "	1.65	0.50 - 4.40	1.68	2
	30 " " "	1.22	0.30 - 3.50	1.36	2
	1 hour " "	0.77	0.20 - 1.90	0.74	2
	2 " " "	0.48	0.01 - 1.20	0.61	2
	3 " " "	0.39	0 - 1.00	0.47	2
	Baseline	0.05	0 - 0.30	0.11	2
Wk. 4:	Chamber Concentration: Fluc. 50-150 ppm				
	1 min., post exit	46.83	43.00 - 51.50	4.31	1
	15 " " "	2.20	1.40 - 3.00	0.80	1
	30 " " "	1.37	1.00 - 1.90	0.47	1
	1 hour " "	1.15	0.90 - 1.40	0.35	1
	2 " " "	0.55	0.25 - 1.00	0.40	1
	3 " " "	0.48	0.30 - 0.65	0.25	1
	Baseline	0.20	0 - 0.50	0.22	1

TABLE XXI

WEEKLY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 3 Hours

GROUP II-b

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Wk. 2:	Chamber Concentration: 100 ppm				
	1 min., post exit	40.06	35.00 - 47.00	4.45	1
	15 " " "	3.19	1.90 - 5.50	1.11	1
	30 " " "	2.10	1.80 - 2.40	0.25	1
	1 hour " "	1.77	1.00 - 2.20	0.36	1
	2 " " "	0.88	0.30 - 1.80	0.17	1
	3 " " "	0.53	0.30 - 1.10	0.10	1
	Baseline	0.37	0 - 0.60	0.21	1
Wk. 3:	Chamber Concentration: 20 ppm				
	1 min., post exit	7.95	6.50 - 9.50	1.23	1
	15 " " "	0.60	0.50 - 0.70	0.12	1
	30 " " "	0.38	0.30 - 0.60	0.15	1
	1 hour " "	0.30	0.20 - 0.40	0.08	1
	2 " " "	0.07	0.05 - 0.10	0.03	1
	3 " " "	0.05	0 - 0.10	0.05	1
	Baseline	0	0	0	1
Wk. 4:	Chamber Concentration: Fluc. 50-150 ppm				
	1 min., post exit	46.83	43.00 - 51.50	4.31	1
	15 " " "	2.20	1.40 - 3.00	0.80	1
	30 " " "	1.37	1.00 - 1.90	0.47	1
	1 hour " "	1.15	0.90 - 1.40	0.35	1
	2 " " "	0.55	0.25 - 1.00	0.40	1
	3 " " "	0.48	0.30 - 0.65	0.25	1
	Baseline	0.20	0 - 0.50	0.22	1
Wk. 5:	Chamber Concentration: 150 ppm				
	1 min., post exit	62.00	60.00 - 64.00	2.83	1
	15 " " "	2.60	2.50 - 2.70	0.14	1
	30 " " "	2.35	2.30 - 2.40	0.07	1
	1 hour " "	2.00	2.00	0	1
	2 " " "	1.53	1.35 - 1.70	0.25	1
	3 " " "	1.28	1.15 - 1.40	0.18	1
	Baseline	0.68	0.35 - 1.00	0.46	1

TABLE XXII

WEEKLY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 1 Hour

GROUP III-a

	Time	Mean (in ppm)	Range (in ppm)	± Standard Deviation	Number of Subjects
Wk. 2:	Chamber Concentration: 100 ppm				
	1 min., post exit	51.95	30.00 - 77.00	19.98	2
	15 " " "	9.14	2.60 - 16.00	6.62	2
	30 " " "	6.59	2.00 - 12.50	4.68	2
	1 hour " "	4.05	1.50 - 8.00	2.54	2
	2 " " "	0.88	0.40 - 2.00	0.58	2
	3 " " "	0.44	0.20 - 1.10	0.29	2
	Baseline	0.31	0.10 - 0.70	0.19	2
Wk. 3:	Chamber Concentration: 20 ppm				
	1 min., post exit	10.63	6.00 - 16.60	3.07	3
	15 " " "	1.29	0.50 - 3.10	1.02	3
	30 " " "	0.97	0.35 - 2.00	0.74	3
	1 hour " "	0.65	0.25 - 1.50	0.52	3
	2 " " "	0.29	0.05 - 0.80	0.22	3
	3 " " "	0.16	0.05 - 0.50	0.14	3
	Baseline	0.02	0 - 0.10	0.03	3
Wk. 4:	Chamber Concentration: Fluc. 50-150 ppm				
	1 min., post exit	56.50	35.00 - 85.00	17.14	3
	15 " " "	5.05	0.90 - 14.00	4.66	3
	30 " " "	3.60	0.35 - 12.20	3.63	3
	1 hour " "	2.75	0.30 - 9.00	2.47	3
	2 " " "	0.51	0.15 - 1.00	0.25	3
	3 " " "	0.35	0.15 - 0.70	0.15	3
	Baseline	0.26	0.10 - 0.45	0.13	3

TABLE XXIII

WEEKLY METHYL CHLORIDE BREATH CONCENTRATION OF

SEDENTARY MALES

Exposure Time: 1 Hour

GROUP III-b

Time	Mean (in ppm)	Range (in ppm)	± Standard Deviation	Number of Subjects
Wk. 2: Chamber Concentration: 100 ppm				
1 min., post exit	33.30	30.00 - 38.00	3.03	1
15 " " "	2.88	2.60 - 3.20	0.26	1
30 " " "	2.20	2.00 - 2.80	0.35	1
1 hour " "	1.86	1.50 - 2.20	0.30	1
2 " " "	0.54	0.40 - 0.80	0.07	1
3 " " "	0.38	0.20 - 0.60	0.09	1
Baseline	0.34	0.10 - 0.70	0.11	1
Wk. 3: Chamber Concentration: 20 ppm				
1 min., post exit	8.86	6.00 - 12.00	1.69	2
15 " " "	0.63	0.50 - 0.80	0.10	2
30 " " "	0.48	0.35 - 0.80	0.14	2
1 hour " "	0.30	0.25 - 0.35	0.03	2
2 " " "	0.1	0.05 - 0.25	0.08	2
3 " " "	0.09	0.05 - 0.20	0.06	2
Baseline	0.01	0 - 0.10	0.03	2
Wk. 4: Chamber Concentration: Fluc. 50-150 ppm				
1 min., post exit	46.50	35.00 - 59.00	7.98	2
15 " " "	2.18	0.90 - 4.20	1.08	2
30 " " "	1.75	0.35 - 3.70	1.11	2
1 hour " "	1.56	0.30 - 3.50	1.13	2
2 " " "	0.47	0.15 - 1.00	0.29	2
3 " " "	0.31	0.15 - 0.40	0.10	2
Baseline	0.26	0.10 - 0.45	0.13	2
Wk. 5: Chamber Concentration: 150 ppm				
1 min., post exit	66.50	60.50 - 76.00	8.32	2
15 " " "	3.87	3.60 - 4.00	0.23	2
30 " " "	2.63	2.30 - 3.20	0.49	2
1 hour " "	1.63	1.30 - 2.30	0.58	2
2 " " "	0.70	0.50 - 0.90	0.28	1
3 " " "	0.48	0.45 - 0.50	0.04	1
Baseline	0.40	0.40	--	1

TABLE XXIV

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF SEDENTARY FEMALES

GROUP I

Exposure Time: 7-1/2 HRS - Chamber Concentration: 100 PPM

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	35.0	31 - 41	5.29	3
	15 " " "	3.75	3.5-4.3	0.38	4
	30 " " "	2.13	1.8-2.5	0.38	4
	1 hour " "	1.25	1.2-1.3	0.06	4
	2 " " "	0.42	0.35-0.5	0.08	3
	3 " " "	0.2	0.15-0.35	0.1	4
	Baseline	0.05	0 - 0.2	0.1	4
Day 2:	1 min., post exit	37.17	32 - 42.5	5.03	3
	15 " " "	4.78	4.5-5.3	0.38	4
	30 " " "	2.85	2.3-3.6	0.58	4
	1 hour " "	1.26	0.8-1.6	0.40	4
	2 " " "	0.87	0.6-1.1	0.25	3
	3 " " "	0.45	0.45	0	2
	Baseline	0.05	0 - 0.5	0.09	3
Day 3:	1 min., post exit	42.67	40 - 45	2.52	3
	15 " " "	3.88	2.8-4.3	0.72	4
	30 " " "	3.05	2.4-3.5	0.48	4
	1 hour " "	1.93	1.6-2.3	0.38	4
	2 " " "	0.53	0.4-0.6	0.10	4
	3 " " "	0.4	0.4	0	4
	Baseline	0	0	0	4
Day 4:	1 min., post exit	39.3	30 - 44	8.08	3
	15 " " "	5.9	4.4-7.6	1.35	4
	30 " " "	4.23	3.7-5.0	0.60	4
	1 " " "	2.25	1.8-3.1	0.61	4
	2 " " "	0.53	0.3-0.6	0.15	4
	3 " " "	0.3	0.1-0.5	0.16	4
	Baseline	0.01	0 - 0.5	0.03	4
Day 5:	1 min., post exit	40.0	38 - 42	2.0	3
	15 " " "	3.83	3.3-4.5	0.62	4
	30 " " "	2.58	1.7-3.2	0.68	4
	1 hour " "	0.83	0.6-0.9	0.15	4
	2 " " "	0.5	0.2-0.7	0.22	4
	3 " " "	0.4	0.3-0.7	0.2	4
	Baseline	0.1	0 - 0.2	0.1	3

TABLE XXV

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF SEDENTARY FEMALES

Exposure Time: 3 HRS - Chamber Concentration: 100 PPM

GROUP IIa

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	45.0	36 - 62	14.73	3
	15 " " "	6.2	1.4-14.2	6.97	3
	30 " " "	4.17	1.0-9.6	4.73	3
	1 hour " "	2.93	1.0-6.6	3.18	3
	2 " " "	0.77	0.4-1.5	0.64	3
	3 " " "	0.60	0.15-1.5	0.78	3
	Baseline	0.37	0.2-0.5	0.15	3
Day 2:	1 min., post exit	52.33	36 - 76	20.98	3
	15 " " "	7.37	1.6-17.5	8.80	3
	30 " " "	5.27	1.1-12.0	5.89	3
	1 hour " "	3.23	1.0-6.5	2.89	3
	2 " " "	1.23	0.5-2.6	1.18	3
	3 " " "	0.63	0.0-1.5	0.78	3
	Baseline	0.13	0.0-0.4	0.23	3
Day 3:	1 min., post exit	42.67	29 - 62	17.21	3
	15 " " "	6.27	1.4-14.1	6.85	3
	30 " " "	4.73	1.2-10.6	3.83	3
	1 hour " "	4.2	1.6-8.6	3.83	3
	2 " " "	0.77	0.4-1.3	0.47	3
	3 " " "	0.6	0.4-0.8	0.28	2
	Baseline	0.12	0.0-0.35	0.20	3
Day 4:	1 min., post exit	40.0	28 - 47	10.44	3
	15 " " "	6.33	1.6-14.3	6.94	3
	30 " " "	5.63	1.2-13.0	6.42	3
	1 " " "	3.2	1.0-6.4	2.84	3
	2 " " "	0.8	0.3-1.8	0.87	3
	3 " " "	0.73	0.1-1.8	0.93	3
	Baseline	0.47	0.0-1.3	0.72	3
Day 5:	1 min., post exit	48.33	35 - 57	11.72	3
	15 " " "	6.6	2.2-14.1	6.53	3
	30 " " "	5.7	2.1-11.2	4.84	3
	1 hour " "	3.57	1.4-6.5	2.64	3
	2 " " "	0.35	0.2-0.5	0.15	3
	3 " " "	0.35	0.1-0.6	0.35	2
	Baseline	0.13	0.0-0.3	0.15	3

TABLE XXVI

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF SEDENTARY FEMALES

Exposure Time: 3 HRS - Chamber Concentration: 100 PPM

GROUP IIb

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	36.5	36 - 37	0.71	2
	15 " " "	2.2	1.4-3.0	1.13	2
	30 " " "	1.45	1.0-1.9	0.64	2
	1 hour " "	1.1	1.0-1.2	0.14	2
	2 " " "	0.4	0.4	0.0	2
	3 " " "	0.15	0.15	0.0	2
	Baseline	0.35	0.2-0.5	0.21	2
Day 2:	1 min., post exit	40.5	36 - 45	6.36	2
	15 " " "	2.3	1.6-3.0	0.99	2
	30 " " "	1.9	1.1-2.7	1.13	2
	1 hour " "	1.6	1.0-2.2	0.85	2
	2 " " "	0.55	0.5-0.6	0.07	2
	3 " " "	0.2	0.0-0.4	0.28	2
	Baseline	0	0	0	2
Day 3:	1 min., post exit	33.0	29 - 37	5.66	2
	15 " " "	2.35	1.4-3.3	1.34	2
	30 " " "	1.8	1.2-2.4	0.85	2
	1 hour " "	2.0	1.6-2.4	0.57	2
	2 " " "	0.5	0.4-0.6	0.14	2
	3 " " "	0.4	0.4	-	1
	Baseline	0	0	0	2
Day 4:	1 min., post exit	37.5	28 - 47	13.44	2
	15 " " "	2.35	1.6-3.1	1.06	2
	30 " " "	1.95	1.2-2.7	1.06	2
	1 " " "	1.6	1.0-2.2	0.85	2
	2 " " "	0.3	0.3	0.0	2
	3 " " "	0.2	0.1-0.3	0.14	2
	Baseline	0.05	0.0-0.1	0.07	2
Day 5:	1 min., post exit	44.0	35 - 53	12.73	2
	15 " " "	2.85	2.2-3.5	0.92	2
	30 " " "	2.95	2.1-3.8	1.20	2
	1 hour " "	2.1	1.4-2.8	0.99	2
	2 " " "	0.43	0.35-0.5	0.11	2
	3 " " "	0.1	0.1	-	1
	Baseline	0.05	0.0-0.1	0.07	2

TABLE XXVII

DAILY METHYL CHLORIDE BREATH CONCENTRATION OF SEDENTARY FEMALES

Exposure Time: 1 HR - Chamber Concentration: 100 PPM

GROUP III

	Time	Mean (in ppm)	Range (in ppm)	Standard ± Deviation	Number of Subjects
Day 1:	1 min., post exit	47.75	41.5-54	8.84	2
	15 " " "	1.7	1.3-2.1	0.57	2
	30 " " "	1.05	1.05	0.0	2
	1 hour " "	0.98	0.9-1.05	0.11	2
	2 " " "	0.6	0.6	-	1
	3 " " "	0.2	0.2	-	1
	Baseline	0.2	0.2	-	1
Day 2:	1 min., post exit	49.0	43 - 55	8.49	2
	15 " " "	2.75	2.5-3.0	0.35	2
	30 " " "	1.85	1.6-2.1	0.35	2
	1 hour " "	1.4	1.4	0.0	2
	2 " " "	trace	trace	0.0	2
	3 " " "	0.0	0.0	0.0	2
	Baseline	0.0	0.0	0.0	2
Day 3:	1 min., post exit	41.75	40.5-43	1.77	2
	15 " " "	1.85	1.6-2.1	0.35	2
	30 " " "	1.13	1.0-1.25	0.18	2
	1 hour " "	1.0	1.0	0.0	2
	2 " " "	trace	trace	-	2
	3 " " "	0.0	0.0	0.0	2
	Baseline	0.0	0.0	0.0	2
Day 4:	1 min., post exit	52.5	50 - 55	3.54	2
	15 " " "	2.95	2.8-3.1	0.21	2
	30 " " "	1.95	1.9-2.0	0.07	2
	1 " " "	1.4	1.4	0.0	2
	2 " " "	0.3	0.3	0.0	2
	3 " " "	0.1	0.1	0.0	2
	Baseline	0.0	0.0	0.0	2
Day 5:	1 min., post exit	44.5	42.0-47.0	3.54	2
	15 " " "	4.8	4.8	0.0	2
	30 " " "	4.5	4.5	0.0	2
	1 hour " "	4.5	4.2-4.8	0.42	2
	2 " " "	0.45	0.2-0.7	0.35	2
	3 " " "	0.2	0 - 0.4	0.28	2
	Baseline	<0.1	<0.1	0.0	2

TABLE XXVIII

WEEKLY METHYL CHLORIDE BREATH CONCENTRATION OF SEDENTARY FEMALES

Chamber Concentration: 100 PPM

	Time	Mean (in ppm)	Range (in ppm)	Standard ±Deviation	Number of Subjects
Week 1:	1 min. post exit	38.94/33.38	30-45/15-45	6.79/10.67	3/4
	15 " " "	4.43	2.8-7.6	1.09	4
Group I	30 " " "	2.95	1.7-5.0	0.85	4
Exposure	1 hour " "	1.50	0.6-3.1	0.63	4
Time: 7-1/2	2 " " "	0.54	0.15-1.1	0.22	4
HRS	3 " " "	0.35	0.15-0.7	0.14	4
	Baseline	0.04	0.0-0.2	0.07	4
Week 1:	1 min. post exit	45.67	28 - 76	13.83	3
	15 " " "	6.55	1.4-17.5	6.16	3
Group IIa	30 " " "	5.1	1.0-13.0	4.63	3
Exposure	1 hour " "	3.43	1.0-8.6	2.66	3
Time: 3 HRS	2 " " "	0.78	0.2-2.6	0.7	3
	3 " " "	0.6	0.0-1.8	0.62	3
	Baseline	0.243	0.0-1.3	0.34	3
Week 1:	1 min. post exit	38.3	28 - 53	7.85	2
	15 " " "	2.41	1.4-3.5	0.85	2
Group IIb	30 " " "	2.01	1.0-3.8	0.91	2
Exposure	1 hour " "	1.68	1.0-2.8	0.67	2
Time: 3 HRS	2 " " "	0.44	0.3-0.6	0.11	2
	3 " " "	0.2	0.0-0.4	0.15	2
	Baseline	0.09	0.0-0.5	0.16	2
Week 1:	1 min. post exit	47.1	40.5-55	5.92	2
	15 " " "	2.81	1.3-4.8	1.20	2
Group III	30 " " "	2.10	1.0-4.5	1.33	2
Exposure	1 hour " "	1.86	0.9-4.8	1.42	2
Time: 1 HR	2 " " "	0.42	0.2-0.7	0.22	2
	3 " " "	0.09	0.0-0.4	0.14	2
	Baseline	0.04	0.0-0.2	0.07	2

TABLE XXIX

METHYL CHLORIDE LEVELS IN BLOOD FOR MALE SUBJECTS
GROUP I
EXPOSURE TIME: 7-1/2 HOURS

WEEK/DAY	METHYL CHLORIDE CONCENTRATION IN PPM IN SUBJECTS				CHAMBER CONCENTRATION IN PPM	REMARKS
	163	229	266	273	100 ppm	*Values obtained on this day appeared due to leaks of container.
Week 2/Day 1*						
Baseline						
Pre-exit		0.1	0.7	1.2		
30 min post-exposure	0.22	<0.1	0.22	0.2		
1 hour post-exposure	0.17	<0.1	0	<0.1		
Week 2/Day 4					100 ppm	
Baseline	<0.1	0	<0.1	<0.1		
Pre-exit	1.1	1.2	1.3	0.6		
15 min post-exposure	0.2	<0.1	0.1	0.1		
30 min post-exposure	<0.1	0.1	0	<0.1		
Week 3/Day 1					20 ppm	
Baseline	0.2	<0.1	0.1	0.1		
Pre-exit	0.3	0.5	0.4	0.3		
15 min post-exposure	0.2	<0.1	0.2	<0.1		
30 min post-exposure	0.3	0.2	<0.1	0.2		
Week 3/Day 4					20 ppm	
Baseline	0.3	0.3	0.1	<0.1		
Pre-exit	0	0	0	0		
15 min post-exposure	0	0	0	0		
30 min post-exposure	0	0	0	0		
Week 4/Day 1					fluct. 50-150 ppm	
Baseline	0	0	0	0		
Pre-exit	4.2	3.2	5.1	5.3		
15 min post-exposure	0.4	0.4	0.4	0.5		
30 min post-exposure	0.3	0.2	0.3	0.3		
Week 4/Day 4					fluct. 50-150 ppm	
Baseline	0.5	0.4	0.3	0.5		
Pre-exit	5.8	3.2	5.8	7.0		
15 min post-exposure	1.5	0.5	1.0	1.2		
30 min post-exposure	0.8	0.6	1.0	0.4		
Week 5/Day 1					150 ppm	
Baseline	0	0	0	0		
Pre-exit	8.1	4.1	7.1	3.9		
15 min post-exposure	0.7	0.2	0.8	1.6		
30 min post-exposure	0.5	0.3	0	0.5		
Week 5/Day 3					0 ppm	
Baseline	0	0	0	0		

TABLE XXX

METHYL CHLORIDE LEVELS IN BLOOD FOR MALE SUBJECTS
GROUP II
EXPOSURE TIME: 3 HOURS

WEEK/DAY	METHYL CHLORIDE CONCENTRATION IN PPM IN SUBJECTS			CHAMBER CONCENTRATION IN PPM	REMARKS
	267	269	270		
Week 2/Day 1*				100 ppm	*Values obtained on this day appeared questionable due to leak of container.
Baseline	0	<0.1	0.1		
Pre-exit					
30 min post-exposure					
1 hour post-exposure					
Week 2/Day 4				100 ppm	
Baseline	0		<0.1		
Pre-exit	15.1		0.3		
15 min post-exposure	5.0		<0.1		
30 min post-exposure	0.9		<0.1		
Week 3/Day 1				20 ppm	
Baseline			0.3		
Pre-exit			0.15		
15 min post-exposure			0.1		
30 min post-exposure			<0.1		
Week 3/Day 4				20 ppm	
Baseline	<0.1		<0.1		
Pre-exit	3.8		0		
15 min post-exposure	0.9		0		
30 min post-exposure	0.8		0		
Week 4/Day 1				fluct. 50-150 ppm	
Baseline			0		
Pre-exit			1.2		
15 min post-exposure			0.2		
30 min post-exposure			0.4		
Week 4/Day 4				fluct. 50-150 ppm	
Baseline			0.4		
Pre-exit			1.4		
15 min post-exposure			0.6		
30 min post-exposure			0.7		
Week 5/Day 1				150 ppm	
Baseline			0		
Pre-exit			1.2		
15 min post-exposure			0.4		
30 min post-exposure			<0.1		
Week 5/Day 3				0 ppm	
Baseline			0		

TABLE XXXI

METHYL CHLORIDE LEVELS IN BLOOD FOR MALE SUBJECTS
GROUP III
EXPOSURE TIME: 1 HOUR

WEEK/DAY	METHYL CHLORIDE CONCENTRATION IN PPM IN SUBJECTS				CHAMBER CONCENTRATION IN PPM	REMARKS
	274	275	276	277		
Week 2/Day 1*					100 ppm	*Values obtained on this day appeared questionable due to leaks of containers.
Baseline						
Pre-exit						
30 min post-exposure						
1 hour post-exposure						
Week 2/Day 4						
Baseline	<0.1	<0.1				
Pre-exit	9.8	0.7				
15 min post-exposure	4.6	<0.1				
30 min post-exposure	1.8	<0.1				
Week 3/Day 1					20 ppm	
Baseline		0.1	0.2	0.2		
Pre-exit		0.2	1.6	0.4		
15 min post-exposure		0.1	0.7	0.2		
30 min post-exposure		0.15	0.2	0.15		
Week 3/Day 4					20 ppm	
Baseline		<0.1	0.2	0.1		
Pre-exit		0.2	2.0	0		
15 min post-exposure		0	0.7	0		
30 min post-exposure		<0.1	0.4	<0.1		
Week 4/Day 1					fluct. 50-150 ppm	
Baseline		0	0	0		
Pre-exit		1.9	9.5	1.9		
15 min post-exposure		0.8	0.6	0.3		
30 min post-exposure		0.5	3.7	0.7		
Week 4/Day 4					fluct. 50-150 ppm	
Baseline		0.4				
Pre-exit		2.8				
15 min post-exposure		0.7				
30 min post-exposure		0.6				
Week 5/Day 1					150 ppm	
Baseline		0		0		
Pre-exit		2.8		3.2		
15 min post-exposure		0.6		0.7		
30 min post-exposure		<0.1		<0.1		
Week 5/Day 3					0 ppm	
Baseline		0				

TABLE XXXII

METHYL CHLORIDE LEVELS IN BLOOD FOR FEMALE SUBJECTS
GROUP I
EXPOSURE TIME: 7-1/2 HOURS

WEEK/DAY	METHYL CHLORIDE CONCENTRATION IN PPM IN SUBJECTS				CHAMBER CONCENTRATION IN PPM	REMARKS
	186	278	279	280		
Week 2/Day 1					100 ppm	
Baseline	off scale	0.6	trace	0.3	↓	
Pre-exit	8.2	5.6	no samp.	6.0		
15 min post-exposure	1.3	1.4	2.1	1.3		
30 min post-exposure	off scale	0.9	0.7	0.5		
Week 2/Day 4						
Baseline	0.2	0.4	0.4	0.3		
Pre-exit	3.9	7.4	6.6	4.5		
15 min post-exposure	1.3	3.3	1.8	1.2		
30 min post-exposure	1.0	1.3	1.2	1.0		
Week 3/Day 1					0 ppm	
Baseline	0.8	0.3	0.6	trace		

TABLE XXXIII

METHYL CHLORIDE LEVELS IN BLOOD FOR FEMALE SUBJECTS
GROUP II
EXPOSURE TIME: 3 HOURS

WEEK/DAY	METHYL CHLORIDE CONCENTRATION IN PPM IN SUBJECTS			CHAMBER CONCENTRATION IN PPM	REMARKS
	214	282	283		
Week 2/Day 1				100 ppm	
Baseline	0.3	0.3	0.2		
Pre-exit	1.8	5.0	trace*		*low blood volume
15 min post-exposure	0.4	trace	0.4		
30 min post-exposure	no specimen	trace	0.2		
Week 2/Day 4					
Baseline	0.3	1.1	0.5		
Pre-exit	1.6	18.3	3.4		
15 min post-exposure	0.9	8.4	1.2		
30 min post-exposure	0.7	4.3	1.1		
Week 3/Day 1					
Baseline	0.8	0.7	0.4	0 ppm	

TABLE XXXIV

METHYL CHLORIDE LEVELS IN BLOOD FOR FEMALE SUBJECTS
GROUP III
EXPOSURE TIME: 1 HOUR

WEEK/DAY	METHYL CHLORIDE CONCENTRATION IN PPM IN SUBJECTS		CHAMBER CONCENTRATION IN PPM	REMARKS
	285	286		
Week 2/Day 1			100 ppm	
Baseline	no specimen	trace		
Pre-exit	no specimen	1.2		
15 min post-exposure	0.4	0.5		
30 min post-exposure	no specimen	0.4		
Week 2/Day 4				
Baseline	0.5	0.5		
Pre-exit	3.9	2.9		
15 min post-exposure	1.1	0.9		
30 min post-exposure	0.8	0.9		
Week 3/Day 1				
Baseline	0.5	0.3	0 ppm	

TABLE XXXV

CARBON MONOXIDE LEVELS IN BLOOD FROM
MALE METHYL CHLORIDE SUBJECTS
GROUP I
EXPOSURE TIME: 7-1/2 HOURS

WEEK/DAY	COHb % SATURATION				CHAMBER CONCENTRATION IN PPM	REMARKS
	163	229	266	273		#163 rides a motorcycle
Week 2/Day 1					100 ppm	
Baseline	3.8	1.4	1.2	1.9		
Pre-exit	2.0	1.1	1.1	1.5		
30 min post-exposure	1.6	1.3	0.9	1.3		
Week 3/Day 1					20 ppm	
Baseline	2.3	1.4	1.2	2.1		
Pre-exit	0.4	1.1	0.7	0.8		
30 min post-exposure	0.4	0.5	0.8	0.9		
Week 4/Day 1					fluct. 50-150 ppm	
Baseline	1.4	1.0	0.5	1.2		
Pre-exit	0.8	0.6	0.6	1.1		
30 min post-exposure	0.8	0.8	0.9	1.3		
Week 5/Day 1					150 ppm	
Baseline	1.5	0.8	1.5	1.7		
Pre-exit	0.7	0.8	0.7	1.0		
30 min post-exposure	1.4	1.1	0.5	1.5		

TABLE XXXVI

CARBON MONOXIDE LEVELS IN BLOOD FROM
MALE METHYL CHLORIDE SUBJECTS
GROUP II
EXPOSURE TIME: 3 HOURS

WEEK/DAY	COHb % SATURATION			CHAMBER CONCENTRATION IN PPM	REMARKS
	267	269	270		
Week 2/Day 1				100 ppm	All subjects in this group smoke.
Baseline	4.6	3.6	5.4		
Pre-exit	3.8	3.2	4.1		
30 min post-exposure	4.2	2.6	4.7		
Week 3/Day 1				20 ppm	
Baseline			2.5		
Pre-exit			2.2		
30 min post-exposure			1.6		
Week 4/Day 1				fluct. 50-150 ppm	
Baseline			4.5		
Pre-exit			3.3		
30 min post-exposure			3.5		
Week 5/Day 1				150 ppm	
Baseline			5.7		
Pre-exit			4.2		
30 min post-exposure			5.1		

TABLE XXXVII

CARBON MONOXIDE LEVELS IN BLOOD FROM
MALE METHYL CHLORIDE SUBJECTS
GROUP III
EXPOSURE TIME: 1 HOUR

WEEK/DAY	COHb % SATURATION				CHAMBER CONCENTRATION IN PPM	REMARKS
	274	275	276	277		
Week 2/Day 1					100 ppm	#275 does smoke
Baseline	1.8	4.8				
Pre-exit	1.8	4.2				
30 min post-exposure	1.75	5.6				
Week 3/Day 1					20 ppm	
Baseline		4.6	2.0	4.5		
Pre-exit		4.5	1.8	3.9		
30 min post-exposure		4.3	2.0	3.6		
Week 4/Day 1					fluct. 30-150 ppm	
Baseline		3.0	1.5	3.7		
Pre-exit		3.0	1.4	3.2		
30 min post-exposure		4.1	1.5	2.2		
Week 5/Day 1					150 ppm	
Baseline		4.3		7.3		
Pre-exit		4.2		6.2		
30 min post-exposure		5.6		4.1		

TABLE XXXVIII

CARBON MONOXIDE LEVELS IN BLOOD
FROM FEMALE METHYL CHLORIDE SUBJECTS

GROUP I, EXPOSURE TIME: 7-1/2 HOURS

WEEK/DAY	COHb % SATURATION #186	#278	#279	#280	CHAMBER CONCENTRATION IN PPM	REMARKS
Week 1/Day 1					100 ppm	Subject #186
Baseline	3.0	1.9	3.0	1.7	↓	smokes
Pre-exit	1.1	1.7	no samp.	1.4		
30 min post-exposure	0.9	1.5	2.0	1.4		
Week 1/Day 4						
Baseline	3.6	1.0	0.6	0.5		
Pre-exit	1.0	0.5	0.5	0.3		
30 min post-exposure	1.8	0.7	0.6	0.5		
Week 2/Day 1					0 ppm	
Baseline	3.5	0.8	0.4	0.4		

GROUP II, EXPOSURE TIME: 3 HOURS

	#214	#282	#283		
Week 1/Day 1				100 ppm	Subject #283
Baseline	1.4	0.8	5.9		smokes
Pre-exit	1.4	0.9	4.5		
30 min post-exposure	no samp.	0.7	5.9		
Week 1/Day 4					
Baseline	0.7	1.4	5.2		
Pre-exit	0.2	0.1	2.3		
30 min post-exposure	0.1	0.3	3.0		
Week 2/Day 1				0 ppm	
Baseline	0.3	0.6	3.9		

GROUP III, EXPOSURE TIME: 1 HOUR

	#285	#286		
Week 1/Day 1			100 ppm	
Baseline		1.6	↓	
Pre-exit	0.7	1.6		
30 min post-exposure		1.5		
Week 1/Day 4				
Baseline	0.6	0.7		
Pre-exit	0.5	0.8		
30 min post-exposure	0.6	0.7		
Week 2/Day 1			0 ppm	
Baseline	0.3	1.7		

TABLE XXXIX

PULMONARY VENTILATION ($\dot{V}_E$-ℓ/min, BTPS) FOR ALL SUBJECTS DURING METHYL CHLORIDE STUDY

MALES

CONC. - PPM	0	100	100	20	20	0	100 f	150	0	0	100	100
DATE - '75	3/13	3/18	3/20	3/25	3/27	4/3	4/10	4/15	4/16	4/25	4/29	5/1
#163 M-Grp. I	11.24	12.30	11.64	10.82	8.71	8.68	7.98	10.08	10.32			
#229 M-Grp. I	--	8.83	8.10	8.63	9.14	9.19	9.45	7.37	9.83			
#266 M-Grp. I	7.93	10.75	10.48	9.92	7.91	10.07	12.32	11.03	10.29			
#273 M-Grp. I	9.33	7.92	9.61	7.12	7.19	6.18	8.60	8.94	10.12			
#267 M-Grp. II	6.95	8.73	5.93	--	10.48	*						
#270 M-Grp. II	7.57	10.11	8.63	8.31	7.45	7.76	6.45	6.98	7.80			
#274 M-Grp. III	7.28	7.28	7.53	--	--	13.47	13.96	15.83	14.91			
#275 M-Grp. III	9.42	12.20	6.08	11.51	13.29	*						
						FEMALES						
#186										7.60	7.05	7.11
#278 GROUP I										8.17	9.54	10.24
#279 FEMALES										11.29	10.31	9.20
#280										6.89	6.45	7.60
#214										5.77	5.10	4.71
#282 GROUP II FEMALES										7.28	9.48	10.17
#283										10.52	8.98	7.88
#285 GROUP III										8.44	7.92	7.01
#286 FEMALES										5.23	7.11	5.89

-- = subject absent
* = subject out of study

TABLE XL

EXPIRATORY VOLUMES AND FLOW RATES OF GROUP I MALE SUBJECTS DURING METHYL CHLORIDE STUDY ($\bar{X}$ and SEM)

DATE	3/14/75		3/21/75		3/26/75		4/4/75		4/11/75		4/16/75	
CONCENTRATION - PPM	0		100 steady		20		0		100 fluct.		0	
MAXIMUM INSPIRATION												
Volume	6.51	0.1	6.47	0.1	6.32	0.2	6.20	0.2	6.50	0.1	6.51	0.2
Peak Flow, PEFR	10.63	0.6	10.70	0.1	10.69	0.5	11.08	0.7	10.39	0.8	10.59	1.1
Flow - 40	4.33	0.8	3.89	0.9	4.00	0.9	4.19	0.9	4.33	0.8	4.40	0.9
Flow - 25	2.47	0.7	2.31	0.6	2.40	0.6	2.36	0.6	2.59	0.6	2.77	0.7
FEV_1/FVC	76.50	4.1	74.70	4.6	72.50	4.5	73.80	5.4	73.90	3.9	75.00	4.9
PARTIAL EXPIRATION												
Volume	4.68	0.2	4.47	0.1	4.25	0.4	4.40	0.2	4.79	0.1	4.82	0.1
Peak Flow	8.30	0.4	7.36	0.4	7.71	0.7	8.51	0.5	8.22	0.7	8.07	0.8
Flow - 40	3.58	0.8	3.53	0.8	3.93	0.8	3.72	0.8	3.74	0.8	3.74	0.8
Flow - 25	2.02	0.6	2.10	0.6	2.44	0.6	2.13	0.8	2.24	0.6	2.35	0.6

Volume = The volume of the maximum vital capacity and partial expiration (ℓ-BTPS).
PEFR = Maximum rate of air flow during expiration (ℓ-sec).
Flow-40 = Expiratory flow rate at a lung volume corresponding to 40% of the vital capacity (ℓ-sec).
Flow-25 = Expiratory flow rate at a lung volume corresponding to 25% of the vital capacity (ℓ-sec).
FEV_1/FVC = Percent of vital capacity exhaled in one second.

TABLE XLI

WITHIN-DAY VARIABILITY IN VARIOUS FUNCTIONS AS MEASURED FROM MAXIMUM AND PARTIAL FORCED EXPIRATORY MANEUVERS
(Between Trial Mean Difference / Actual Mean x 100)

	Trial 1 vs. Trial 2	Trial 1 vs. Trial 3
Max. Vol.	2.81	1.06
Partial Vol.	1.61	2.78
Partial - Flow @ 25%	2.81	2.59
Max. - Flow @ 25%	2.80	2.20
Partial - Flow @ 40%	0.39	0.81
Max. - Flow @ 40%	0.92	0.52
Peak Flow	2.96	3.24

TABLE XLII

ANALYSIS OF VARIANCE FOR THE 10 SECOND TIME ESTIMATIONS

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARE	MSR(F)
TOTAL	47	167.013		
SESSIONS	11	17.090		
DAY TREND	1	3.996	3.996	2.308
CONC.	1	.001	.001	.0006
OTHER	9	12.967	1.441	.832
PEOPLE	3	92.791	30.939	17.865*
RESIDUAL	33	57.132	1.731	

*Significant at $p \leq .001$

TABLE XLIII

ANALYSIS OF VARIANCE FOR THE 30 SECOND TIME ESTIMATIONS

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	MSR(F)
TOTAL	47	961.873		
SESSIONS	11	75.022		
DAY TREND	1	18.979	18.979	1.578
CONC.	1	16.939	16.939	1.408
OTHER	9	44.855	4.984	.414
PEOPLE	3	489.834	162.278	13.480*
RESIDUAL	33	397.018	12.031	

*Significant at $p \leq .001$

TABLE XLIV

ANALYSIS OF VARIANCE FOR THE MARQUETTE TEST

ESTIMATE/STIMULUS--SOUND STIMULUS

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	MSR(F)
TOTAL	47	1.421		
SESSIONS	11	.059		
DAY TREND	1	.003	.003	.287
CONC.	1	.0004	.0004	.044
OTHER	9	.056	.006	.642
PEOPLE	3	1.042	.347	35.727*
RESIDUAL	33	.321	.010	

*Significant at $p \leq .001$

TABLE XLV

ANALYSIS OF VARIANCE FOR THE MARQUETTE TEST

|ESTIMATE-STIMULUS|--SOUND STIMULUS

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	MSR(F)
TOTAL	47	6.111		
SESSIONS	11	.236		
DAY TREND	1	.004	.004	.131
CONC.	1	.001	.001	.048
OTHER	9	.232	.026	.931
PEOPLE	3	4.963	1.654	59.899
RESIDUAL	33	.912	.028	

TABLE XLVI

ANALYSIS OF VARIANCE FOR THE MARQUETTE TEST

REACTION TIME--SOUND STIMULUS

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	MSR(F)
TOTAL	47	1.021		
SESSIONS	11	.473		
DAY TREND	1	.196	.196	12.027*
CONC.	1	.027	.027	1.653
OTHER	9	.271	.030	1.848
PEOPLE	3	.012	.004	.243
RESIDUAL	33	.537	.016	

*Significant at $p \leq .005$

TABLE XLVII

ANALYSIS OF VARIANCE FOR THE MARQUETTE TEST

ESTIMATE/STIMULUS--LIGHT STIMULUS

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	MSR(F)
TOTAL	47	.501		
SESSIONS	11	.078		
DAY TREND	1	.0008	.0008	.136
CONC.	1	.033	.033	5.609*
OTHER	9	.041	.005	.792
PEOPLE	3	.231	.077	13.208
RESIDUAL	33	.192	.006	

*Significant at $p \leq .025$

TABLE XLVIII

ANALYSIS OF VARIANCE FOR THE MARQUETTE TEST

|ESTIMATE-STIMULUS|--LIGHT STIMULUS

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	MSR(F)
TOTAL	47	1.995		
SESSIONS	11	.149		
DAY TREND	1	.007	.007	.433
CONC.	1	.040	.040	2.390
OTHER	9	.106	.012	.700
PEOPLE	3	1.291	.430	25.568
RESIDUAL	33	.556	.017	

TABLE XLVIX

ANALYSIS OF VARIANCE FOR THE MARQUETTE TEST

REACTION TIME--LIGHT STIMULUS

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	MSR(F)
TOTAL	47	.997		
SESSIONS	11	.499		
DAY TREND	1	.186	.186	14.786*
CONC.	1	.029	.029	2.291
OTHER	9	.306	.034	2.704
PEOPLE	3	.083	.028	2.201
RESIDUAL	33	.414	.013	

*Significant at $p \leq .001$

TABLE L

ANALYSIS OF VARIANCE FOR THE ARITHMETIC TEST

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	MSR(F)
TOTAL	47	12868.000		
SESSIONS	11	603.000		
DAY TREND	1	236.945	236.945	8.839*
CONC.	1	10.178	10.178	.380
OTHER	9	365.989	40.665	1.517
PEOPLE	3	11380.333	3793.444	141.504
RESIDUAL	33	884.668	26.808	

*Significant at $p \leq .01$

TABLE LI

ANALYSIS OF VARIANCE FOR THE COORDINATION TEST

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	MSR(F)
TOTAL	47	4220.973		
SESSIONS	11	672.229		
DAY TREND	1	65.769	65.769	.854
CONC.	1	46.152	46.152	.599
OTHER	9	534.214	59.357	.770
PEOPLE	3	1007.896	335.965	4.161
RESIDUAL	33	2540.848	76.995	

TABLE LII

ANALYSIS OF VARIANCE FOR THE INSPECTION TEST

DURING EXPOSURE TO METHYL CHLORIDE (7-1/2 HR/DAY)

SOURCE	DF	SUM OF SQUARES	MEAN SQUARES	MSR(F)
TOTAL	47	12310.813		
SESSIONS	11	1429.062		
DAY TREND	1	701.571	701.571	14.098*
CONC.	1	60.599	60.599	1.218
OTHER	9	556.233	61.804	1.242
PEOPLE	3	9239.562	3079.854	61.890
RESIDUAL	33	1642.187	49.763	

*Significant at $p \leq .005$

TABLE LIII

LATENCY (in m sec) BETWEEN DELIVERY OF ELECTRICAL STIMULUS AND THE ONSET OF THE REFLEXLY ELICITED ELECTROMYOGRAM

MALES

Condition		0 ppm	20 ppm	100s ppm	100f ppm	150 ppm
0.5 hr	$\bar{x}$	33.2	33.9	33.8	33.4	32.7
	sem	0.7	0.7	0.6	0.6	1.0
3.5 hr	$\bar{x}$	33.3	34.3	33.8	33.4	33.2
	sem	0.7	0.7	0.6	0.5	1.1
6.5 hr	$\bar{x}$	33.2	34.1	33.4	33.2	33.2
	sem	0.6	0.7	0.6	0.6	1.0

FEMALES

0.5 hr	$\bar{x}$	29.1		29.4		
	sem	.7		.4		
3.5 hr	$\bar{x}$	29.2		29.6		
	sem	.4		.5		
6.5 hr	$\bar{x}$	29.2		29.5		
	sem	.4		.4		

TABLE LIV
METHYL CHLORIDE STUDY
SUBJECTIVE RESPONSES AND ODOR DETECTION

WEEK	DAY OF WEEK	CONC. PPM	GROUP I - 7-1/2 HR NO. OF[a] SUBJECTS	SUBJ.[b] RESPONSE	ODOR[c] NOTED	GROUP II - 3 HR NO. OF[a] SUBJECTS	SUBJ.[b] RESPONSE	ODOR[c] NOTED	GROUP III - 1 HR NO. OF[a] SUBJECTS	SUBJ.[b] RESPONSE	ODOR[c] NOTED
						MALE					
1	4	0	4	2	0	4	2	4	2	0	1
	5	0	3	1	0	3	2	2	2	0	0
2	1	100	4	0	0	3	2	0	2	0	0
	2	100	3	0	0	4	2	2	2	1	0
	3	100	4	1	0	3	1	2	2	0	0
	4	100	4	0	0	2	0	2	2	0	0
	5	100	3	0	0	0			2	0	0
3	1	20	4	1	0	1	0	1	3	0	0
	2	20	4	0	0	1	0	0	3	0	0
	3	20	4	1	1	1	0	0	3	0	0
	4	20	3	0	0	1	0	0	3	1	0
4	4	0	3	0	0	1	0	1	1	0	0
	5	0	4	0	0	1	0	1	1	0	0
5	1	100f	4	0	0	1	0	1	3	0	0
	2	100f	4	2	1	0			2	0	0
	3	100f	4	0	0	0			3	0	0
	4	100f	4	0	0	1	1	0	1	0	0
	5	100f	4	0	0	1	0	0	3	1	0
6	1	150	4	1	0	1	0	0	1	1	0
	2	150	3	0	0	1	0	0	1	0	0
	3	0	4	0	0	1	0	0	0		
						FEMALE					
1	5	0	4	2	0	3	0	0	2	0	0
2	1	100	4	1	0	3	0	0	2	0	0
	2	100	4	0	0	3	0	0	2	0	0
	3	100	4	0	0	3	0	0	2	0	0
	4	100	4	0	0	3	1	0	2	1	0
	5	100	3	0	0	3	2	0	2	0	0
3	1	0	4	1	0	0			2	0	0

[a] Number of subjects returning a subjective response form..

[b] Number of subjects who noted a response, including headache, nausea, dizziness, abdominal pain, chest pain, ENT irritation, or other, regardless of severity.

[c] Number of subjects who noted what they perceived to be methyl chloride odor

TABLE LV

METHYL CHLORIDE STABILITY IN BREATH CONTAINERS

	Number of Hours After Filling Containers								
	0		24		48		120		
CONTAINER	SARAN BAG	GLASS TUBE	SARAN BAG	GLASS TUBE	SARAN BAG	GLASS TUBE	SARAN BAG	GLASS TUBE	GLASS* TUBE
No. Filled	6	10	6	5	6	5	6	5	5
No. Valid	6	10	6	5	5	5	4	5	3
Mean Conc. in ppm	47	52	47	48	49	44	48	41	36
±S.D.	1.5	3.7	1.7	3.8	3.6	6.1	5.0	2.8	3.5
High	49	55	49	51	54	54	54	45	38
Low	45	44	45	42	44	38	42	39	32
% of Saran Bag at 0 hr	100	110	100	102	104	94	102	87	77
	Assay of Individual Saran Bags								
#1	48		49		44		49		
#2	49		48		leaked		--		
#3	46		48		54		54		
#4	46		45		50		42		
#5	45		45		49		leaked		
#6	47		47		50		47		

*Airmailed

TABLE LVI

ALVEOLAR BREATH CONCENTRATIONS IMMEDIATELY AFTER EXPOSURE TO METHYL CHLORIDE, 100 OR 20 PPM

TYPE B SUBJECT	HR. EXP.	SEX	PPM ± SD	COMPARED TO TYPE A SUBJS. PPM ± SD
267	3	M	70.2 ± 5.2 16.1 ± 2.0	40.1 ± 4.5 8.0 ± 1.2
282	3	F	64.3 ± 8.2	38.3 ± 7.9
274	1	M	70.6 ± 4.4	33.3 ± 3.0
276	1	M	79.0 ± 5.5 14.2 ± 1.7	46.5 ± 8.0 8.9 ± 1.7

TABLE LVII

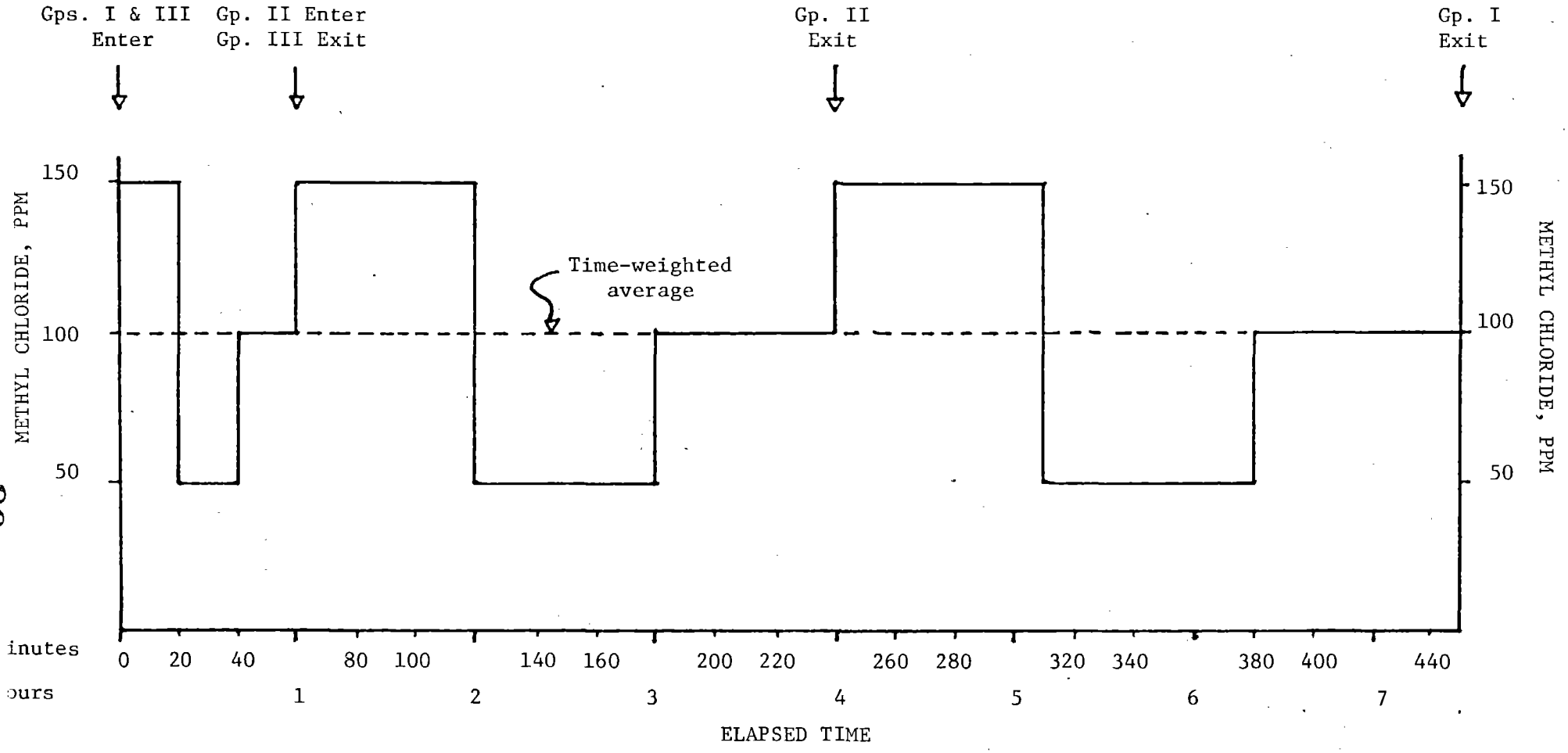
ALVEOLAR BREATH CONCENTRATIONS 1 HR AFTER EXPOSURE TO METHYL CHLORIDE, 100 OR 20 PPM

TYPE B SUBJECT	HR. EXP.	SEX	PPM ± SD	COMPARED TO TYPE A SUBJS. PPM ± SD
267	3	M	8.7 ± 1.1 1.7 ± 0.3	1.8 ± 0.4 0.3 ± 0.1
282	3	F	6.9 ± 0.9	1.7 ± 0.7
274	1	M	6.2 ± 1.6	2.2 ± 0.4
276	1	M	6.5 ± 2.4 1.4 ± 0.1	1.6 ± 1.1 0.3 ± 0.1
5&6 (1962)	6-1/2	M	5.8 & 5.3	0.6 ± 0.1

FIGURE 1

FLUCTUATION OF METHYL CHLORIDE CONCENTRATION IN CHAMBER

MALES, WEEK 5, DAYS 1-5



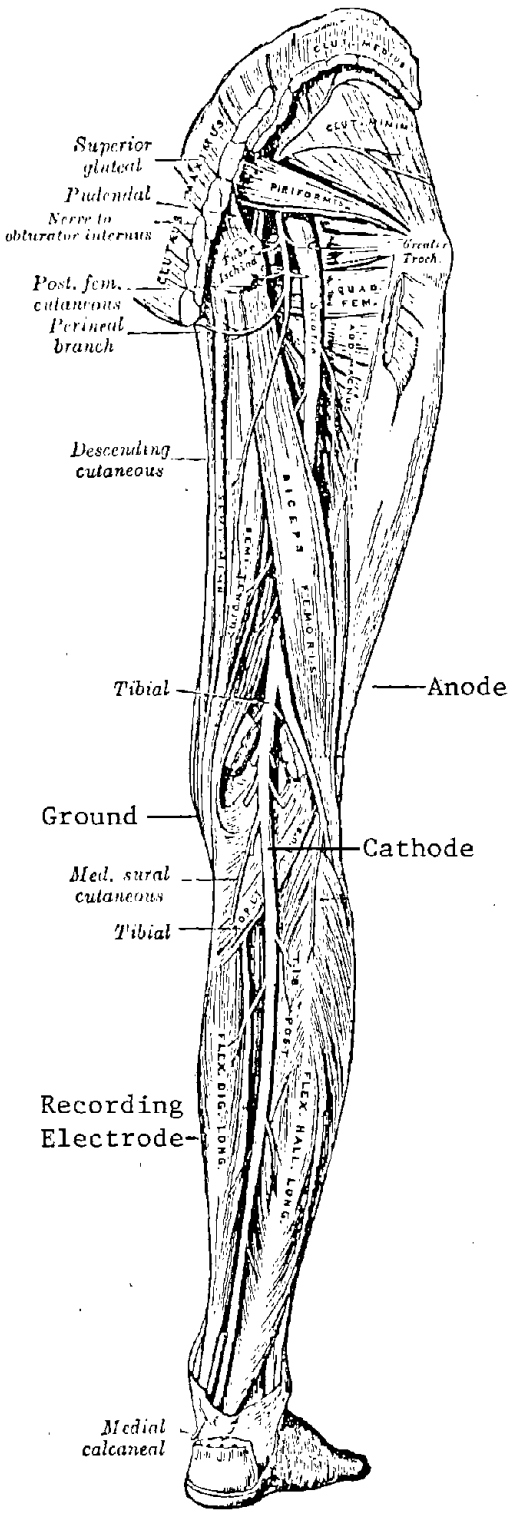


FIGURE 2

Electrode placement for recording electrically elicited electromyograms from gastrocnemius muscle. This muscle is the most superficial muscle on the posterior aspect of the calf; hence, it has been removed in the above photo so that the nervous pathways can be demonstrated.

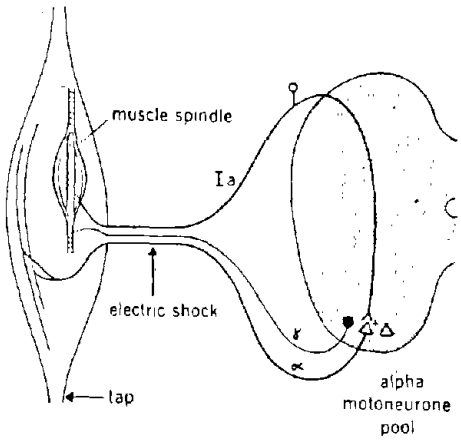


FIGURE 3

Diagram depicting components of neural circuit involved in the H response.

FIGURE 4

SPONTANEOUS EEG ACTIVITY DURING EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #163, GROUP I

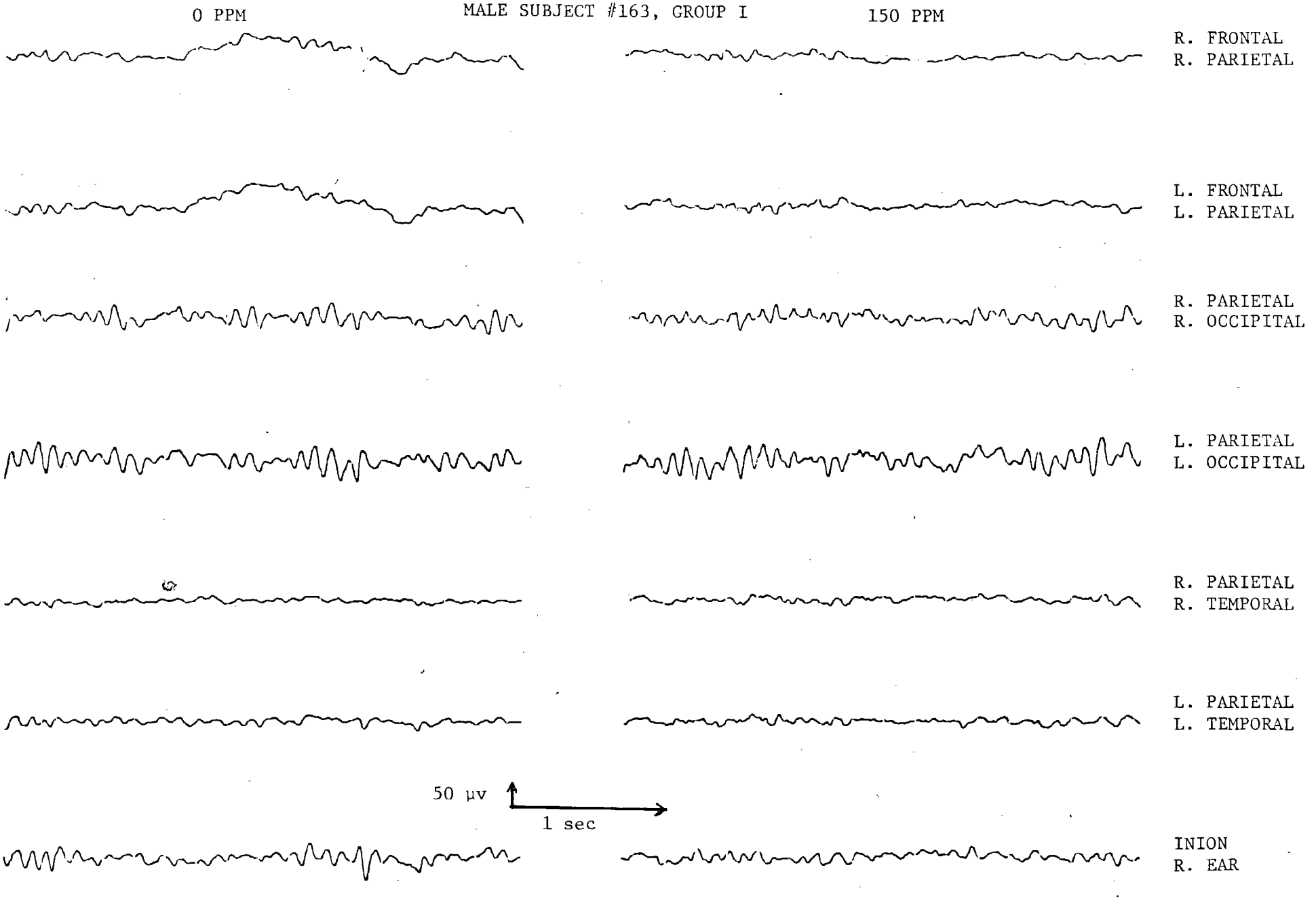


FIGURE 5

SPONTANEOUS EEG ACTIVITY DURING EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #229, GROUP I

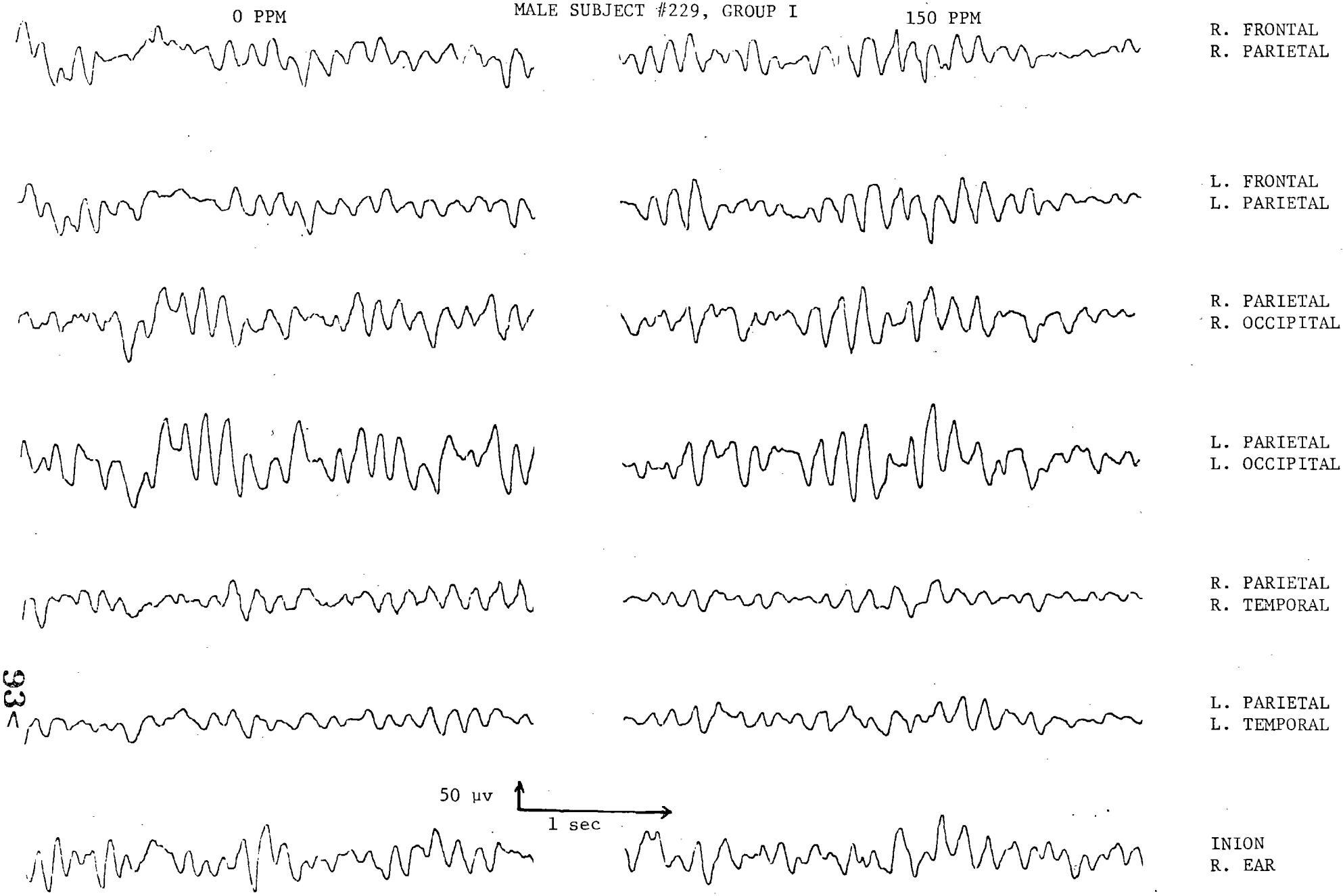


FIGURE 6

SPONTANEOUS EEG ACTIVITY DURING EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #266, GROUP I

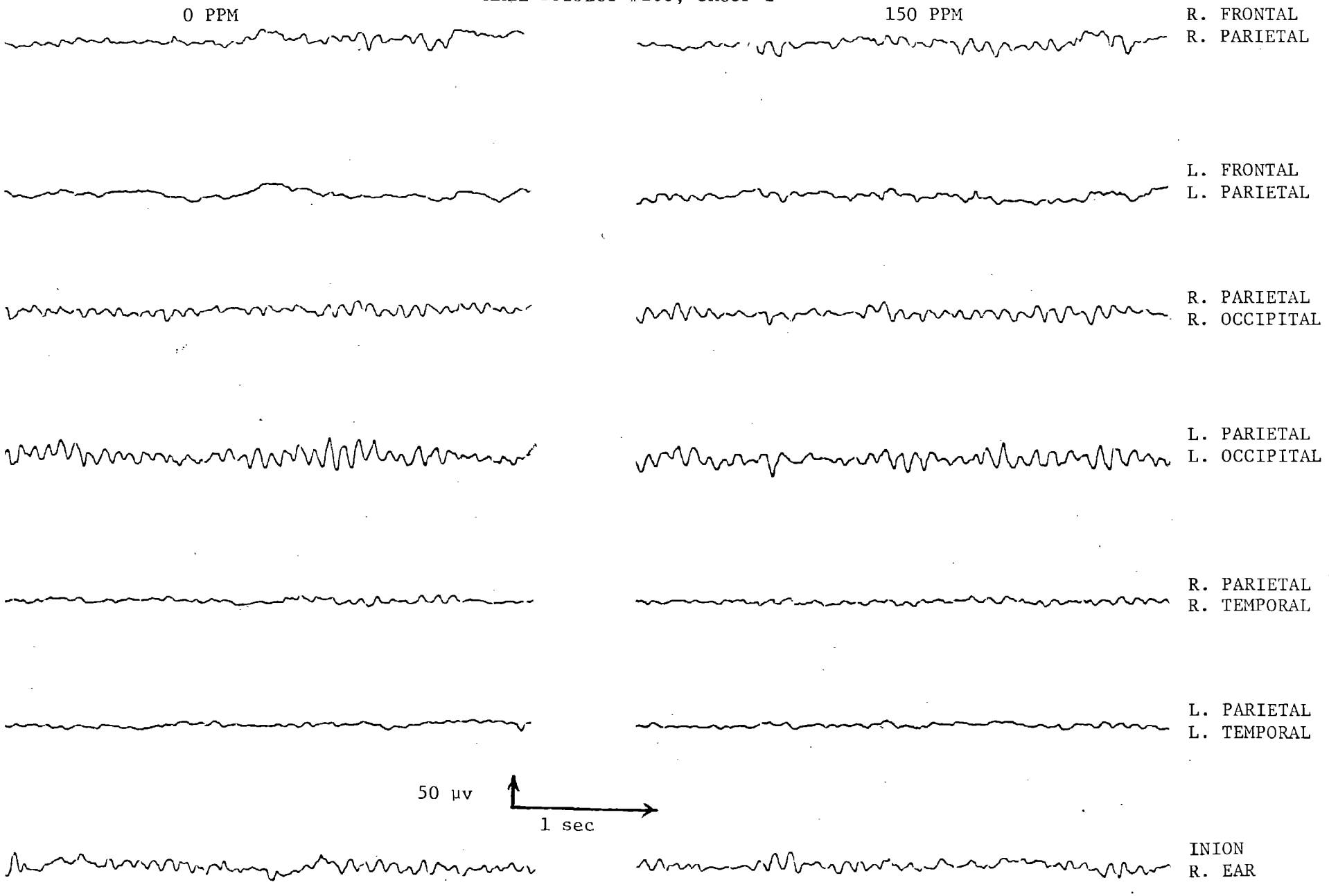


FIGURE 7

SPONTANEOUS EEG ACTIVITY DURING EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #273, GROUP I

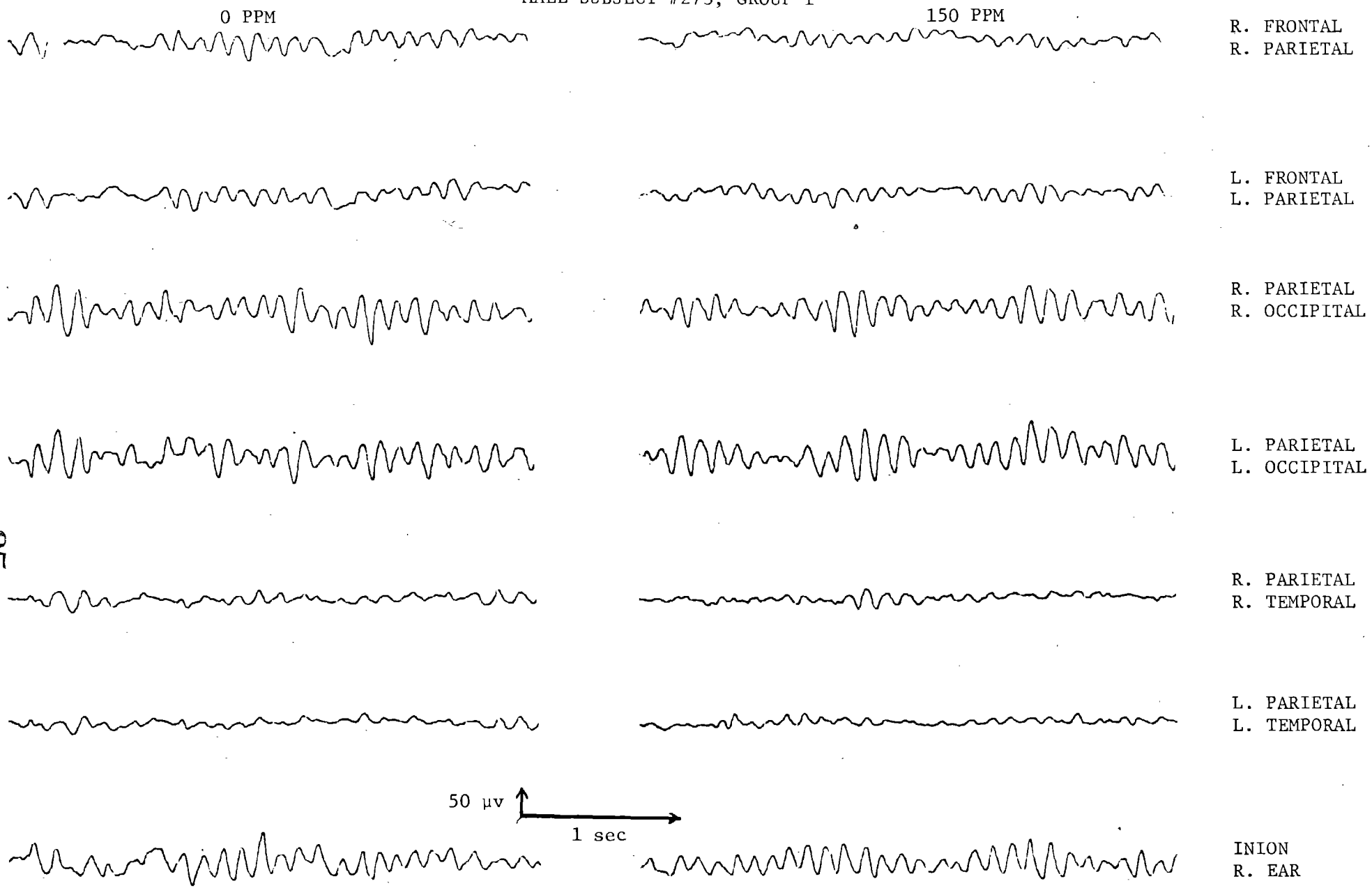


FIGURE 8

SPONTANEOUS EEG ACTIVITY DURING EXPOSURE TO METHYL CHLORIDE

FEMALE SUBJECT #186, GROUP I

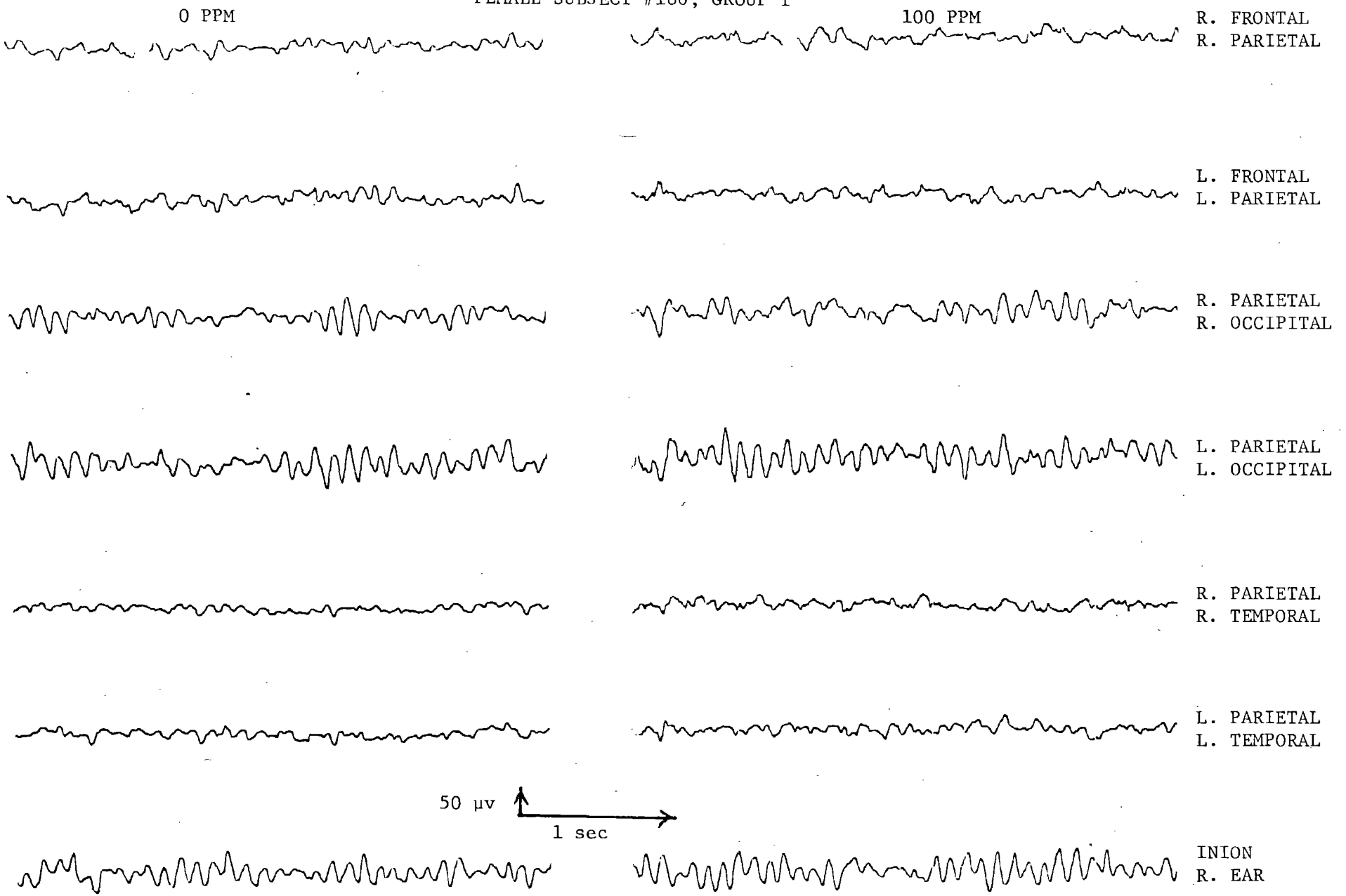


FIGURE 9

SPONTANEOUS EEG ACTIVITY DURING EXPOSURE TO METHYL CHLORIDE

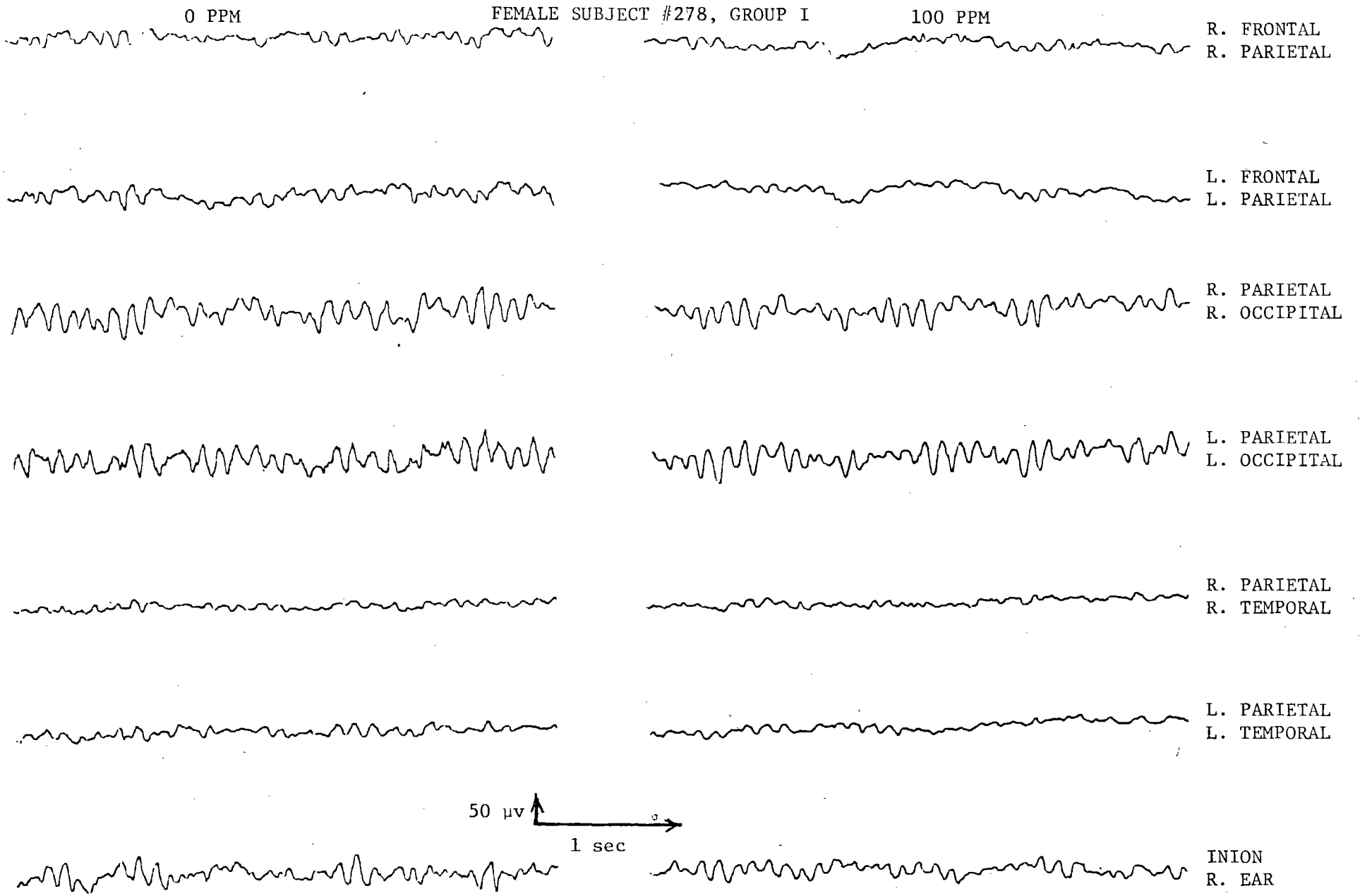


FIGURE 10

SPONTANEOUS EEG ACTIVITY DURING EXPOSURE TO METHYL CHLORIDE

FEMALE SUBJECT #279, GROUP I

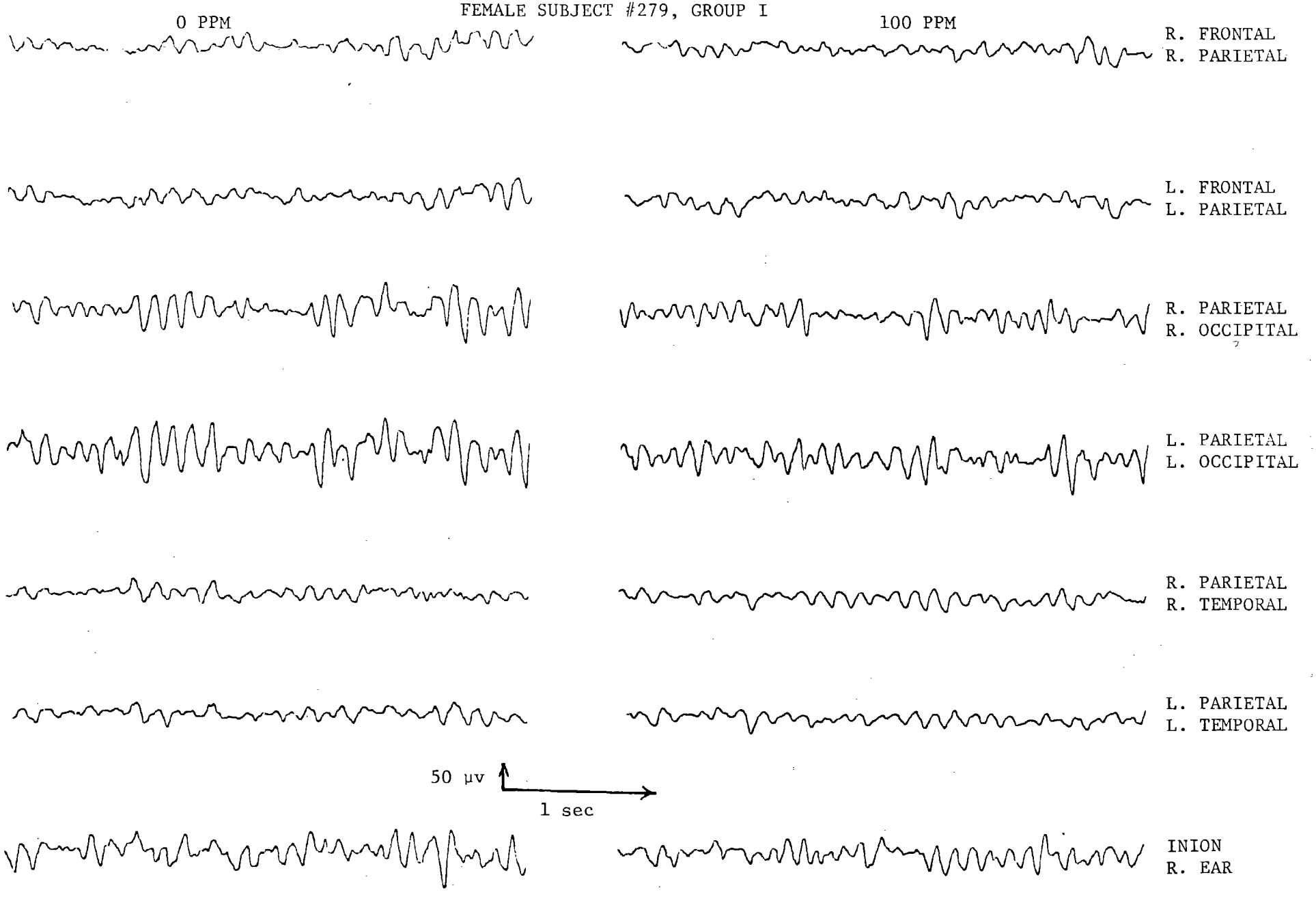


FIGURE 11

SPONTANEOUS EEG ACTIVITY DURING EXPOSURE TO METHYL CHLORIDE

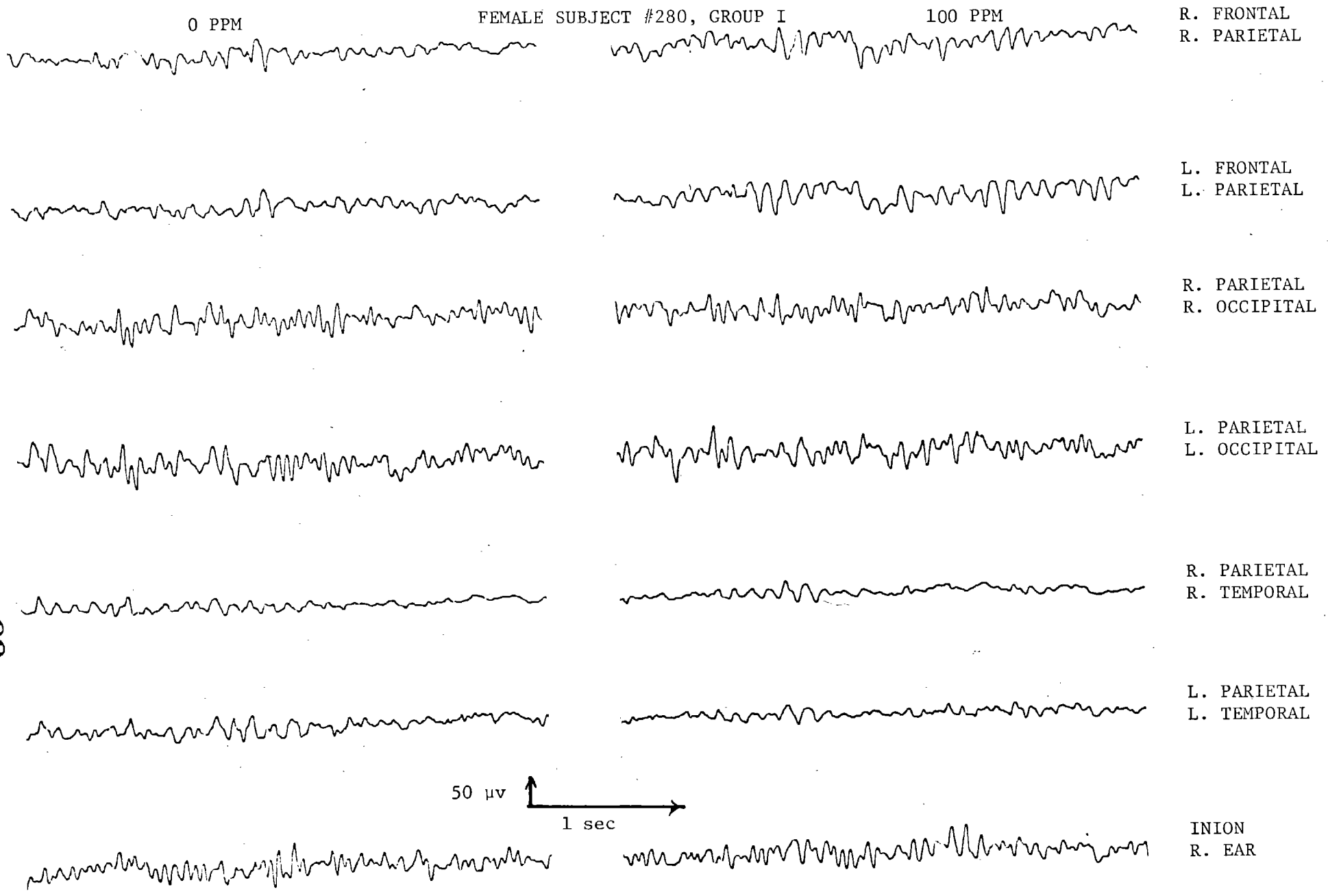


FIGURE 12

CONTROL VER'S FOR EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #163, GROUP I

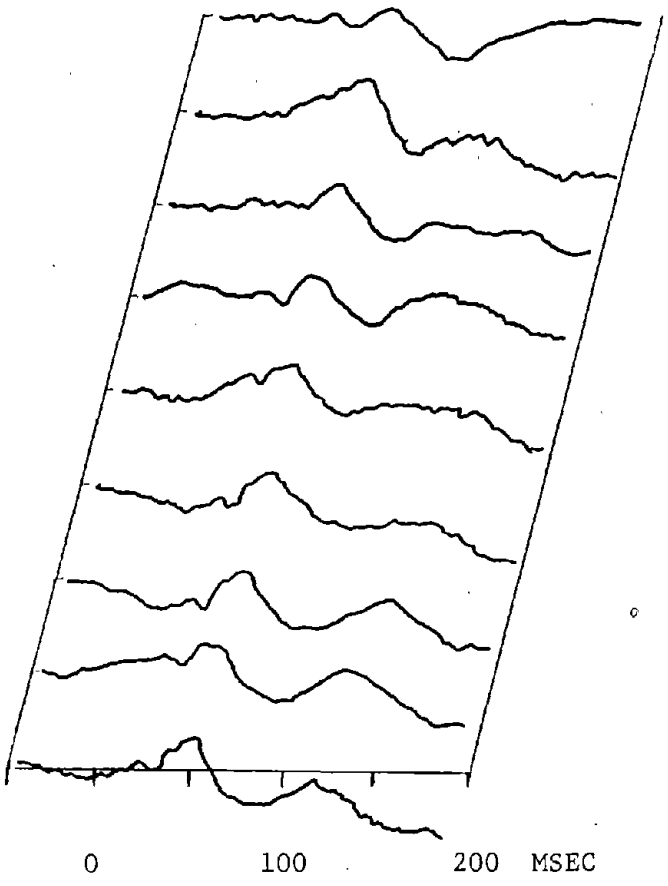


FIGURE 13

CONTROL VER'S FOR EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #229, GROUP I

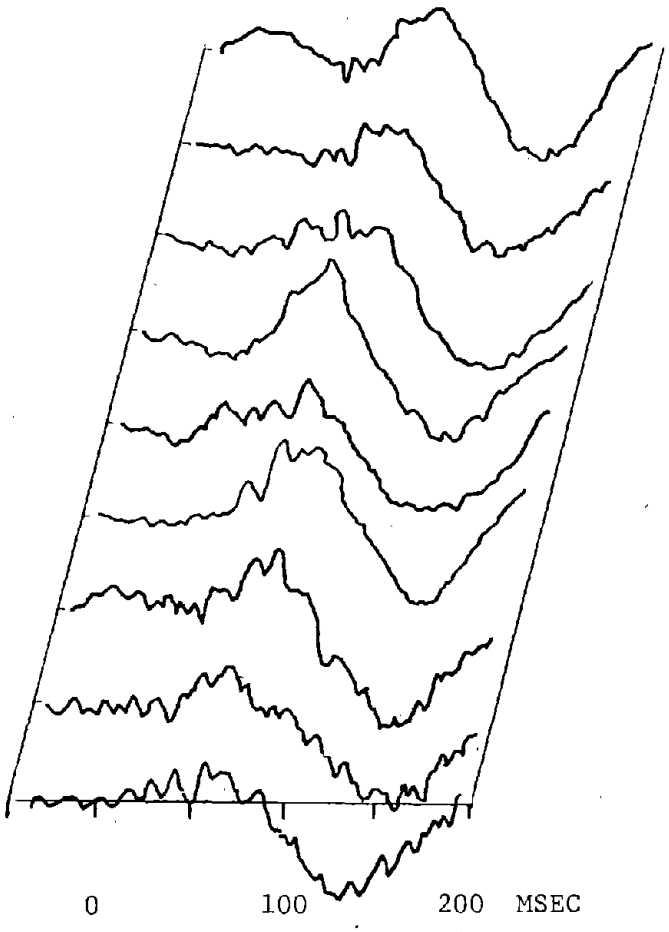


FIGURE 14

CONTROL VER'S FOR EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #266, GROUP I

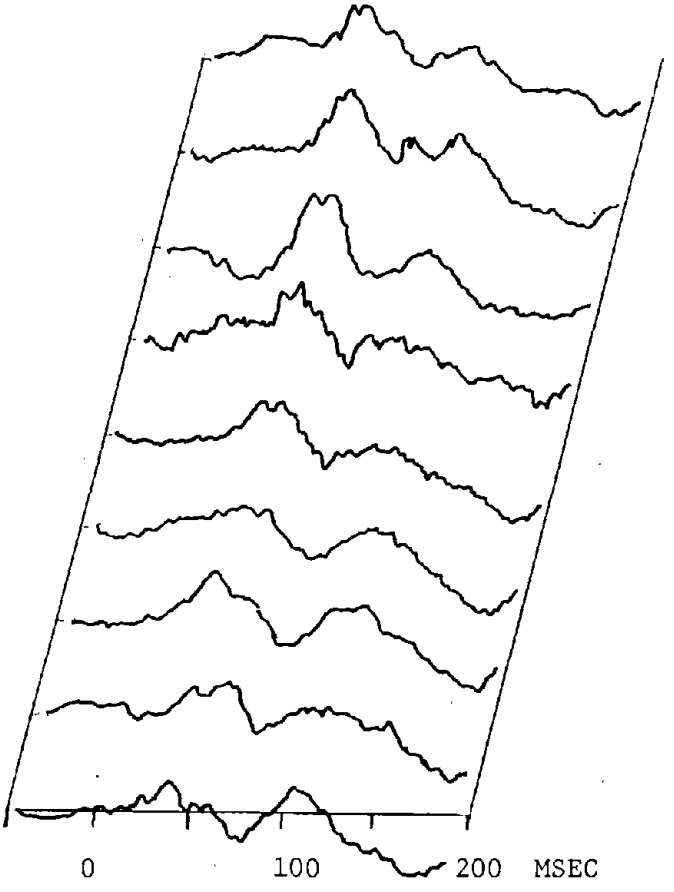


FIGURE 15

CONTROL VER'S FOR EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #273, GROUP I

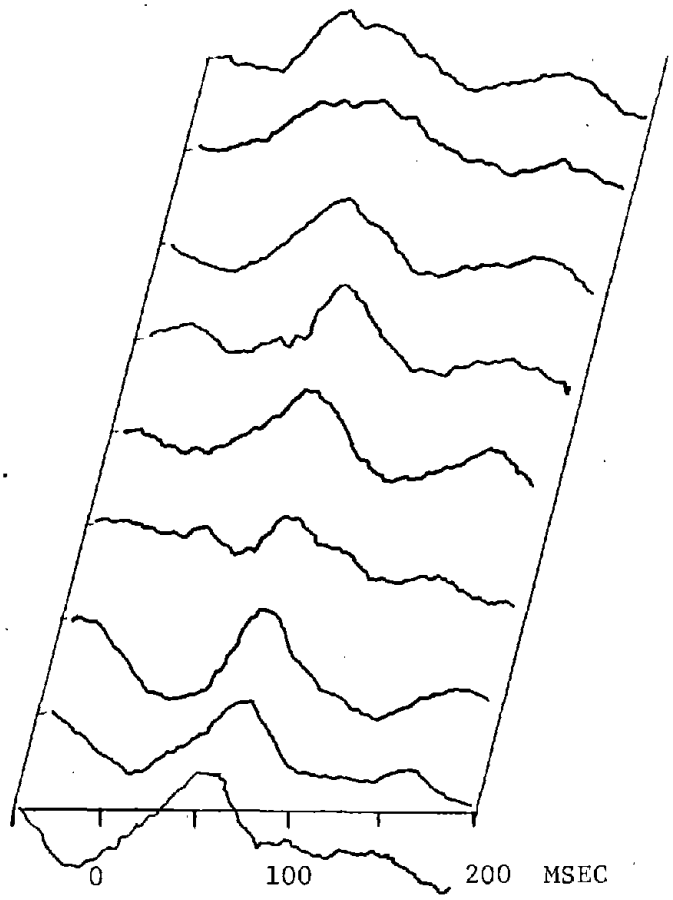


FIGURE 16

CONTROL VER'S FOR EXPOSURE TO METHYL CHLORIDE

FEMALE SUBJECT #186, GROUP I

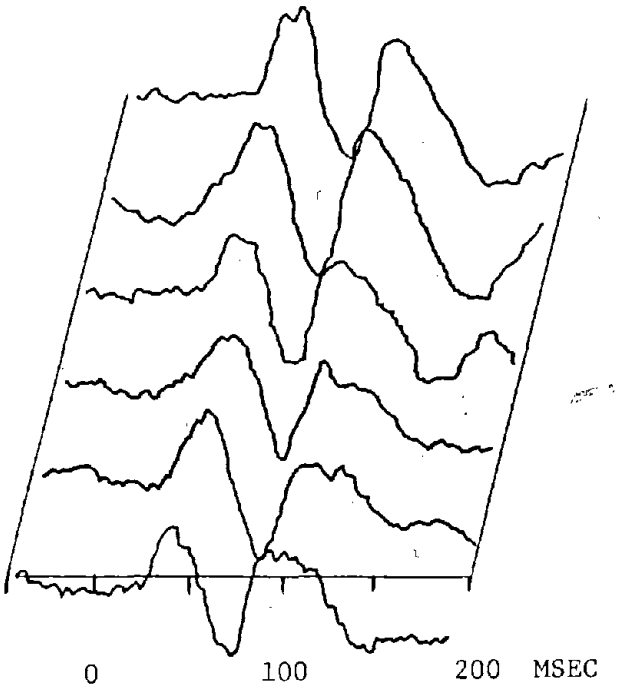


FIGURE 17

CONTROL VER'S FOR EXPOSURE TO METHYL CHLORIDE

FEMALE SUBJECT #278, GROUP I

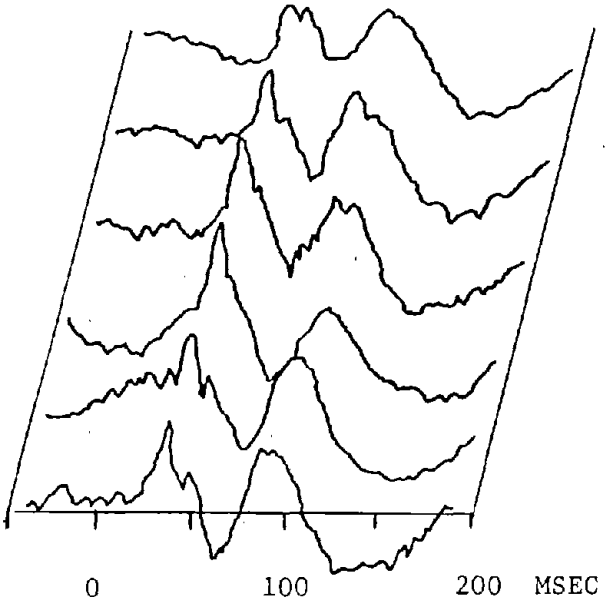


FIGURE 18

CONTROL VER'S FOR EXPOSURE TO METHYL CHLORIDE

FEMALE SUBJECT #279, GROUP I

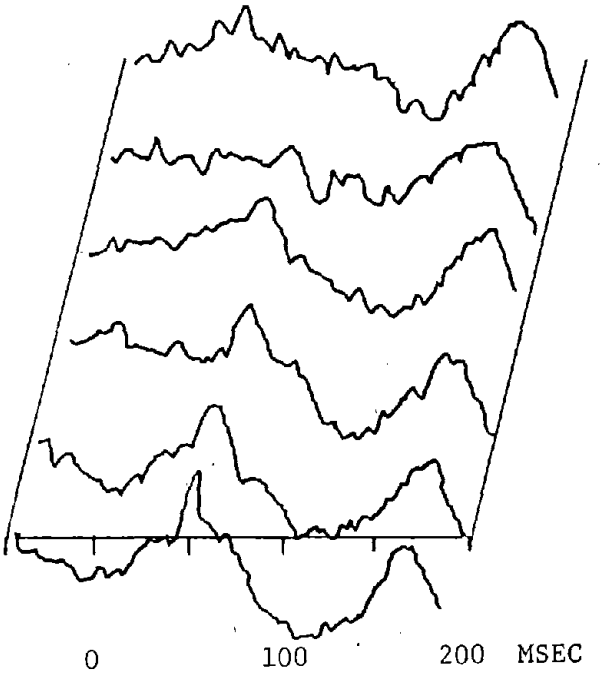


FIGURE 19

CONTROL VER'S FOR EXPOSURE TO METHYL CHLORIDE

FEMALE SUBJECT #280, GROUP I

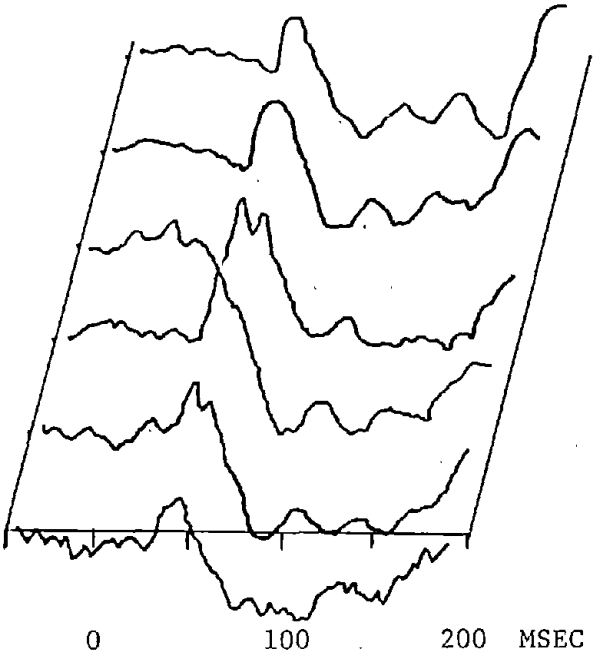


FIGURE 20

SUMMARY VER'S FOR EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #163, GROUP I

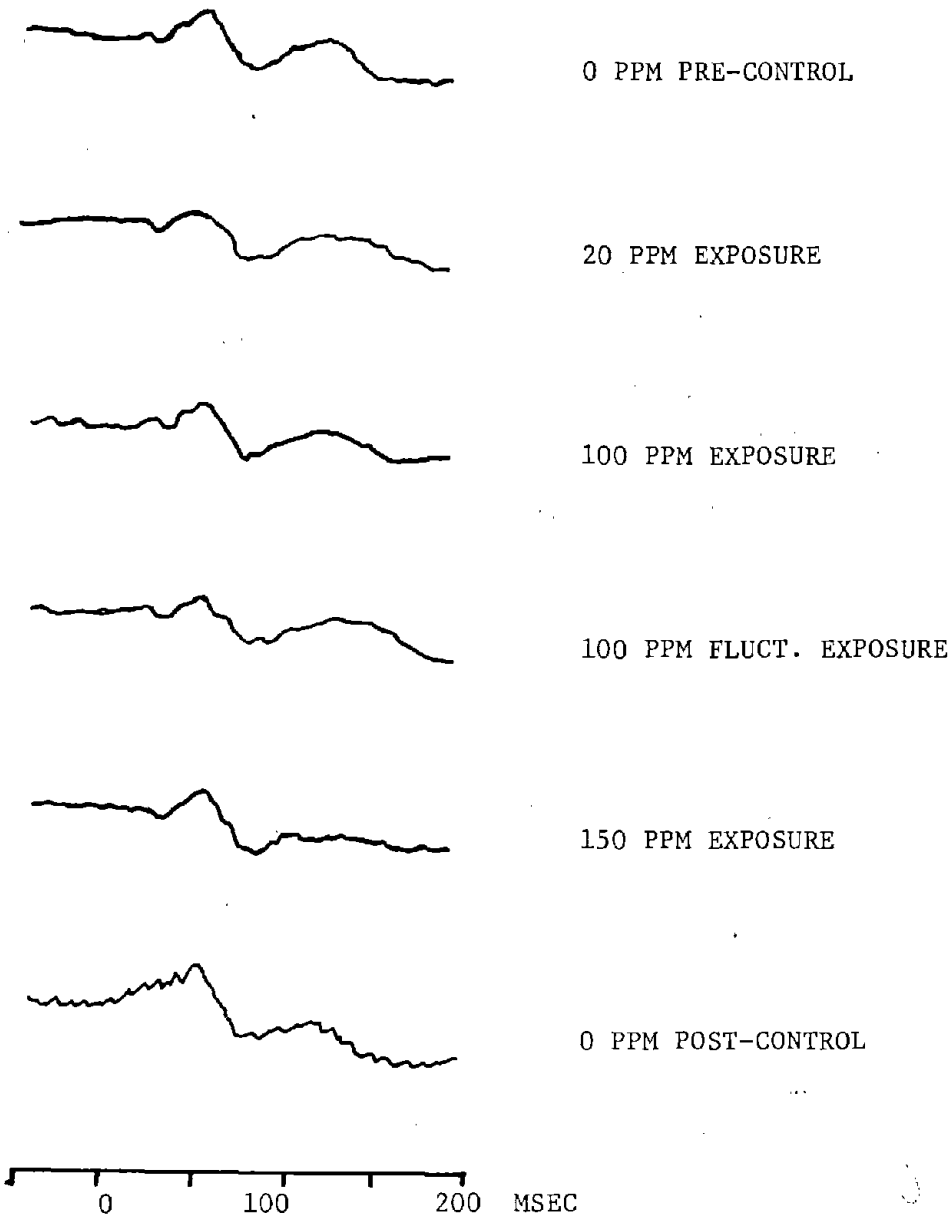


FIGURE 21

SUMMARY VER'S FOR EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #229, GROUP I

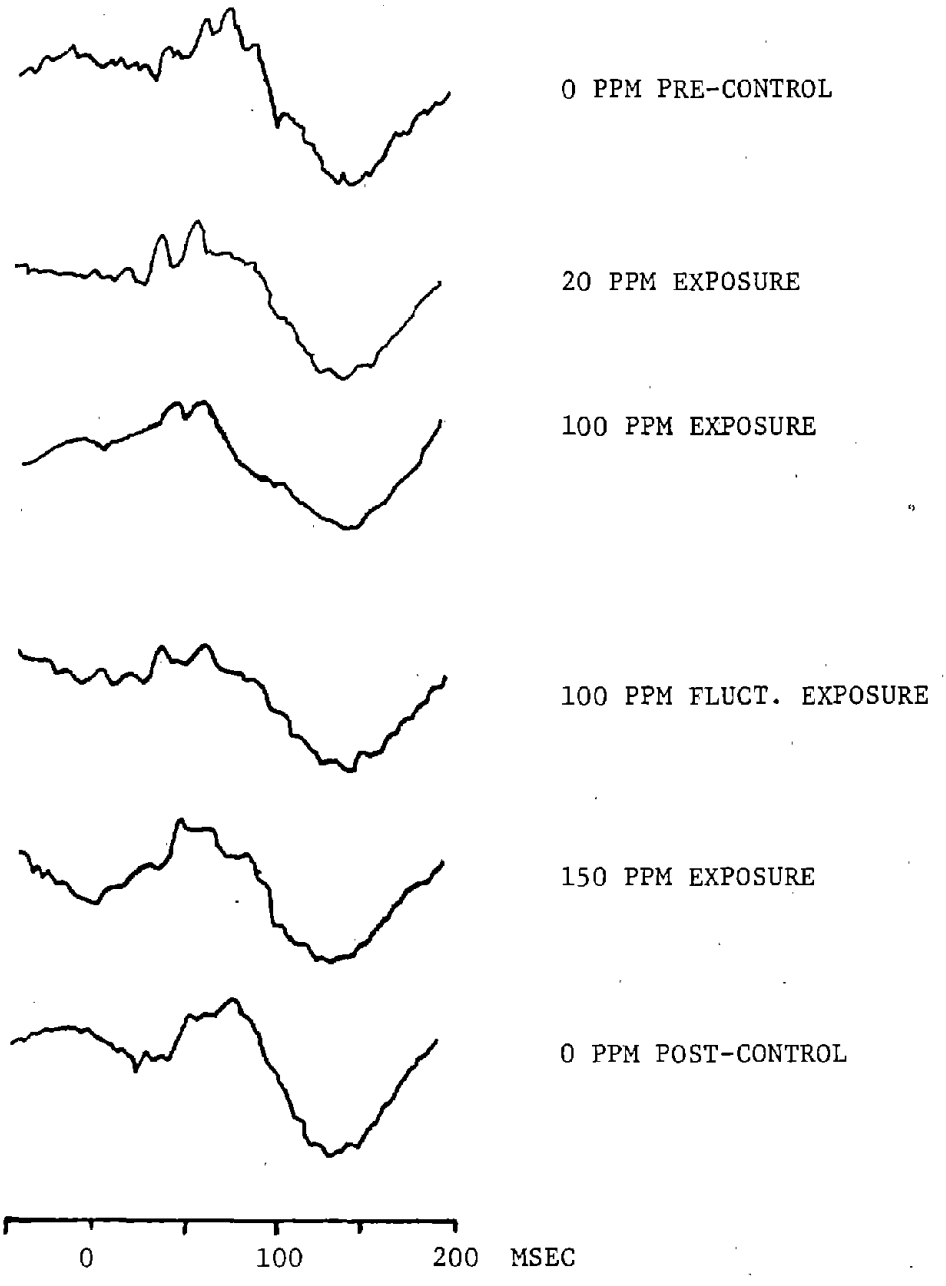


FIGURE 22

SUMMARY VER'S FOR EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #266, GROUP I

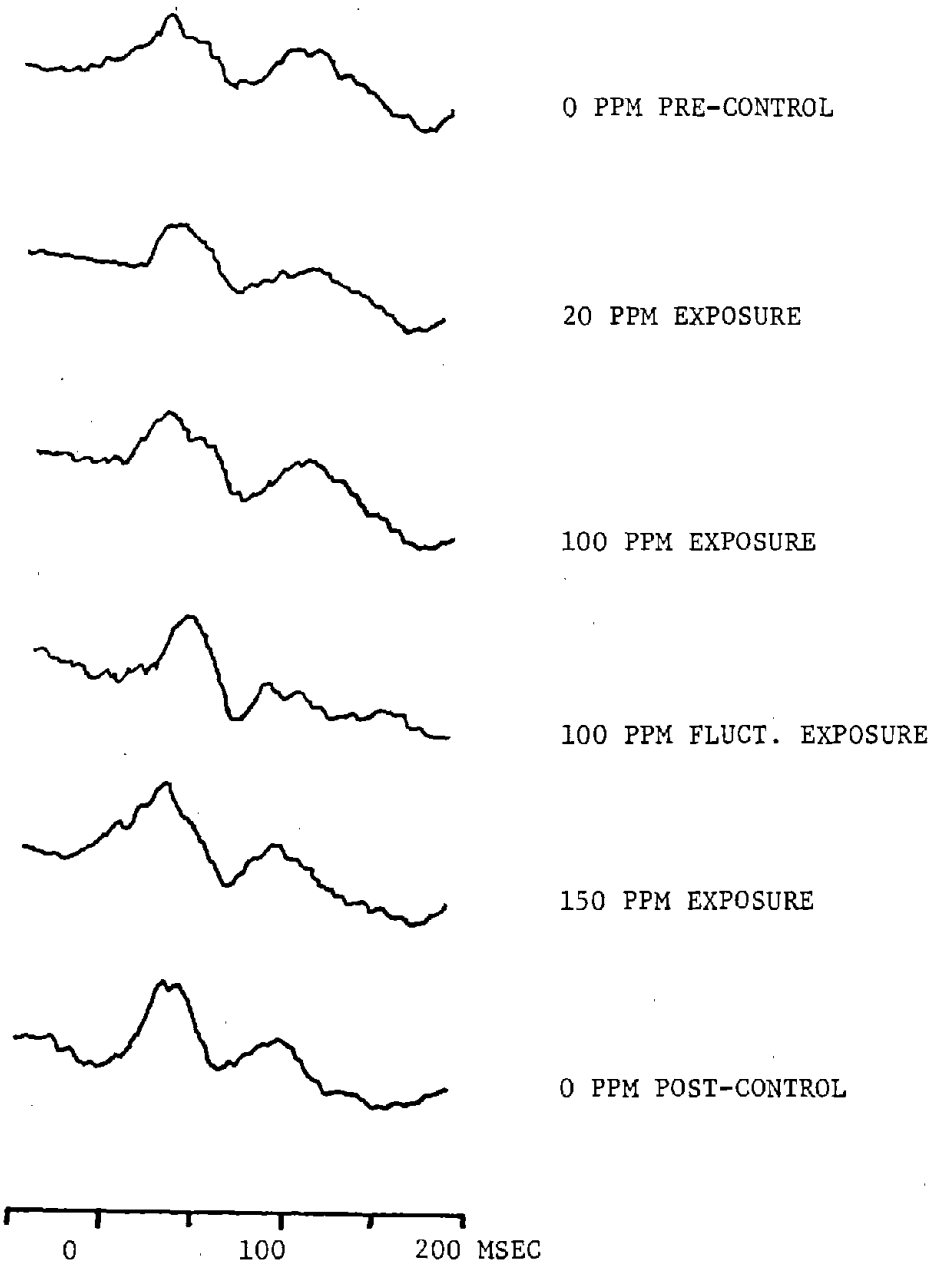


FIGURE 23

SUMMARY VER'S FOR EXPOSURE TO METHYL CHLORIDE

MALE SUBJECT #273, GROUP I

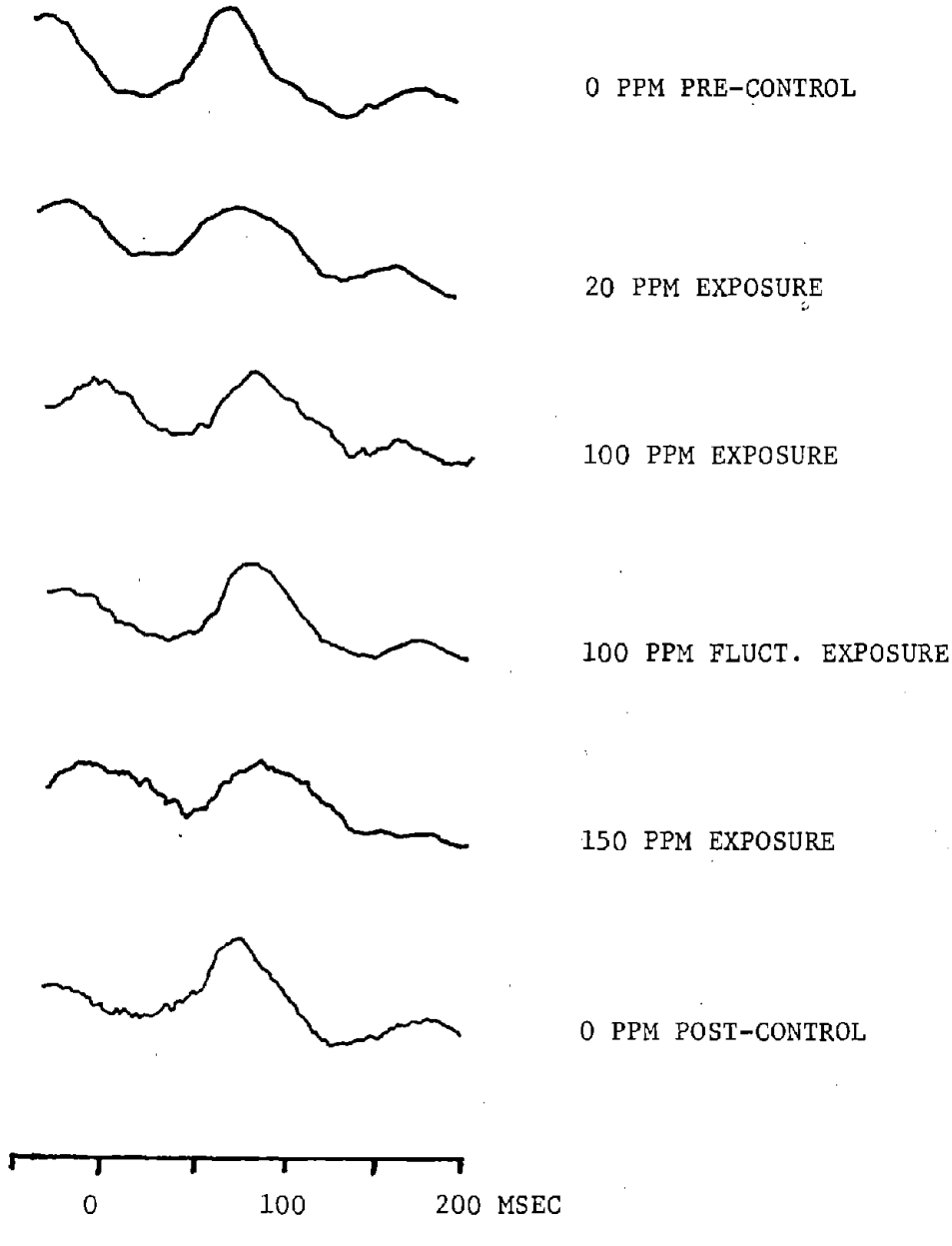


FIGURE 24

SUMMARY VER'S FOR EXPOSURE TO METHYL CHLORIDE

FEMALE SUBJECT #186, GROUP I

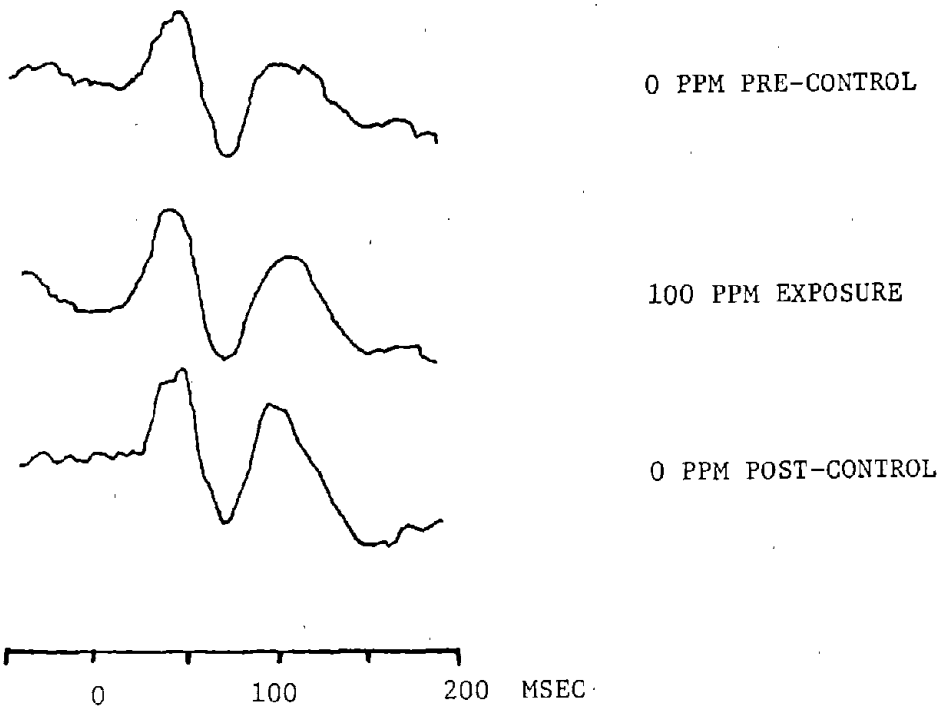


FIGURE 25

SUMMARY VER'S FOR EXPOSURE TO METHYL CHLORIDE

FEMALE SUBJECT #278, GROUP I

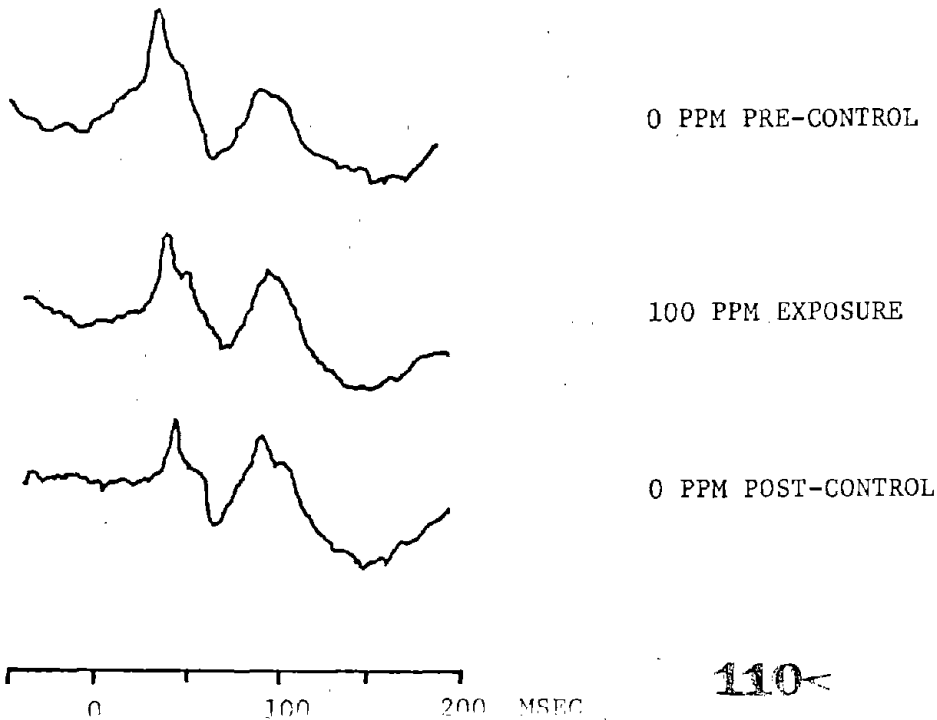


FIGURE 26

SUMMARY VER'S FOR EXPOSURE TO METHYL CHLORIDE

FEMALE SUBJECT #279, GROUP I

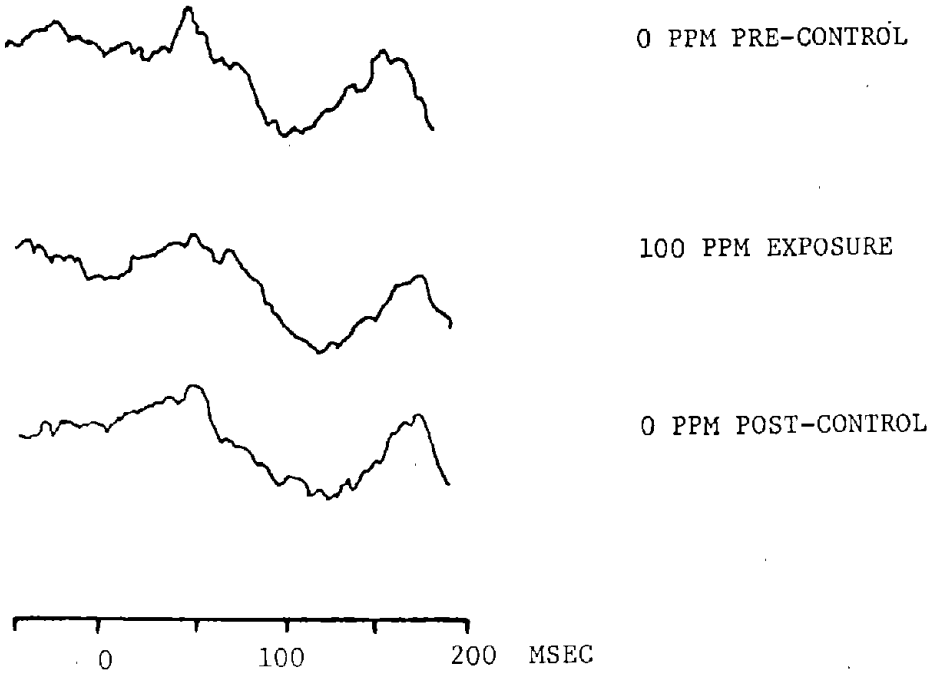


FIGURE 27

SUMMARY VER'S FOR EXPOSURE TO METHYL CHLORIDE

FEMALE SUBJECT #280, GROUP I

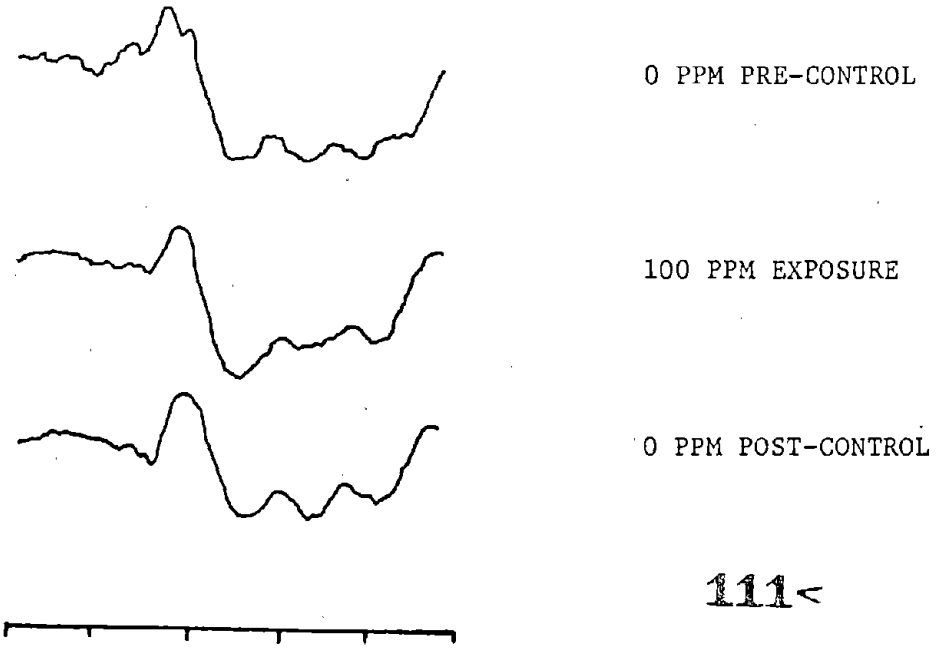
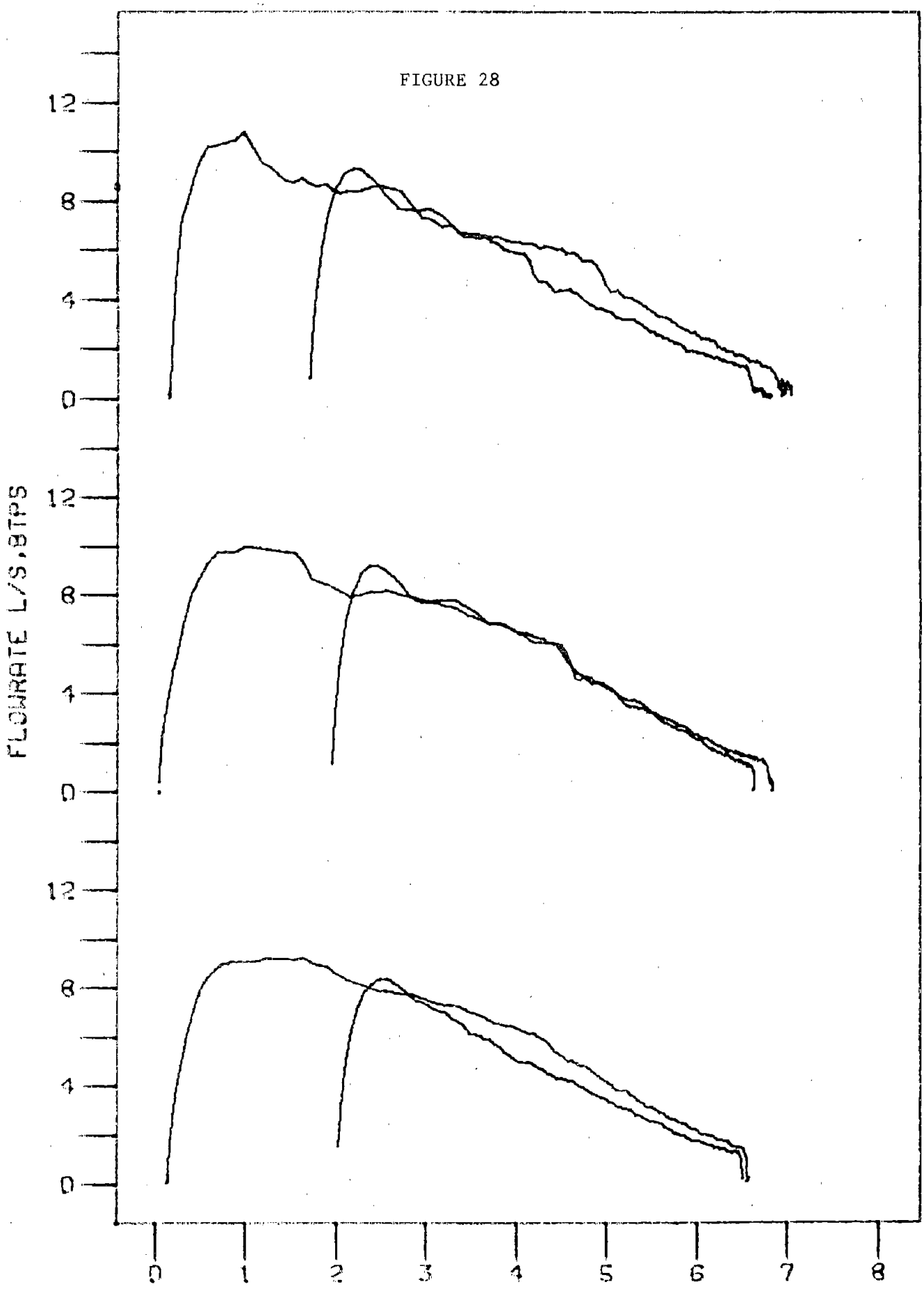


FIGURE 28

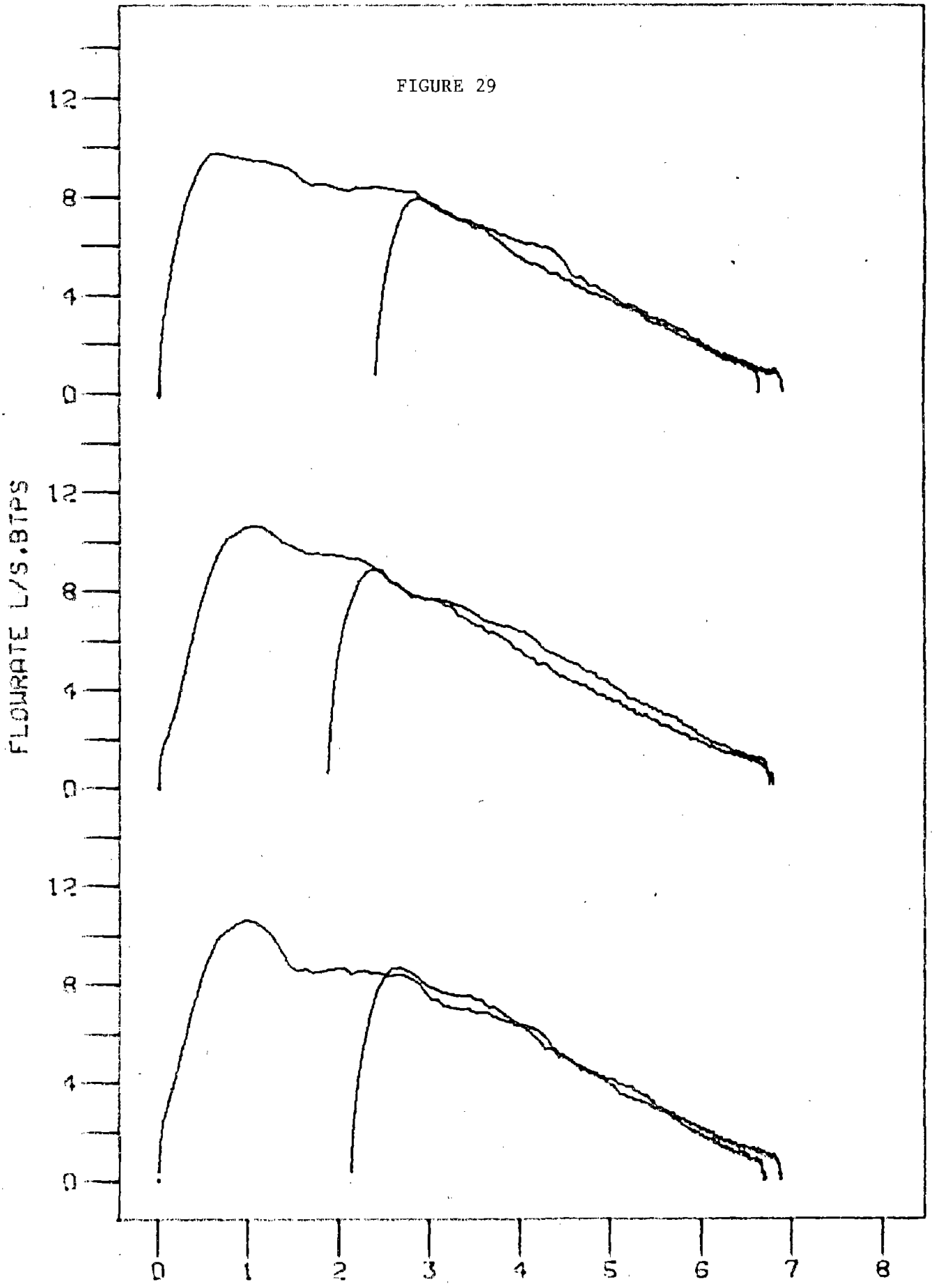


VOLUME EXPIRED, BTPS

FLOW-VOLUME CURVES CONSTRUCTED FROM THREE PARTIAL AND THREE MAXIMUM EXPIRATIONS

MALE SUBJECT 229, DURING 0 PPM EXPOSURE CONDITIONS

FIGURE 29

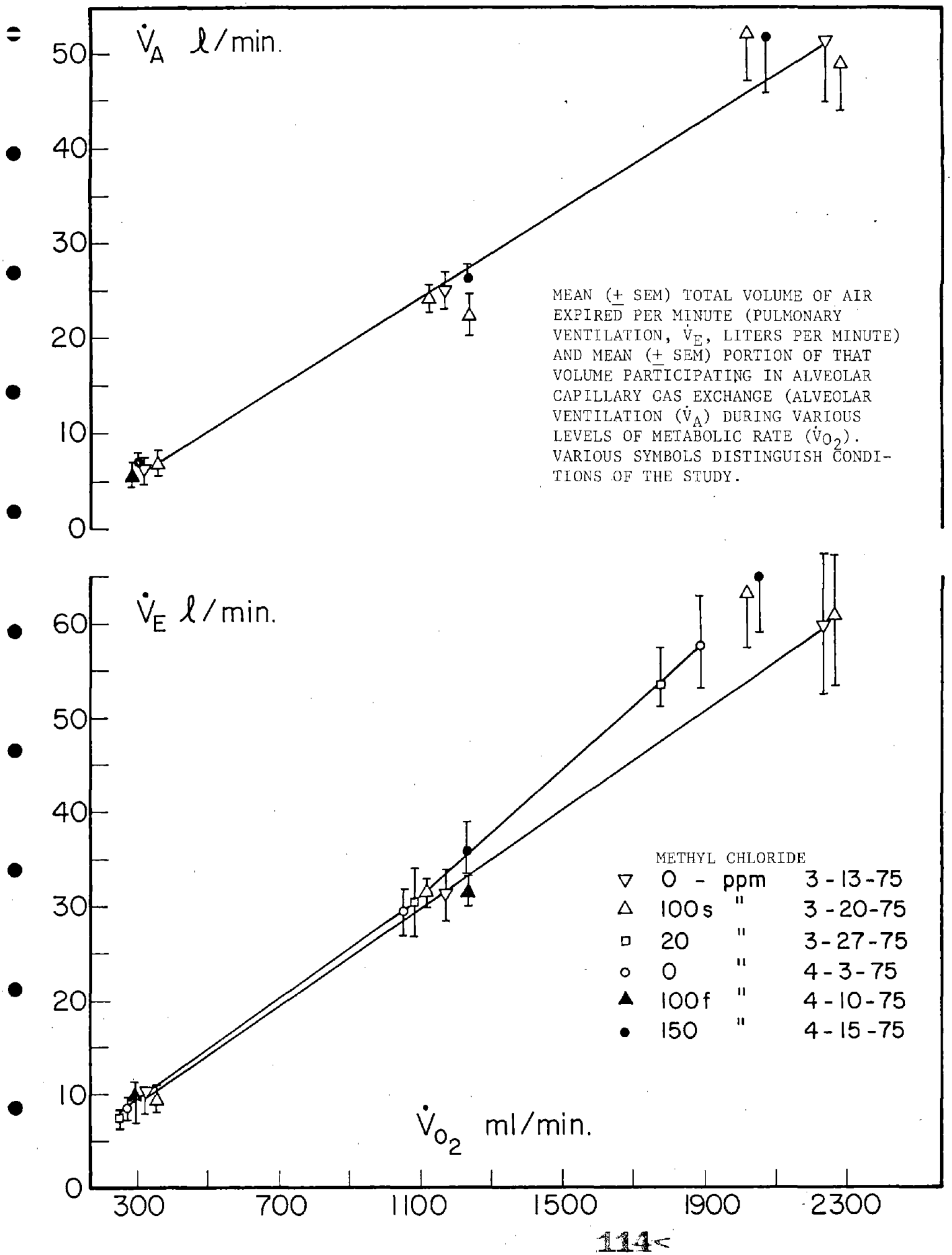


VOLUME EXPIRED, BTPS

FLOW-VOLUME CURVES CONSTRUCTED FROM THREE PARTIAL AND THREE MAXIMUM EXPIRATIONS

MALE SUBJECT 229, DURING 100 EXPOSURE CONDITIONS

FIGURE 30



MEAN (± SEM) TOTAL VOLUME OF AIR EXPIRED PER MINUTE (PULMONARY VENTILATION, $\dot{V}_E$, LITERS PER MINUTE) AND MEAN (± SEM) PORTION OF THAT VOLUME PARTICIPATING IN ALVEOLAR CAPILLARY GAS EXCHANGE (ALVEOLAR VENTILATION ($\dot{V}_A$) DURING VARIOUS LEVELS OF METABOLIC RATE ($\dot{V}_{O_2}$). VARIOUS SYMBOLS DISTINGUISH CONDITIONS OF THE STUDY.

FIGURE 31

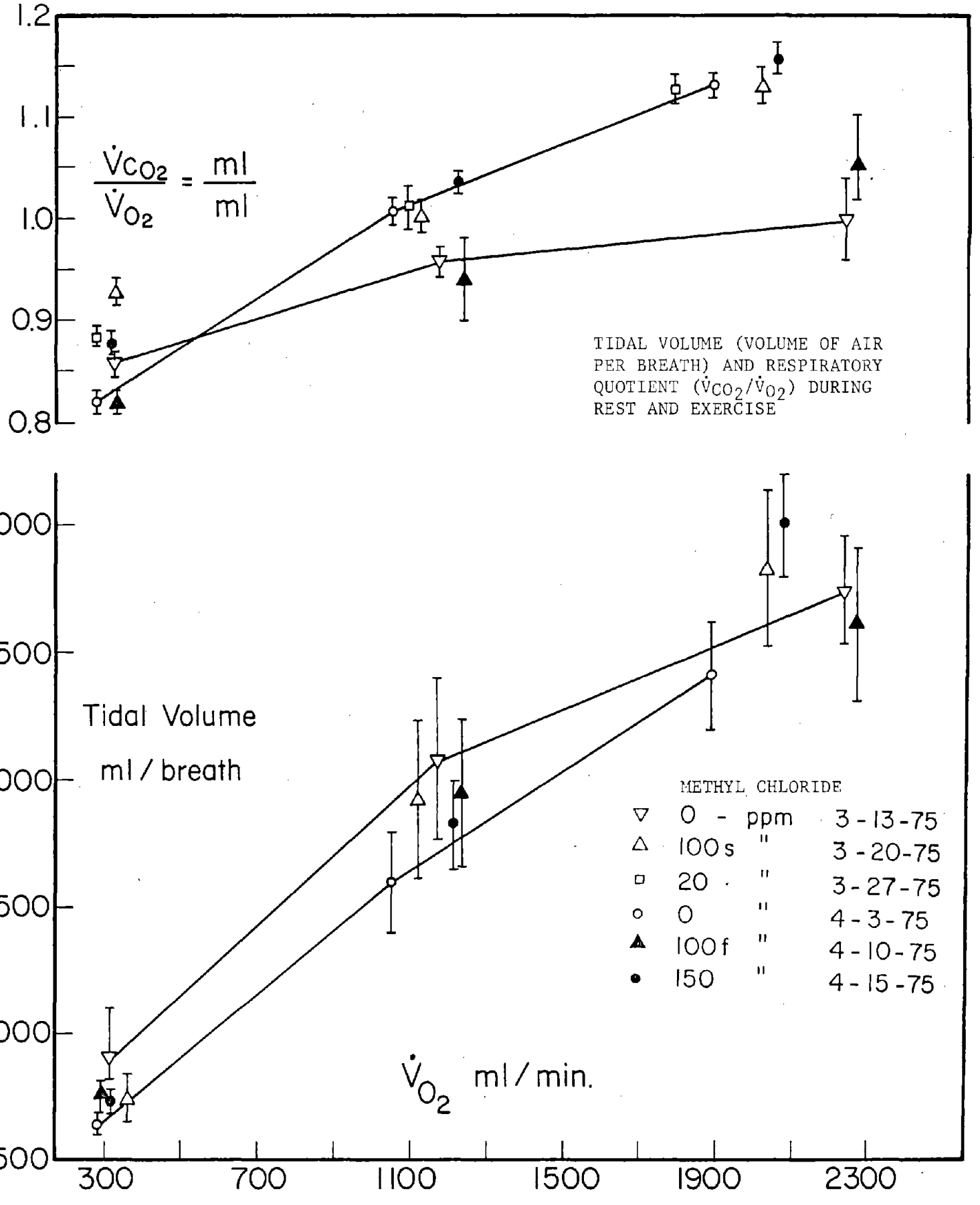
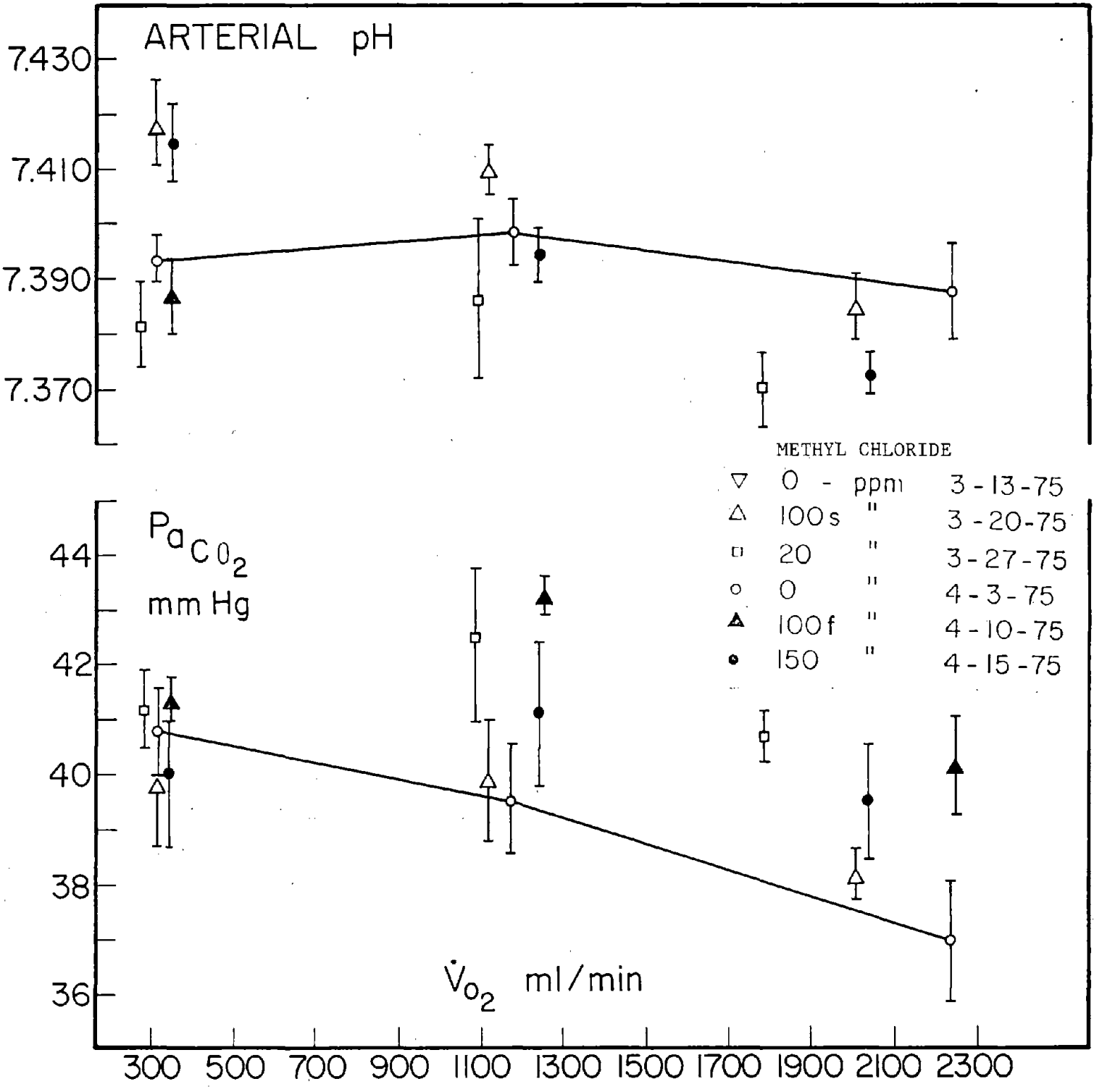
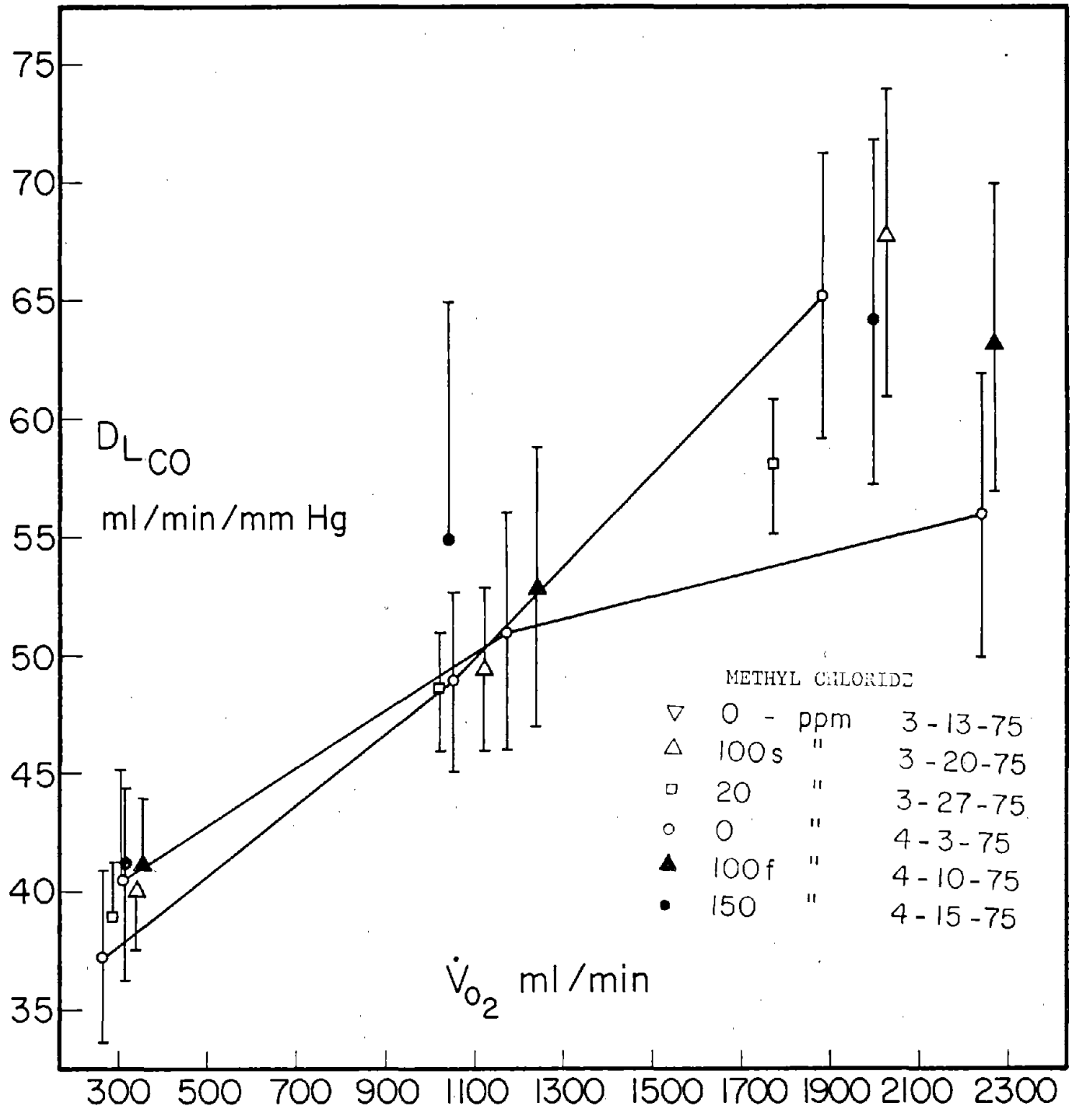

1.2
1.1
1.0
0.9
0.8
$\frac{\dot{V}CO_2}{\dot{V}O_2} = \frac{ml}{ml}$
TIDAL VOLUME (VOLUME OF AIR PER BREATH) AND RESPIRATORY QUOTIENT ($\dot{V}CO_2/\dot{V}O_2$) DURING REST AND EXERCISE
3000
2500
2000
1500
1000
500
Tidal Volume
ml / breath
METHYL CHLORIDE
0 - ppm 3-13-75
100s " 3-20-75
20 " 3-27-75
0 " 4-3-75
100f " 4-10-75
150 " 4-15-75
$\dot{V}O_2$ ml / min.
300
700
1100
1500
1900
2300

FIGURE 32



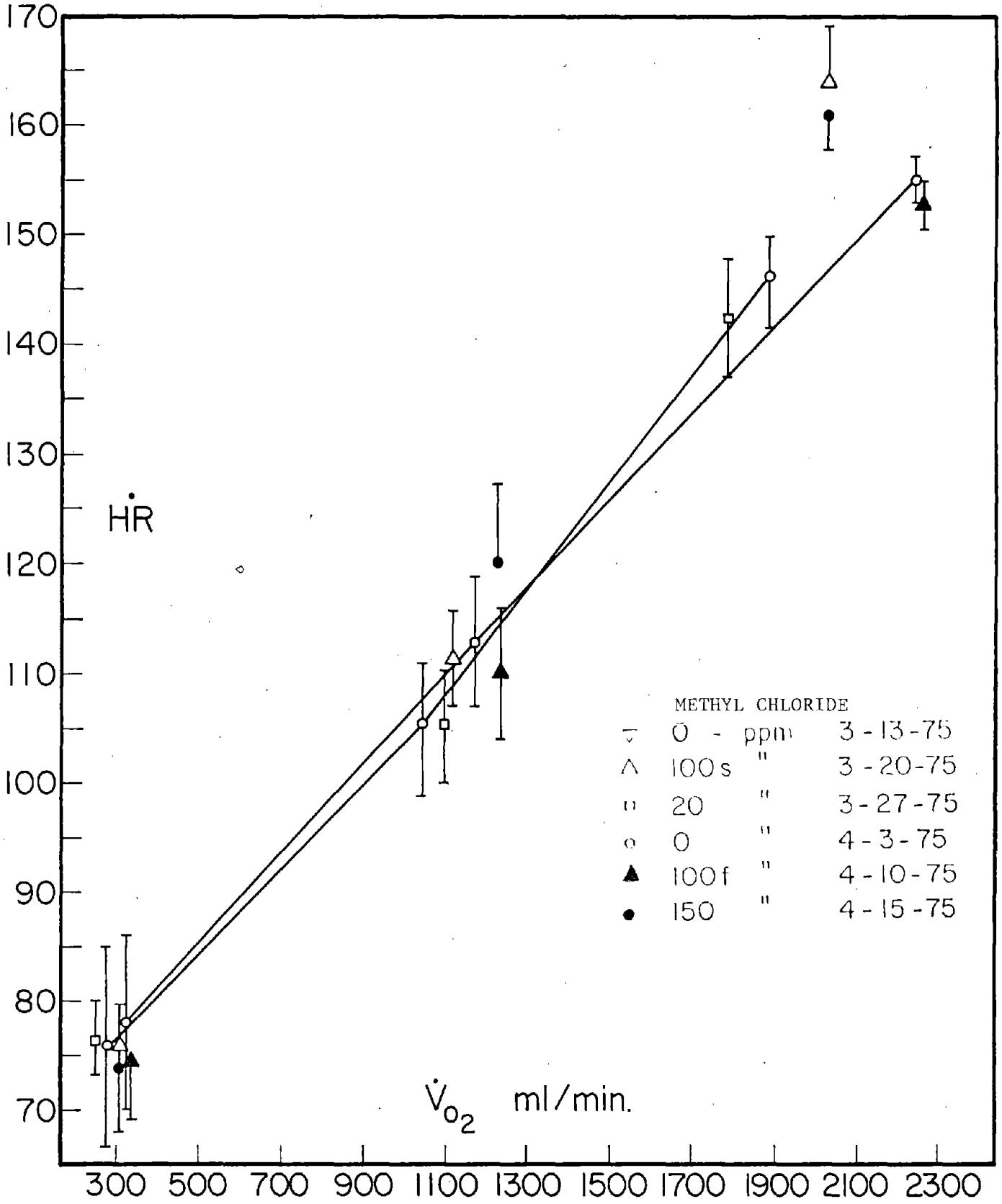
ARTERIAL P_{CO_2} (Pa_{CO_2}) AND pH DURING REST AND EXERCISE

FIGURE 33



PULMONARY DIFFUSING CAPACITY ($D_{L_{CO}}$) DURING REST AND EXERCISE

FIGURE 34



HEART RATE PER MINUTE (HR) DURING REST AND EXERCISE

FIGURE 35

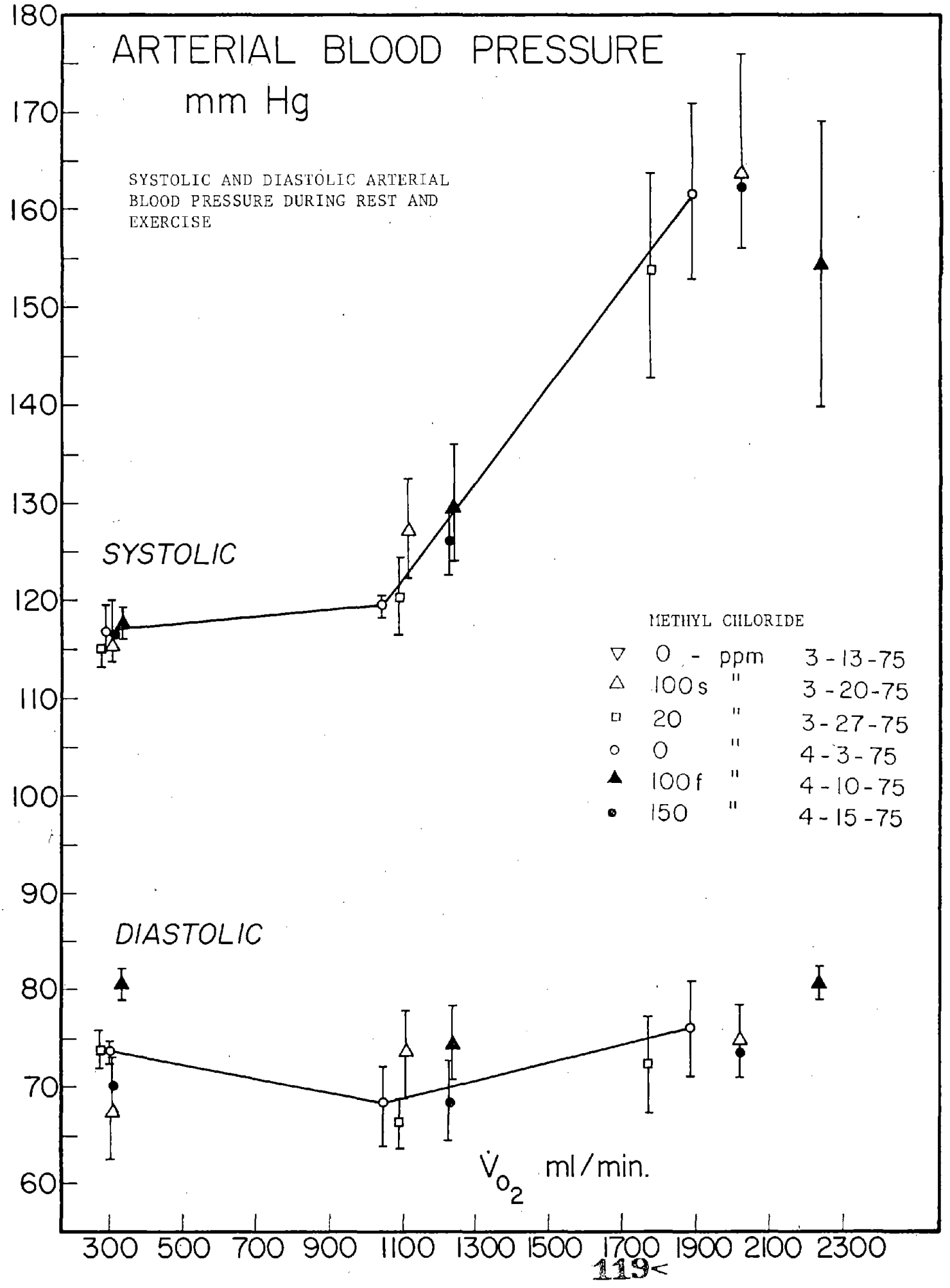

ARTERIAL BLOOD PRESSURE
mm Hg
SYSTOLIC AND DIASTOLIC ARTERIAL BLOOD PRESSURE DURING REST AND EXERCISE
SYSTOLIC
DIASTOLIC
METHYL CHLORIDE
0 - ppm 3-13-75
100s " 3-20-75
20 " 3-27-75
0 " 4-3-75
100f " 4-10-75
150 " 4-15-75
180
170
160
150
140
130
120
110
100
90
80
70
60
300 500 700 900 1100 1300 1500 1700 1900 2100 2300
$\dot{V}_{O_2}$ ml/min.

FIGURE 36

THE EFFECT OF EXPOSURE (7-1/2 HR/DAY) TO METHYL CHLORIDE ON THE TIME ESTIMATION TEST

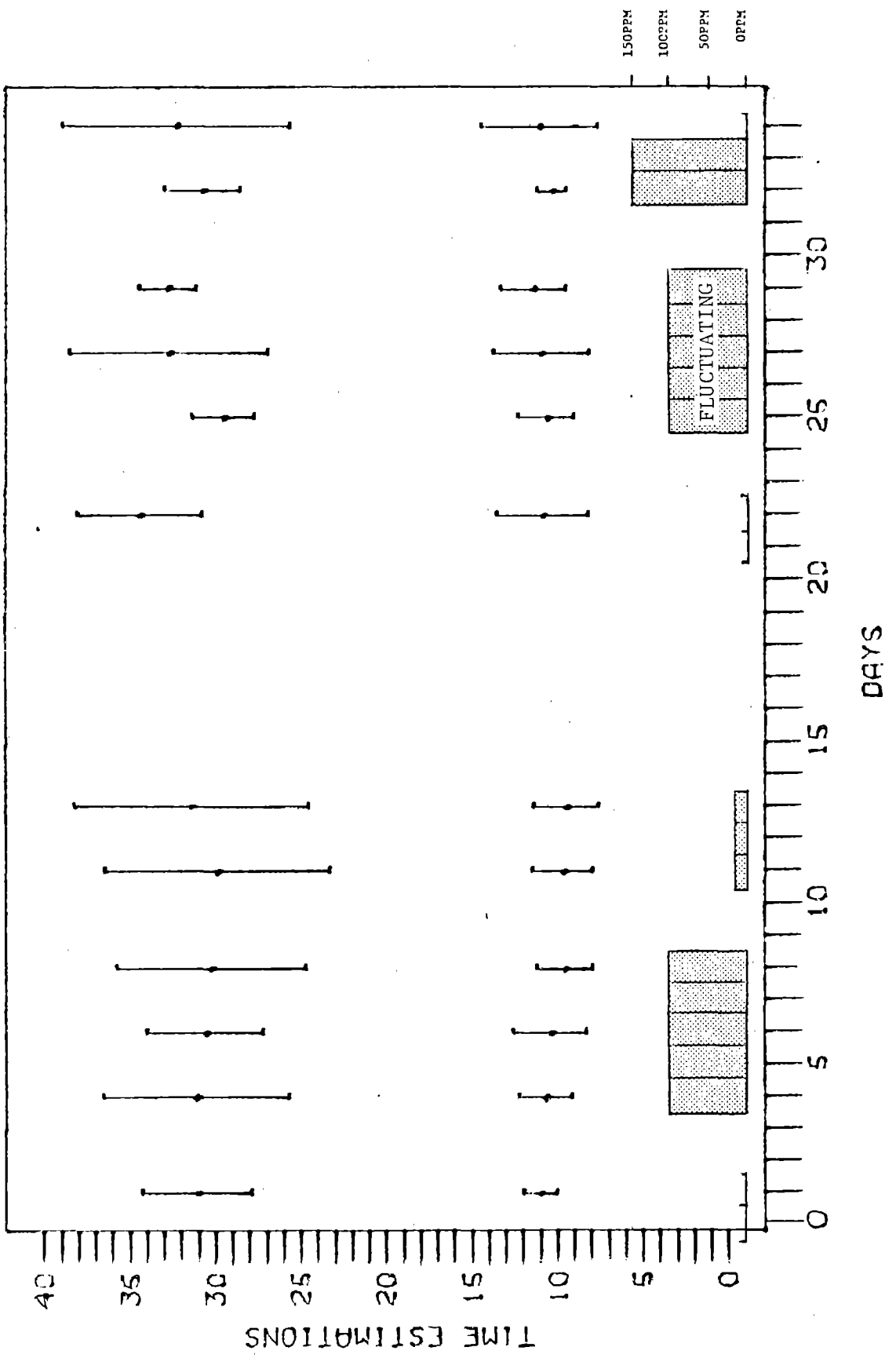


FIGURE 37

THE EFFECT OF EXPOSURE (7-1/2 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

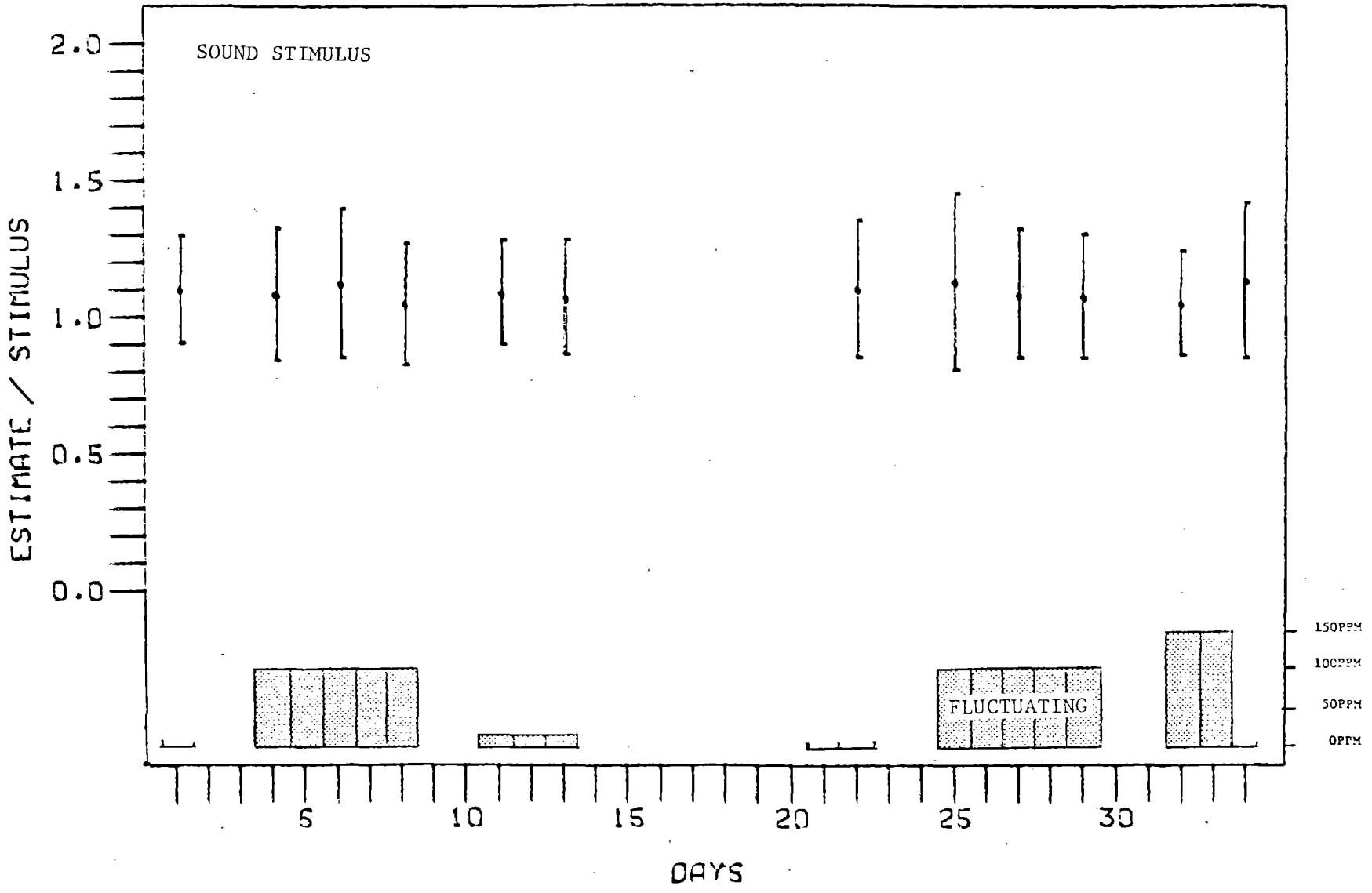


FIGURE 38

THE EFFECT OF EXPOSURE (7-1/2 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

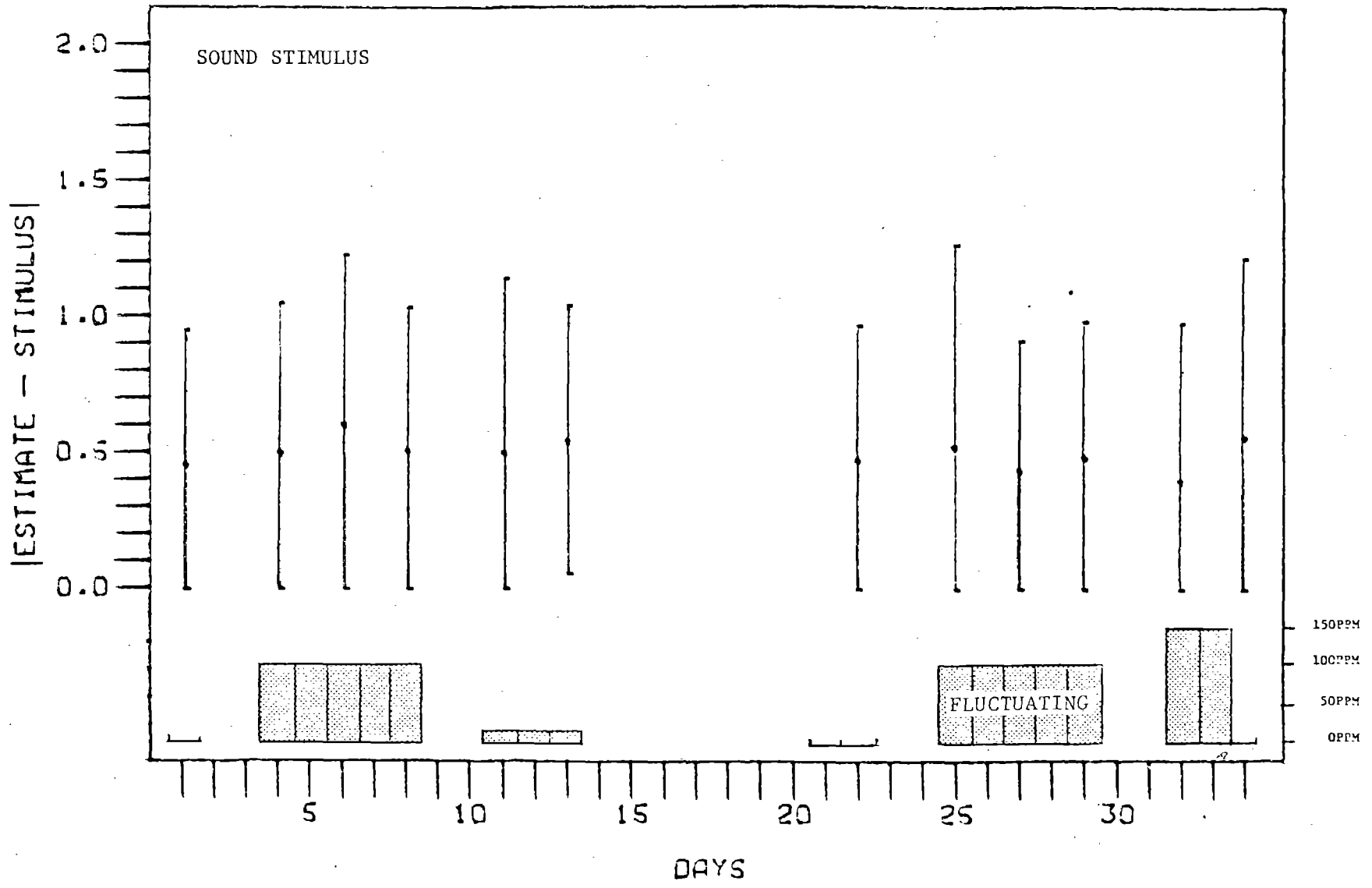


FIGURE 39

THE EFFECT OF EXPOSURE (7-1/2 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

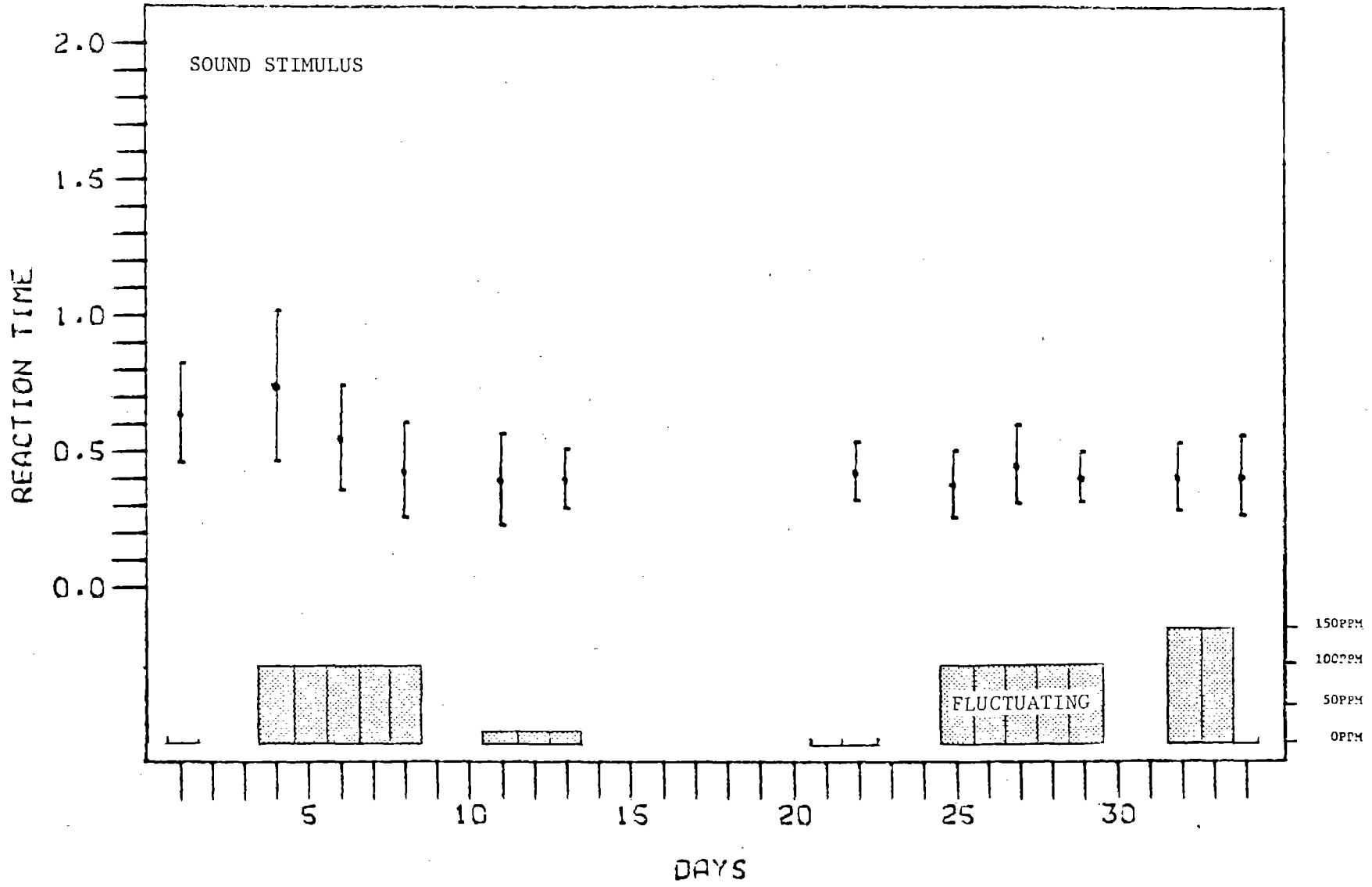


FIGURE 40

THE EFFECT OF EXPOSURE (7-1/2 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

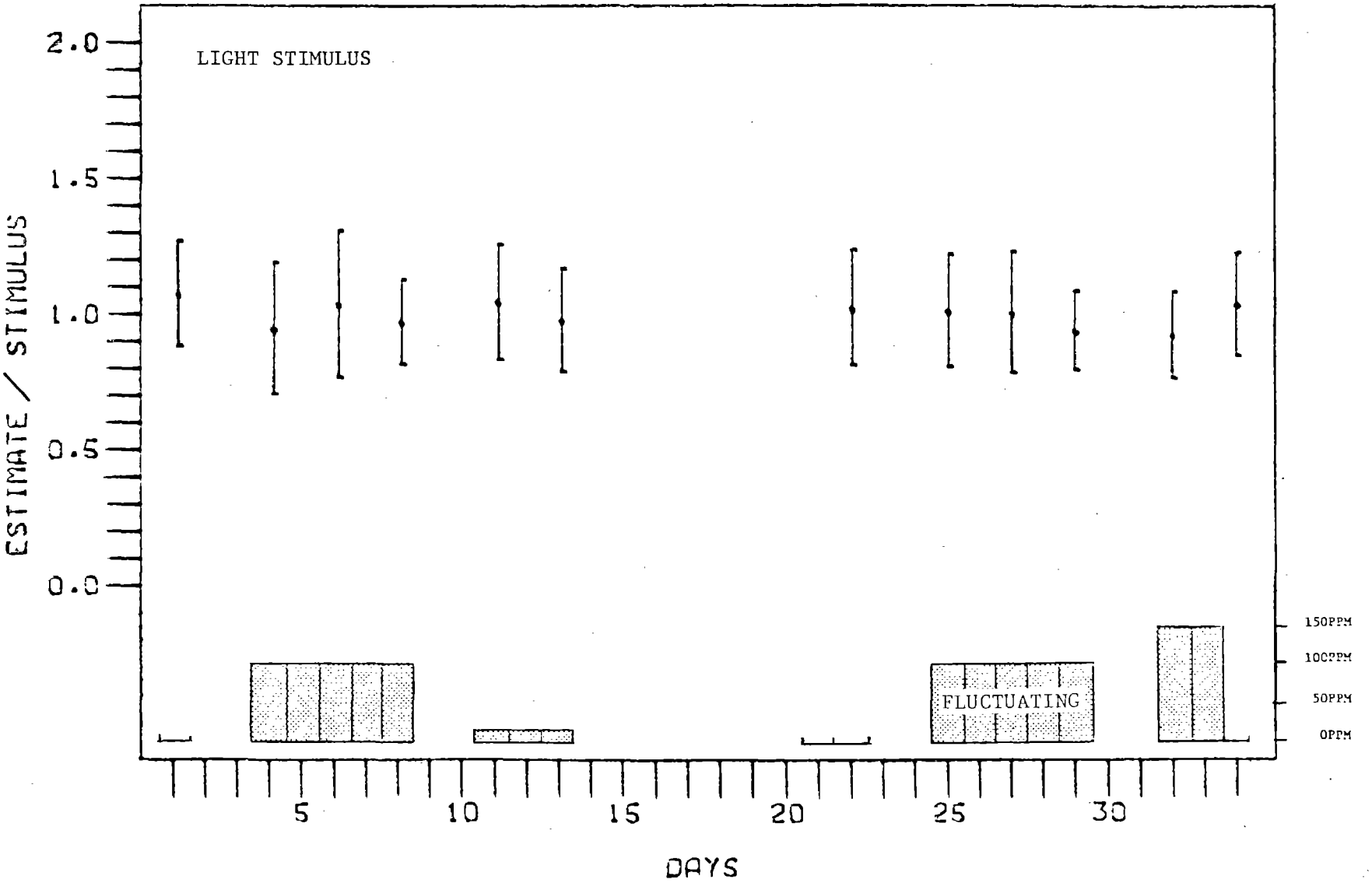


FIGURE 41

THE EFFECT OF EXPOSURE (7-1/2 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

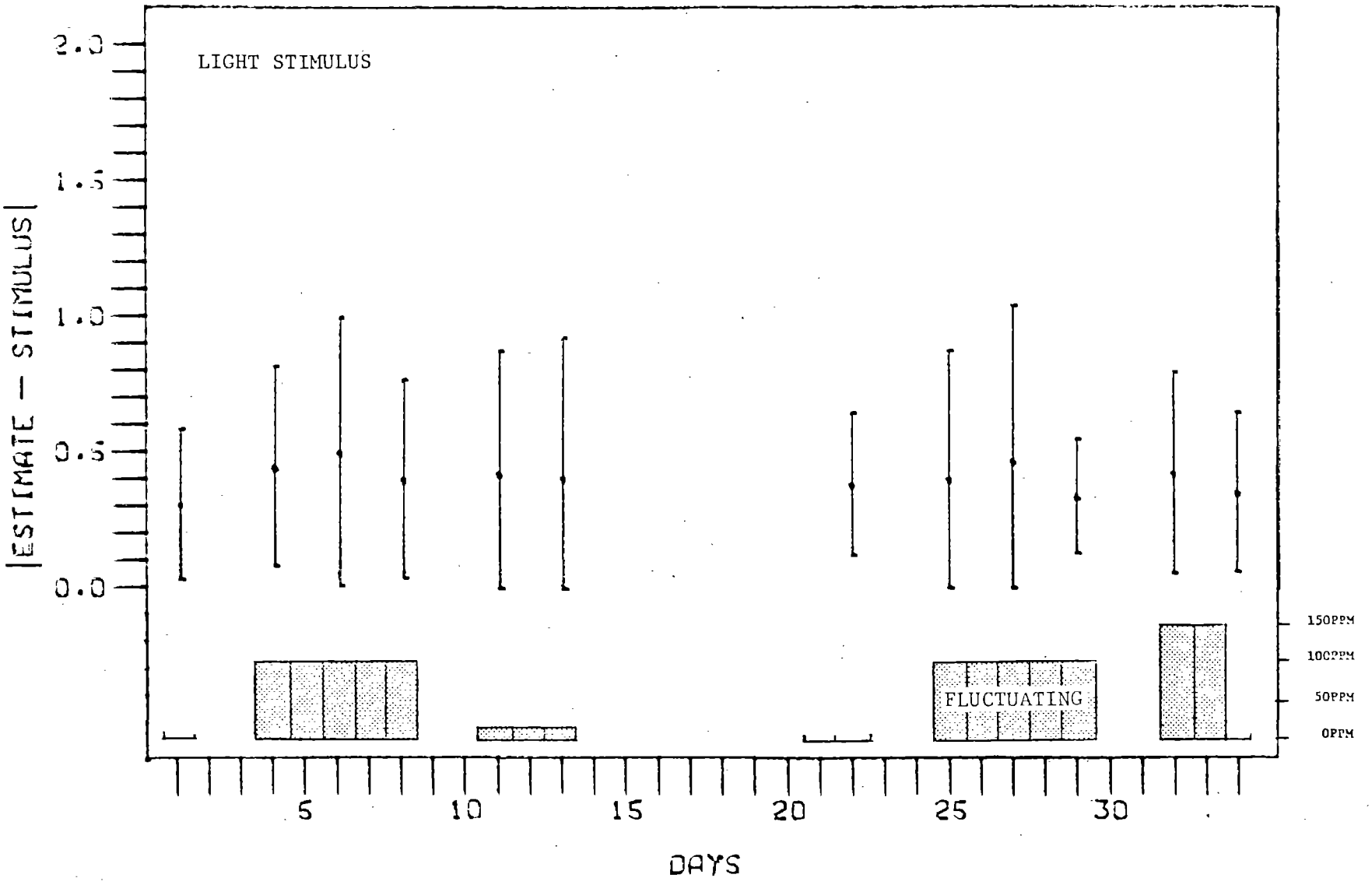


FIGURE 42

THE EFFECT OF EXPOSURE (7-1/2 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

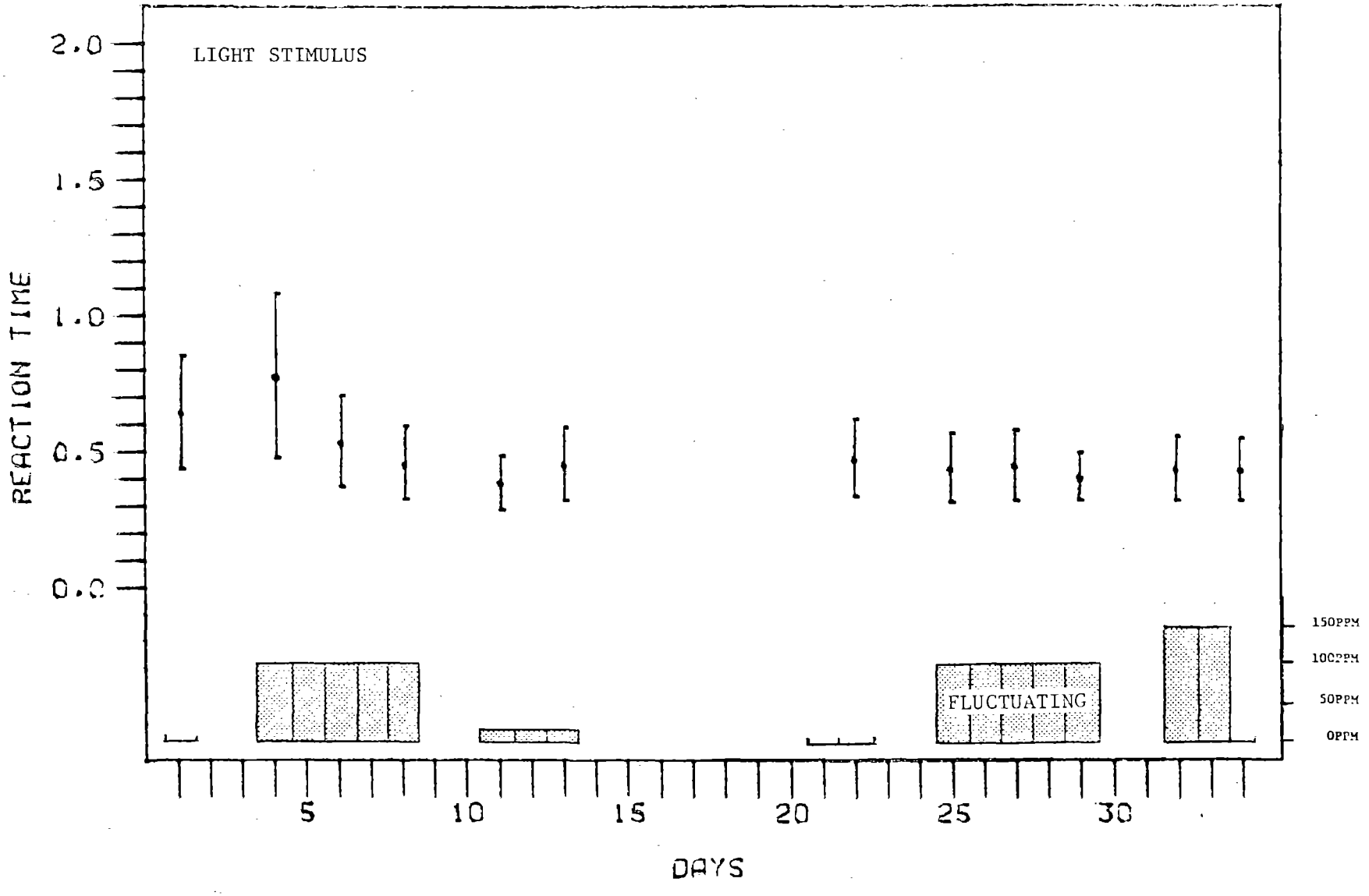


FIGURE 43

THE EFFECT OF EXPOSURE (7-1/2 HR/DAY) TO METHYL CHLORIDE ON THE ARITHMETIC TEST

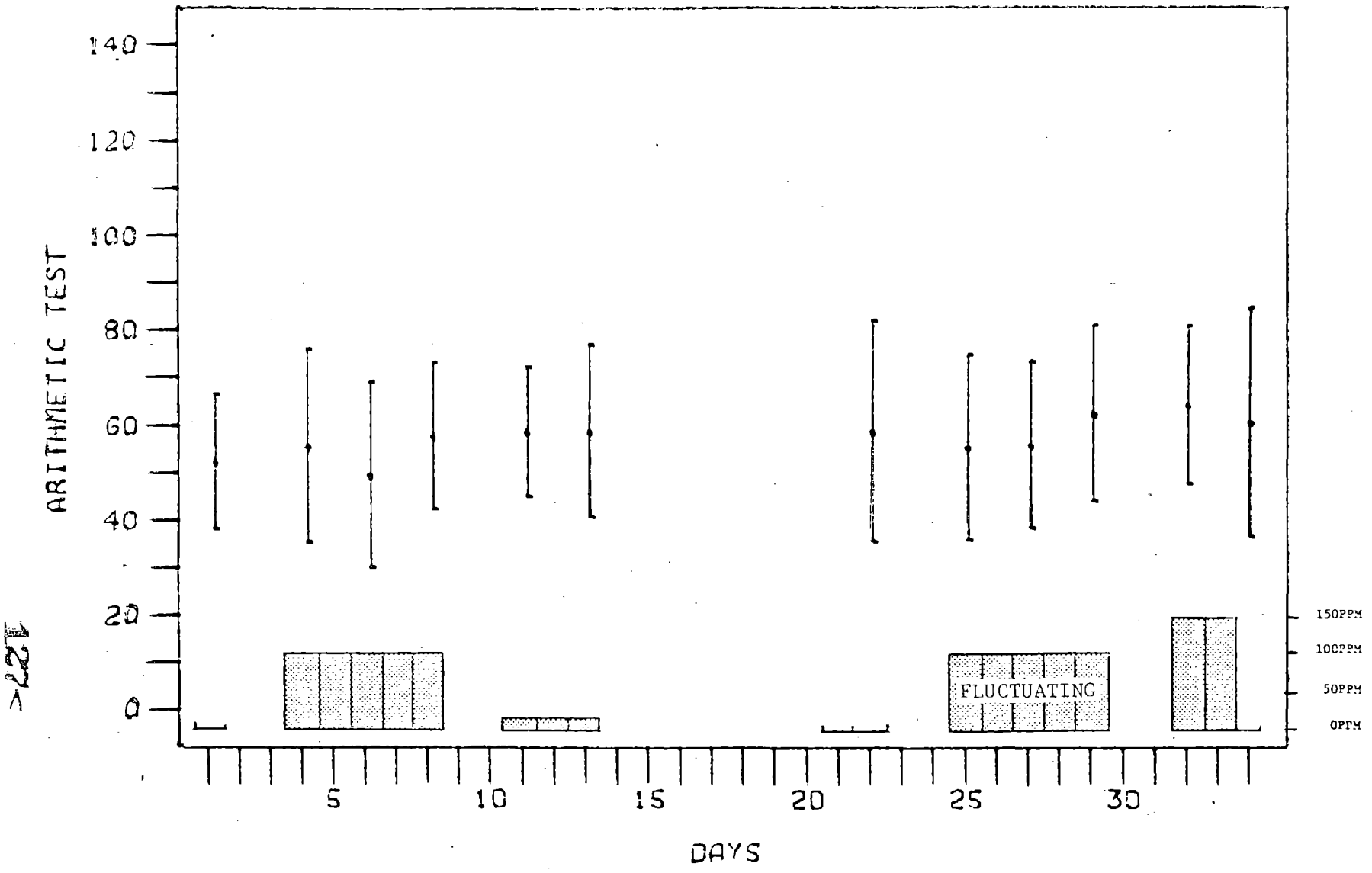


FIGURE 44

THE EFFECT OF EXPOSURE (7-1/2 HR/DAY) TO METHYL CHLORIDE ON THE COORDINATION TEST

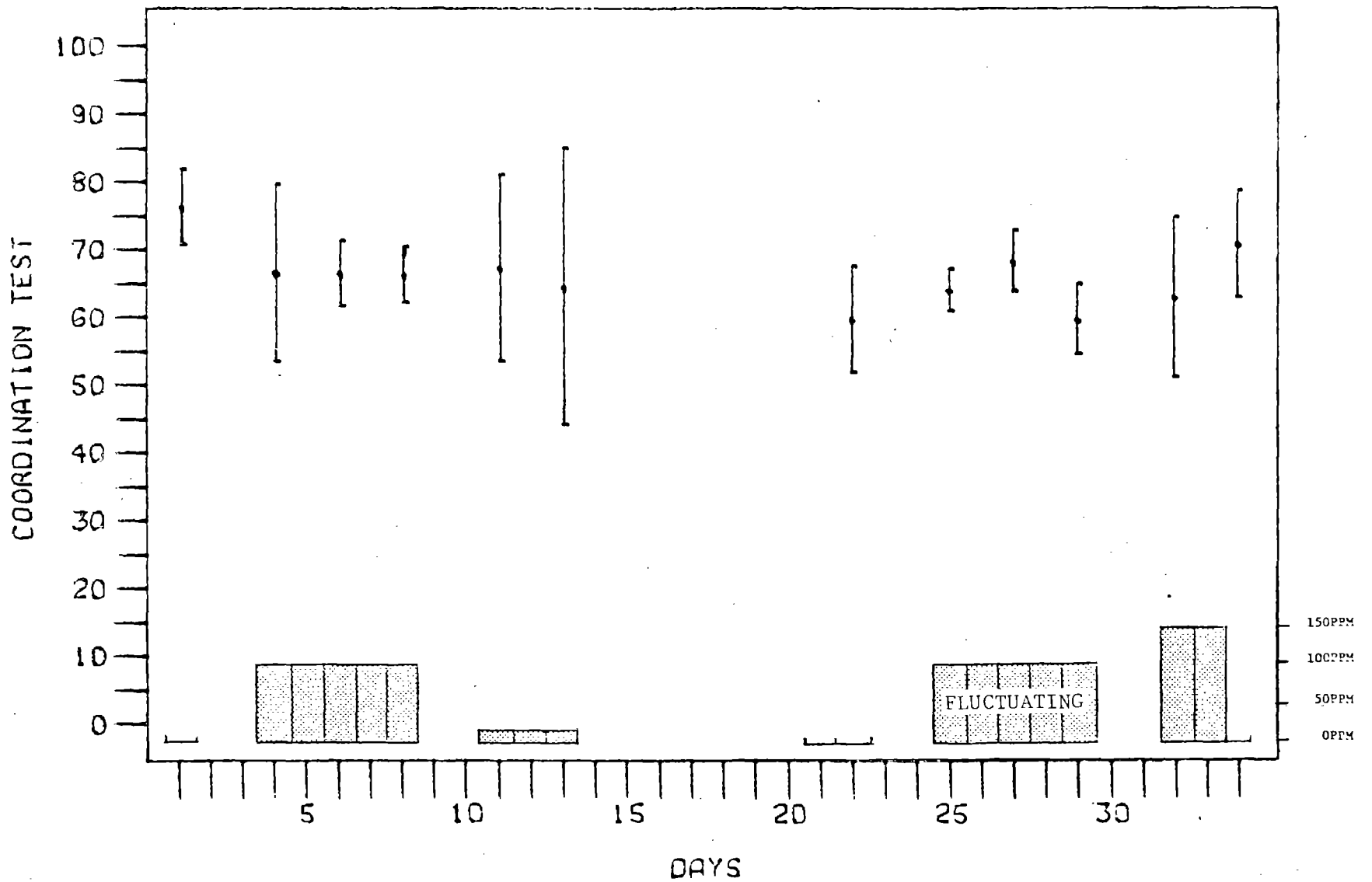


FIGURE 45

THE EFFECT OF EXPOSURE (7-1/2 HR/DAY) TO METHYL CHLORIDE ON THE INSPECTION TEST

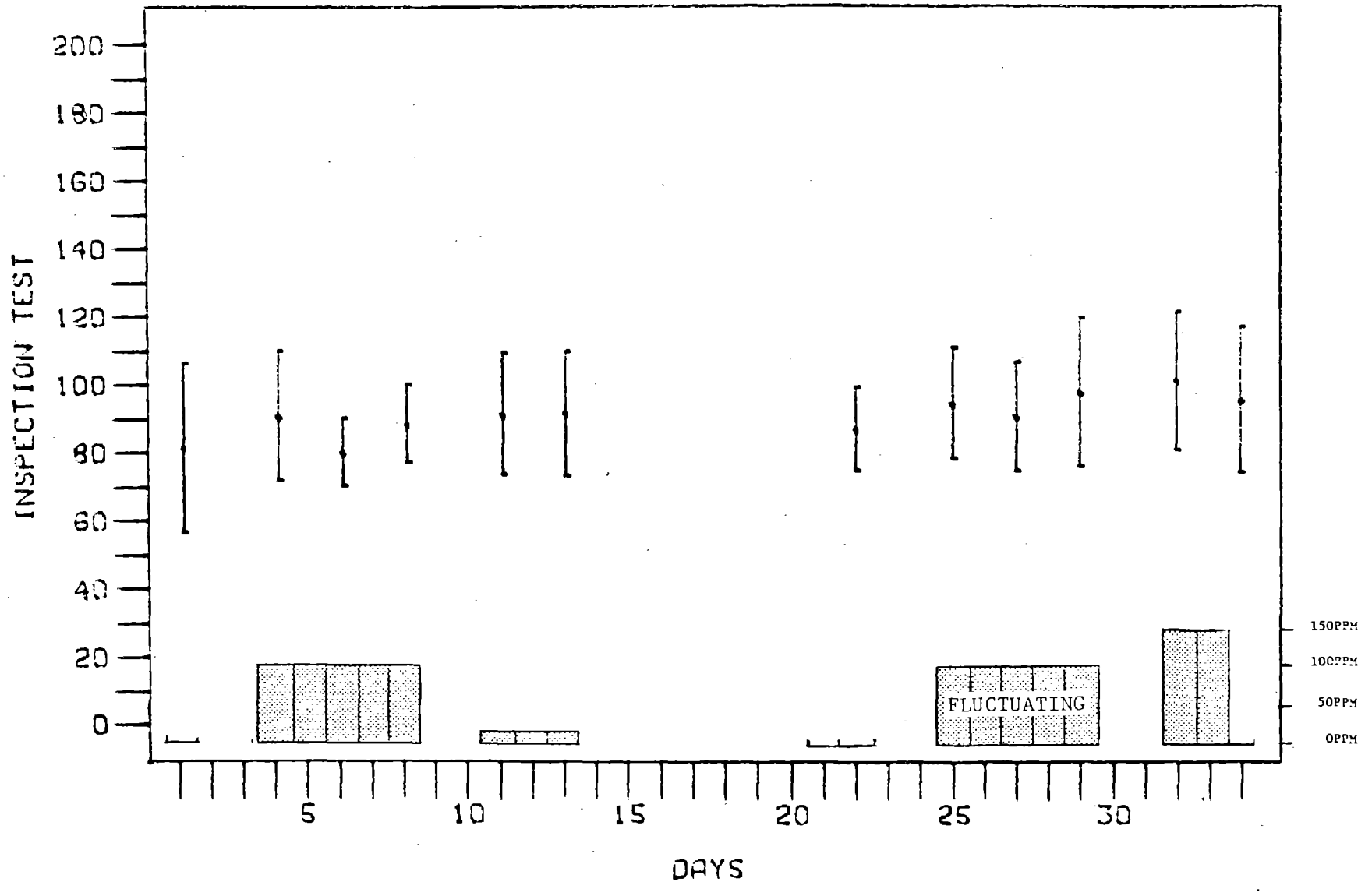


FIGURE 46

THE EFFECT OF EXPOSURE (3 HR/DAY) TO METHYL CHLORIDE ON THE TIME ESTIMATIONS TEST

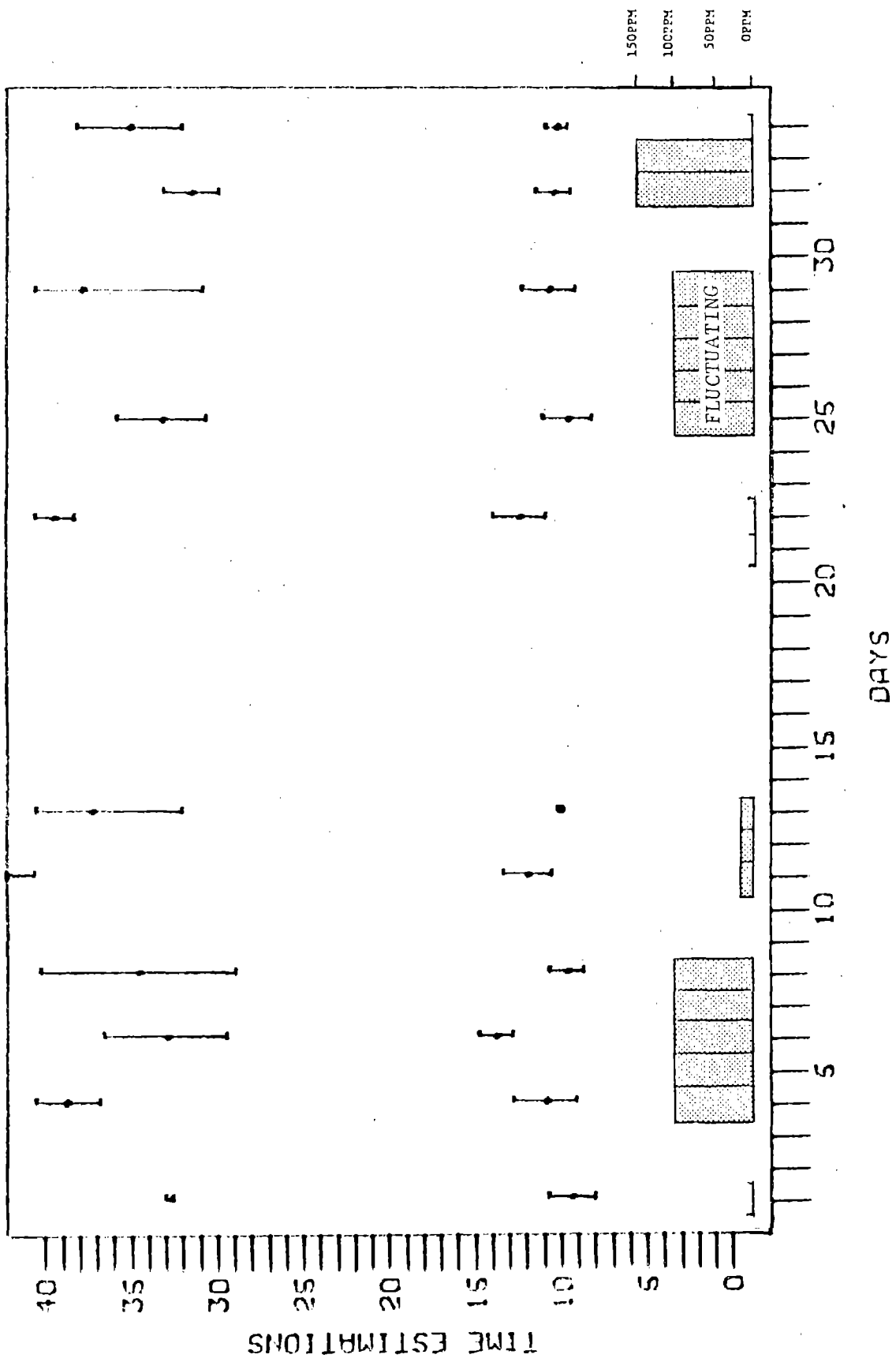


FIGURE 47

THE EFFECT OF EXPOSURE (3 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

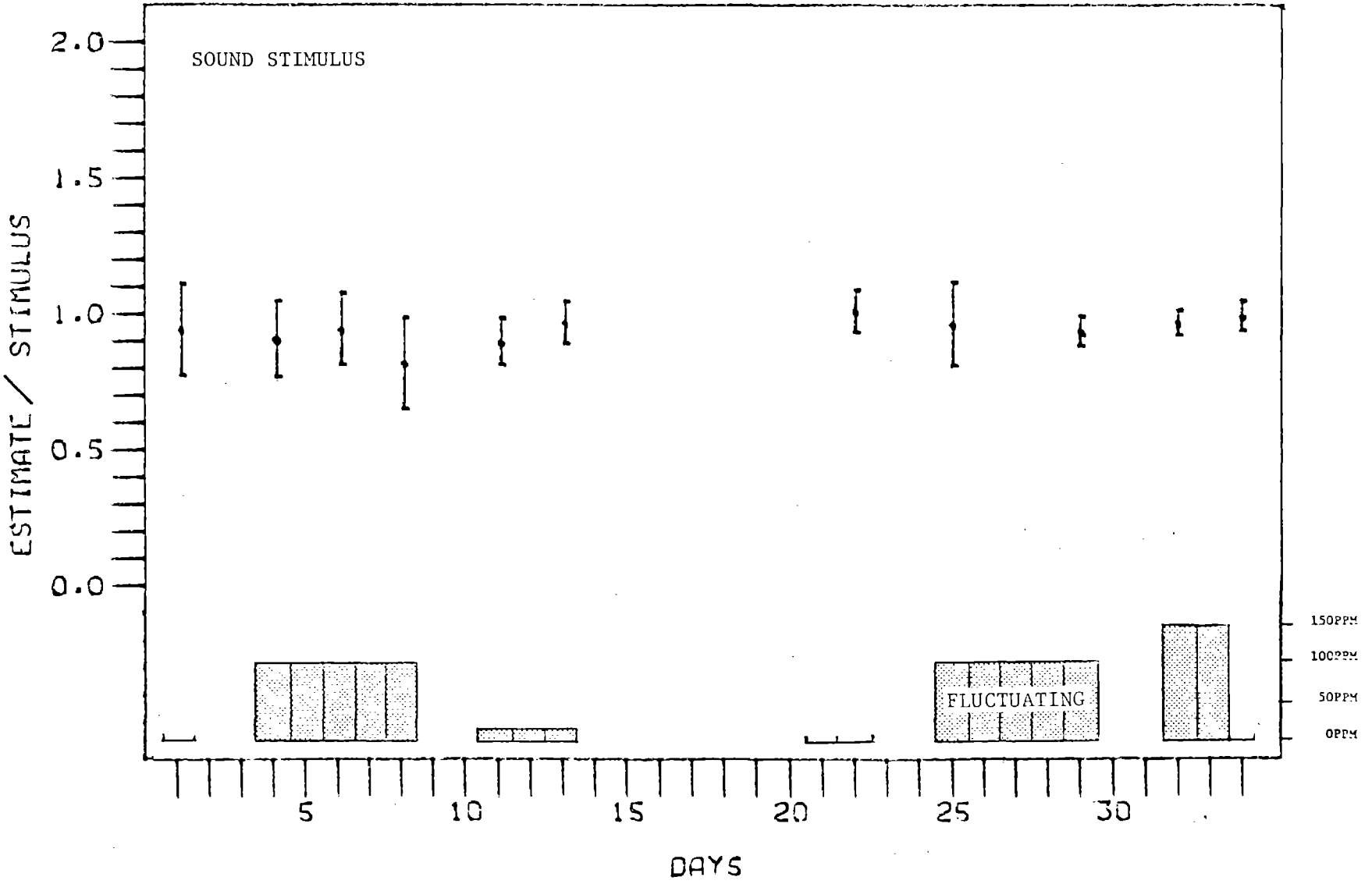


FIGURE 48

THE EFFECT OF EXPOSURE (3 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

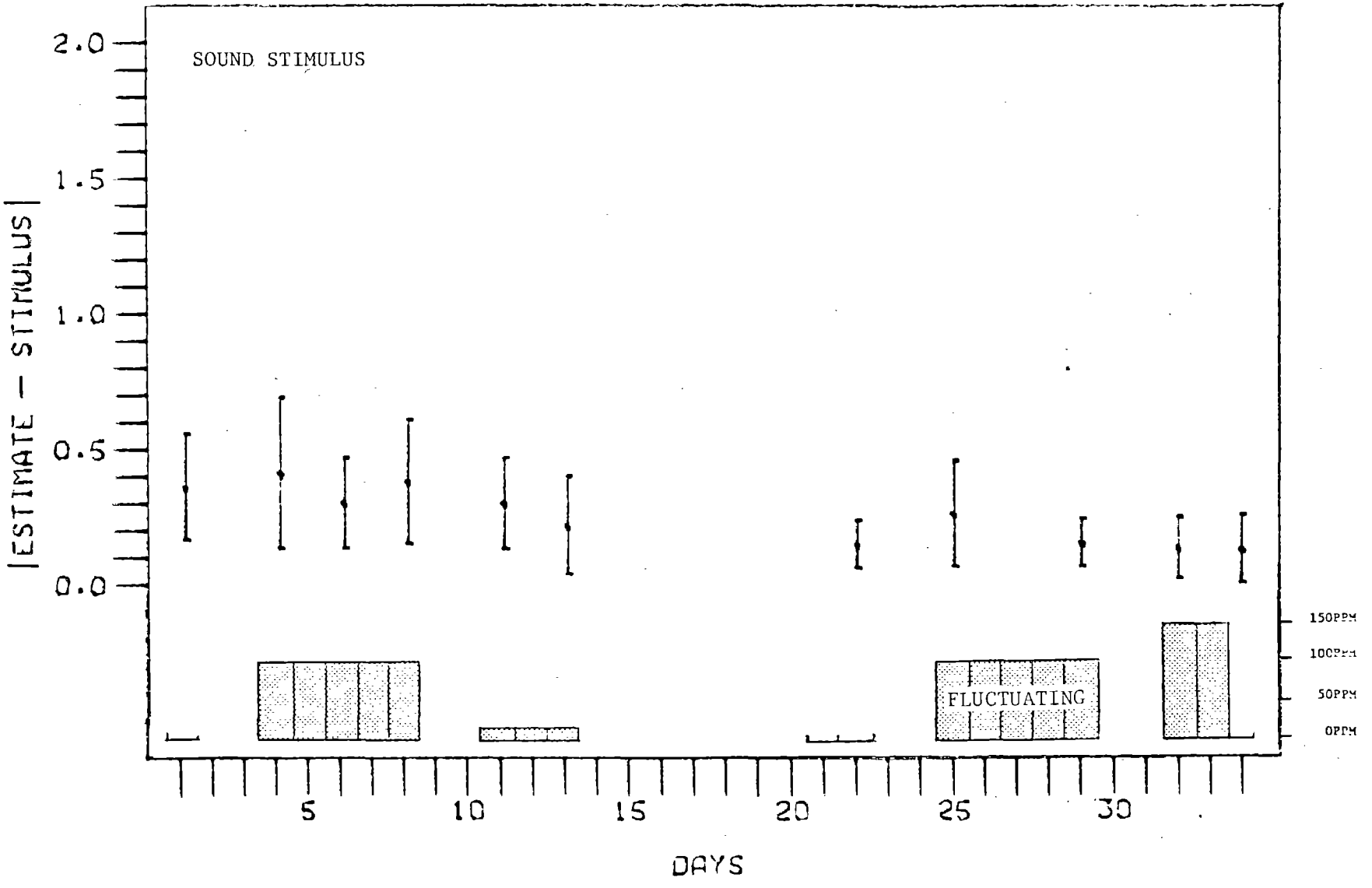


FIGURE 49

THE EFFECT OF EXPOSURE (3 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

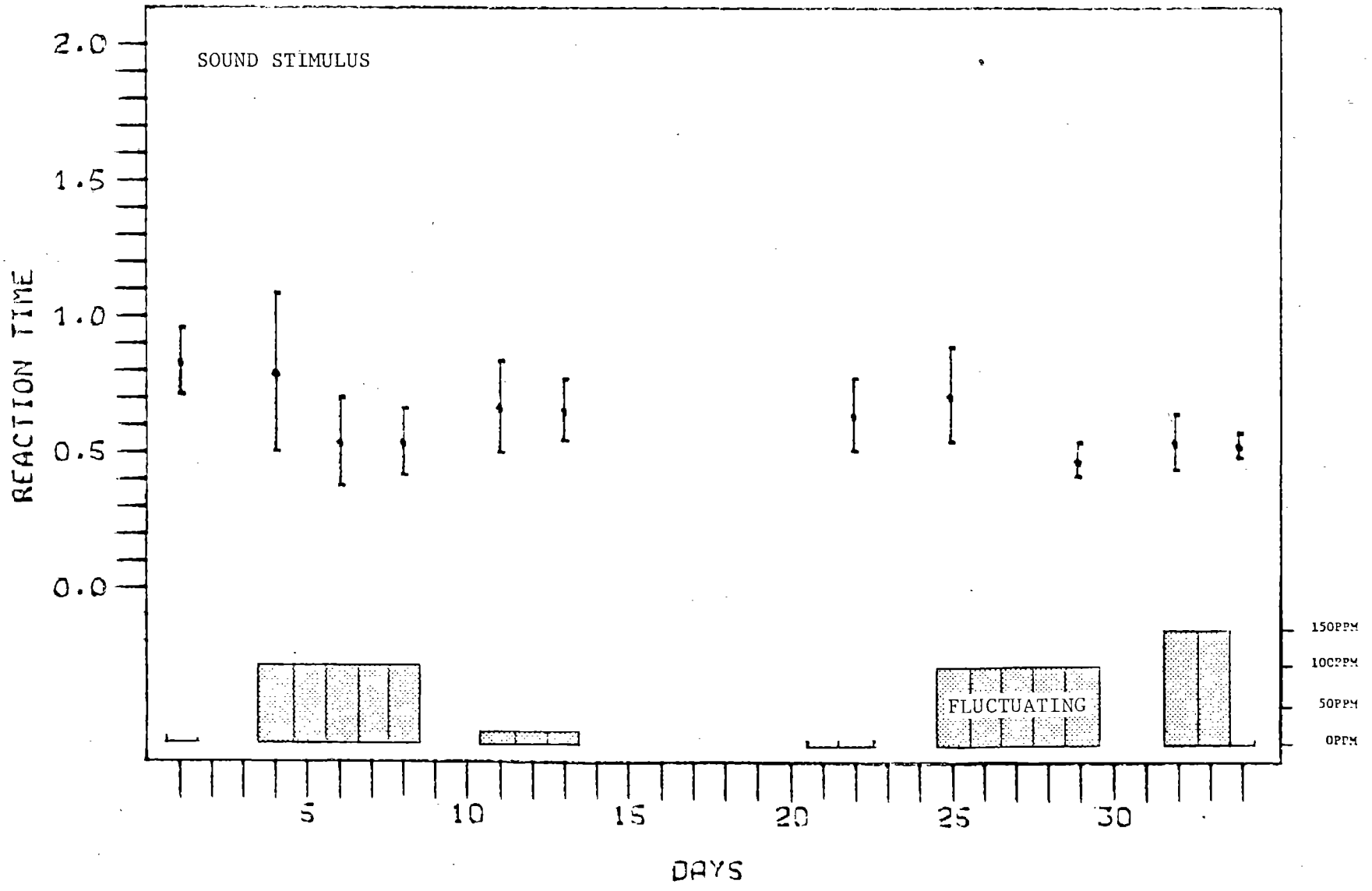


FIGURE 50

THE EFFECT OF EXPOSURE (3 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

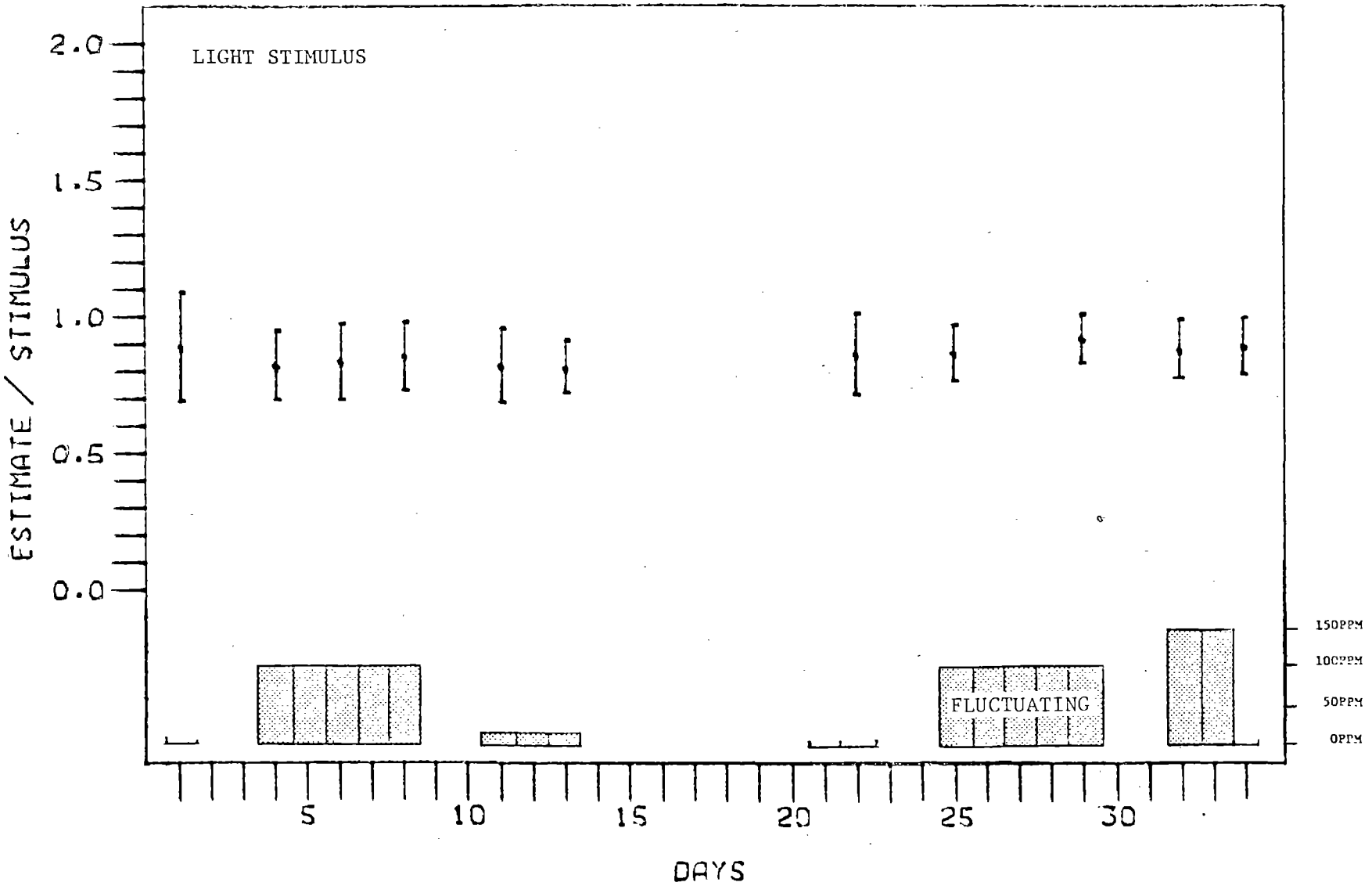


FIGURE 51

THE EFFECT OF EXPOSURE (3 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

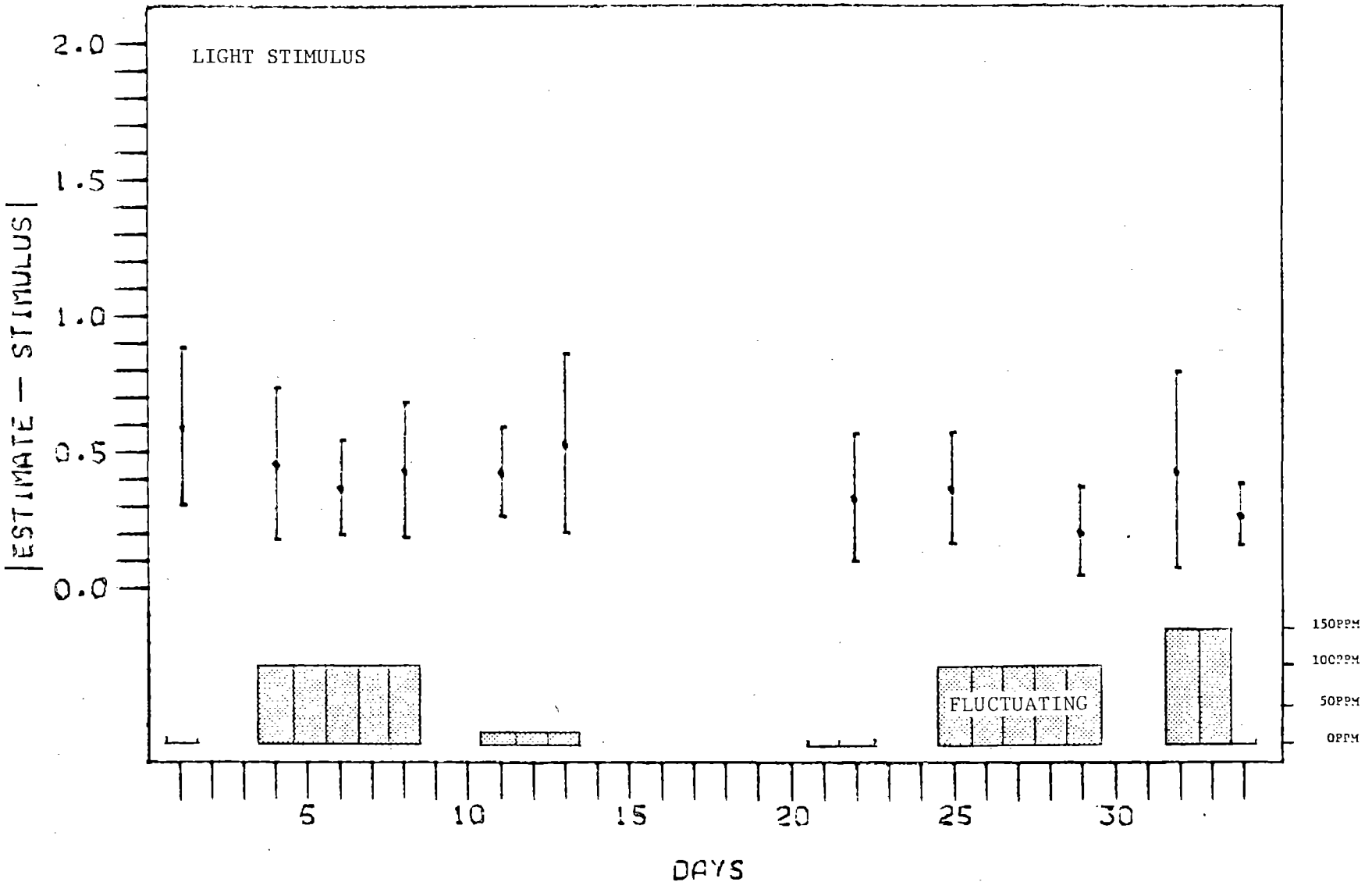


FIGURE 52

THE EFFECT OF EXPOSURE (3 HR/DAY) TO METHYL CHLORIDE ON THE MARQUETTE TEST

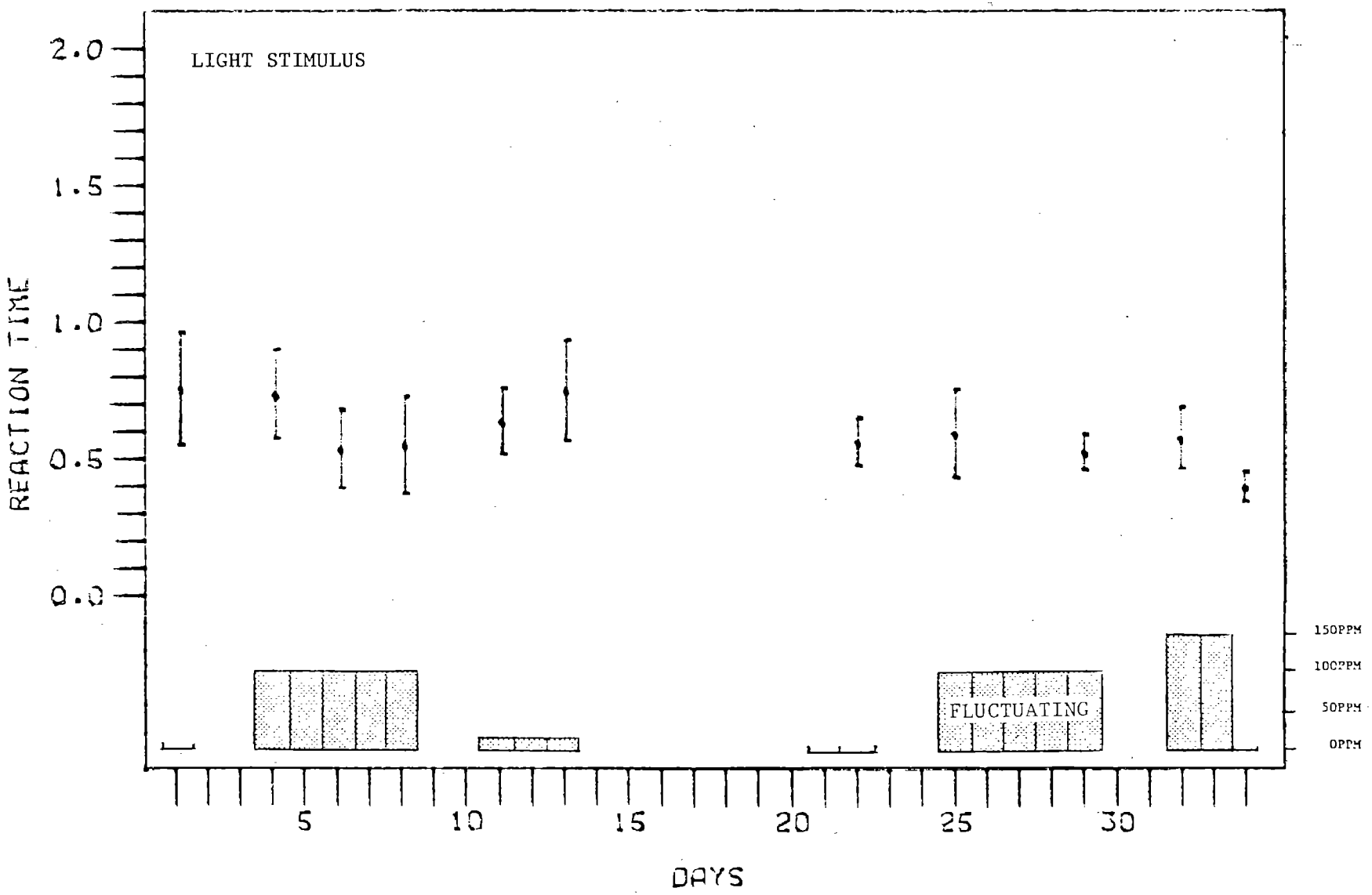


FIGURE 53

THE EFFECT OF EXPOSURE (3 HR/DAY) TO METHYL CHLORIDE ON THE ARITHMETIC TEST

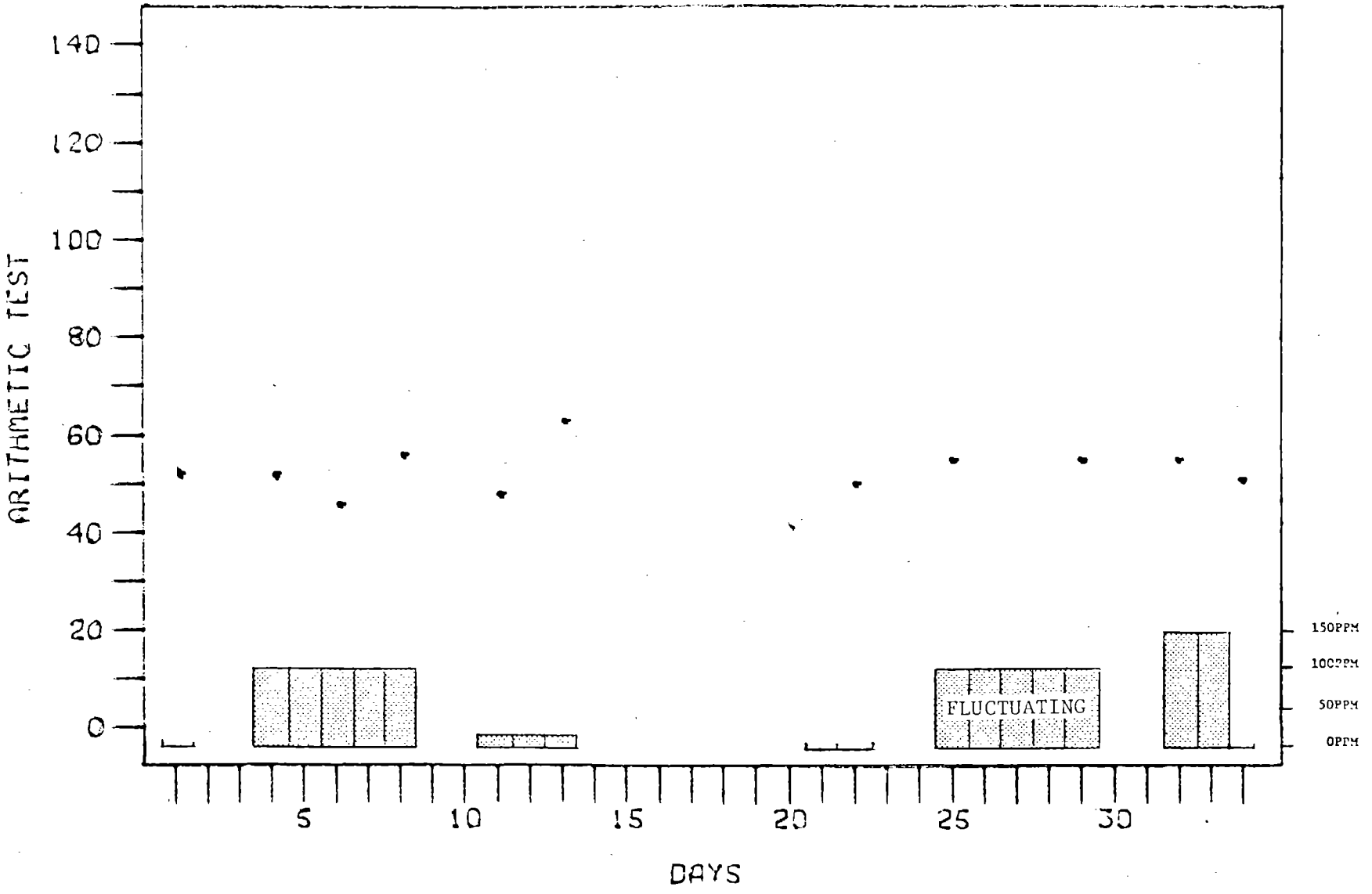


FIGURE 54

THE EFFECT OF EXPOSURE (3 HR/DAY) TO METHYL CHLORIDE ON THE COORDINATION TEST

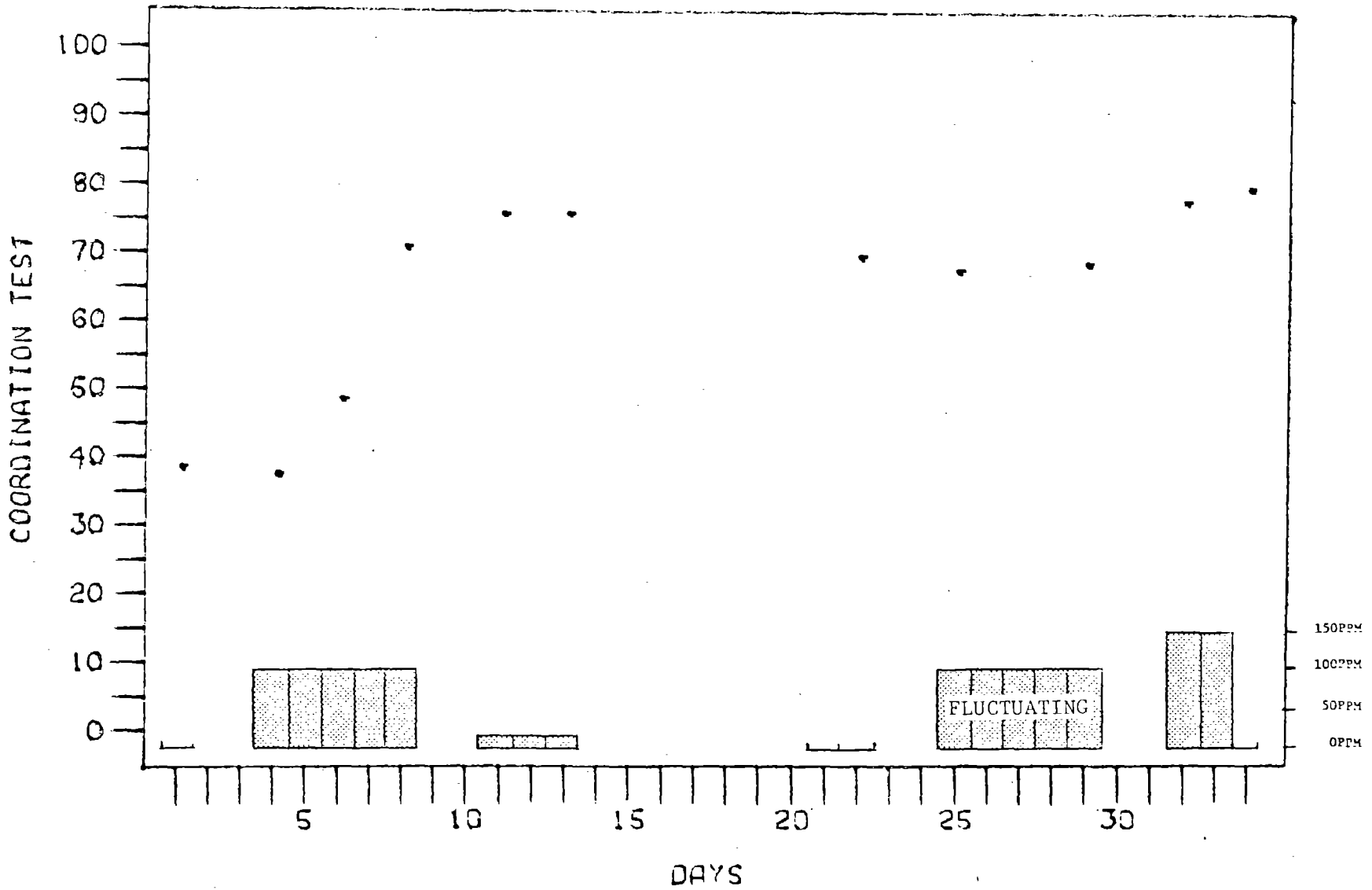


FIGURE 55

THE EFFECT OF EXPOSURE (3 HR/DAY) TO METHYL CHLORIDE ON THE INSPECTION TEST

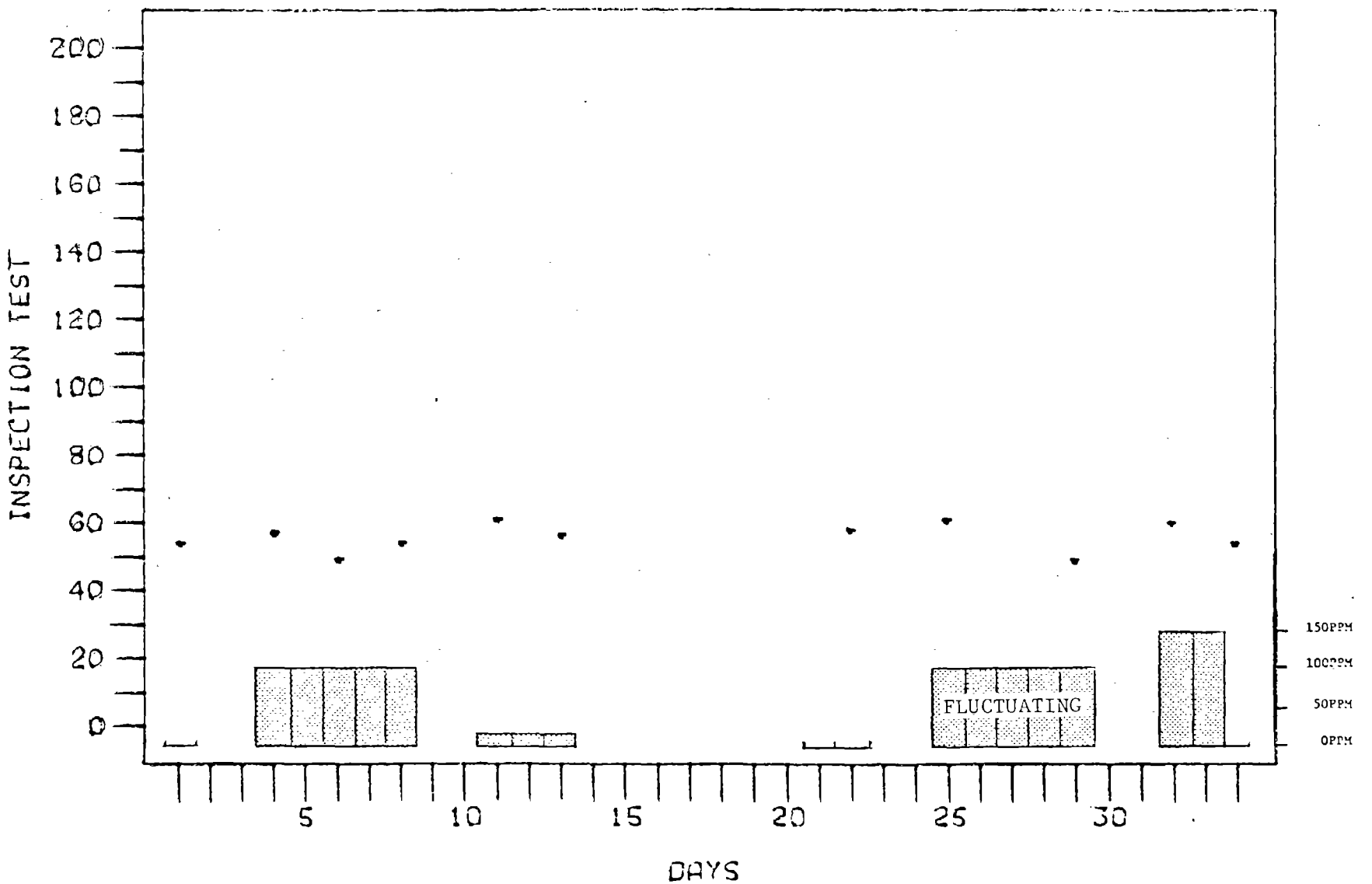


FIGURE 56

THE EFFECT OF EXPOSURE TO METHYL CHLORIDE ON THE MARQUETTE TEST

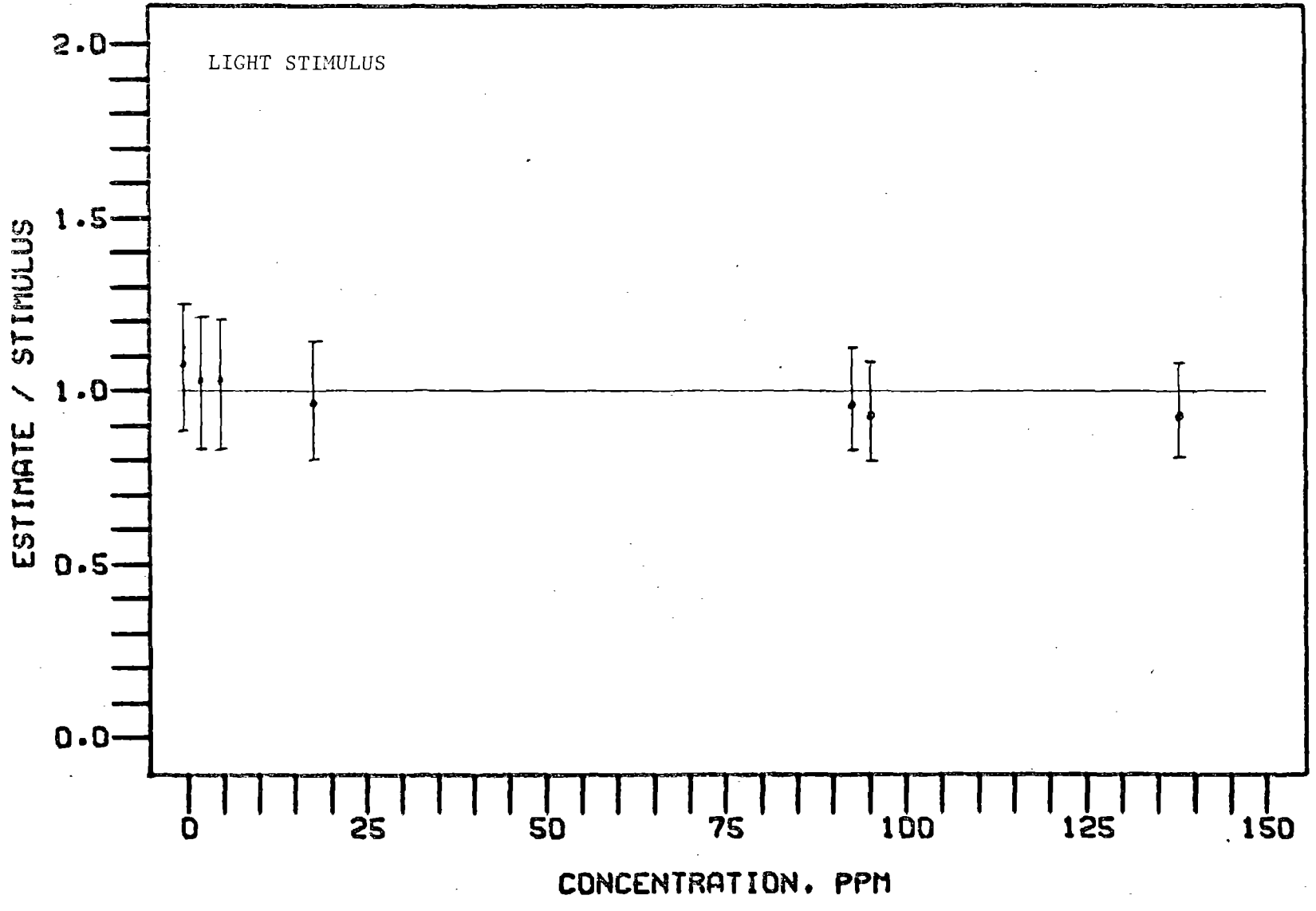
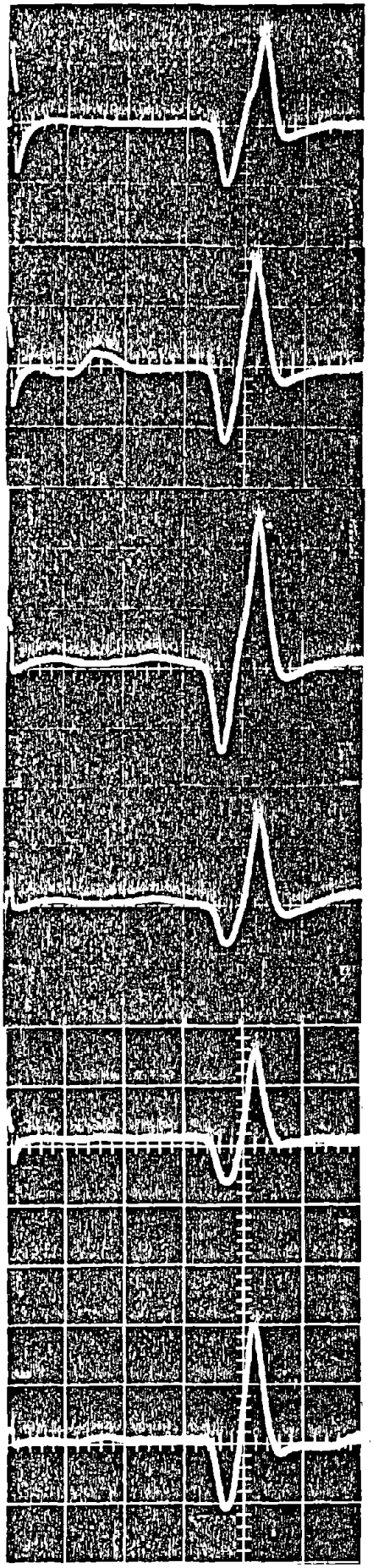


FIGURE 57

SELECTED EMG'S OF SUBJECT 163 DURING METHYL CHLORIDE STUDY



4-4-75, +41 m at 0 ppm

4-4-75, +3 hr 43 m at 0 ppm

4-4-75, +6 hr 31 m at 0 ppm

4-7-75, +1 hr 15 m at 100 ppm

4-7-75, +4 hr at 100 ppm

4-7-75, +6 hr 50 m at 100 ppm

FIGURE 58

MEAN DAILY ALVEOLAR BREATH CONCENTRATIONS AFTER 7 1/2 HOURS OF EXPOSURE (SEDENTARY) TO 100 PPM METHYL CHLORIDE (4 Male Subjects)

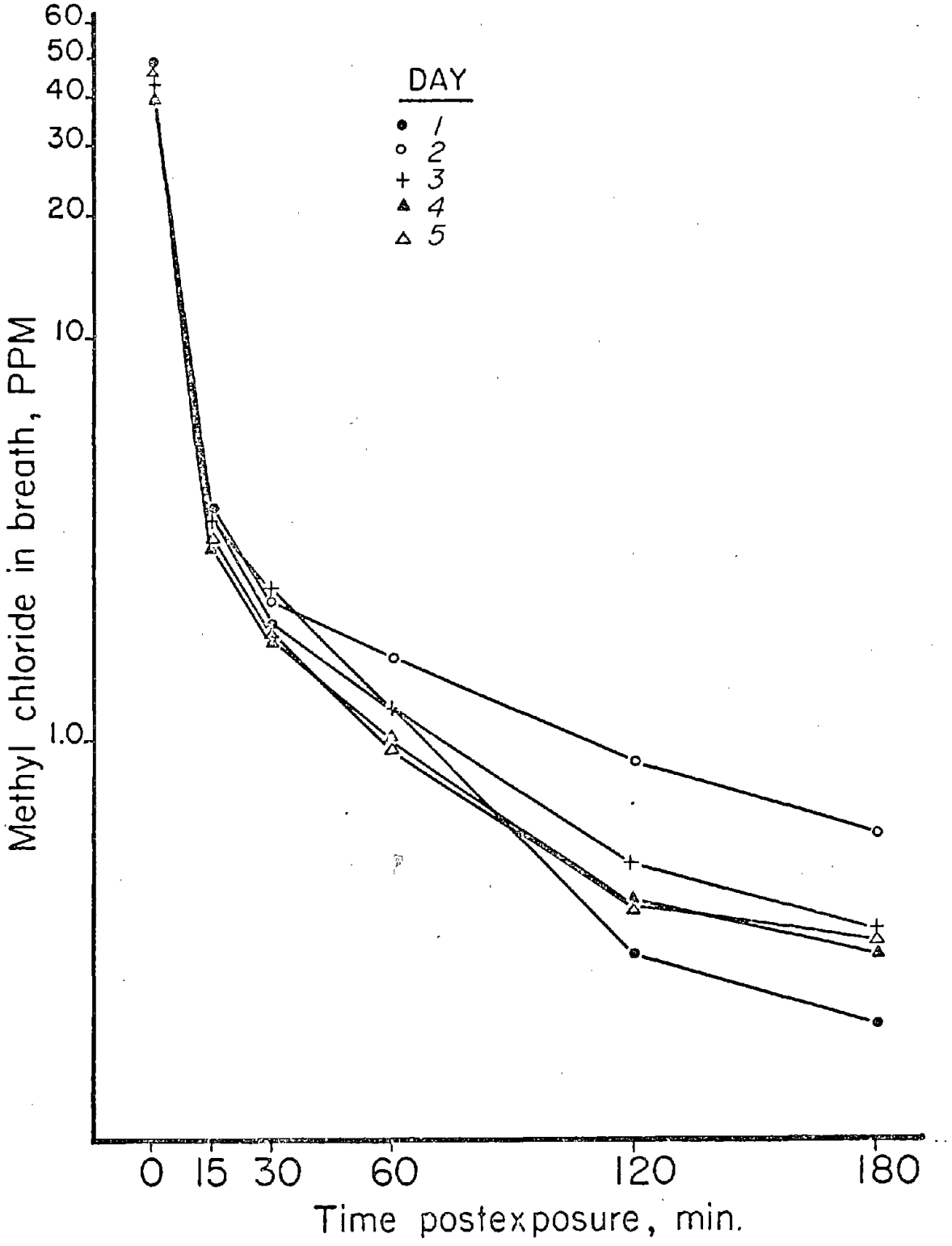


FIGURE 59

MEAN DAILY ALVEOLAR BREATH CONCENTRATIONS AFTER 7 1/2 HOURS OF EXPOSURE (SEDENTARY) TO 100 PPM METHYL CHLORIDE (4 Female Subjects)

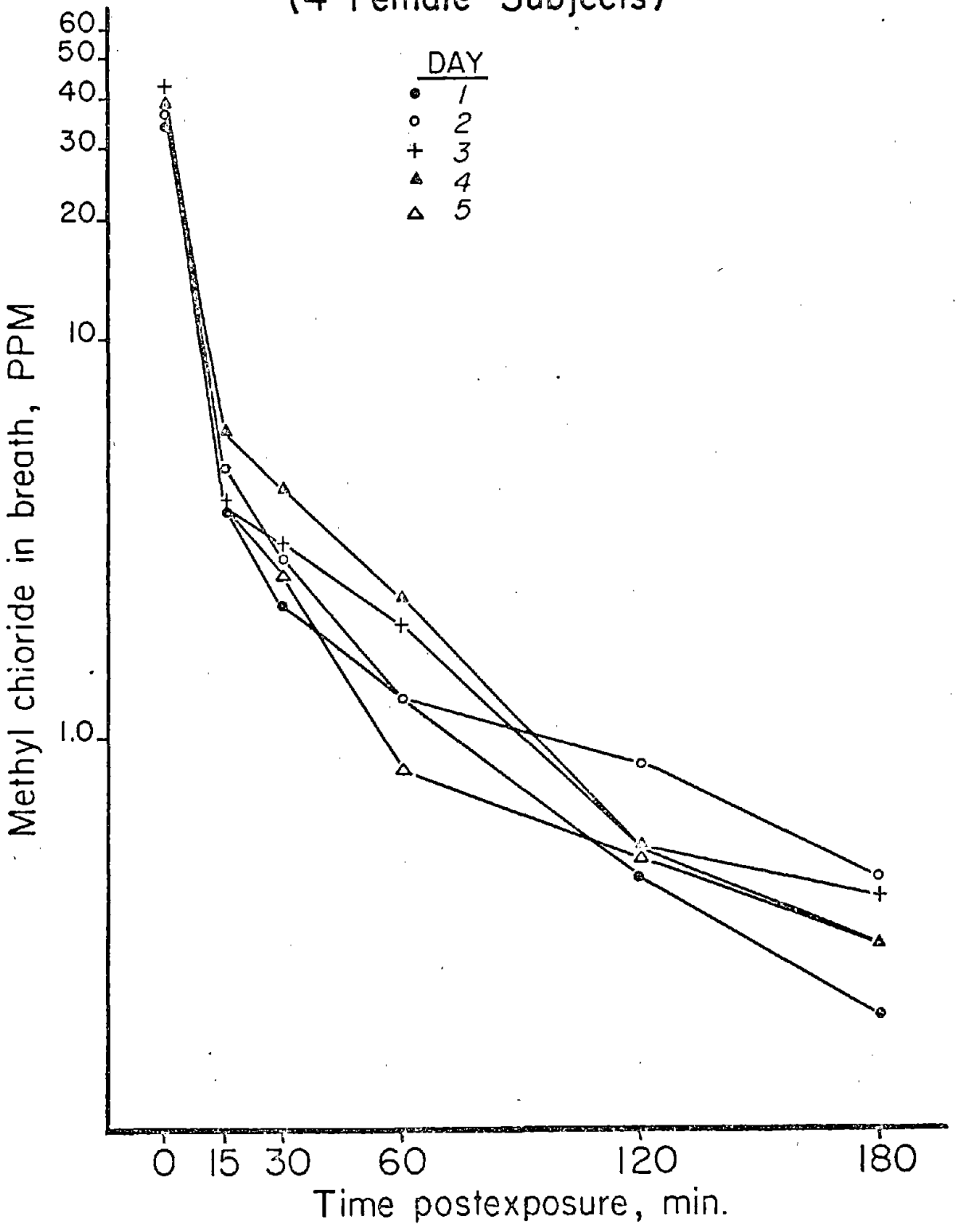


FIGURE 60

MEANS OF ALL ALVEOLAR BREATH CONCENTRATION AFTER 7 1/2 HOURS OF EXPOSURE (SEDENTARY) ON CONSECUTIVE DAYS TO METHYL CHLORIDE

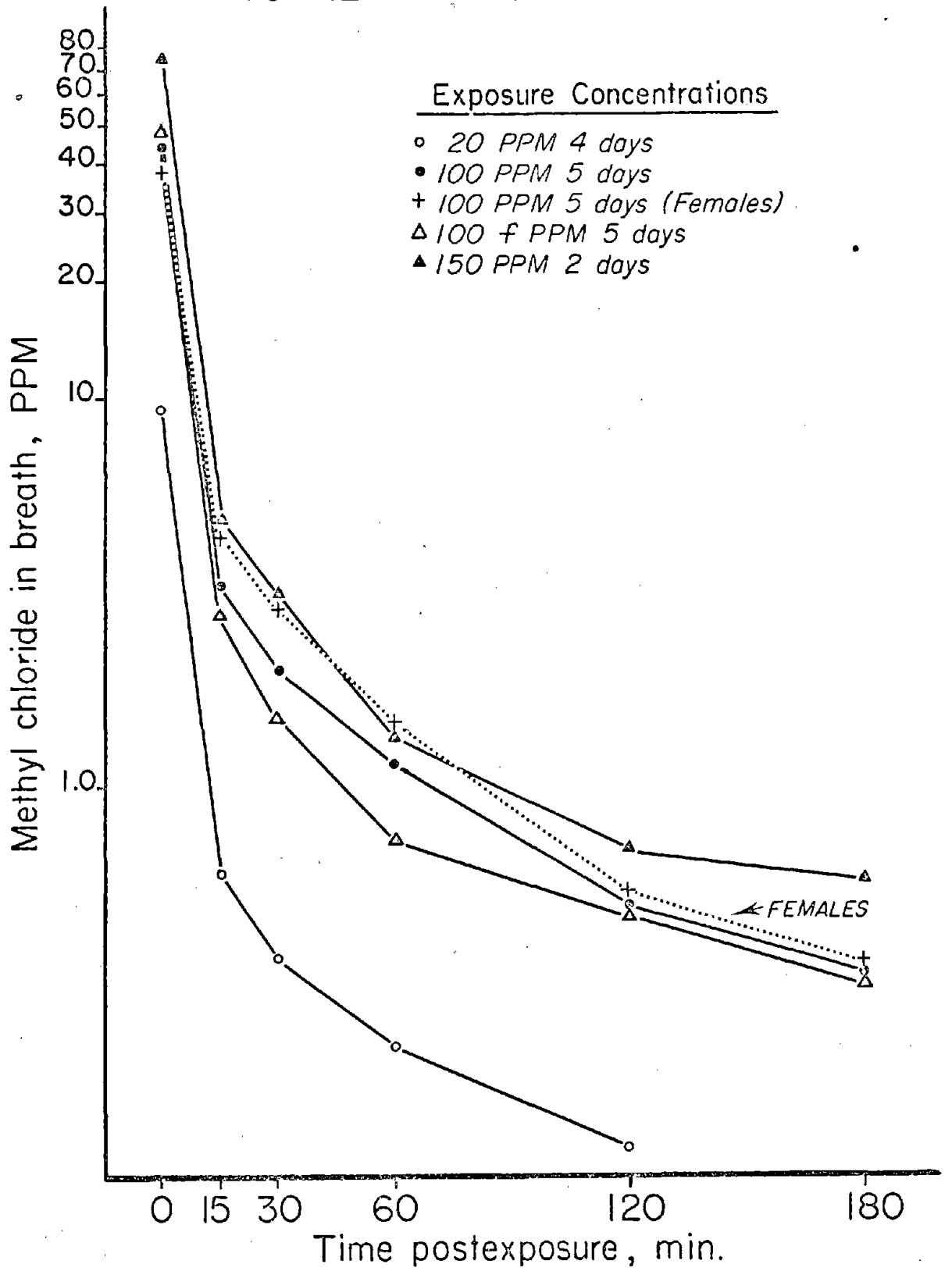


FIGURE 61

MEANS OF ALVEOLAR BREATH CONCENTRATIONS AFTER VARYING LENGTHS OF EXPOSURE (SEDENTARY) FOR FIVE CONSECUTIVE DAYS TO 100 PPM METHYL CHLORIDE

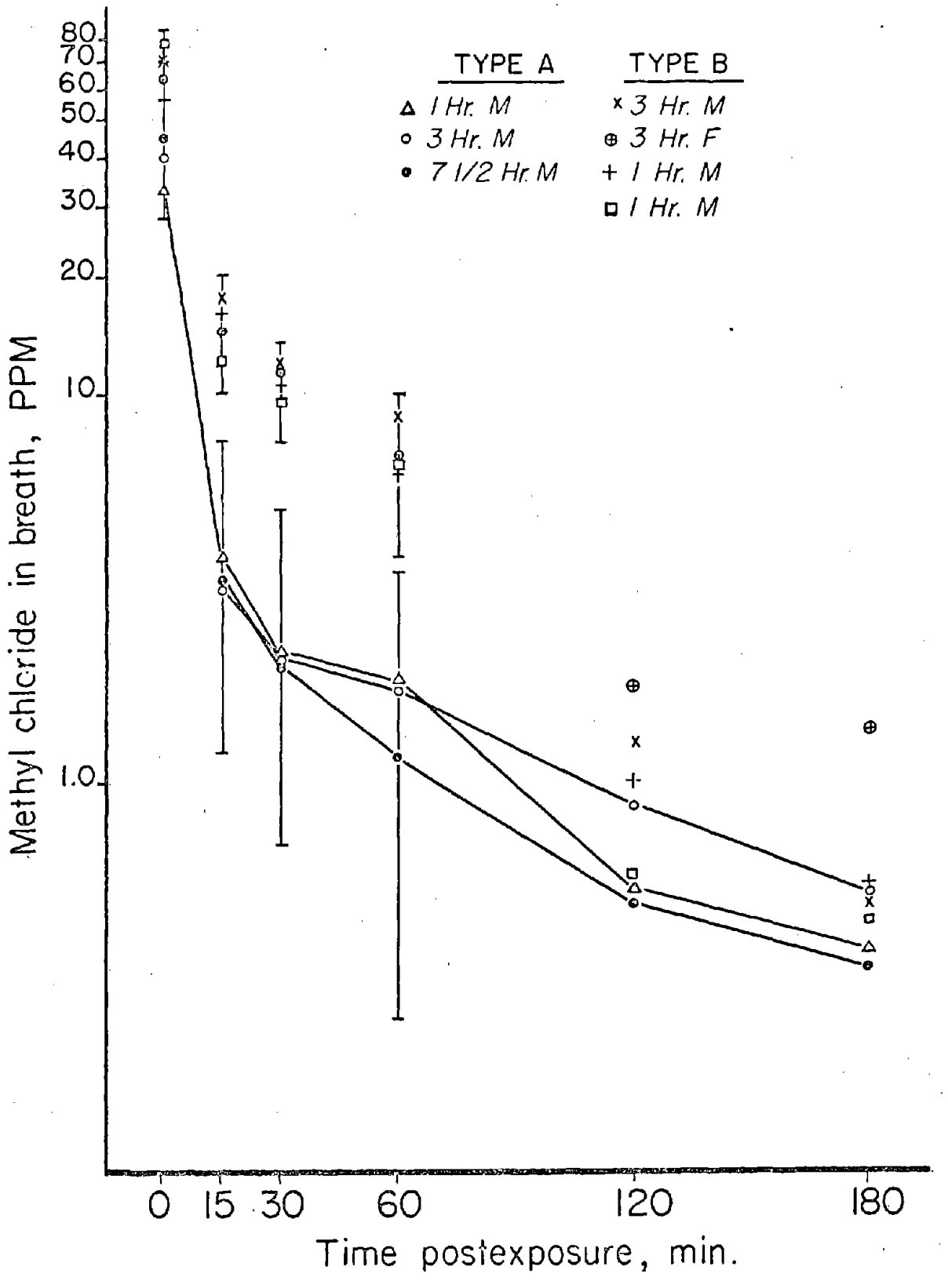
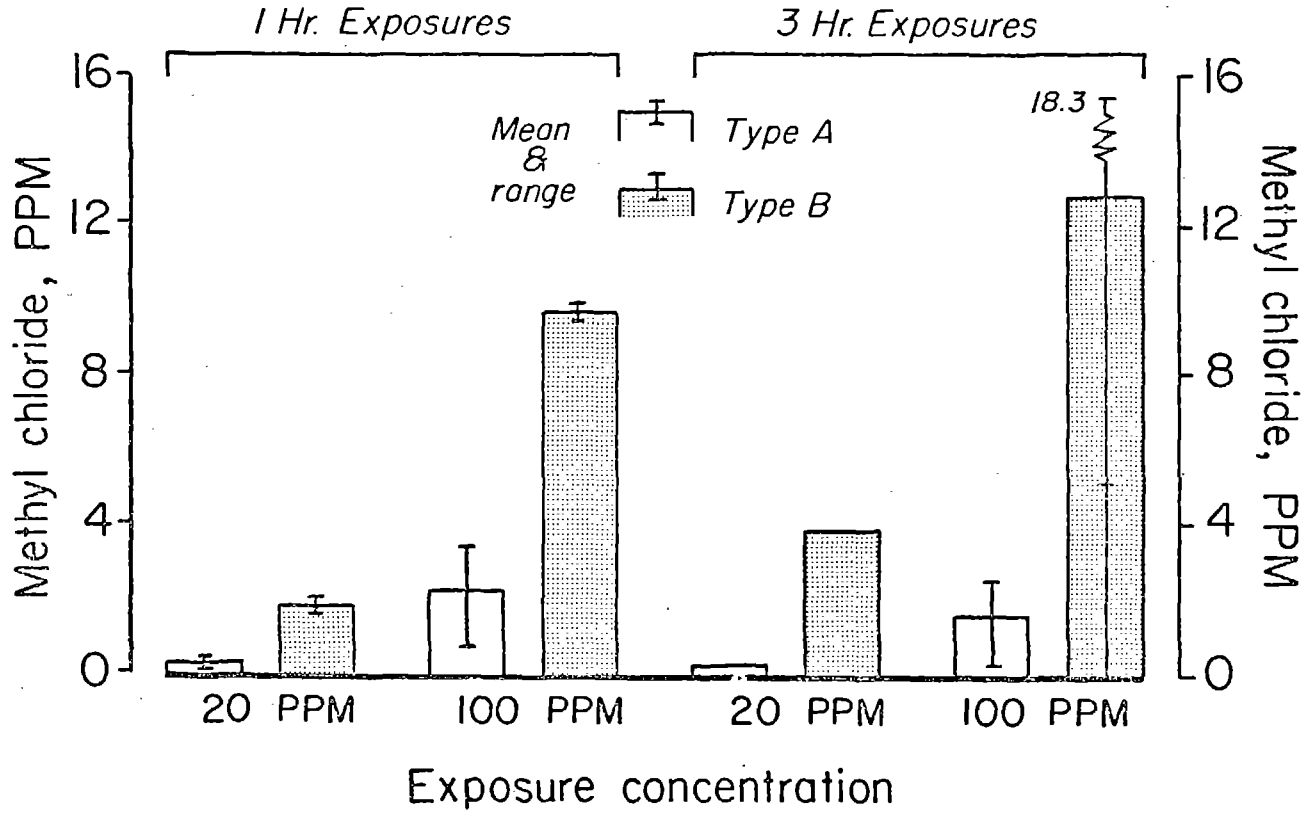


FIGURE 62

COMPARISON OF BLOOD CONCENTRATIONS (Headspace) IN TWO TYPES OF SUBJECTS EXPOSED TO IDENTICAL CONCENTRATIONS OF METHYL CHLORIDE



APPENDIX I

STATEMENT OF VOLUNTARY CONSENT

FOR RESEARCH INVESTIGATION OF

HUMAN EXPOSURE TO:

METHYL CHLORIDE

I, _____, hereby agree to participate as a subject, in a program of research investigation under the direction and supervision of Dr. R. D. Stewart.

The general purpose of this research is to determine rates of uptake, excretion and metabolism of _____.

The studies have been described to me and the known risks involved in this experimental procedure have been explained to me. I understand that the most frequently described known risks are:

NONE KNOWN AT THIS LEVEL OF CONCENTRATION

I understand also that it is not possible to identify all potential risks in experimental procedures which involve controlled exposures to the chemical in a specially designed chamber.

I further understand that reasonable precautions and safeguards have been and will be taken to remove and reduce both the known and the potential but unknown risks and to provide for my safety and comfort.

I also understand that, while the program will be under the direction and supervision of Dr. R. D. Stewart, other professional persons who work with him may be designated to assist him or to act for him.

In view of those considerations, I hereby authorize Dr. R. D. Stewart and his representatives to proceed with the investigation on the understanding that I may terminate my service as a subject in this research at any time I so desire. I also authorize Dr. R. D. Stewart to use any type of data, pictures, films etc. for use in any scientific report or publication.

I am offering my service freely, in consideration of similar actions on the part of other subjects involved in like voluntary efforts to improve our society through research.

Witness _____ Signed _____

Investigator Subject

Date _____

HISTORY

NAME | DATE

P.M.H.

GENERAL HEALTH | WT.

ILLNESSES | OP | HOSP. | INJ.

S.F

R.F.

D. MELL

T.B.C.

TYPHOID

MALARIA

NER. BK.

GOUT

MEDICATION

P.H.

RELIG. | ED.

VOCAT.

MARITAL

HABITS | SLEEP | COFFEE | CIG. | ALCOL.

WK. HRS./WK.

IMMUNIZATIONS

SMALLPOX

TETANUS

DIPTH.

POLIO

INFLU.

TYPH.

MEAS.

F.H.

M | W/H

F

MM

MF

FM

FF

D. MELL

LARGE INFANTS

STILLBORN

TBC

B.P.

HEART

COR. THROM

ANGINA

STROKE

BLEED. TEND.

CA

ASTHMA

HAY FEVER

EPILEPSY

NER. BK.

INSANITY

GOUT

KIDNEY

EYES	VISION	PAIN	GLASSES	
EARS	HEARING	DISCHARGE	PAIN	TINNITUS
NOSE	SMELL	OBST.	EPIS	DISCH.
C.R.	URI/YR	SORE THROATS	HORSENESS	COUGH
	SPUTUM	HEMOP	NIGHT SWEATS	FEVER
	WHEEZE	PAIN	DOE	
	EPEMA	ORTHOP	PND	↑ B.P
G.I.	MOUTH			
	APPETITE	DIET	DYSPHAGIA	
	N & V	PAIN		
	STOOLS			
	JAUNDICE	MASS		
G.U.	FREQ.	NOC	PAIN	DYSURIA
	INCONTIN.	COLOR		
	ALB.	SUGAR	WBC	RBC
	V.D.			
M.S.	PREV. TRAUMA			
	NECK	BACK	VAR. VEIN	
	JOINTS		LEG CRAMPS	
NEURO	HEADACHE	TRAUMA		
	ATAXIA	PARALYSIS		
	ANESTH-PARE	TREMOR		
	FAINTING	CONVUL.		
	MEMORY	PERSONALITY		
SKIN	ERUPTION			
	ITCHING	COLOR CHANGE		
LYMPH-HEMAT.	BLEEDING DISORDER			
END.				
ALLERGY				
MENSES	ONSET	LAST WEEKS AGO	DURATION	FREQUENCY / PAIN
	MENOPAUSE	SPOTTING		
	V.D.	VAGINAL DISCHARGE		
BREASTS				

PHYSICAL EXAMINATION

X = NOT EXAMINED – = NO; NEGATIVE
✓ = NORMAL, YES O = ABSENT

NAME | DATE

TEMP. | B.P. | P. | HT. | WT. | ST. WT.

APPEARANCE | POSTURE

HAIR — COLOR | TEXTURE | DISTRIBUTION

SCALP — CLEAN | ERUPTION | ALOPECIA

SKULL — DEFORMITIES | TENDERNESS

FACE — PALSIES | EXPRESSION | LIPS

EARS — CERUMEN | TYM MEMB | WATCH HEARD R L | TOPHI

NOSE — DISCHARGE | OBSTRUCTION | PERFORATION

MOUTH — BREATH | ULCERS | AB. PIGMENTATION

TEETH — R 8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8 L | X = CARIOUS O = ABSENT
R 8 7 6 5 4 3 2 1 | 1 2 3 4 5 6 7 8 L | CLEAN | ADEQUATE CHEWING SURFACE

GUMS — RETRACTION | PYORRHEA

TONGUE — PROTRUDED MIDLINE | TREMOR | ATROPHY

TONSILS — STATUS | ENLARGED | INJECTION | EXUDATE

PHARYNX — GAG REFLEX | INJECTION | EXUDATE

EYES — COLOR | ARCUS SENILIS | PERRLA | NEOM | NYSTAGMUS
EXOPHTHAL | LID LAG | PTOSIS | PERIORBITAL EDEMA
VISION | NEAR R L | FAR R L | FIELDS
OPHTHAL | DISC | H GR. | A GR. | TONOMETER R L

LARYNX — VOICE NORMAL | MIDLINE | TUG

NECK — STIFFNESS | NODES | VEINS | CAROTID | TRACHEA | THYROID | PALPABLE

SPINE — TENDERNESS | RIGIDITY | AB. CURVATURE

THORAX — SYMMETRICAL | CVA TENDERNESS | STERNAL TENDERNESS

RESPIRA — RATE | REGULAR | DEPTH | SYMMETRICAL | FORCED

LUNGS — COUGH | SPUTUM | PERCUSSION
RESONANT | BREATH SOUNDS | VESICULAR
RALES | TACTILE FREMITUS | VOICE SOUNDS

HEART — HEAVE | SHOCK | THRILL
APEX IMPULSE PALPABLE IN _____ I.C.S. _____ CM. TO L. OF M.C.L. FROM M.S.L. | B.C.D. EXTENDS _____ CM. TO L. OF M.S.L. _____ I.C.S.
SOUNDS A_2 P_2 M_1 M_2 | RHYTHM | MURMUR

BREASTS — SIZE NORMAL | TENDERNESS | MASSES

ABDOMEN — SYMMETRICAL | DILATED VEINS | ASCITES
PALPABLE LIVER | SPLEEN | KIDNEY | MASSES
TENDERNESS | RIGIDITY | SOUNDS | HERNIA

GENIT-ALIA — DISCHARGE | SKIN LESION | TESTES
PELVIC

ARMS — RADIAL PULSE | TREMOR | CLUBBING | CYANOSIS | JOINTS

LEGS — DORSALIS PEDIS | VARICOSITIES | EDEMA | ULCER
JOINTS

L. NODES	CERVICAL	AXILLARY	INGUINAL	ENLARGED
SKIN	IDENT. MARKS			TEXTURE
	COLOR	JAUNDICE	ERUPTION	AB. PIGMENTATION
RECTAL	HEMORRHOIDS	MASSES	TENDERNESS	COLOR FECES
PROSTATE	ENLARGED	TENDER	MASS	
NEURO-LOGICAL				

CRANIAL NERVES

R		L
	SMELL	
	VISION	
	FIELD	
	FUNDUS	
	OCULAR MOVEMENTS	
	PTOSIS	
	NYSTAGMUS	
	PUPILS SIZE - SHAPE	
	PUPILS REFLEXES	
	HEARING	
	TASTE	

SWALLOWING

REFLEXES (ENCIRCLE (REINFORCED))

R		L
	CORNEAL CR.	
	SUCKING	
	PHARYNX CR. IX, X	
	JAW CR. V	
	BICEPS C56	
	BRACHIORADIALIS C-56	
	TRICEPS C678	
	HOFFMANN	
	EPIGASTRIC T6-9	
	MID. ABD. T9-11	
	HYPOGASTRIC T11-L1	
	CREMASTERIC L12	
	QUADRICIPS L234	
	GASTROC. SOLEUS L5 S12	
	CLONUS (ANKLE)	
	HAMSTR. INT. L45 S12	
	HAMSTR. EXT. L5 S12	
	ANAL S34	
	BULBOCAV S34	
	BABINSKI	

ROMBERG

FACIES - POSTURE

SPEECH

HANDEDNESS RT. LT.

MENTAL STATUS

TREMOR

STATION

GAIT

R		L
	ON TOES	
	ON HEELS	
	HOPPING	
	ARM SWING	

STRAIGHT AWAY

ON TURNS

TANDEM

DESCRIPTION

MUSCLES

A = ATROPHY F = FASICULATION

R	STRENGTH	L
	TEMPORAL CR V	
	MASSETER V	
	FOREHEAD VII	
	ORBIC. OC. VII	
	MOUTH VII	
	SOFT PALATE X	
	PHARYNX X	
	STERNOMASTOID XI	
	TONGUE XII	
	NECK FLEX. C 1-6	
	NECK EXT. C1-T1	
	SCAPULAR C4-7	
	PECTORALIS MAJ. 5-T1	
	DELTOID C 56	
	BICEPS BRACH. 56	
	TRICEPS 6 78	
	WRIST EXT. 678	
	WRIST FLEX. 678 T1	
	DIGITS EXT. 678	
	DIGITS FLEX. 78 T1	
	THENAR 8 1	
	HYPOTHENAR 8 1	
	INTEROSSEI 8 1	
	BACK	
	ABDOMAN T6-L1	
	ILIOPSOAS L1234	
	ADDUCTORS, THIGH 234	
	ABDUCTORS, THIGH 45 S1	
	GLUTEUS MAX. 5 12	
	QUADRICEPS 234	
	HAMSTRINGS 45 12	
	TIBIALIS ANT. 45 1	
	TOES EXT. 45 1	
	PERONEI 45 1	
	TIBIALIS POST 5 1	
	GASTROC. SOLEUS 5 12	
	TOES FLEX. 5 12	

ALT. MOT. RATE

R	(A.M.R.)	L
	HANDS (PRO. SUP.)	
	FINGERS	
	FEET	

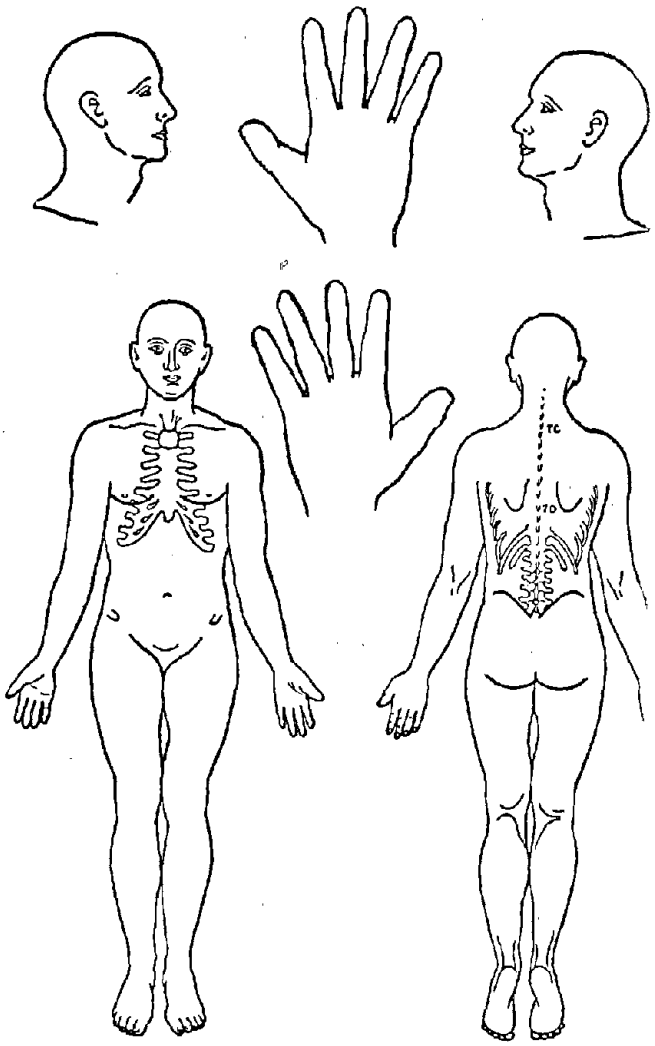
TONGUE

COORDINATION

R		L
	NOSE-FINGER-NOSE	
	KNEE PAT.-(PRO. SUP)	
	TOE-FINGER	
	FINGER - NOSE	
	HEEL - KNEE	

(UNDERLINE IF NORMAL - OTHERWISE ENCIRCLE AND CHART)

TOUCH	JOINT SENSE
PAIN	STEREOGNOSIS
TEMPERATURE	TRACED FIGURES
DEEP PAIN	TWO POINT
VIBRATION	



TOUCH - ARABIC; PAIN - ARABIC IN CIRCLE; TEMP. - ROMAN

LOW BACK SYNDROMES

R		L
	S.L.R.	
	LOC. PAIN	
	FABERE	
	KERNIG	
	SPASM	

CHIN-CHEST

LIST

SCOLIOSIS

LORDOSIS

L R

FLEX

RECTAL (SACRUM, SPHINCTER)

STIFF NECK

CRANIUM

BRUIT