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TECHNICAL REPORT

OCCUPATIONAL EXPOSURE to LEPTOPHOS and OTHER CHEMICALS

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Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health

NIOSH HEALTH SURVEY OF VELSICOL PESTICIDE WORKERS

Occupational Exposure to Leptophos and Other Chemicals

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PREFACE

The National Institute for Occupational Safety and Health (NIOSH) is responsible for helping ensure that every person in the Nation has safe and healthful working conditions. To accomplish this end, the Institute engages in research on occupational safety and health problems including evaluation of hazards and toxicity determinations. One of the many hazards considered for investigation by the Institute's Division of Surveillance, Hazard Evaluations, and Field Studies (DSHEFS) is multiple exposure of workers to neurotoxic chemicals. In one of our investigations in this area, we initiated and conducted a comprehensive medical examination of workers exposed to leptophos and other neurotoxic chemicals at the Velsicol Chemical Company plant in Bayport, Texas.

This publication reports the medical findings regarding the health status of the workers and the results of a reproductive survey of wives of current and former Velsicol workers. The difficulty in establishing causal relationships when workers are occupationally exposed to multiple chemicals is also discussed.

Also included in this report is a special case study evaluation of Velsicol workers allegedly chemically poisoned and previously diagnosed as experiencing severe neurological problems. Some of these workers were examined during this study and the question of permanent damage was considered in relation to their current health status.

We hope that the findings from this study will provide additional basis for recognizing the need for prevention and early detection of health problems associated with worker exposure to toxic chemicals.

Bobby J. Craft

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ABSTRACT

NIOSH was advised by a Federal EPA official of potential health problems at Velsicol's Bayport, Texas plant among employees who were involved in the manufacture and packaging of leptophos. Twelve cases of serious neurological disorders had been identified by a medical consultant to the company. This plant also manufactured a resin called Klyrvel, at about the time they produced leptophos. N-hexane, a known neurotoxic solvent that can cause neurologic effects, was used in considerable quantities in the production of the resin during the period 1971-1975. The plant had experienced a high rate of employee turnover and many workers who had been exposed to leptophos and other chemicals were no longer employed by the Velsicol Company. NIOSH considered it essential that a health study be conducted of all current and former workers.

With the assistance of the Harris County Health Department and the Velsicol Chemical Company, nearly all of the 301 current and former employees were notified of the availability of medical examinations. Between January and April, 1977, 155 persons reported for comprehensive examinations that evaluated general physical status, neurological status, and measures of neuromuscular, ophthalmological, psychological, and biochemical function. A reproductive history survey was also conducted. Additionally, industrial and medical records were reviewed and case studies compiled to define the circumstances that led to reported serious neurological disturbances in certain workers.

NIOSH's medical evaluation showed that a substantial number of those examined were found to have neurological, electromyographic, electroneurographic, and psychological performance abnormalities ranging from slight to serious. A causal association of these findings with worker exposure to leptophos is difficult to establish in individual cases because of the presence of other neurotoxic agents such as n-hexane. A comparison, however, of the medical findings with available "normal values" suggests a worker population whose health has been adversely affected.

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ACKNOWLEDGMENTS

We wish to thank the workers who volunteered to participate in the medical examinations and the wives who agreed to be interviewed in the reproductive history survey. Without their cooperation, this study would not have been possible. The Velsicol Chemical Company paid lost wages and transportation costs to workers participating in the study and we wish to acknowledge this assistance. The help provided to NIOSH by the Harris County Health Department, Texas, during the early stages of the study is deeply appreciated. The communications media in Houston were very active in alerting workers regarding NIOSH's medical study and deserve special recognition. Mrs. Betty Wilcox and her staff of the Kelsey-Seybold Clinic were especially helpful in the planning and scheduling of workers and in maintaining the clinical files. The support provided by NIOSH staff was extensive. To these investigators, especially Harry Markel for his work on environmental evaluation, Dave Brown and Greg Ness for their effort on employee information retrieval, Bobby Taylor for his assistance in the instrumentation for the psychological testing, Claire White and Joni Bier for their effort in manuscript preparation, we gratefully acknowledge their help. Many other people, both within and outside of NIOSH,helped in this study and deserve special thanks for their assistance.

PART I - MEDICAL EXAMINATION

INTRODUCTION

In late January, 1976, NIOSH was advised by a Federal EPA official of potential health problems among employees at the Velsicol Chemical Company's Bayport Plant in Houston, Texas; a plant involved in the manufacture and packaging of leptophos, also known by the trade name "PHOSVEL". At that time leptophos was registered by EPA primarily for export with only limited experimental use allowed in this country. Velsicol, however, was applying to EPA for full domestic use of leptophos on several crops and for further experimental use. The increased domestic use was being questioned because of scientific reports that leptophos was neurotoxic to mammals and birds.

On February 12, 1976, a NIOSH health hazard evaluation team visited the plant and conducted a walk-through inspection which included interviews and medical screening examinations of current employees. At the time of the visit, the plant management told NIOSH investigators that they were suspending the manufacture of leptophos and, indeed, no operations involving leptophos were seen during the visit. However, information later submitted by the company indicated that leptophos was handled there through March, 1976.

A number of other potentially toxic chemicals were used in the manufacture of leptophos. One of these, toluene, is a suspected neurotoxic solvent. This plant also manufactured a resin called Klyrvel, about the time they produced leptophos. n-hexane, a solvent that can cause neurologic effects, was used in considerable quantities in the production of the resin during the period 1971-1975.

During the initial NIOSH visit in February, 1976, only two of the twenty-six workers NIOSH examined displayed signs and symptoms of mild neurological dysfunction. However, 12 cases of serious neurological disorders had been identified in June, 1975, by a medical consultant to the company.

Since the plant had experienced a high rate of employee turnover, many workers who had been exposed to leptophos and other chemicals were no longer employed by the Velsicol Company. For example, 11 of the 12 workers previously reported to be seriously affected were not employed at the time of our visit. For these reasons, when NIOSH announced on December 1, 1976, that we would conduct a medical study of all present employees at the Bayport plant, we included former employees as well.

With the assistance of the Harris County Health Department and the Velsicol Chemical Company, nearly all of the 301 current and former employees were notified of the availability of medical examinations. A contract was awarded to the Kelsey-Seybold Clinic in Houston, Texas, to conduct a comprehensive medical examination based on an extensive protocol developed by NIOSH. Between January and April, 1977, 155 persons reported for the comprehensive examinations that evaluated general physical status, neurological status, and measures of neuromuscular, ophthalmological, psychological, and biochemical function.

All participants and their designated physicians were notified of the medical findings within two months of the examination. Medical findings which required prompt attention were reported immediately.

In order to maintain objectivity and eliminate any potential bias in the medical and psychological examinations administered to the study participants, investigators were asked not to discuss their findings with each other. NIOSH received reported findings for all the study participants. Although this approach maintains objectivity and minimizes bias in the examination of the workers, NIOSH sacrificed the advantage clinicians have in evaluating, during a medical examination, all related medical data in arriving at a differential diagnosis. In spite of this deficiency, we do not feel that any significant medical finding was overlooked in evaluating the current health of the study participants.

After the completion of the medical examinations, a reproductive history was elicited by NIOSH staff from 63 wives of Velsicol workers, two female office workers, and for comparative purposes, from 53 women of similar age and socioeconomic status who neither themselves nor their husbands had any connection with Velsicol or known occupational exposure to potentially toxic chemicals.

To evaluate the circumstances that allegedly led to workers experiencing serious neurological disorders and to fully document the medical findings in these workers, an evaluation was made of their medical files, production data for the Velsicol Chemical plant and other information made available through workers' compensation files. Several of the more seriously affected workers also participated in NIOSH's medical examination study. Therefore, the current health status of these workers and the possibility of permanent damage could be evaluated. The results of this comparison are included in the medical findings of Part I - Medical Examination. The findings of the retrospective medical evaluation are reported in Part III of this report.

METHODOLOGY

At the Clinic, the participating individuals were received and identified. The medical examination was explained to him (her) and the informed consent to participate voluntarily was obtained. A detailed occupational history, with particular emphasis on exposure to pesticides and other chemicals, a health history that emphasized neurological symptoms, and a history of smoking and drinking habits were obtained. (Appendixes A, B, C).

Physical Examination

The participants were examined by one of the two physicians conducting medical examinations to assess their general physical status. Height, weight, pulse rate, and blood pressure were measured. The head, eyes, ears, nose, mouth, and throat were examined. Chest sounds (heart and lungs) were noted and the abdomen was palpated. The general condition of the skin and the limbs was also checked (Appendix D).

Ophthalmological Examination

The ophthalmological examination was done by one of the two participating ophthalmologists. The eye lids, cornea, lens, retina, pupillary reflex, and other cardinal items were examined. The visual field was tested on two axes using a perimeter. The ocular pressure was checked for glaucoma using a non-contact tonometer (Appendix E).

Chest X-ray

A 36-X-43 cm PA (posterior-anterior) chest X-ray was taken and read by a radiologist.

Laboratory Tests

The laboratory tests that were run included urinalysis, complete blood count (CBC), serology, sequential multiphasic analysis (SMA), and red blood cell cholinesterase (RBC-CHE) determination. Included in the SMA were analyses for glucose, sodium, potassium, chloride, carbon dioxide, blood urea nitrogen (BUN), creatinine, calcium, phosphorus, uric acid, total protein, albumin, globulin, iron, total bilirubin, alkaline phosphatase, serum glutamic pyruvic transaminase (SGPT), lactic dehydrogenase (LDH), cholesterol, and triglycerides.

Neurological Examination

A neurological examination was done by one of the three participating neurologists. Tests for the following were included in the examination: mental status (orientation, memory, and alertness), cranial nerves, deep tendon reflexes, plantar reflex (Babinski's sign), general motor survey (walk on toes

and heels), muscle coordination, gait and stance, muscle tone and strength, tremor, and sensory survey.

The evaluation of each participant's mental status included the following tests of memory: Serial 7's, 6 Digits Forward, 5 Digits Backward, and Sentence Retention (Appendix G). Criteria used to assess a satisfactory result in these tests were: greater than 11 correct for Serial 7's, more than 3 correct in 6 Digits Forward, more than 2 correct in 5 Digits Backward, and success in one of three trials in Sentence Retention.

The results of the aforementioned mental status evaluation were not used to classify participants into abnormal or slightly abnormal categories.

Criteria for Classification

For the purpose of the neurological examination, each individual was classified as follows:

1. Neurologically abnormal if:

    a) plantar reflex (Babinski's sign) was positive (extensor), or

    b) spastic gait was observed, or

    c) increased deep tendon reflex was present and accompanied by an EMG abnormality (altered insertional activity) of the extensor digitorum brevis or tendon reflex was noted and accompanied by abnormal motor unit potentials of the extensor digitorum brevis muscle or abductor hallucis muscle, or

    d) decreased deep tendon reflex was noted and accompanied by abnormal motor unit potentials of the extensor digitorum brevis muscle or abductor hallucis muscle, or

    e) decreased sensorium was noted and accompanied by abnormal latency in median, ulnar or sensory nerve, or

    f) any three of the following four were positive - increased or decreased deep tendon reflex, nystagmus, decreased sensorium, and muscle weakness.

2. Neurologically slightly abnormal if any abnormality not qualifying for the "abnormal category" was noted in:

    a) deep tendon reflex, or

    b) muscle strength or tone, or

    c) sensory testing.

3. Neurologically normal if none of the above symptoms/signs were evidenced.

PSYCHOLOGICAL PERFORMANCE MEASURES

Exposure of humans to neurotoxic chemicals can result in degraded performance on tests of psychological function. Indeed, such behavioral observations are often among the earliest indications of the effects of a neurotoxic agent (Xintaras and Johnson, 1976). In order to evaluate the extent to which Velsicol employees might exhibit impaired psychological performance, a battery of eight tests was administered to each participant in the study. This battery of tests was chosen to evaluate, in an objective manner, each individual on cognitive, psychomotor, and perceptual-motor performance. A description of each psychological performance test follows:

1. Santa Ana Dexterity (dexterity and eye-hand coordination): The Santa Ana test is primarily a measure of finger dexterity and eye-hand coordination (Tuttle et al.,1976). The test apparatus consists of a board possessing 48 square holes. Each hole has placed in it a removable peg which has a square base. The subject's task is to lift each peg, rotate it 180 degrees, then replace it in the same hole. The number of pegs correctly repositioned within 30 seconds constituted the performance score. The Santa Ana test was performed twice with the right hand, then twice with the left hand, and finally, once using both hands simultaneously. The total number of pegs successfully rotated during all five trials constituted the performance score.

2. Choice Reaction Time (response speed): The time required for a person to quickly respond to a visual, randomly presented stimulus was measured using an eight-choice reaction time apparatus described by Johnson et al. (1974). In operation, the subject was presented with a series of 24 visual stimuli at the rate of one stimulus every 15 seconds. The subject's response to each stimulus was to move the index finger of the preferred hand a fixed distance in order to extinguish a stimulus lamp. The mean time required to respond to each of the 24 stimuli constituted each person's performance on the choice reaction time test.

3. Time-Shared Performance (divided attention): The ability of a person to divide his or her attention between two tasks being performed concurrently was measured through use of a task originally described by Johnson et al. (1974). This task required the subject 1) to tap his or her foot in an evenly maintained rhythm, and at the same time 2) to detect the occurrence of a visual stimulus (a lighted red lamp) presented in random sequence. The degree to which a subject maintained an evenly paced tapping rhythm was used as the performance measure for this test. This measure was obtained by recording each person's tapping data on magnetic tape, then analyzing the variability in time intervals between successive taps. Good performance on this test was indicated by low variability in the tapping task data.

4. Digit Span (memory): This test, a subtest of the Wechsler Adult Intelligence Scale (WAIS), provides a measure of short-term memory for digits presented both forward and backward. The Digit Span test was presented to each participant by having the person listen to a series of spoken digits, then asking the subject to repeat the sequence back to the experimenter. The number of digits correctly repeated in sequence constituted the person's digit span. Both forward digit span and reverse digit span were measured for each worker, depending upon whether the digits were repeated in an identical or reverse order from the sequence spoken by the tester. The sum of each worker's forward digit span and reverse digit span was used as the performance measure on the Digit Span Test.

5. Digit Symbol (memory efficiency): The Digit Symbol test, also a subtest of the WAIS, measures a person's ability to code symbols with numbers, using a predetermined code. For example, the digit "3" might have associated with it the code "X". Each time, therefore, that "3" appeared in a set of numbers the subject's correct response was to write an "X" beneath the "3". The number of symbols correctly coded in 90 seconds represented the worker's performance score.

6. Block Design (perceptual organization): The Block Design test, which like the Digit Span and Digit Symbol tests is a subtest from the WAIS measures a person's ability to organize patterns. In use, the worker was presented with a set of colored cubes. Two sides of each cube were red, two sides were white, and two sides were half red and half white. The test required the subject to arrange the cubes in various patterns in order to form a pattern identical to that displayed by the experimenter. The number of designs correctly reproduced, as well as the speed of problem solution, constituted the performance scores.

7. Neisser Letter Search (visual filtering): A measure of speed of visual filtering of information was obtained through use of the Neisser Letter Search test (Tuttle et al., 1976). This test consisted of having the worker search for 20 seconds a standardized sheet of letters for the occurrence of target letters. The worker was given two trials each to search for a) single target letters, b) dual target letters, and c) targets consisting of four letters. The total number of correctly identified target letters identified during the six trials constituted the performance score.

8. Raven Progressive Matrices (visual organization): The ability of an individual to organize visual information was measured using the Raven Progressive Matrices test (Raven 1958), a test which required the participant to examine a series of diagrams of progressive difficulty. Each diagram has one element missing. The subject's task is to choose from a set of possibilities the correct figure that completes the diagram. The

Raven Matrices are divided into five sets. Each set, in turn, consists of 12 problems. Each set of problems was scored by computing the ratio of number of correct problems to number of problems attempted. The mean ratio of the five problem sets represented the performance scores.

At the time of examination, each worker was made familiar with each of the eight psychological performance tests through instruction by a psychological aide. Following instruction in performance of a particular test, the worker was given one training trial, following by an actual data collection trial (Appendix F).

A tape recorder containing instructions for each test was used to standardize the instructions given to the workers. Instructions were given in either English or Spanish, depending upon the worker's choice.

Criteria for Classification

The psychological performance results for each worker were compared to the results from the total study population of 130. Group means were calculated for each psychological performance test. Each worker's results from each psychological test (e.g., Digit Span) were then compared with the group mean score. If the worker's performance was one or more standard deviations different from the group mean and in the direction of impaired performance, then the worker was defined as having failed the particular test under consideration. For example, the group mean for the Digit Span test was found to be 11.4, with a standard deviation of 2.3. Using the aforementioned definition, any worker who scored 9.1 or less on the Digit Span test was counted as having failed the Digit Span test.

As discussed previously, eight psychological performance tests were administered to each worker. Due to an equipment malfunction, however, the data from the Time-Shared Performance test were not recorded for all workers. The psychological performance results from the remaining seven tests were reviewed, and the following classifications established with criteria below:

1. Abnormal - any worker who failed five or more of the seven psychological performance tests.

2. Slightly Abnormal - any worker who failed four of the seven tests.

3. Normal - all workers with fewer than four failures.

VISUAL FUNCTION MEASURES

Three additional tests of visual function were added to the clinical ophthalmological examination given to each worker. These additional tests were added 1) to provide as complete a picture as possible of each person's visual function and 2) in recognition of the fact that mild to moderate exposure to organophosphate compounds can produce blurred vision and marked miosis (Key et al., p. 455, 1977). Results of these tests were recorded on the ophthalmologi-

cal examination form (Appendix E). A description of these three tests follows:

1. Visual Field: A measure of the extent of each worker's visual field was obtained through use of an Aimark Projection Perimeter (Model Mark 4). This apparatus maps the subject's visual field for each eye onto a graduated scale. Each eye's visual field was further divided into horizontal and vertical components. The horizontal fields for each eye were summed and divided by two in order to arrive at an average horizontal field width for each person. A similar procedure was also applied to the vertical field data.

2. Critical Flicker Frequency (CFF): The ability of the visual system to discern the transition of a fused light to a flickering light was measured using a Critical Flicker Frequency apparatus (Lafayette, Model 12020). This apparatus consists of a variable frequency light source viewed binocularly through a darkened viewing hood. The subject decreased the frequency of the light source until the light was judged to begin to flicker. The frequency of the light source at this transition point was read from the apparatus' graduated dial. The mean of six such determinations constituted each subject's CFF performance.

3. Color Vision: Each person's color vision was measured using the Farnsworth Dichotomous Test for Color Blindness (Farnsworth 1947). This test required the worker to sort 15 colored discs into an order of descending hue. Analysis of each subject's arrangement of the color discs permitted classification of color vision as normal, red deficient, green deficient, or blue deficient.

ELECTRONEUROGRAPHY AND ELECTROMYOGRAPHY

Electroneurography (ENG) and electromyography (EMG) provide sensitive and objective methods of detecting impairment of nerve and muscle function. Since Velsicol employees were reported to have worked with neurotoxic chemicals known to cause peripheral neuropathy, an ENG/EMG examination was administered to each participant in the study to determine the degree and permanency of peripheral nervous system impairment. One hundred and thirty-six participants were administered ENG/EMG tests at the Kelsey-Seybold Clinic, Houston, Texas. Because of scheduling problems, nineteen participants were sent to the St. Luke's Episcopal Hospital for ENG/EMG tests. Instructions were provided to the electromyographer at St. Luke's to assure that similar procedures were used at the Kelsey-Seybold Clinic and at St. Luke's Episcopal Hospital. A description of the ENG/EMG examination and the criteria used by NIOSH to classify ENG/EMG results as normal, slightly abnormal or abnormal follows:

Electroneurography

For the ENG examination sensory and/or motor nerve conduction studies were carried out on the following nerves: 1) median motor/sensory, 2) ulnar motor/sensory, 3) peroneal motor, 4) posterior tibial motor and 5) sural sensory.

Although not routinely measured by the laboratories selected for the study, skin temperatures were recorded at proximal and distal stimulation points with surface thermocouples manufactured by the Yellow Springs Instrument Company and supplied to the clinics by NIOSH. All subjects who were examined at the Kelsey-Seybold Clinic were in the clinic at least 45 minutes before any electrophysiological tests were administered. At St. Luke's Episcopal Hospital the subjects were examined after a 10-15 minute waiting period. Room temperatures were maintained at 72-74°F. Proximal and distal latency, amplitude of the sensory or motor action potential, and distance from stimulation to recording site were recorded on a standardized form (Appendix H). Although not indicated in Appendix H, the sural sensory nerve response was recorded at 7, 14 and 21 cm.

For classification of each subject into a normal or abnormal category, the "normal values" used were provided to NIOSH by Kelsey-Seybold and St. Luke's Episcopal Hospital. Each subject was notified regarding his ranking among the 155 subjects tested after reference of his/her nerve conduction velocity (NCV) raw measure to a standardized temperature (mode temperature for upper limb and lower limb were calculated from the mean limb temperature for each participant in the study). The NCV data were corrected using DeJesus' (1973) temperature correction formula. A few subjects with low limb temperatures were critically reviewed to avoid any misclassification resulting from an abnormally low limb temperature.

Electromyography

For the EMG examination, electrical activity was recorded from the following muscles: 1) extensor digitorum brevis, 2) abductor hallucis, 3) tibialis anterior, 4) gastrocnemius, 5) quadriceps, 6) abductor pollicis brevis, and 7) first dorsal interosseous. For each muscle tested, information was recorded on a standardized format (Appendix H) for the following: insertional activity, positive waves, fasciculations, fibrillations, abnormal motor unit potentials (amplitude, duration, polyphasics), and firing patterns.

At the Kelsey-Seybold Clinic a TECA TE 4 electrograph was used for ENG and EMG measures. A Flexline-S Medic was used at St. Luke's Episcopal Hospital.

Criteria for Classification

The following criteria were used by NIOSH to classify the electrophysiological measures as normal, abnormal, or slightly abnormal.

1. Electromyography:

   a) Normal: Motor unit potentials, firing pattern, insertional activity, positive waves, fasciculations, and fibrillations were all normal (See Appendix H).

   b) Slightly Abnormal: Motor unit potentials were normal but the EMG revealed an altered firing pattern (other than full interference), decreased or increased insertional activity, increased positive waves, increased fasciculations, or increased fibrillations.

c) Abnormal: Abnormal motor unit potentials detected in one or more of the seven muscles examined (this measure reflects the degree of peripheral sprouting of terminal nerve fibers and is the single most important way in which the nervous system attempts to compensate for loss of motor units. Altered firing pattern, insertional activity, increased positive waves, fasciculations, or fibrillations may have been present in addition to abnormal motor unit potentials).

2. Electroneurography (See Appendix H):

a) Normal: All nerve conduction velocities, distal latencies and amplitudes of the motor nerves, and latencies of the sensory nerves tested were within the normal ranges provided by the Kelsey-Seybold Clinic and St. Luke's Episcopal Hospital.

b) Slightly Abnormal: Values in 2a were normal, but out-of-range values were reported for one or more of the eight measurements of the distal latency or amplitude of the median, ulnar, peroneal or posterior tibial nerves.

c) Abnormal ENG: Nerve conduction velocities for the median, ulnar, peroneal or posterior tibial motor nerves were classified abnormal if they were lower than the normal values reported by the Kelsey-Seybold or St. Luke's Episcopal Hospital (Appendix I and J). Latencies for the median, ulnar or sural sensory nerves were considered abnormal if the latency values were higher than the normal values reported by the two clinics noted above. An increase in latency is the single most important pathological change in the sensory electroneurogram. An ENG result was thus classified as abnormal if one or more of these seven measures was found abnormal.

3. Effects of Temperature and Age on Conduction Velocity

Studies indicate that the conduction velocity may be lowered 2-2.4 meters/sec. for each drop in temperature of $1^{o}C$ (Goodgold, J., A. Eberstein, 1972). As noted earlier, all participants were required to wait in the clinic (temperature equilibration) prior to ENG/EMG testing. Additionally, surface skin temperatures were measured and used to identify participants with extremely low or high limb temperatures.

Previous NIOSH studies have shown age to be a factor which influences conduction velocity (Johnson, et al. 1978). Therefore, statistical comparisons of Velsicol participants were performed with age as a covariate.

DATA ANALYSIS AND RESULTS

The questionnaire results and laboratory results for each of the 155 participants were coded and entered into the computer. Although the summary tables include results for all 155 participants, 25 of these (including four female participants) were excluded from the statistical analyses. Twenty-one (21) males were excluded because of a "confounding factor". A "confounding factor" was defined to be 1) diagnosed diabetes or 2) high blood glucose, or 3) excessive alcohol consumption. Of these 21, 15 were diabetic or had high blood glucose (or both) and six reported excessive alcohol consumption. The following criteria were used to identify diabetics, those having high blood glucose values, and those with excessive consumption of alcohol:

Diabetics: Affirmative response to the directed question "Have you been told by a doctor you have this condition?"

Blood Glucose: Any value greater than 135 mg/dl.

Excessive Alcohol: A response greater than that shown for any of the following questions from the questionnaire:

a) "On the average, how many beers do you drink per day?" 6

b) "About how many bottles of wine do you drink per week?" 10

c) "About how many cocktails or drinks of other liquor do you have per week?" 42

A significance level of 5% was used to determine statistical significance in all of the following statistical analyses.

Work History:

The Velsicol work history was provided by the company and verified by the study participant at the time of the interview. Pre- and post-Velsicol occupational histories, as reported by the participants, were taken by the interviewer. These occupational histories were used to classify each participant into one of three exposure groups according to three time periods. These groups were:

Group I: Worked at Velsicol (or was sub-contractor to Velsicol) before October, 1971, only.

Group II: Worked at Velsicol (or was sub-contractor to Velsicol) all or part of the time between October, 1971, and March, 1976.

Group III: Worked at Velsicol (or was sub-contractor to Velsicol) after March, 1976, only.

Group I had possible exposure to methyl parathion plus other chemical exposures (except leptophos); Group II had possible exposure to leptophos plus other chemical exposures; and Group III had possible exposure to EPN and other

chemical exposures (except leptophos). With this definition of exposure, the number of workers in each group is as follows:

	All Study Participants (n=155)	Screened Participants (n=130)
Group I	21	17
Group II	119	101
Group III	15	12

The small number of workers in Groups I and III should be noted.

Styrene and/or n-hexane exposure at Velsicol and other than at Velsicol occurred (as reported by participants) across all three exposure groups (see Table 1). A total of 79 subjects reported n-hexane exposure at Velsicol (four didn't know). It appeared that no participant was exposed only to a single compound and that all had multiple chemical exposures. Exposure to n-hexane is particularly important since some of the health effects due to exposure to this compound (Spencer, P.S., Schaumburg, H.H. 1977a) are indistinguishable from those due to exposure to leptophos. Exposure to several other neurotoxic chemicals is also thought to cause similar health effects (Key, et al., 1977). Non-Velsicol related exposure to these other chemicals, as reported by the participants, is summarized in Table 2. In summary, the occupational work histories indicate a worker population that has been exposed to many chemicals at a wide range of jobs.

Age:

The average age of the population is 32.3 years (Table 3). The mean ages of the exposure groups were found to be significantly different (using the analysis of variance technique). The mean age of Group I (37.9 years) is significantly higher than that of Group III (27.8 years). Therefore, for statistical analyses involving variables that are thought to be age dependent, age was used as a covariate or an age-adjustment was made.

Educational Level:

Because educational level is thought to affect the outcome of four of the psychological tests administered, educational level was used as a covariate when appropriate. However, as can be seen in Table 4, the educational level among groups was not significantly different.

Blood and Urine Tests:

The descriptive statistics (mean and standard deviation) for blood and urine tests results are shown in Table 5. These statistics are given for each exposure group and for the total sample population. The normal ranges provided by the processing laboratory were used to determine the number of out-of-range values (Table 6). The association of the number of out-of-range values and exposure group was tested for each variable using the chi-square statistic. The tests of association were non-significant for each variable. The number of out-of-range non-fasting triglyceride values (31%) appears to be in excess of what one would expect in the general population.

Using the sub-population of 130 (which excluded both males with confounding factors and all females), the hypothesis of equal means among exposure groups was tested using analysis of variance (ANOVA) for the following variables: SGOT, SGPT, BUN, cholesterol, triglycerides, LDH and cholinesterase. The results show no statistically significant difference among groups for any of the variables tested.

The summary statistics for blood count values by exposure group are shown in Table 7. There is no statistically significant difference among group means and the means were found not to differ significantly from the "normal" mean values provided by the laboratory.

Ophthalmological Examination:

The descriptive statistics for three visual function tests - Critical Flicker Frequency, Aimark Visual Perimetry, and Farnsworth Dichotomous-are shown by exposure group in Table 8. The means of the exposure groups for the Critical Flicker Frequency and Aimark Visual Perimetry tests were found not to be significantly different using analysis of covariance with age as a covariate. The number of failures for the Farnsworth Dichotomous was not associated with exposure groups (as determined using a chi-test of association).

When the results of the visual function tests were compared to existing values for an unexposed population (Tuttle, Wood, and Grether 1976), the following results were observed. For the Critical Flicker Frequency test a significant difference was seen, using a t-test, between the unexposed population ($X=50.0$, $s.d.=4.5$, $n=46$) and the study population. No difference was seen for the horizontal field means of the Aimark Visual Perimetry; however, the unexposed group mean ($\bar{X}=124.8$, $s.d.=12.3$, $n=35$) was found to be significantly higher than the study population mean. The 8% failure rate seen in the Farnsworth was not statistically significantly different from the 5.5% seen in published literature (Farnsworth, D. 1947) for an unexposed population.

Other ophthalmological tests revealed several cases of abnormal extraocular movement, pupillary shape and position, reaction to light (direct and consensual) and accommodation reaction. Several other types of abnormalities were reported, such as eyelid ptosis, eye muscle disorder, conjunctivitis, corneal and lens changes, choroidal pigmentation and other retinal findings, and abnormal non-contact tonometry for glaucoma screening. In some cases a participant was found to have more than one of these ophthalmological abnormalities.

Chest X-ray Examination:

One-hundred and six (106) of the 155 participants were considered to have a normal chest X-ray. Of the remaining 49, 29 had calcified granuloma. This type of shadow is most frequently a result of healed histoplasmosis or primary tuberculosis infection and frequently is seen among the general population. There were six cases of slight fibrotic changes with or without granuloma. None of the above was accompanied by active disease processes. Of the remaining 14, 5 showed increased vascularity, 3 small round opacity, 2 increased translucency, or 4 other changes.

Neurology Examination:

The results of four neurology tests of mental status - Serial 7's, 6 Digits Forward, 5 Digits Backward and Sentence Retention are shown in Table 9. Abnormal performance in these tests was not associated with the exposure groups.

Results of the reflexes and muscles tested, tremor observations, and tests of sensation are also shown in Table 9. There are no marked detectable differences between exposure groups for these results. There were four reported observed abnormalities for general motor survey or ataxia (all in Group II) and six observed cases of positive plantar reflex (Babinski) (one in Group I and five in Group II) and ten clonus (all in Group II). Hyperreflexia was observed in 15 cases for the upper limb reflexes and in 28 cases for the lower limb reflexes. Hyporeflexia was observed in 13 cases for the upper limb reflexes and 14 cases for the lower limb reflexes. Of particular interest is the number of clinically observed sensation abnormalities of the hand and foot. These are in keeping with the ENG findings discussed later.

Psychology Tests:

The descriptive statistics are given in Table 10 for the following psychological tests:

Digit Symbol (WAIS)
Digit Span (WAIS)
Block Design (WAIS)
Neisser Letter Search
Santa Ana Dexterity
Raven Progressive Matrices
Choice Reaction Time (movement, perception)

The results of the Time-Shared Performance Test are not reported because more than half of the results were not retrievable due to malfunctioning equipment. The Digit Symbol, Digit Span, Block Design, and Raven Progressive Matrices test results were adjusted for age and education level and the Neisser Letter Search, Choice Reaction Time, and Santa Ana Dexterity test results, for age only. This is in keeping with previously reported dependency of these tests on the variables, age and education level (Mattarazzo, J.D. 1972). The appropriate adjusted means are shown in Table 10. Analysis of covariance was used to test for the equality of the adjusted means of the exposure groups for each of the seven psychological tests using age and educational level when appropriate. The statistical tests show no significant differences between means other than for Choice Reaction Time. The Choice Reaction Time test means were significantly different for perception ($p=.09$) and for movement ($p=.03$). Group I had the highest age-adjusted mean for perception and Group III, the lowest. Group II had the highest age-adjusted mean for movement and Group I, the lowest. The inconsistency of the results should be noted.

Comparable mean values were available in the literature (Mattarazzo 1972, Tuttle et al., 1977) for five of the tests (the Neisser Letter Search and Raven Progressive Matrices values were not comparable). Significant differences were found between the literature values and the study group values for Block Design (WAIS), Choice Reaction Time (movement) and Santa Ana Dexterity Test.

Electromyography Tests:

The results are shown in Table 11. The results indicate no significant patterns or differences due to exposure. It should be noted, however, that the extensor digitorum brevis, the abductor hallucis and the gastrocnemius muscles showed some type of muscle abnormality. For example, insertional activity was increased in the extensor digitorum brevis and the abductor hallucis. Additionally, for these two muscles abnormal motor unit potentials were observed and firing patterns were abnormal. The non-specific reduction in firing pattern of the gastrocnemius muscle is also of interest.

Electroneurography Tests:

Nerve conduction velocity and latency and amplitude (unadjusted) results are summarized in Table 12. Previous work (and results of this study) show a significant correlation of nerve conduction velocity with age. Therefore, analyses of covariance (age the covariate) was used to test mean differences between exposure groups using the nerve conduction velocities of the median, ulnar, peroneal, and posterior tibial motor nerves. No significant differences were found. Latency and amplitude value means were not significantly different among groups. Surface skin temperatures for both upper and lower limbs are comparable for all groups. A cooler temperature of the legs as compared to the arms should be noted and this difference is considered a factor in the lower conduction rates in the lower extremities.

ENG normal values as provided by the two clinics involved in the study were used to develop a frequency count to identify out-of-range measurements (Table 13). The data in Table 13 show that the latency measurements for sensory median, ulnar and sural nerves were out-of-range in 17, 13, and 7 percent, respectively, for the participants studied. Twenty-nine participants had either one or both sensory latencies abnormal (ulnar or median). Of special interest was the observation that 8 of these 29 (28 percent) showed impairment in both median and ulnar nerves. This finding should be considered in light of the numerous complaints by the participants of numbness or tingling in their hands or feet. A 10% abnormality rate was also seen for the posterior tibial motor nerve.

A review of Table 13 also shows that the amplitude of the muscle action potential (negative deflection) was out-of-range (smaller) in 13, 14, and 39 percent of the study participants for the ulnar, peroneal and posterior tibial nerves, respectively.

Nerve conduction was out-of-range in 8, 8, and 5 percent of the participants for the median, peroneal, and posterior tibial motor nerves, respectively.

Health History:

The interviewer asked the participants a series of health history questions. The participants were asked to respond to the question "Have you ever been told by a doctor you had this health condition?". A list of the conditions and the frequency of positive responses are shown in Table 14. Bronchitis, skin rash or disease, and back trouble were the most frequently reported conditions ($\sim$22%) for the total group. High blood pressure (38%) and kidney problems (29%) were the most frequently reported by Group I. These problems were not seen in Group

III and occurred to a lesser extent in Group II. It should be considered in interpreting these findings that Group I is an older group with considerably longer exposure to a variety of chemicals.

Physical Examination:

The results of the physical examination were in general, on a group basis, unremarkable. A few participants appeared to have overt functional impairment of the nervous system. This was discussed under the section on neurology examination. Thirteen were found to have out-of-range blood pressure values, and they were advised to seek further medical consultation.

Health Symptoms:

The interviewer asked the participants to respond (yes, no, or don't know), to a set of 30 questions related to health symptoms. These health symptoms and frequency of positive responses reported are listed in Table 15 by exposure groups, and in Table 19 for total sample population and subpopulation (those with confounding factors removed). The participant was first asked if he had experienced the symptom within the last five years (the top line for each symptom in Tables 15 and 19) and if the answer was positive, he was asked if he was experiencing the symptom presently (the second line for each symptom in Tables 15 and 19). The ranks of these positive responses within each group for each symptom are also shown in Tables 15 and 19. The two symptoms most often reported, both now and in last five years, are "changes in eyesight" and "feeling fatigued" - two non-specific complaints. It should be noted that 30 percent of the participants reported "numbness or tingling in hands or feet."

Sixteen of the health symptoms were thought to be particularly relevant to the neurology findings. They were:

Drooping eyelids, blurring or double vision	Decrease in memory or thinking ability
Difficulty in speaking	*Paralysis of any part of the body
*Loss of balance or staggering	*Numbness or tingling in hands or feet
*Difficulty in walking	*Problem with coordination
Spells of dizziness	*Muscle weakness
Nervousness or uncontrollable tension	Frequently feel fatigued
Difficulty in sleeping	Change in handwriting
Drowsy or sleepy during the day	Unexplained sweating

The six symptoms with asterisks are particularly relevant to the ENG findings. Of the sixteen neurology-related symptoms, six were among the ten most often reported. One of the six ENG-related symptoms "numbness or tingling in hands or feet" was among the ten most often reported.

The number of subjects who reported one or more of the neurology-related symptoms in the last five years is summarized by exposure group in Table 16. The association of symptom groups (as defined in Table 16) with exposure groups was tested using the chi-square statistic and rejected.

The results of the ENG-related symptoms reported for the last five years, are summarized by exposure group in Table 17. The association of symptom categories with exposure group was tested using the chi-square test and rejected.

Health Status of Study Participants:

The results of the preceding tests were used to classify each individual into one of three categories - "normal", "slightly abnormal", or "abnormal" - for each of the four batteries of tests (psychology, neurology, ENG and EMG). The criteria for classification were stated previously in the Methodology Section. An individual was classified as "abnormal" if he was "abnormal" in one or more of the test batteries (ENG, EMG, psychology, or neurology). He was classified as "slightly abnormal" if he was not classified as "abnormal" but was "slightly abnormal" in one or more of the test batteries. The criteria for classification into the abnormality categories within each battery of tests are stated in the Methodology Section.

The number found for each of the three types of abnormality categories is shown in Table 18 by exposure groups. The number having one or more "abnormalities" is also shown in Table 18. There were 60 of the 130 member subpopulation with one or more abnormality, 51 with one or more slight abnormality, and 19 with no abnormal finding.

The association of the number of abnormalities within each abnormality category with exposure groups was tested. No association was found except when the abnormality groups having the classification of one or more abnormality, one or more slightly abnormality, or no abnormality were tested with exposure groups. The association was statistically significant ($p \leq .03$) using the chi-square test of association. Group I had a 76% rate of abnormalities; Group II, 44%, and Group III, 25%. This grouping reflects age differences and length of exposure to chemicals, perhaps explaining the trend we see. This trend appears to be present in each of the individual battery of tests, also.

The relationship of the health symptoms to the abnormality categories was explored. Table 19 shows the frequency and rank of each symptom within an abnormality category. The expected relationship of selected symptom to a particular type of abnormality is seen in these results.

In the results previously discussed, 7 of the 12 workers who had been reported as having had a diagnosed chemical poisoning were included. Of these seven, five were found to have a neurology abnormality; two, psychology; three, ENG; and one, EMG abnormality.

CONCLUSIONS

The study population was a relatively young (mean age=32.3 years) group of 155 workers with those having possible occupational exposure to leptophos comprising most of the group. Each worker reported multiple exposure to chemicals other than pesticides, with n-hexane being the most often reported.

The ophthalmology examination showed few abnormalities; however, the visual function tests indicated a population with significantly lowered Critical Flicker Frequency test results and lowered vertical peripheral field measurements for the Aimark Visual Perimetry Test.

Results from chest X-ray, blood, and urine tests revealed no unusual findings.

Considering the occupational histories of the study participants, the number of abnormal reflexes observed and the presence in four persons of the Babinski Sign were not unexpected. Noteworthy was the high number of participants showing abnormal sensation in the neurological testing of the hands and feet. The psychological performance measurements indicated no significant differences among exposure group means for the Choice Reaction Time test. However, the Choice Reaction Time results, as well as those from the Santa Ana Dexterity and Block Design (WAIS), were significantly different from the results from an unexposed comparison population. This suggests an impairment of psychomotor performance of the study population. The non-significant test results suggest no detectable differences in cognitive and perceptual functions, as measured by the other psychological tests and the neurological evaluation of mental status.

Few workers showed significant EMG abnormalities. Three muscles (extensor digitorum brevis, abductor hallucis, and gastrocnemius) accounted for most of the abnormalities noted. The extensor digitorum brevis and abductor hallucis muscles are very susceptible to injury since they are located in the foot and the abnormalities noted could, in part, be due to local trauma. There are no data on the frequency of abnormalities of these two muscles in a "normal" population.

A substantial number of participants (57) were classified as abnormal based on the ENG results. Of considerable interest are the number of out-of-range latency measurements for the sensory (median, ulnar, and sural) nerves (17, 13, and 7%), respectively. Of special significance was the observation that of the 29 workers showing abnormal latency findings, eight of them showed abnormal findings for both the median and ulnar nerves. It is of interest to note these findings in light of the previously discussed psychomotor performance impairment and complaints of numbness or tingling in hands or feet. The number of out-of-range values for muscle action potentials and nerve conduction velocities of motor nerves was greater than expected.

Initially a number of Velsicol workers had been diagnosed by local physicians as having encephalitis or multiple sclerosis because their symptoms and clinical examinations were thought to be consistent with these disorders. Although there are some subtle differences the symptoms and type of nerve damage seen in encephalitis or multiple sclerosis could mimic those caused by neurotoxic chemicals encountered in the workplace. Since the sick workers had been seen by different physicians who may not have been able to elicit a good occupational history and since appropriate toxicologic information about the relevant workplace chemicals might not have been immediately available to the attending physicians, it is not surprising that the diagnosis of encephalitis or multiple sclerosis was considered rather than pesticide poisoning. The clustering of three relatively rare cases of suspected multiple sclerosis in a small group of workers alerted the medical consultant to the company to the possibility of pesticide poisoning. It is the opinion of NIOSH medical officers that the signs and symptoms presented by these workers are compatible with organophosphate poisoning. Nonetheless, in view of the stated history of concurrent exposure to n-hexane and other neurotoxic chemicals, it is difficult to exclude the role played by these other chemicals.

In summary, NIOSH's medical evaluation of the workers showed that a substantial number of those examined were found to have neurological, electromyographic, electroneurographic, and psychological performance abnormalities. A causal association of the medical findings with worker exposure to leptophos is difficult to establish in individual cases because of the possibility of exposure to other neurotoxic agents that were present. Our investigation does lead us to conclude that workers in this plant were adversely affected by conditions that could have been prevented by more careful medical surveillance, work practices, and engineering controls.

RECOMMENDATIONS

Prevention and Early Detection

All worker safety and health programs should be directed to prevention and early detection of problem areas. This means current awareness and communication among Federal agencies, manufacturers, formulators, and users of toxic chemicals.

Industrial Hygiene Practices

Adequate engineering controls, improved work practices, and effective worker protective equipment should be implemented where workers in their job-environment may be exposed to known toxic chemicals. This requires knowing what is hazardous at the work site, how specifically to prevent or control the hazards, and active surveillance to effect control and prevention.

Medical Surveillance and Monitoring

Medical surveillance and monitoring should be initiated to assure the adequacy of worker protection. This should include the use of functional tests and the development of baseline medical data for each worker for comparison with subsequent medical examinations. Worker awareness of toxic effects should be insured through use of educational programs focusing on signs and symptoms associated with exposure to specific toxic chemicals in the work environment. Local physicians should be directly and specifically alerted to the need for emphasis on occupational histories to evaluate the potential for job-related chemical poisoning. Those responsible for protecting the worker's health should provide the detailed specific information necessary to effect these programs.

Medical Examinations for Evaluating Reversibility of Effects

Since the medical findings in this study may reflect slow or incomplete recovery and in some instances permanent damage of serious consequence to the worker, medical follow-up examinations should be undertaken in appropriate cases to determine the reversibility of the observed effects and to better understand the significance of any diminished functional capacity to the demands of the worker's current and potential job opportunities.

PART II - REPRODUCTIVE HISTORY

INTRODUCTION

Since it is known that exposure to a number of substances can adversely affect reproductive processes, a reproductive history study was undertaken. There was specific support for doing this study in view of the experience in the Kepone pesticide episode. Some of the Kepone workers had reported infertility and loss of libido, but there was a general lack of information concerning potential hazards to reproductive ability and pregnancy outcome from exposure of workers to pesticides and other chemicals. This reproductive history study would also serve as a pretest of the NIOSH Reproductive History Interview Schedule and field procedures designed to be used in large scale industry wide studies (Appendix K).

METHODOLOGY

Sample Selection:

The reproductive study focused on the wives of the 151 current and former Velsicol employees who were tested in the medical study. In order to assess possible reproductive effects related to chemical exposures at the Velsicol plant, an "exposed wife" was defined as a woman married to her husband at the time of his employment at the plant and who was still married to him. Present marital status was important, because of the transient nature of the population. Current telephone numbers and addresses were available for wives of men tested in the medical study. Eighty men reported that they were married to their present wives at the time they worked for Velsicol.

Efforts were made to contact by telephone all the 80 eligible Velsicol wives, as previously defined. During this contact, the interviewer explained the nature of the study and estimated how long the interview would take. The Velsicol wives agreeing to participate were then asked to specify a convenient time for the interview, as well as, their date of birth. Date of birth was requested to enable one interviewer to locate a comparison woman, while the other interviewed the Velsicol wife. Sixty-three (79%) were contacted and interviewed. Of the 17 eligible wives who were <u>not</u> interviewed, ten could not be contacted by telephone; two refused to be interviewed; and five agreed to participate, but failed to be home at designated appointment times.

In addition to the interviews with the wives of exposed male workers, interviews were also conducted with two of the four female Velsicol employees who were tested in the medical study. The other two female employees were excluded because neither had ever been pregnant nor married. Since the two female employees who were interviewed for the reproductive study held clerical positions at the plant and were thought to have minimal exposures, their interviews and the Velsicol wives' interviews were combined into one group with a total of 65 completed interviews. For convenience, this group will be referred to as the "exposure group". The so-called exposure group is, therefore,

composed not only of wives of exposed employees (n=63) but also of clerical women employed at the plant (n=2).

The selected comparison group of women was also interviewed. Comparison women were selected taking into account the confounding variables of socioeconomic status and age, using the following criteria:

1. Reside within the same neighborhood as the Velsicol wife.

2. Be within plus or minus five years of the Velsicol wife's age.

3. Married to a man who has never been employed by the Velsicol Company and who has never worked with chemicals or pesticides.

4. Never had worked with chemicals or pesticides herself.

The location of comparison women was systematically approached, with an interviewer starting with the second house (or door) to the right of the Velsicol wife's residence and moving around the block. She continued going to every second door until a comparison woman was located who matched the worker's wife. If no one was located on the block, the interviewer went to the house most directly across the street from the wife's residence and circled that block in the same systematic way.

Due to the difficulty of locating women with husbands who had never worked with chemicals or pesticides, the interviewer frequently canvassed all contiguous blocks, as well as, those residences initially skipped. Fifty-three eligible women were located and interviewed, and constitute the comparison group.

Interviews:

During the last week of March and the first week of April, 1977, a personal interview was conducted in the home of each of the 118 respondents. A structured interview schedule was used to collect comprehensive reproductive histories. The structured schedule was used to maximize comparability of responses, control interviewer effects, and maximize quality control in the field. Prior to the study experienced NIOSH interviewers attended a two-day training session during which they were familiarized with the schedule, field procedures, and geographic area in which they would be interviewing.

Five female interviewers and a field supervisor worked in two-woman teams. Teams were rotated, which enabled the supervisor to work with and observe individual interviewers. Team members alternated interviewing Velsicol wives and comparison women, so that each interviewed approximately equal portions of case and comparison women.

At the end of each day, the interview schedules were checked by the supervisor. Interviews with missing or inconsistent information were returned to the interviewer, who contacted the respondent to re-ask the designated questions.

DATA ANALYSIS AND RESULTS

A significance level of 5% was used to determine statistical significance in all of the following statistical analyses.

The exposure and comparison groups are characterized by the summary statistics in Table 20. Both groups are similar in terms of age, years of education completed, number of pregnancies, smoking history, and alcohol consumption. The means of these variables were found not to be different statistically (using a t-test). Given the similarity in years of education, as well as residence in common neighborhoods, similarity in socioeconomic status could be assumed.

Analysis of the responses obtained on the reproductive history schedules can be divided into three major categories:

I.	Reproductive Outcome:	Live birth, stillbirth, spontaneous abortion, therapeutic abortion.
II.	Effect on Offspring:	Birth weight, congenital anomalies, mental retardation, prematurity, cases of cancer, neonatal and post-neonatal deaths.
III.	Effect on Worker and/ or Spouse:	Difficulty conceiving, menstrual irregularities in women.

Reproductive Outcome:

A summary of reproductive outcomes is given in Table 21. The association of the number of reproductive outcomes and group was tested for each of the four outcomes using the chi-square statistic. Except for stillbirths, the differences between the groups were non-significant for specific outcomes. The number of women reporting having had any specific outcome is small and, therefore, results of the analyses are questionable. This is especially true for stillbirths, where three of the comparison women reported having one stillbirth and none of the exposure group reported having any.

The responses of the exposure group merit further discussion. Five of the seven therapeutic abortions were reported by women in the exposure group; each of the five reported having one abortion. All five procedures were performed before the husband's employment at the Velsicol plant, and therefore, could not be related to employment at Velsicol.

The other outcomes were also reviewed in light of the spouse's initial date of employment at Velsicol. Pregnancies and resultant outcomes occurring during and after employment were combined because of the small number of cases and the relatively short length of employment of spouse at the plant ($\bar{X}$=1.75 years). In the exposure group, a total of 51 women reported at least one pregnancy. Fourteen (27.45%) of these 51 women reported a total of 24 pregnancies occurring after their spouses began working at the plant, with each woman reporting at least one live birth. Six of these 24 pregnancies resulted in spontaneous abortions. Three of the six spontaneous abortions were reported by one woman (Table 22).

Effect on Offspring:

The mean birth weights of children born to women in the exposure and comparison groups were compared using the t-test for two means for unpaired observations with equal variances. Differences in birth weights were not statistically significant. Another comparison which was not significant was the number of live births weighing less than 5½ pounds for exposure and comparison groups.

Ten women in the exposure group had live births both before and after spouse's initial date of employment at the plant. The differences in the birth weights of their children born before and after initial Velsicol employment were found not to be statistically significant.

Prematurity was defined as a live birth delivered before end of term. Using the chi-square statistic, there was no significant association found between the number of premature live births and group. There were no significant differences between the number of premature births by group either when controlling by birth order or when not controlling for birth order.

The association of the number of children mentally retarded and a group was non-significant. Similarly, the association of the number of children born with one or more congenital anomalies and a group was not significant using the chi-square statistic (Table 23).

Six of the seven children with congenital anomalies born to women in the exposure group were born prior to parent's initial employment at Velsicol. Both of the mentally retarded children born to women in the exposure group were also born prior to Velsicol employment.

There were no reported deaths among children under one year of age in either group. Four women in the exposure group reported having one deceased child; three of whom died before parent's employment at the plant. The fourth child died of cancer after the parent stopped working at the plant, but the cancer had been diagnosed prior to the parent's Velsicol employment. This was the only reported case of cancer among the children of women in the exposure group. In the comparison group, there were two deceased children and three cases of cancer.

Effect on Exposed Worker and/or Spouse:

There was no statistical difference between the number of reported reproductive problems for both groups. The association between women unable to conceive and group was non-significant, as was the association between the number of women in each group reporting that they and/or their husbands had seen a physician due to difficulties in conceiving. There were no significant differences between the number of women in each group who reported any menstrual irregularity or who reported each specific irregularity (Table 24).

Little can be said about the exposure group in terms of reproductive related problems occurring during or after employment at Velsicol, since the date of the physician visits was not requested. Although dates of onset of menstrual irregularities were recorded, these dates were not retrievable at the time of analysis.

CONCLUSIONS AND RECOMMENDATIONS

No statistically significant differences were found between the women in the exposure and comparison groups in terms of reproductive outcome, effects on offspring, reported infertility, or reported reproductive related health problems. It must be emphasized that the results of this survey are questionable due to two factors: 1) small sample size and 2) relatively short length employment for the wives' husbands and two female employees at Velsicol ($\bar{X}$=1.75 years). The multiple chemical exposures at the plant, as well as in previous and subsequent jobs with other petrochemical operations, makes impossible the association of any results on reproduction with leptophos exposure.

Although few reliable conclusions can be drawn from this study, it is strongly recommended that other epidemiologic studies of this type be undertaken when appropriate. The appropriateness or utility of this particular study design should be carefully considered. The size of the exposed population must be evaluated in terms of characteristics such as age, length of employment at the plant, and marital status. These and other factors determine the number of available respondents, number of pregnancies, and number of pregnancies subsequent to chemical exposure.

Due to the large number of respondents and pregnancies required to detect statistically significant differences, careful consideration of these two factors is recommended. Exposures must also be identified before proceeding with a reproductive history study since multiple exposures or exposure of relatively short duration can easily obscure causal associations.

PART III - CASE STUDIES OF ALLEGED LEPTOPHOS POISONING

INTRODUCTION

Organophosphorus compounds are potent inhibitors of carboxylic esterase enzymes. These enzymes include acetylcholinesterase which is found in nervous tissues and erythrocytes, and pseudocholinesterase in the liver and plasma. The pharmacological mechanism of such inhibition involves the phosphorylation of a serine residue within the active site of acetylcholinesterase. Acetylcholine accumulates at the synapse resulting initially in stimulation and later in paralysis of transmission in cholinergic synapses (Drenth, H.F. et al. 1972; Jager, K.W. et al. 1970; Gershon and Shaw, 1961). These events produce rather diffuse clinical manifestations shown in Table 25. It must be noted here that CNS manifestations, although clinically not as well defined as those of muscarinic manifestations, are important features of such poisoning (Namba, T. et al. 1971).

The diagnosis of acute organophosphorus intoxication is generally based on history of exposure and clinical evidence of diffuse parasympathetic (muscarinic) stimulation (Holmes and Gaon, 1957). The time interval between exposure and onset of symptoms varies with the route and degree of exposure. Some compounds are known to produce so-called delayed neurotoxicity. Absorption of organophosphate compounds in cases of occupational intoxication has been through the skin and respiratory tract. This is particularly true for agricultural workers who are exposed during or shortly after spraying crops and for industrial workers involved in manufacture, formulation or transportation of organophosphorus pesticides.

Toxic Neuropathies:

A variety of agents are known to be capable of producing symptoms of nervous system damage. Toxic neuropathies can result from exposure to the following substances: metals-lead, arsenic, selenium, mercury, and manganese; solvents-MnBK, n-hexane, trichloroethylene, and carbon disulfide; monomers-acrylamide; organophosphorus compounds-tri-ortho-cresylphosphate (TOCP), mipafox, and diisopropyl phosphorofluoridate (DEA); and drugs-isoniazid, disulfiram, streptomycin and vincristine (Schaumburg and Spencer 1976; Mendell, T.R. et al. 1974; O'Donoghue, T.L. et al. 1974; Herskowitz, A. et al. 1971).

The organophosphorus compound, tri-ortho-cresylphosphate or TOCP, is well known for its tragic large scale intoxications (Smith and Elove 1930; Smith and Spalding 1959). It produces a typical, persistent neuropathy that begins with paresthesias or pain in the distal extremities, especially the calves and feet. The paralytic phase commences with motor weakness which initially involves the feet before ascending proximally. The condition may remain stationary at this point or progress to a flaccid paralysis, muscle wasting, or spastic paralysis. Similar clinical findings have occurred after exposure to mipafox, malathion, and parathion.

A number of investigators consider the polyneuritis associated with n-hexane to be similar to that caused by tri-orthocresylphosphate and other neurotoxins. Extensive studies of workers exposed to n-hexane have generally revealed that onset of symptoms is insidious with sensory changes appearing first in the form of burning, numbness, or paresthesias followed by distal weakness of extremities. Nerve biopsies have shown swollen axons and demyelination (Korobkin, R. et al. 1975; Towfighi, T. et al. 1976). Individuals exposed to extremely high n-hexane levels while glue-sniffing exhibit a clinical picture which includes altered deep tendon reflexes, dysesthesia and blurred vision in addition to the sensory changes (Schaumburg and Spencer 1976a; Herskowitz, A. et al. 1971; Korobkin, R. et al. 1975; Towfighi, T. et al. 1976).

In general, laboratory tests of persons exposed to n-hexane have been within normal limits except for slight elevation of CSF protein. Nerve conduction is abnormal and can be correlated with the severity of clinical involvement (Prockip, L. et al. 1974). Interesting, however, is an isolated report indicating reduced serum cholinesterase activity associated with exposure to n-hexane (Paulson and Waylons, 1976).

Similar human exposure has not occurred with leptophos. Recently, leptophos was highly suspected as the organophosphorus pesticide which produced an outbreak of paralysis in several hundred water buffaloes in Egypt, eventually resulting in the death of more than 1,000 animals. The disease was initially characterized by loss of coordination in the hind quarters and, in more severe cases, generalized paralysis with death resulting from respiratory failure (Abou-Donia, M.B. et al. 1974).

Subsequent research revealed that hens developed ataxia 8-14 days after a single oral dose of leptophos ranging from 200 to 800 mg/kg (Abou-Donia and Preissig, 1975). Further study of the intoxicated birds indicated that erythrocyte acetylcholinesterase was inhibited but recovered when the administration of leptophos was stopped. However, plasma cholinesterase, after initial inhibition and recovery, became severely inhibited as neurotoxicity progressed (Abou-Donia and Preissig, 1976a; Abou-Donia and Preissig 1976b). Pathological examination of early cord lesions revealed swelling of axons and fragmentation of myelin in the cervical and lumbar cord. Lesions in the sciatic nerve and lateral medulla also showed foci of swollen axons with some fragmentation of myelin (Abou-Donia and Preissig, 1975; Preissig and Abou-Donia, 1976). The damage to the central nervous system by leptophos exposure has not been studied as extensively as in hexacarbon intoxication (Schaumburg 1978).

Mechanisms of Neurotoxic Action by Organophosphates and n-hexane

Histological examination of specimens obtained from animals paralyzed with TOCP led to the conclusion that the lesions were a result of demyelination of long nerve axons (Smith and Lillie, 1931). It was subsequently shown that the axon itself was primarily affected and that damage to the myelin sheath was secondary (Cavanagh 1954; Fenton 1955; Schaumburg, H.H. et al. 1974). Ultrastructural studies have failed to reveal any specific features in neurons or elsewhere prior to the typical Wallerian degeneration. Chromatolytic repair responses later occur in the affected neurones. Thus, the intracellular organelles do not appear to be grossly damaged (Bischoff 1970; Prineas 1969).

These pathological investigations indicated that metabolic enzymes might be a likely target for the neurotoxins. Studies showed that effects related only to cholinergic symptoms appeared during the first few days after dosing. It was further reported that the use of atropine and oxime to reactivate the inhibited cholinesterase did not alter the onset nor degree of delayed neurotoxicity (Johnson 1969; Davis and Holland 1972).

Work by Johnson (1969) showed that neurotoxic organophosphorus compounds phosphorylate a characteristic nervous tissue protein and inhibit its activity as an esterase. Both the phosphorylation and inhibition represented a covalent reaction at the same active enzyme site (Johnson 1973). Further research has defined two groups of "neurotoxic esterases." The group A compounds which included phosphates, phosphoramides and phosphonates were neurotoxic. The compounds in group B which included sulphonates, phosphinates and carbamates were not neurotoxic and appeared to protect against the neurotoxic effects of group A compounds (Johnson 1974; Johnson 1973; Johnson 1975). With the latter group, phosphorylation was followed by hydrolysis which produced a changed monosubstituted phosphoric acid residue attached to the protein. The protective group did not undergo hydrolysis to form the charged residue (Johnson 1975; Johnson 1973). Since no neurotoxic effects were observed with the group B compounds, it appeared that the charged group might be responsible for a metabolic disturbance leading to degeneration of long nerves (Johnson 1974; Cavanagh 1973; Johnson 1975).

Schaumburg and Spencer have classified various neuropathies into four major groups based on histopathological reactions of the peripheral nerve. Chemicals such as acrylamide, triorthocresylphosphate and hexane were categorized as producing axonal degeneration. It was hypothesized that distal regions of axons degenerated as a result of impaired metabolic activities stemming from neurotoxic injury to the neuron or axon itself. The symptoms of the neuropathy were then associated with progressive proximal deterioration of axons in peripheral nerves and selected tracts of the central nervous system (central peripheral distal axonopathy). The cardinal histopathological feature of n-hexane axonal neuropathy was focal, giant axonal swelling associated with unusually large accumulations of neurofilaments within the axons (Schaumburg and Spencer 1976b; Schaumburg, H.H. et al. 1974; Spencer, P.S. et al. 1975; Spencer and Schaumburg, 1977b).

Animal studies have suggested a common metabolite may exist for some solvent induced neuropathies. Investigators isolated 5-hydroxy-2-hexanone and 2,5-hexanedione as metabolites following the administration of MnBK and n-hexane in separate experiments. Peripheral neuropathy has been induced in animals following administration of MnBK, n-hexane, and 2,5-hexanedione (DiVincenzo, G.D. et al. 1976; Spencer and Schaumburg 1975; Raleigh, R. et al. 1975).

It has also been demonstrated that n-hexane can induce degeneration of the central nervous system (CNS) and represents the expression of dying-back axonal disease in the CNS. Recovery from lesions within the CNS is unlikely to occur and following some recovery from the peripheral neuropathy one might anticipate the appearance of signs associated with damage to the dorsal columns (permanent sensory loss), spinocerebellar tracts (ataxia) and descending motor tracts (spasticity) (Schaumburg and Spencer, 1976b). Recent studies have shown that 2,5-Hexanedione, the principal neurotoxic metabolite of n-hexane causes axonal degeneration in the mammillary body and visual nuclei of cats. Prolonged low-level exposure to hydrocarbons in the environment may cause premature

deteriorations in areas of the human brain vital for perception and behavior. The changes in mammillary body and optic tract are probably the pathological correlates of the alterations in memory and vision that have been infrequently reported in human n-hexane neuropathy (Schaumburg and Spencer 1978).

FACILITY AND PROCESS DESCRIPTION

The Velsicol Chemical plant at Bayport, Texas, has manufactured a number of phosphate-based agricultural insecticides. Prior to 1970, the plant produced methyl parathion. After that time, PHOSVEL (trademark) (leptophos) was manufactured. Table 26 shows that a total of 13,953,550 pounds of this insecticide was produced and subsequently exported from 1971 until production of leptophos was terminated in 1976.

Bulk chemicals used in the process were delivered to the plant by rail or tank truck and piped into storage tanks. Formulations and chemical reactions took place within a closed system. Leptophos was made by first reacting benzenephosphorusthiochloride (BPT) with methanol in the presence of trimethylamine. The intermediate product, O-methylphenylthiophosphonylchloride, was reacted with 4-bromo-2,5-dichlorophenol in the presence of potassium carbonate to give technical leptophos. Upon removal of toluene, the final product is a waxy solid which decomposes at a temperature of 180°C.

From 1970 until September, 1974, the molten leptophos was poured into shallow trays for overnight cooling. This procedure resulted in significant splashing of leptophos and created a potentially high dermal exposure. After a solidification, the trays were conveyed overhead and manually dumped into a pulverizer.

After September, 1974, the molten product was put into fiber drums where it cooled and solidified at ambient temperatures. The drums, each containing approximately 220 pounds of PHOSVEL, were then split with an axe. The solid PHOSVEL was next broken into smaller pieces with an axe before being manually placed on a conveyor belt which led to the pulverizer. Although it was estimated that the use of drums reduced handling by 40%, industrial surveys and accident reports indicated that significant, potential exposure to leptophos occurred during filling and again during removal of the product.

The pulverized product was fed by gravity into lined metal drums. This procedure required the assistance of one or two operators to package the leptophos. The operation usually involved chopping and grinding for 4 to 5 hours and then cleaning the area by scraping, sweeping, and steam cleaning. There is evidence that solvents such as n-hexane were used during cleaning operations. The packaging personnel also transferred the drums to the warehouse for storage.

Protective clothing for both the operators and maintenance personnel included a uniform, gloves, safety glasses, and hard hat. In January, 1975, production of leptophos was increased to 3 shifts for 5 days a week. Additional workers were obtained from area labor pools for several weeks, but they were not supplied with protective clothing. MSA respirators were supplied to the employees in April, 1975. Employees were also advised to follow plant hygiene programs and told not to re-use the gloves before they were decontaminated.

Cholinesterase determinations were made from 1969 to 1975 using the Unopette method. This monitoring was completed monthly unless overexposure was suspected. The procedure was revised early in 1975 with cholinesterase activity of erythrocytes determined using the methods described by Grainger (1975).

An industrial hygiene survey was completed at the facility during December, 1975 and January, 1976 by Environmental Labs, Diamond Shamrock Corporation (Levitan 1976). Air samples were collected using a Bendix Micronair II pump preceded by a 37mm glass fiber filter and collection tube containing 1 gm of chromosorb 102. All persons monitored exhibited a wide range of detectable exposure to leptophos. Results of the study are presented in Table 27.

During the week of December 6, 1976, the Environmental Protection Agency conducted a survey of the environment encompassing the industrial facility. A wide variety of samples was collected to determine if leptophos had permeated the environment. Selected results presented in Table 28 show the existence of leptophos in a number of samples (Levitan 1977).

RETROSPECTIVE MEDICAL EVALUATION

It has been estimated that nearly 300 people were potentially exposed to leptophos at the Bayport plant. The National Institute for Occupational Safety and Health completed an investigation of 155 present and former industrial employees, office, and subcontract workers. Results of the extensive neurological examinations, physicals, laboratory and psychological tests were reported elsewhere in this publication. This epidemiologic study involved nine employees whose medical records at Velsicol Chemical Corporation and the Texas Industrial Accident Board suggested the possibility of chemical intoxication. All of the employees except one were classified as warehousemen or packagers (Table 29). Accident reports, medical records, and industrial hygiene surveys indicated that each of the latter employees were potentially exposed to substantial levels of leptophos. Further review of records also indicated the possibility of exposure to a variety of solvents including n-hexane.

The employees studied were generally, relatively young with an average age of 26.7 years at the onset of symptomatology. The onset of complaints took place between March, 1974, and June, 1975, which in most instances was within 6 months of employment. Medical records indicated that the workers generally presented to physicians as anxious, confused, weak and in some instances with early evidence of peripheral and/or central nervous system involvement. As shown in Table 30, five of the workers were disoriented and also had impaired judgement and memory; three employees had auditory or visual hallucinations; and four of the nine workers initially presented to physicians with anxiety.

A number of the early complaints appeared to be related to diffuse parasympathetic stumulation. This included six workers with nausea and vomiting, four with profuse perspiring, and two employees with diarrhea (Table 31).

Headaches, drowsiness, tremulousness, dizziness and decreased visual acuity were also generally present during initial visits to company or local physicians. Miosis was not noted in any of the medical records. Significant weight loss was indicated by four employees.

These findings were sometimes followed by recovery, but in most instances they progressed to more serious peripheral and central nervous system involvement. This sequence often included considerable cerebellar dysfunction in the most serious cases (Table 31). Nystagmus was present in five employees, clonus was elicited in four workers, and marked ataxia was exhibited by seven of the nine employees. Dysmetria was present in three instances.

Paresthesia of the extremities, which was present in eight of nine workers, constituted the most prevalent abnormality found in the medical records. A Babinski was present in four employees and six exhibited increased deep tendon reflexes. Altered pain, vibration and position sense, decreased motor function and decreased muscle tone were found in six employees. Results of routine laboratory tests (Table 32) consistently fell within normal limits. Only one abnormal erythrocyte cholinesterase determination was observed. This determination was completed shortly after the employee was hospitalized and decreased cholinesterase activity was reported by two independent laboratories. Tests for antinuclear antibodies, rheumatoid factors, heavy metals, and viruses were nonrevealing. Examinations of spinal fluid proved to be within normal limits for the six individuals who received lumbar punctures. One specimen revealed an elevated γ-globulin level in conjunction with a normal spinal fluid protein.

Records indicated that one hospitalized employee had decreased nerve conduction. Table 33 also shows that there were two abnormal electroencephalograms and one abnormal electromyogram.

Hospital records showed that physicians entertained the possibility of organophosphorus intoxication. The bizarre peripheral and central nervous system involvement, absence of depressed cholinesterase activity, and lack of overt parasympathetic overstimulation appeared to make organophosphorus intoxication unlikely. Physicians felt that the clinical picture was more compatible with diseases of demyelination or encephalitis. Table 34 indicates that four employees were diagnosed as having multiple sclerosis, two were thought to have psychiatric disorders, and the remaining three employees considered to have encephalitis, encephalomyelitis, or post-infectious encephalomyeloradiculitis.

DISCUSSION

It was established from Velsicol's records, Industrial Accident Board files, and medical records that the nine individuals involved in this survey were employed in the manufacture of leptophos. Although formulating, mixing, and chemical reactions took place within a closed system, subsequent manufacturing processes and hygiene did not minimize the hazards associated with organophosphorus compounds. There was significant dermal exposure resulting from pouring of the molten pesticide and manually transferring the solid product. The fiber drums often contained liquid cores which contaminated the worker as the drums were split. Exposure was further increased by recycling contaminated gloves and not strictly enforcing personal hygiene such as washing before eating, showering, and changing clothes.

The Velsicol Chemical Corporation instituted changes in their plant safety program in April, 1975. Workers were then supplied with MSA respirators and strongly urged to follow strengthened hygiene practices designed to reduce

exposure to leptophos. Unfortunately, at least six of the workers did not directly benefit from the new practices since the onset of their symptomatology was recorded prior to April, 1975. It was also during 1974 and 1975 that the Velsicol Chemical Corporation reached its highest export quotas of leptophos, 4.9 million and 3.1 million pounds, respectively. Quantitative measurements of airborne leptophos are not available for these peak periods of production. However, the industrial hygiene survey conducted by Environmental Labs just prior to termination of leptophos production showed evidence of airborne leptophos reaching levels of 383 $\mu g/m^3$ (Levitan 1976).

It is known that in addition to substantial exposure to leptophos, the workers received concurrent exposure to high levels of n-hexane and toluene. The neurotoxic effects of n-hexane constitute an important factor in this study. Atmospheric concentrations of n-hexane ranging from 500 to 2500 ppm have been associated with polyneuropathies (Herskowitz et al., 1971; Sobue, T. et al., 1968). Workers who had experienced a severe neuropathy from exposure were examined recently by a neurologist who found spasticity and Babinski signs of central nervous system damage (Schaumburg 1978). Quantitative measurements for n-hexane vapor are not available, but reports indicate that workers used large volumes of n-hexane during clean-up operations. Narcosis and high dermal exposure to n-hexane have been reported by two workers with other workers listing only exposure to "solvents" or "chemicals" on their medical records. Workers were reportedly contaminated with leptophos and toluene when the cooled product was broken into smaller pieces prior to pulverization. Literature indicates that subjects have experienced paresthesias of the skin, changes in muscular coordination and mental confusion at 200 ppm exposure levels to toluene vapors (Oettingen, W.F. et al., 1942a; Oettingen, W.F. et al., 1942b; and Ogata, M. et al., 1970). Recent evidence in the literature suggests chronic toluene exposure may be associated with persistent cerebellar ataxia (Boor, J.W. et al. 1977).

CONCLUSIONS AND RECOMMENDATIONS

In retrospect, the employees in this study generally presented symptoms of organophosphorus intoxication. These included muscarinic manifestations such as nausea, vomiting, diarrhea, increased sweating, and blurred vision. Central nervous system manifestations such as anxiety, hallucinations, drowsiness, tremulousness, depression, and psychotic reactions were also evident. Table 35 compares the clinical profile of neuropathies associated with n-hexane and organophosphorus compounds. Clinical presentation of the neuropathies is apparently identical at high levels of exposure. Manifestations often seen with acute toxicity to organophosphate pesticides are shown at the bottom of the column in Table 35. These clinical changes were often present in the Velsicol employees. This does not exclude the possibility that the clinical presentations of the Velsicol employees were a result of n-hexane or even toluene intoxication. It was more likely that excessive dermal exposure with solvents increased the total body burden of leptophos. Prolonged toxic effects of this thiophosphonate could be anticipated, based on its high potential for deposition in fat (Davies, T.E. et al., 1975).

Progression of the toxic manifestations resulted in a pattern resembling that of encephalitis and/or multiple sclerosis. Medical evaluations produced

strikingly similar patterns among Velsicol employees, with laboratory tests failing to show an illness of viral, connective tissue or heavy metal etiology. Of the four individuals diagnosed as having multiple sclerosis, only one showed an elevated γ-globulin fraction in spinal fluid. This is not pathognomonic for multiple sclerosis, but approximately 70% of the cases do show an elevated immunoglobulin-G level when spinal fluid is within normal limits.

The prevalence of multiple sclerosis in the southern states ranges from six to fourteen per 100,000. It seems doubtful that seven out of 300 Velsicol employees handling similar materials could by chance exhibit multiple sclerosis or other diseases of demyelination. This survey indicated the possibility of axonopathy secondary to chemical exposure. Literature is replete with evidence concerning the neurotoxic effects of certain chemicals. There is evidence that these employees received substantial exposure to n-hexane and leptophos. Toxicological studies and epidemiological evidence presently implicates these compounds as prime suspects in producing neuropathies in the Velsicol employees. The possibility exists that the effects from leptophos and n-hexane could be additive. This study also shows the need for improving hygiene practices and biologic monitoring. It should also alert medical personnel to the clinical characteristics of neuropathies associated with solvents and organophosphorus compounds.

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TABLE 1

NUMBER OF REPORTED HEXANE AND/OR STYRENE EXPOSED PARTICIPANTS

GROUP / EXPOSURE	EXPOSURE GROUP									TOTAL		
	I n = 21			II n = 119			III n = 15			(n = 155)		
	YES	NO	DK*	YES	NO	DK	YES	NO	DK	YES	NO	DK
Hexane exposure at Velsicol	4	9	8	73	22	24	2	4	9	79	35	41
Hexane exposure other than Velsicol	1	18	2	15	102	2	2	13	0	18	133	4
Styrene exposure at Velsicol	5	8	8	59	29	31	3	6	6	67	43	45
Styrene exposure other than Velsicol	4	15	2	21	95	3	3	12	0	28	122	5

**DK = participant did not know.*

TABLE 2

NUMBER OF REPORTED CHEMICAL (OTHER THAN HEXANE AND STYRENE) EXPOSURES

GROUP / EXPOSURE	EXPOSURE GROUP I n = 21			EXPOSURE GROUP II n = 119			EXPOSURE GROUP III n = 15			TOTAL (n = 155)		
	YES	NO	DK	YES	NO	DK	YES	NO	DK	YES	NO	DK
1. Metallic Mercury	2	18	1	7	108	4	0	15	0	9	141	5
2. Methyl Mercury	0	18	3	0	114	5	0	15	0	0	147	8
3. Methyl Chloride	4	14	3	5	108	6	1	13	1	10	135	10
4. Arsenic	0	19	2	4	113	2	0	15	0	4	147	4
5. Thallium	0	19	2	0	117	2	0	15	0	0	151	4
6. Acrylamide	0	19	2	1	116	2	0	15	0	1	150	4
7. Trichloro-ethylene	3	17	1	13	99	7	1	13	1	17	129	9
8. Methyl bromide	0	19	2	2	114	3	1	14	0	3	147	5
9. Carbon Monoxide	4	16	1	15	102	2	2	13	0	21	131	3
10. Lead	5	15	1	12	104	3	2	13	0	19	132	4
11. Solvents other than n-hexane (e.g. benzene)	9	11	1	37	80	2	5	10	0	51	101	3
12. Pesticides (other than leptophos, methyl para-thion, or EPN)	2	18	1	10	108	1	1	14	0	13	140	2

TABLE 3

SUMMARY OF AGE BY EXPOSURE GROUP

GROUP / AGE	EXPOSURE GROUP I n=21 n (%) (1)	EXPOSURE GROUP II n=119 n (%)	EXPOSURE GROUP III n=15 n (%)	TOTAL n=155 n (%)
<20 years	1 (5)	0 (0)	1 (7)	2 (1)
20-40 years	14 (67)	98 (82)	13 (87)	125 (81)
>40 years	6 (28)	21 (18)	1 (6)	28 (18)
Mean Age (years) (Standard Deviation)	37.9 (8.8)	32.0 (9.3)	27.8 (6.7)	32.3 (8.6)

1) % of exposure group in age category

TABLE 4

DESCRIPTIVE STATISTICS OF EDUCATIONAL LEVEL BY GROUP

GROUP / EDUCATIONAL LEVEL	EXPOSURE GROUP			TOTAL
	I	II	III	n=155
	n (%)	n (%)	n (%)	n (%)
Level <8 years (elementary)	2 (9)	4 (4)	0 (0)	6 (4)
8 <Level <12 years (secondary)	11 (52)	70 (59)	10 (67)	91 (59)
12 <Level <16 years (college)	8 (38)	37 (31)	5 (33)	50 (32)
Level >16 years (graduate work)	0 (0)	7 (6)	0 (0)	7 (4)
Mean (years)	12.1	12.4	12.3	12.4
(Standard Deviation)	(2.1)	(2.6)	(2.0)	(2.4)

TABLE 5

SUMMARY BY EXPOSURE GROUP OF RESULTS OF BIOCHEMICAL MEASUREMENTS

GROUP / VARIABLE	EXPOSURE GROUP						TOTAL	
	I (n=21)		II (n=119)		III (n=15)		n=155	
	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.	$\bar{X}$	S.D.
Glucose (mg/dl)	106.7	24.7	102.3	34.6	99.8	17.6	102.6	32.0
Sodium (mm/liter)	139.7	1.4	139.8	2.4	139.1	2.1	139.8	2.2
Potassium (mm/liter)	4.2	0.3	4.2	0.3	4.3	0.3	4.2	0.3
Chloride (mm/liter)	104.0	1.7	103.2	3.3	102.7	2.3	103.3	3.0
CO_2 (mm/liter)	26.4	1.3	27.1	1.9	26.2	1.7	26.9	1.8
BUN (mg/dl)	12.7	3.5	12.9	4.1	12.3	2.1	12.9	3.8
Creatinine (mg/dl)	1.0	0.1	1.0	0.2	1.0	0.2	1.0	0.2
Calcium (mg/dl)	9.9	0.5	10.0	0.4	10.1	0.5	10.0	0.4
Phosphorous (mg/dl)	3.1	0.4	3.3	0.4	3.8	1.6	3.4	0.6
Uric Acid (mg/dl)	5.9	1.1	5.9	1.2	5.8	0.8	5.9	1.1
Total Protein (g/dl)	7.2	0.3	7.3	0.4	7.4	0.3	7.3	0.4
Albumin (g/dl)	4.4	0.2	4.4	0.2	4.5	0.2	4.4	0.2
Iron (ug/dl)	110.2	42.2	103.6	33.6	110.7	41.3	105.2	35.4
Total bilirubin (mg/dl)	0.7	0.2	0.6	0.3	0.7	0.2	0.6	0.2
Alkaline phosphatase (u/liter)	68.9	18.0	74.6	19.0	80.4	22.2	74.3	19.3
SGOT (U/liter)	27.9	12.8	27.4	11.1	29.7	9.6	27.6	11.2
SGPT (U/liter)	29.8	22.0	25.8	18.0	25.3	15.1	26.3	18.2
LDH (U/liter)	161.4	30.1	161.0	24.0	170.1	23.9	161.9	24.8
Cholesterol (mg/dl)	200.3	35.0	203.1	54.4	204.9	36.6	202.7	50.3
Triglycerides (mg/dl)	147.2	88.9	156.0	105.9	125.1	86.5	151.3	101.9
Globulin	2.8	0.3	2.9	0.3	2.9	0.2	2.9	0.3
A/G	1.6	0.1	1.6	0.2	1.6	0.2	1.6	0.2
Cholinesterase-RBC (DELTA pH)	0.9	0.1	0.9	0.1	0.9	0.1	0.9	0.1

TABLE 6

SUMMARY OF OUT-OF-NORMAL RANGE BIOCHEMICAL VALUES

GROUP / VARIABLE	EXPOSURE GROUP I (N=21) n	(%) (1)	EXPOSURE GROUP II (N=119) n	(%)	EXPOSURE GROUP III (N=15) n	(%)	TOTAL (N=155) n	(%)
Glucose (mg/dl)	1	(5)	8	(7)	1	(7)	10	(6)
BUN (mg/dl)	0	(0)	1	(<1)	0	(0)	1	(<1)
SGOT (U/liter)	3	(14)	8	(7)	2	(13)	13	(8)
SGPT (U/liter)	3	(14)	11	(9)	2	(13)	16	(10)
Cholesterol (mg/dl)	1	(5)	3	(2)	0	(0)	4	(3)
Triglycerides (mg/dl)	7	(33)	37	(32)	4	(27)	48	(31)
LDH (U/liter)	2	(9)	8	(8)	2	(13)	12	(8)

1) n = number of out-of-normal-range values
% = percent of out-of-range values within group

TABLE 7

SUMMARY OF BLOOD COUNT VALUES

GROUP / VARIABLE	EXPOSURE GROUP			TOTAL
	I (n=21)	II (n=119)	III (n=15)	(n=155)
	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)
WBC ($x\ 10^3$)	7.8 (1.9)	7.8 (2.0)	9.0 (3.0)	7.9 (2.1)
RBC ($x\ 10^6$)	5.1 (0.4)	5.2 (0.3)	5.2 (0.5)	5.2 (0.3)
HCT (%)	45.8 (2.5)	45.5 (2.5)	45.9 (2.0)	45.5 (2.4)
Hgb (g)	16.0 (2.8)	15.9 (0.9)	16.0 (1.0)	15.9 (0.9)

TABLE 8

SUMMARY OF RESULTS OF VISUAL FUNCTION TESTS

GROUP / TEST	EXPOSURE GROUP			TOTAL	TOTAL
	I (n=21)	II (n=119)	III (n=15)	n=155	n=130
	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)
Critical Flicker Frequency Test	43.4 (3.6)	42.3 (3.1)	42.3 (2.6)	42.5 (3.2)	42.5 (3.0)
Aimark Visual Perimetry Test					
Horizontal Field	152.7 (11.1)	152.1 (9.7)	152.6 (11.3)	152.2 (9.7)	152.4 (10.0)
Vertical Field	117.2 (14.8)	114.8 (11.1)	117.2 (12.1)	115.3 (12.1)	115.3 (12.0)
	n (%)	n (%)	n (%)	n (%)	n (%)
Farnsworth Dichotomous					
No. of Pass	21 (100%)	106 (91%)	14 (93%)	141 (92%)	118 (92%)
No. of Failure	0 (0%)	11 (9%)	1 (7%)	12 (8%)	10 (8%)

TABLE 9

SUMMARY OF NEUROLOGICAL EXAM RESULTS

GROUP / VARIABLE	EXPOSURE GROUP						TOTAL	
	I (n=21)		II (n=119)		III (n=15)		N=155	
	Fail (%)(1)		Fail (%)		Fail (%)		Fail (%)	
I. Tests (Mental Status)								
Serial 7's	4(19)		25(21)		2(13)		31(20)	
6 Digits Forward	0(0)		2(2)		0(0)		2(1)	
5 Digits Backward	1(5)		6(5)		1(7)		8(5)	
Sentence Retention	1(5)		12(10)		2(13)		15(10)	
II. Reflexes	DEC.	INC.	DEC.	INC.	DEC.	INC.	DEC.	INC.
Biceps or Brachioradialis or Triceps	3(14)	2(9)	9 (8)	13(11)	1(7)	0(0)	13(8)	15(10)
Quadriceps or Gastroc. Soleus	2(9)	6(28)	12(10)	20(17)	0(0)	2(13)	14(9)	28(18)
	Positive (%)		Positive (%)		Positive (%)		Positive (%)	
Plantar (Babinski)	1(5)		5(4)		0(0)		6(2)	
Clonus (ankle)	0(0)		10(8)		0(0)		10(7)	
	Abnormal (%)		Abnormal (%)		Abnormal (%)		Abnormal (%)	
III. General Motor Survey or Ataxia	0(0)		4(3)		0(0)		4(2)	

TABLE 9 (con't.)

SUMMARY OF NEUROLOGICAL EXAM RESULTS

GROUP / VARIABLE	EXPOSURE GROUP I (n=21) Abnormal (%)	EXPOSURE GROUP II (n=119) Abnormal (%)	EXPOSURE GROUP III (n=15) Abnormal (%)	TOTAL N=155 Abnormal (%)
IV. Muscle Strength				
Iliopsoas or Toe Extensor or Toe Flexor	2(9)	8(7)	0(0)	10(7)
	Present (%)	Present (%)	Present (%)	Present (%)
V. Tremor	0(0)	2(2)	0(0)	2(1)
	Abnormal (%)	Abnormal (%)	Abnormal (%)	Abnormal (%)
VI. Sensation				
Hand	2(9)	8(7)	2(13)	12(8)
Forearm	0(0)	3(3)	0(0)	3(2)
Upper Arm	0(0)	0(0)	0(0)	0(0)
Foot	5(24)	13(11)	2(13)	20(13)
Calf	0(0)	4(3)	0(0)	4(3)
Thigh	0(0)	0(0)	0(0)	0(0)

1) % of group showing response

TABLE 10

SUMMARY OF PSYCHOLOGY TEST RESULTS

GROUP / TEST	EXPOSURE GROUP						TOTAL n=130	TOTAL n=155
	I (n=21)		II (n=119)		III (n=15)			
	$\bar{X}$ (S.D.)	$\bar{X}$ (Adj.)*	$\bar{X}$ (S.D.)	$\bar{X}$ (Adj.)*	$\bar{X}$ (S.D.)	$\bar{X}$ (Adj.)*	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)
Digit Symbol (1) (WAIS)	48.5 (11.7)	50.6	53.6 (11.2)	54.0	58.2 (10.5)	55.6	53.7 (11.3)	53.5 (11.5)
Digit Span (1) (WAIS)	11.1 (1.9)	11.3	11.3 (2.3)	11.3	11.8 (2.2)	11.6	11.4 (2.3)	11.3 (2.2)
Block Design (1) (WAIS)	34.7 (6.5)	35.9	36.4 (7.7)	36.5	38.9 (7.3)	37.8	36.5 (7.8)	36.4 (7.5)
Neisser Letter Search (2)	55.7 (10.9)	56.2	58.4 (11.9)	58.2	62.5 (10.8)	59.6	58.1 (11.7)	58.5 (11.7)
Santa Ana Dexterity (2)	102.6 (20.2)	105.9	109.7 (17.4)	110.0	115.5 (12.5)	113.4	109.8 (18.)	109.3 (17.5)
Raven Progressive Matrices (1)	0.74 (.14)	0.75	0.75 (.15)	0.75	0.75 (.16)	0.72	0.75 (.13)	0.75 (.15)
Choice Reaction Time (msec)								
Movement (2)	376.2 (69.0)	344.9	407.72(98.0)	407.2	368.0 (64.6)	396.4	398.1 (93.2)	399.6 (92.5)
Perception (2)	277.6(116.5)	283.6	252.6 (69.5)	247.8	225.0 (54.4)	214.4	249.7 (79.4)	253.6 (76.9)

(1) = Adjusted means adjusted for age and education.

(2) = Adjusted means adjusted for age.

*Note: The adjusted means are based on the subpopulation (n=130)

TABLE 11

SUMMARY OF ELECTROMYOGRAPHY RESULTS (n = 155)

VARIABLE / MUSCLE	INSERTIONAL ACTIVITY			POSITIVE WAVE					FASCICULATIONS					FIBRILLATIONS					ABNORMAL MOTOR UNIT POTENTIALS									Poly-phasics			FIRING PATTERNS*					
	N	Dec	Inc	0	1+	2+	3+	4+	0	1+	2+	3+	4+	0	1+	2+	3+	4+	N	AB+	Amplitude N	Amplitude Dec	Amplitude Inc	Duration N	Duration Dec	Duration Inc	N	Dec	Inc	0	1	2	3	4	5
Extensor Digitorum Brevis																																			
Group I	17	0	4	19	1	0	1	0	20	1	0	0	0	20	0	0	1	0	20	1	20	0	1	20	0	1	21	0	0	18	2	0	1	0	0
Group II	96	0	18	104	6	4	0	0	112	1	1	0	0	110	3	1	0	0	110	4	111	1	2	110	0	4	110	0	4	93	10	8	0	0	3
Group III	14	0	0	14	0	0	0	0	14	0	0	0	0	14	0	0	0	0	14	0	14	0	0	14	0	0	14	0	0	14	0	0	0	0	0
All	127	0	22	137	7	4	1	0	146	2	1	0	0	144	3	1	1	0	144	5	145	1	3	144	0	5	145	0	4	125	12	8	1	0	3
Abductor Hallucis																																			
Group I	21	0	0	21	0	0	0	0	21	0	0	0	0	21	0	0	0	0	21	0	21	0	0	21	0	0	21	0	0	14	7	0	0	0	0
Group II	103	0	11	105	4	4	1	0	112	1	1	0	0	109	2	2	1	0	108	6	111	0	3	110	0	4	109	0	5	66	39	4	1	0	4
Group III	14	0	0	14	0	0	0	0	14	0	0	0	0	14	0	0	0	0	14	0	14	0	0	14	0	0	14	0	0	11	3	0	0	0	0
All	138	0	11	140	4	4	1	0	147	1	1	0	0	144	2	2	1	0	143	6	146	0	3	145	0	4	144	0	5	91	49	4	1	0	4
Tibialis Anterior																																			
Group I	21	0	0	21	0	0	0	0	21	0	0	0	0	21	0	0	0	0	21	0	21	0	0	21	0	0	21	0	0	20	1	0	0	0	0
Group II	113	0	1	113	1	0	0	0	113	1	0	0	0	114	0	0	0	0	114	0	114	0	0	114	0	0	104	0	0	104	7	0	0	0	3
Group III	14	0	0	14	0	0	0	0	14	0	0	0	0	14	0	0	0	0	14	0	14	0	0	14	0	0	14	0	0	14	0	0	0	0	0
All	148	0	1	148	1	0	0	0	148	1	0	0	0	149	0	0	0	0	149	0	149	0	0	149	0	0	149	0	0	138	8	0	0	0	3
Gastrocnemius																																			
Group I	21	0	0	21	0	0	0	0	21	0	0	0	0	21	0	0	0	0	21	0	21	0	0	21	0	0	21	0	0	17	4	0	0	0	0
Group II	113	0	1	114	0	0	0	0	113	1	0	0	0	114	0	0	0	0	113	0	113	0	1	113	0	1	113	0	1	98	10	1	0	0	5
Group III	14	0	0	14	0	0	0	0	14	0	0	0	0	14	0	0	0	0	14	0	14	0	0	14	0	0	14	0	0	12	2	0	0	0	0
All	148	0	1	149	0	0	0	0	148	0	0	0	0	149	0	0	0	0	148	0	148	0	1	148	0	1	148	0	1	127	16	1	0	0	5
Quadriceps																																			
Group I	21	0	0	21	0	0	0	0	21	0	0	0	0	21	0	0	0	0	21	0	21	0	0	21	0	0	21	0	0	20	1	0	0	0	0
Group II	112	0	1	112	1	0	0	0	113	0	0	0	0	113	0	0	0	0	112	0	113	0	0	113	0	0	113	0	0	105	3	0	0	0	5
Group III	14	0	0	14	0	0	0	0	14	0	0	0	0	14	0	0	0	0	14	0	14	0	0	14	0	0	14	0	0	14	0	0	0	0	0
All	147	0	11	147	1	0	0	0	148	0	0	0	0	148	0	0	0	0	147	0	148	0	0	148	0	0	148	0	0	139	4	0	0	0	5
Abductor Pollicis Brevis																																			
Group I	20	0	0	20	0	0	0	0	20	0	0	0	0	20	0	0	0	0	20	0	20	0	0	20	0	0	20	0	0	19	1	0	0	0	0
Group II	109	1	2	110	1	1	0	0	112	0	0	0	0	111	1	0	0	0	109	3	111	0	1	111	0	1	110	0	2	106	3	0	1	0	2
Group III	15	0	0	15	0	0	0	0	15	0	0	0	0	15	0	0	0	0	15	0	15	0	0	15	0	0	15	0	0	15	0	0	0	0	0
All	144	1	2	145	1	1	0	0	147	0	0	0	0	146	1	0	0	0	144	3	146	0	1	146	0	1	145	0	2	140	4	0	1	0	2
First Dorsal Interosseous																																			
Group I	21	0	0	21	0	0	0	0	21	0	0	0	0	21	0	0	0	0	21	0	21	0	0	21	0	0	21	0	0	21	1	0	0	0	0
Group II	111	0	1	111	1	0	0	0	112	0	0	0	0	112	0	0	0	0	111	0	112	0	0	112	0	0	112	0	0	107	3	0	0	0	2
Group III	15	0	0	15	0	0	0	0	15	0	0	0	0	15	0	0	0	0	15	0	15	0	0	15	0	0	15	0	0	15	0	0	0	0	0
All	147	0	1	147	1	0	0	0	148	0	0	0	0	148	0	0	0	0	147	1	148	0	0	148	0	0	148	0	0	142	4	0	0	0	2

* 0=Full Interference 1=Non-specific reduction 2=Diminished recruitment 3=Single Unit 4=No units under Voluntary Control
5=Pattern Consistent With Lack of Voluntary Effort + = Abnormal

TABLE 12

SUMMARY OF NERVE CONDUCTION RESULTS (n = 155)

VARIABLE / NERVE	SKIN TEMPERATURE (°C)				LATENCY[1] (m/sec)				AMPLITUDE[2]				NERVE CONDUCTION VELOCITY (m/sec)			
	I	II	III	ALL	I	II	III	ALL	I	II	III	ALL	I	II	III	ALL
	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)	$\bar{X}$ (S.D.)
Upper Limb	31.7 (1.0)	32.0 (0.8)	32.0 (0.8	32.0 (0.8)												
Median Motor					3.4 (0.4)	3.6 (0.7)	3.4 (0.3)	3.6 (0.7)	10.7 (3.0)	10.1 (3.4)	11.9 (3.1)	10.3 (3.4)	54.9 (5.2)	57.2 (6.0)	57.8 (3.4)	56.9 (5.8)
Median Sensory (13 cm)					3.0 (0.5)	3.0 (0.3)	3.0 (0.3)	3.0 (0.4)	19.3 (11.4)	18.7 (7.7)	15.4 (5.9)	18.4 (8.1)				
Ulnar Motor					2.7 (0.4)	2.7 (0.4)	2.6 (0.3)	2.7 (0.4)	10.3 (4.9)	8.5 (2.8)	8.3 (3.1)	8.7 (3.2)	56.9 (4.9)	58.3 (5.0)	57.9 (5.7)	58.1 (5.1)
Ulnar Sensory (11 cm)					2.6 (0.3)	2.7 (0.3)	2.6 (0.3)	2.6 (0.3)	16.3 (8.2)	15.0 (6.4)	16.8 (7.1)	15.3 (6.7)				
Lower Limb	30.8 (0.9)	30.9 (1.0)	30.7 (0.8)	30.8 (1.0)												
Peroneal Motor					4.4 (0.7)	4.6 (0.9)	4.8 (0.9)	4.6 (0.9)	4.4 (2.0)	4.5 (2.2)	5.2 (2.4)	4.6 (2.2)	45.5 (5.9)	47.0 (6.3)	47.6 (3.7)	46.8 (6.0)
Posterior Tibial Motor					4.4 (0.8)	4.6 (1.1)	4.2 (0.6)	4.6 (1.0)	6.6 (3.2)	7.1 (3.3)	9.8 (4.0)	7.2 (3.4)	46.6 (4.9)	48.5 (6.2)	49.6 (4.7)	48.3 (5.9)
Sural Sensory (14 cm)					3.1 (0.2)	3.3 (0.4)	3.0 (0.2)	3.2 (0.4)	17.4 (7.4)	15.4 (6.4)	17.0 (5.6)	15.8 (6.5)				

1 - Distal Latency for motor nerves; latency for sensory nerves (orthodromic stimulation)
2 - Sensory nerve amplitudes are in μV (orthodromic stimulation)
and Motor nerve amplitudes are in mV (distal recording)

TABLE 13

FREQUENCY OF OUT-OF-RANGE ENG MEASUREMENTS (N = 130)

VARIABLE / NERVE	LATENCY(1) I N	(%)	II N	(%)	III N	(%)	ALL(2) N	(%)	AMPLITUDE I N	(%)	II N	(%)	III N	(%)	ALL N	(%)	NERVE CONDUCTION VELOCITY I N	(%)	II N	(%)	III N	(%)	ALL N	(%)
Upper Limb																								
Median Motor	0	(0)	3	(3)	0	(0)	3	(2)	0	(0)	2	(2)	0	(0)	2	(2)	2	(12)	8	(8)	0	(0)	10	(8)
Median Sensory	2	(12)	18	(19)	1	(8)	21	(17)																
Ulnar Motor	1	(6)	1	(1)	1	(8)	3	(2)	1	(6)	14	(15)	1	(8)	16	(13)	1	(6)	0	(0)	0	(0)	1	(1)
Ulnar Sensory	1	(6)	14	(15)	1	(8)	16	(13)																
Lower Limb																								
Peroneal Motor	0	(0)	1	(1)	0	(0)	1	(1)	3	(18)	11	(12)	3	(25)	17	(14)	2	(12)	8	(8)	0	(0)	10	(8)
Posterior Tibial Motor	1	(6)	11	(11)	0	(0)	12	(10)	10	(59)	36	(37)	3	(25)	49	(39)	2	(12)	4	(4)	0	(0)	6	(5)
Sural Sensory	0	(0)	8	(9)	0	(0)	8	(7)																

1) Distal Latency for motor nerves; latency for sensory nerves (orthodromic stimulation)
2) The number of reported results varied, % is based on number reported

TABLE 14

SUMMARY OF REPORTED HEALTH CONDITIONS

GROUP / CONDITION	EXPOSURE GROUP I n = 21 YES	%*	II n = 119 YES	%	III n = 15 YES	%	TOTAL n = 155 YES	%
Asthma	1	5	6	5	0	0	7	5
Bronchitis	5	24	27	23	2	13	34	22
Tuberculosis	0	0	3	3	0	0	3	2
Cancer (any type)	1	5	3	3	1	7	5	3
Skin rash or disease	5	24	26	22	3	20	34	22
Heart Disease	1	5	5	4	0	0	6	4
Stroke	0	0	1	1	0	0	1	1
Meningitis	0	0	1	1	0	0	1	1
High blood pressure	8	38	13	11	1	7	22	14
Migraine headaches	0	0	6	5	0	0	6	4
Head injury or concussion	5	24	18	15	2	13	25	16
Thyroid	1	5	3	3	0	0	4	3
Gall bladder	0	0	1	1	0	0	1	1
Kidney	6	29	20	17	0	0	26	17
Liver trouble	3	14	6	5	1	7	10	6
Diabetes	0	0	6	5	0	0	6	4
Anemia	0	0	7	6	0	0	7	5
Ulcers	4	19	5	4	0	0	9	6
Arthritis or Rheumatism	3	14	7	6	0	0	10	6
Back trouble	9	43	21	18	5	33	35	23
Epilepsy	1	5	2	2	0	0	3	2
Poisoning	3	14	14	12	1	7	18	12
Nervous breakdown	0	0	6	5	1	7	7	5

* - % of positive responses within group

TABLE 15

RESPONSE AND RANK BY EXPOSURE GROUP OF SYMPTOMS REPORTED WITHIN LAST FIVE YEARS AND THOSE PRESENTLY REPORTED (N=155)

GROUP / SYMPTOM	EXPOSURE GROUP								
	I (n = 21)			II (n = 119)			III (n = 15)		
	n[1]	(%)[2]	Rank	n	(%)	Rank	n	(%)	Rank
Pain or Stiffness	8	(38)	6	45	(38)	6	5	(33)	11
In Neck	6	(29)	6	33	(28)	7	3	(20)	17
Changes in Eyesight	14	(67)	1	52	(44)	2	7	(47)	7
	13	(62)	1	38	(32)	2	6	(40)	4
Drooping Eyelids Blurring or Double Vision	11	(52)	2	44	(37)	7	7	(47)	7
	8	(38)	3	33	(28)	7	6	(40)	4
Complete or Partial Loss of Vision	2	(10)	24	4	(3)	30	2	(13)	25
	2	(10)	20	3	(3)	28	2	(13)	23
Changes in Hearing	5	(24)	11	22	(18)	23	4	(27)	19
	5	(24)	9	20	(17)	17	4	(27)	12
Ringing or Noise in Ears	7	(33)	7	40	(34)	12	9	(60)	1
	6	(29)	6	31	(26)	11	8	(53)	1
Difficulty in Speaking	0	(0)	31	26	(22)	21	3	(20)	23
	0	(0)	27	20	(17)	17	3	(20)	17
Difficulty in Swallowing	4	(19)	13	19	(16)	24	1	(7)	27
	3	(14)	16	15	(13)	23	1	(7)	25
Spells of Sickness to Stomach	6	(29)	9	34	(29)	15	8	(53)	3
	6	(29)	6	20	(17)	17	5	(33)	9
Frequent Vomiting	3	(14)	20	6	(5)	28	0	(0)	30
	2	(10)	20	3	(3)	28	0	(0)	29

TABLE 15 (page 2)

RESPONSE AND RANK BY EXPOSURE GROUP OF SYMPTOMS REPORTED WITHIN LAST FIVE YEARS AND THOSE PRESENTLY REPORTED (N=155)

GROUP / SYMPTOM	EXPOSURE GROUP								
	I (n = 21)			II (n = 119)			III (n = 15)		
	n[1]	(%)[2]	Rank	n	(%)	Rank	n	(%)	Rank
Loss of Balance or Staggering	5	(24)	11	35	(29)	14	5	(33)	11
	2	(10)	20	20	(17)	17	4	(27)	12
Difficulty in Walking	3	(14)	20	30	(25)	18	5	(33)	11
	2	(10)	20	19	(16)	21	4	(27)	12
Spells of Dizziness	7	(33)	7	50	(42)	3	9	(60)	11
	3	(14)	16	30	(25)	12	8	(53)	1
"Black-outs" or Fainting	0	(0)	27	18	(15)	25	5	(33)	11
	0	(0)	27	5	(4)	26	1	(7)	25
Convulsion or Seizure	0	(0)	27	3	(3)	31	1	(7)	27
	0	(0)	29	1	(1)	29	1	(7)	25
Nervousness or Uncontrollable Tension	10	(48)	3	41	(34)	11	5	(33)	11
	8	(38)	3	27	(23)	13	5	(33)	9
Difficulty in Sleeping	9	(43)	4	48	(40)	4	6	(40)	10
	8	(38)	3	36	(30)	4	6	(40)	4
Drowsy or Sleepy During Day	4	(19)	13	47	(39)	5	8	(53)	3
	4	(19)	10	35	(29)	5	6	(40)	4
Decrease in Memory or Thinking Ability	4	(19)	13	44	(37)	7	7	(47)	7
	4	(19)	10	37	(31)	3	6	(40)	4
Paralysis of Any Part of Body	1	(5)	26	6	(5)	28	1	(7)	27
	1	(5)	25	5	(4)	26	0	(0)	29

TABLE 15 (page 3)

RESPONSE AND RANK BY EXPOSURE GROUP OF SYMPTOMS REPORTED WITHIN LAST FIVE YEARS AND THOSE PRESENTLY REPORTED (N=155)

GROUP / SYMPTOM	EXPOSURE GROUP								
	I (n = 21)			II (n = 119)			III (n = 15)		
	n (1)	(%) (2)	Rank	n	(%)	Rank	n	(%)	Rank
Numbness or Tingling in Hands or Feet	9	(43)	4	43	(36)	9	5	(33)	11
	9	(43)	2	33	(28)	7	4	(27)	12
Problems with Coordination	3	(14)	20	31	(26)	17	5	(33)	11
	3	(14)	16	24	(20)	14	3	(20)	17
Muscle Weakness	3	(14)	20	36	(30)	13	4	(27)	19
	3	(14)	16	32	(27)	10	1	(7)	25
Frequently Feel Fatigued	4	(19)	13	56	(47)	1	8	(53)	3
	4	(19)	10	41	(34)	1	5	(33)	9
Change in Handwriting	4	(19)	13	26	(22)	21	4	(27)	19
	4	(19)	10	21	(18)	16	4	(27)	12
Unexplained Sweating	4	(19)	13	27	(23)	19	3	(20)	23
	2	(10)	20	18	(15)	22	3	(20)	17
Difficulty with Urination	1	(5)	26	15	(13)	26	4	(27)	19
	1	(5)	25	10	(8)	24	3	(20)	17
Unexplained Weight Change	0	(0)	27	33	(28)	16	5	(33)	11
	0	(0)	29	17	(14)	13	3	(20)	17
Decreased Interest in Sex	4	(19)	13	27	(23)	19	2	(20)	25
	4	(19)	10	22	(18)	15	2	(20)	23
Frequent Headache	6	(29)	9	42	(35)	10	8	(53)	3
	4	(19)	10	34	(29)	6	7	(47)	3

1) n = number of positive responses to participant having had symptom in last 5 yrs. (top line) and if he now has symptom (second line).

2) Percent responding positively within group.

TABLE 16

ASSOCIATION OF 16 NEUROLOGY RELATED SYMPTOMS(1) WITH EXPOSURE GROUP

GROUP / SYMPTOM GROUP	EXPOSURE GROUP I n (%)	EXPOSURE GROUP II n (%)	EXPOSURE GROUP III n (%)	TOTAL N=130 n (%)
I - One or more of 16 neurology related symptoms	14 (82)	81 (80)	11 (92)	106 (82)
II - Other than 16 symptoms only	2 (12)	8 (8)	0 (0)	10 (8)
III - No symptoms	1 (6)	12 (12)	1 (8)	14 (10)

Test of independence of symptom and exposure groups: $\chi^2 = 2.03$ *(p = .73)*

(1) Symptoms reported within last 5 years.

TABLE 17

ASSOCIATION OF SIX ENG-RELATED SYMPTOMS(1) WITH EXPOSURE GROUPS

GROUP / SYMPTOM GROUP	EXPOSURE GROUP			TOTAL
	n (%)	n (%)	n (%)	n=130
I - One or more of 6 ENG related symptoms	8 (47)	56 (55)	8 (67)	72 (55)
II - Other than 6 symptoms only	8 (47)	33 (33)	3 (25)	44 (34)
III - No symptoms	1 (6)	12 (12)	1 (8)	14 (11)

Test of independence of symptom and exposure groups: $\chi^2 = 2.24$ ($p = .69$)

(1) Symptoms reported within last 5 years.

TABLE 18

RESULTS OF TESTS OF ABNORMALITIES BY GROUP AND ASSOCIATION

ABNORMALITY GROUP \ GROUP	EXPOSURE GROUP I n (%)	EXPOSURE GROUP II n (%)	EXPOSURE GROUP III n (%)	TOTAL N=130 n (%)	χ^2-value	p
EMG					3.71	.45
Abnormal	1 (6)	3 (3)	0 (0)	4 (3)		
Normal	9 (53)	58 (57)	10 (83)	77 (59)		
Slightly abnormal	7 (41)	40 (40)	2 (17)	49 (38)		
ENG					5.67	.23
Abnormal	8 (47)	35 (35)	2 (17)	45 (35)		
Normal	3 (18)	33 (33)	7 (58)	43 (33)		
Slightly abnormal	6 (35)	33 (33)	3 (25)	42 (32)		
Neurology					6.92	.14
Abnormal	4 (24)	7 (7)	0 (0)	11 (8)		
Normal	8 (47)	63 (63)	9 (75)	80 (61)		
Slightly abnormal	5 (29)	31 (31)	3 (25)	39 (30)		
Psychology					1.60	.81
Abnormal	3 (18)	11 (11)	1 (8)	15 (12)		
Normal	13 (76)	84 (84)	11 (92)	108 (83)		
Slightly abnormal	1 (6)	6 (6)	0 (0)	7 (5)		
One or More Abnormalities					10.82	.03*
Abnormal (1)	13 (76)	44 (44)	3 (25)	60 (46)		
Normal (2)	1 (6)	14 (14)	4 (33)	19 (15)		
Slightly (3) abnormal	3 (18)	43 (43)	5 (42)	51 (39)		

* *Indicates we reject hypothesis that number of participants having one or more abnormalities is independent of exposure group at* $p \leq .05$ *level.*

1) *Has one or more abnormality, may or may not have slight abnormality.*
2) *Has no abnormality or slight abnormality.*
3) *Has one or more slight abnormality but no abnormality.*

TABLE 19

RESPONSE AND RANK BY ABNORMALITY GROUP OF SYMPTOMS
REPORTED WITHIN LAST FIVE YEARS AND PRESENTLY REPORTED

Abnormality Group / SYMPTOM	Neurology N = 13			Psychology N = 17			ENG N = 57			EMG N = 8			One or more Abnormality N = 73			TOTAL N = 130			TOTAL N = 155		
	n[1]	(%)[2]	R[3]	n	(%)	R	n	(%)	R	n	(%)	R	n	(%)	R	n	(%)	R	n	(%)	R
Pain or Stiffness	5	(38)	12	8	(47)	5	21	(37)	8	3	(38)	8	27	(37)	10	46	(35)	8	57	(37)	8
in Neck	4	(31)	10	7	(41)	5	17	(30)	8	2	(25)	9	21	(29)	10	31	(24)	11	42	(27)	10
Changes in Eyesight	7	(54)	3	9	(53)	3	30	(53)	1	4	(50)	4	38	(52)	1	59	(45)	1	73	(47)	1
	6	(46)	3	8	(47)	4	28	(50)	1	3	(38)	3	34	(47)	1	45	(35)	1	57	(37)	1
Drooping Eyelids	6	(46)	7	8	(47)	5	19	(33)	9	2	(25)	13	29	(40)	7	53	(41)	4	62	(40)	5
Blurring or Double Vision	5	(38)	4	7	(41)	5	18	(32)	4	1	(13)	13	26	(36)	4	40	(31)	2	47	(30)	4
Complete or Partial	1	(8)	26	3	(18)	25	3	(5)	28	0	(0)	26	6	(8)	27	7	(5)	28	8	(5)	29
Loss of Vision	1	(8)	25	3	(18)	24	3	(5)	26	0	(0)	23	6	(8)	26	6	(5)	26	7	(4)	26
Changes in Hearing	1	(8)	26	4	(24)	23	12	(21)	21	1	(13)	20	15	(21)	21	27	(21)	20	31	(20)	22
	1	(8)	25	4	(24)	19	11	(19)	17	0	(0)	23	14	(20)	19	25	(19)	14	29	(19)	16
Ringing or Noise	6	(46)	7	5	(29)	15	18	(32)	12	2	(25)	13	26	(36)	11	46	(35)	8	56	(36)	9
in Ears	4	(31)	10	4	(24)	19	15	(26)	11	1	(13)	13	20	(27)	12	36	(28)	7	45	(29)	7
Difficulty in	3	(23)	22	3	(18)	25	8	(14)	22	1	(13)	20	10	(14)	26	24	(18)	23	29	(19)	23
Speaking	3	(23)	18	3	(18)	24	7	(12)	22	1	(13)	13	9	(13)	24	19	(15)	21	23	(15)	21
Difficulty in	3	(23)	22	2	(12)	27	8	(14)	22	1	(13)	20	12	(16)	23	19	(15)	24	24	(15)	24
Swallowing	2	(15)	21	2	(12)	26	4	(7)	25	1	(13)	13	8	(11)	25	14	(11)	24	19	(12)	24
Spells of Sickness	4	(31)	18	5	(29)	15	17	(30)	13	2	(25)	13	23	(32)	13	41	(32)	13	49	(31)	13
to Stomach	2	(15)	21	5	(29)	14	10	(18)	20	1	(13)	13	15	(21)	17	24	(18)	16	31	(20)	14
Frequent Vomiting	1	(8)	26	0	(0)	30	4	(7)	27	0	(0)	26	4	(5)	28	8	(6)	27	9	(6)	27
	1	(8)	25	0	(0)	30	2	(4)	28	0	(0)	23	2	(3)	29	3	(2)	29	5	(3)	29
Loss of Balance	5	(38)	12	5	(29)	15	15	(26)	15	3	(38)	8	20	(27)	16	36	(28)	14	45	(29)	14
or Staggering	4	(31)	10	5	(29)	14	11	(19)	17	1	(13)	13	15	(21)	17	21	(16)	18	26	(17)	19

TABLE 19 (page 2)

RESPONSE AND RANK BY ABNORMALITY GROUP OF SYMPTOMS
REPORTED WITHIN LAST FIVE YEARS AND PRESENTLY REPORTED

Abnormality Group / SYMPTOM	Neurology N = 13			Psychology N = 17			ENG N = 57			EMG N = 8			One or more Abnormality N = 73			TOTAL N = 130			TOTAL N = 155		
	n	(%) (1)	R (2) (3)	n	(%)	R	n	(%)	R	n	(%)	R	n	(%)	R	n	(%)	R	n	(%)	R
Difficulty in Walking	5	(38)	12	5	(29)	15	8	(14)	22	1	(13)	20	15	(21)	21	31	(24)	18	38	(24)	17
	4	(31)	10	5	(29)	14	7	(12)	22	1	(13)	13	13	(18)	20	20	(15)	19	25	(16)	20
Spells of Dizziness	7	(54)	13	9	(53)	3	27	(47)	3	5	(63)	2	37	(51)	2	54	(42)	3	66	(42)	3
	4	(31)	10	9	(53)	2	18	(32)	4	3	(38)	3	25	(34)	6	32	(25)	10	41	(26)	11
"Black-outs" or Fainting	2	(15)	25	5	(53)	15	6	(10)	26	1	(13)	20	11	(15)	25	19	(15)	24	23	(14)	25
	0	(0)	29	2	(12)	26	2	(4)	28	0	(0)	23	4	(5)	27	6	(5)	26	6	(4)	27
Convulsion or Seizures	0	(0)	30	1	(6)	28	1	(2)	30	0	(0)	26	2	(3)	30	4	(3)	31	4	(2)	30
	0	(0)	29	1	(6)	28	1	(2)	30	0	(0)	23	2	(3)	29	2	(2)	30	2	(1)	30
Nervousness or Uncontrollable Tension	7	(54)	3	7	(41)	8	19	(33)	9	4	(50)	4	29	(40)	7	44	(34)	12	56	(36)	9
	5	(38)	4	6	(35)	10	14	(24)	12	3	(38)	3	21	(29)	10	30	(23)	12	40	(26)	12
Difficulty in Sleeping	10	(77)	1	11	(65)	1	23	(40)	5	4	(50)	4	33	(45)	5	51	(39)	5	63	(41)	4
	8	(61)	1	10	(59)	1	16	(28)	10	3	(38)	3	25	(34)	6	39	(30)	5	50	(32)	2
Drowsy or Sleepy During Day	5	(38)	12	7	(41)	8	23	(40)	5	5	(63)	2	29	(40)	7	48	(37)	7	59		6
	3	(23)	18	6	(35)	10	17	(30)	8	5	(63)	1	22	(30)	9	35	(27)	9	45		7
Decrease in Memory or Thinking Ability	5	(38)	12	7	(41)	8	19	(33)	9	3	(23)	8	26	(36)	11	45	(35)	11	56	(38)	9
	5	(38)	4	6	(35)	10	18	(32)	4	2	(25)	9	23	(32)	8	37	(28)	6	47	(30)	4
Paralysis of Any Part of Body	1	(8)	26	1	(6)	28	3	(5)	28	0	(0)	26	4	(5)	28	6	(5)	29	9	(6)	27
	1	(8)	25	1	(6)	28	3	(5)	26	0	(0)	23	4	(5)	27	5	(4)	28	6	(4)	27
Numbness or Tingling in Hands or Feet	8	(61)	2	10	(59)	2	25	(44)	4	2	(25)	13	35	(48)	3	51	(39)	5	58	(37)	7
	7	(54)	2	9	(53)	2	21	(37)	2	1	(13)	13	29	(40)	2	40	(31)	2	46	(30)	6
Problems with Coordination	6	(46)	7	5	(29)	15	13	(23)	19	2	(25)	13	21	(29)	15	33	(25)	16	39	(25)	16
	4	(31)	10	5	(29)	14	12	(21)	15	1	(13)	13	18	(25)	15	25	(19)	14	30	(19)	15

TABLE 19 (page 3)

RESPONSE AND RANK BY ABNORMALITY GROUP OF SYMPTOMS
REPORTED WITHIN LAST FIVE YEARS AND PRESENTLY REPORTED

Abnormality Group / SYMPTOM	Neurology N = 13			Psychology N = 17			ENG N = 57			EMG N = 8			One or more Abnormality N = 73			TOTAL N = 130			TOTAL N = 155		
	n(1)	(%)(2)	R(3)	n	(%)	R	n	(%)	R	n	(%)	R	n	(%)	R	n	(%)	R	n	(%)	R
Muscle Weakness	5	(38)	12	6	(35)	13	15	(26)	15	3	(38)	8	20	(27)	16	36	(28)	14	43	(28)	15
	5	(38)	4	6	(35)	10	14	(24)	12	3	(38)	3	19	(26)	14	30	(23)	12	36	(23)	13
Frequently Feel Fatigued	7	(54)	3	8	(47)	5	23	(40)	5	6	(75)	1	33	(45)	5	56	(43)	2	68	(44)	2
	5	(38)	4	7	(41)	5	18	(32)	4	5	(63)	1	26	(36)	4	40	(31)	2	50	(32)	2
Change in Hand-writing	6	(46)	7	5	(29)	15	13	(23)	19	2	(25)	13	19	(26)	18	25	(19)	22	34	(22)	19
	5	(38)	4	5	(29)	14	12	(21)	15	2	(25)	9	17	(23)	16	20	(15)	19	29	(19)	16
Unexplained Sweating	6	(46)	7	6	(35)	13	15	(26)	15	2	(25)	13	19	(26)	18	28	(22)	19	34	(22)	19
	4	(31)	10	4	(24)	19	11	(19)	17	0	(0)	23	13	(18)	20	19	(15)	21	23	(15)	21
Difficulty With Urination	4	(31)	18	4	(24)	23	7	(12)	25	3	(38)	8	12	(16)	23	17	(13)	26	20	(13)	26
	2	(15)	21	4	(24)	19	7	(12)	22	2	(25)	9	10	(14)	23	11	(8)	25	14	(9)	25
Unexplained Weight Change	3	(23)	22	5	(29)	15	16	(28)	14	0	(0)	26	19	(26)	18	33	(25)	16	38	(24)	17
	2	(15)	21	4	(24)	19	10	(18)	20	0	(0)	23	13	(18)	20	18	(14)	23	20	(13)	23
Decreased Interest in Sex	4	(31)	18	7	(41)	8	15	(26)	15	4	(50)	4	22	(30)	14	27	(21)	20	33	(21)	21
	3	(23)	18	7	(41)	5	13	(23)	14	3	(38)	3	20	(27)	12	22	(17)	17	28	(18)	18
Frequent Headache	4	(31)	18	7	(41)	8	28	(49)	2	1	(13)	20	34	(47)	4	46	(35)	8	56	(36)	9
	4	(31)	10	7	(41)	5	21	(37)	2	1	(13)	13	27	(37)	3	36	(28)	7	45	(29)	7

1) n = number of positive responses to participant having had symptom in last 5 years (top line)
and if he now has symptom (second line)
2) Percent responding positively within group
3) Rank within group

TABLE 20

SUMMARY STATISTICS FOR EXPOSURE AND COMPARISON GROUPS FOR REPRODUCTIVE STUDY

GROUP / VARIABLE	EXPOSURE GROUP (n=65)		COMPARISON GROUP (n=53)	
	MEAN	S.D.	MEAN	S.D.
Age	33.39	9.74	31.76	8.96
No. of yrs. of education completed	12.18	2.08	11.64	2.67
No. of pregnancies per woman	2.82	1.58	2.57	1.64
No. of yrs. smoked cigarettes	9.76	12.04	10.10	7.94
No. of yrs. of alcohol consumption	13.41	8.60	10.75	6.40

TABLE 21

NUMBER OF WOMEN BY GROUP REPORTING A REPRODUCTIVE OUTCOME

GROUP / OUTCOME	EXPOSURE GROUP (n = 65) n	%	COMPARISON GROUP (n = 53) n	%
Live births	51[1] (124)[3]	78[2] (81)[4]	42 (99)	77 (83)
Spontaneous abortions	19 (24)	29 (16)	12 (16)	23 (13)
Stillbirth	0	0	3 (3)	6 (3)
Therapeutic abortions	5 (5)	8 (3)	1 (2)	2 (2)

1) Number of women reporting a specific outcome.
2) Percent is based on total number of women within each group.
3) Actual number of outcomes.
4) Percent is based on total number of outcomes within each group.

TABLE 22

REPRODUCTIVE OUTCOMES OF WOMEN IN THE EXPOSURE GROUP WHO REPORTED PREGNANCIES AFTER SPOUSES' VELSICOL EMPLOYMENT

SPONTANEOUS ABORTIONS / NO. OF LIVE BIRTHS	NO. OF SPONTANEOUS ABORTIONS (n=14)							
	0		1		2		3	
	n	%*	n	%	n	%	n	%
1	7	50	2	14	0	0	1	7
2	3	22	1	7	0	0	0	0

*Percent is based on total number of women who reported pregnancies after spouses' initial date of employment at Velsicol.

TABLE 23

CONGENITAL ANOMALIES AND MENTAL RETARDATION BY GROUP

GROUP / CONDITION	EXPOSURE GROUP (n = 124) (1)		COMPARISON GROUP (n = 99)	
	n	%*	n	%
Congenital anomalies	7	6	12	12
Mental retardation	2	2	2	2

*Percent is based on actual number of live births within each group.

(1) n = total number of live births.

TABLE 24

SUMMARY OF REPORTED REPRODUCTIVE PROBLEMS BY GROUP

GROUP / VARIABLE	EXPOSURE GROUP (n = 65)		COMPARISON GROUP (n = 53)	
	n	%*	n	%
No. of couples in which one or both partners saw a physician due to difficulty in conceiving	9	14	7	13
No. of women unable to conceive	7	11	4	8
Women reporting any menstrual irregularity, since leaving school	47	72	33	62

* Percent is based on total number of women within each group.

TABLE 25

CLINICAL MANIFESTATIONS OF ORGANOPHOSPHORUS COMPOUNDS

A. Nicotinic Manifestations

1. *Muscular twitching*
2. *Fasciculation*
3. *Weakness*
4. *Pallor*
5. *Tachycardia*

B. Muscarinic Manifestations

1. *Increased sweating*
2. *Increased salivation*
3. *Nausea and vomiting*
4. *Diarrhea*
5. *Miosis*
6. *Blurred vision*
7. *Urinary incontinence*
8. *Wheezing*
9. *Chest tightness*

C. Central Nervous System Manifestations

1. *Anxiety*
2. *Giddiness*
3. *Tremulousness*
4. *Emotional lability*
5. *Depression*
6. *Psychotic reactions*
7. *Confusion*
8. *Drowsiness*
9. *Nightmares*
10. *Slurred speech*
11. *Inability to concentrate*
12. *Hallucinations*

TABLE 26

POUNDS OF PHOSVEL (TRADEMARK) EXPORTED BY VELSICOL FOR YEARS 1971 THROUGH 1976

	YEAR	TOTAL IN POUNDS
	1971	359,154
	1972	1,597,173
	1973	2,668,851
	1974	4,908,346
	1975	3,092,842
	1976	1,327,184
TOTAL	1971-76	13,953,550

TABLE 27

PHOSVEL (TRADEMARK) DISTRIBUTION AT VELSICOL CHEMICAL CORPORATION, PARTICULATE AND VAPOR PHASE

JOB DESCRIPTION	TOTAL CONCENTRATION IN ug/m^3	
Casting operator	110	1170
Assisting casting	100	175
Chopper	3830	3900
Chopper	125	
Grinding and packaging	510	
Grinding and packaging	600	
Observing flaking	220	360
Packaging	100	145
Packaging	440	470
Packaging	1110	
Packaging	220	
Cleanup, chipping floor	27	90
Cleanup, chipping floor	380	
Steam cleaning	2230	
Upwind	41	
Downwind	12	

TABLE 28

ENVIRONMENTAL SURVEY FOR LEPTOPHOS, PLANT AND VICINITY

LOCATION	LEPTOPHOS CONCENTRATION
A. Near building used for grinding	
1. Top strata of soil	772 mg/kg (ppm)
2. Middle strata (6" depth)	142 mg/kg (ppm)
3. Bottom strata (12" depth)	465 mg/kg (ppm)
B. Near warehouse	
1. Top strata of soil	117 mg/kg (ppm)
2. Bottom strata (12" depth)	0.33 mg/kg (ppm)
C. Near toluene stripper	
1. Composite strata (ground to 12" depth)	81.8 mg/kg (ppm)
D. Air samples	
1. Near scrubber tower	0.67 ug/m^3*
2. Near toluene recovery unit	Not detected
3. Downwind on property line	Not detected
4. Upwind on property line	Not detected

*Estimated, as samples were not taken isokinetically

TABLE 29

GENERAL CHARACTERISTICS CONCERNING EMPLOYMENT AND SYMPTOMS OF THE 9 WORKERS WITH ALLEGED CHEMICAL POISONING

CHARACTERISTICS	EMPLOYEE								
	A	B	C	D	E	F	G	H	I
Age	19	46	26	21	23	27	22	31	22
Job classification	W	L/P	PO	W	W/P	P	W	W	W
Onset of symptoms									
a) Months employment	2	1.5	7	4	5	9	1	10	3
b) Date of onset	9-74	6-75	5-75	3-74	5-74	4-75	9-74	5-74	5-75

W = Warehouseman
L = Laborer
P = Packager
PO = Process operator

TABLE 30

CLINICAL FINDINGS ASSOCIATED WITH EMPLOYEE ILLNESSES,PSYCHOLOGICAL DISTURBANCES OF 9 WORKERS WITH ALLEGED CHEMICAL POISONING

PSYCHOLOGICAL DISTURBANCES	EMPLOYEE								
	A	B	C	D	E	F	G	H	I
Disoriented	+	+			+	+			+*
Impaired memory and judgement	+	+			+	+			+
Vis/aud. hallucin.	+	+					+		
Anxiety	+	+					+	+	

*+ = Positive finding

TABLE 31

CLINICAL FINDINGS ASSOCIATED WITH EMPLOYEE ILLNESS, SIGNS AND SYMPTOMS FOR 9 WORKERS WITH ALLEGED CHEMICAL POISONING

	EMPLOYEE								
SIGNS AND SYMPTOMS	A	B	C	D	E	F	G	H	I
Slurred speech	+								+
Visual acuity (↓)	+	+		+				+	+
Nystagmus	+			+			+	+	+
Ataxia	+	+		+	+	+		+	+
Clonus				+		+	+	+	
Babinski*	P			P				P	P
DTR's (↑)	+			+		+		+	+
Motor func. extrem.(↓)	+	+		+	+			+	+
Muscle tone (↓)	+	+		+	+			+	+
Alt. pain/vib/pos.	+	+			+	+		+	+
Dysmetria	+							+	+
Paresthesias	+	+	+	+	+	+		+	+
Dizziness	+	+	+	+		+			+
Nuchal rigidity	+		+	+					+
Tremulousness	+			+				+	+
Headache	+	+	+			+			
Drowsiness	+	+	+		+	+			+
Nausea/vomiting	+	+	+			+	+		+
Profuse perspiring		+			+			+	+
Diarrhea				+					+
Weight loss			+	+	+				+
Chest tightness/ wheezing									+

*P = present

TABLE 32

CLINICAL FINDINGS ASSOCIATED WITH EMPLOYEE ILLNESSES, LABORATORY TESTS FOR 9 EMPLOYEES HAVING ALLEGED CHEMICAL POISONING

	EMPLOYEE								
LABORATORY TESTS	A	B	C	D	E	F	G	H	I
WBC	N	N	N	N		N		N	N*
RBC	N	N	N	N		N		N	N
Electrolytes	N	N	N	N		N		N	N
Urinalysis	N	N	N	N	N	N		N	N
VDRL	NR	NR		NR	NR	NR		NR	NR
RBC cholinesterase	↓		N	N	N	N	N	N	N
Serum protein electrophoresis	N			N				N	
RA-latex	-					-			
ANA	-	-				-		-	-
Heavy metal screen	-								-
Viral screen	N/-							N/-	N/-
Spinal fluid	N	N		N	N	N		N	N
Spinal fluid electrophoresis	N	N		N		N		ABN	N

* N = normal
NR = nonreactive
- = negative findings
+ = positive results

TABLE 33

RESULTS OF OTHER DIAGNOSTIC PROCEDURES USED TO EVALUATE ILLNESS OF 9 ALLEGED CHEMICALLY POISONED WORKERS

	EMPLOYEE								
DIAGNOSTIC TESTS	A	B	C	D	E	F	G	H	I
Pneumoencephalogram	N	N							
Brain scan	N	N						N	N
Nerve conduction	↓					N		N	
Skull X-rays	N	N			N			N	N
EEG	N		N		N			ABN	ABN
EMG						N		ABN	

TABLE 34

WORKING AND FINAL DIAGNOSES OF WORKERS HAVING AN ALLEGED CHEMICAL POISONING

	EMPLOYEES								
DIAGNOSIS	A	B	C	D	E	F	G	H	I
Encephalitis			F			W			W
Encephalomyelitis	F			W					
Multiple sclerosis			F	F	F			F	
Anxiety neurosis	W	F					F		
Dissociative rxn	W								
Nonpsychotic OBS		F					F		
Undif. schizophrenia		W			W				
Post-infect. encephalomyeloradiculitis					W				F

W = Working diagnosis
F = Final diagnosis

TABLE 35

PROFILE OF NEUROPATHIES ASSOCIATED WITH EXPOSURE TO n-HEXANE AND ORGANOPHOSPHORUS COMPOUNDS

n-HEXANE NEUROPATHY	*ORGANOPHOSPHORUS TOXICITY AND NEUROPATHY*
Insidious onset	*Insidious onset (abrupt ante toxicity)*
Progressive distal weakness	*Progressive distal weakness*
Sensory loss in extremities	*Sensory loss in extremities*
Ataxia and slapping gait	*Ataxia and slapping gait*
Altered pain, vibration and position sense	*Altered pain, vibration and position sense*
Altered deep tendon reflex (at high concentrations)	*Altered deep tendon reflexes*
Muscle weakness	*Muscle weakness*
Normal clinical laboratory tests	*Normal clinical laboratory tests*
	Depression, psychotic reactions, anxiety, hallucinations, increased sweating and salivation, miosis and blurred vision, nausea, vomiting, and diarrhea, tremulousness

Appendix A

ROUTING CARD

OMB NO. 68-R1009

DATE & DAY	TIME	FLOOR RM. #	TESTS	DOCTOR's SIG. OR TECH. I.D.	COMMENTS
			REGISTRATION		
			INTERVIEW (QUESTION-NAIRE)		
			EMG		
			NEUROLOGY		
			PSYCHOLO-GICAL		
			URINE		
			BLOOD		
			X-RAY		
			PHYSICAL EXAM		
			OPHTHAL-MOLOGY		

VELSICOL PESTICIDE STUDY
CDC/NIOSH (C) TF 2.14A
EXPIRATION 4-15-77 12/76

Appendix B

Form Approved
OMB No. 68-R1009

HUMAN SUBJECTS PARTICIPANT DOCUMENT

I. PROJECT DESCRIPTION

1. Title and Number:

Velsicol Pesticide Study _____

2. Project Director:

Charles Xintaras, Sc.D.

3. Purpose and Benefits:

This medical examination, to be administered to workers exposed to pesticides and other toxic chemicals during manufacturing operations of the Velsicol Chemical Corporation, will look for possible links between certain adverse health effects especially delayed neurotoxic findings, and exposure to toxic substances in the work environment.

The results of the medical examination will assist NIOSH in determining whether adverse health effects are associated with worker exposure to toxic substances in his work environment, achieve a better understanding of possible delayed neurotoxicity in workers exposed to specific organophosphate pesticides, provide useful direction for the medical management of workers suffering health effects, and to identify early indicators of these adverse health effects for medical monitoring and, thus, provide the worker with a safe and healthful work environment.

II. CONSENT TO PARTICIPATE

I, _____, age ____, hereby voluntarily agree to cooperate in the above named study and to undergo the tests listed in Attachment A. The study has been discussed with me and I have been given a copy of this document. I understand that:

1. The procedures and tests to be followed are as stated in Attachment A with those procedures which are experimental, so identified.

2. Attendant discomforts and risks are as noted in Attachment A and, except as noted, are minimal and provision has been made for any necessary medical care, and I have been told what to do if I have any reaction.

3. Benefits are as indicated in the "Purpose and Benefits" section in Part I.

4. If alternative procedures advantageous to me are available, they are specified in Attachment A, and if they become available during the project, the procedure most advantageous for me will

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be indicated and used or an explanation will be given to me as to use of any other procedure.

5. My inquiries will be answered by the project director or other personnel involved in the project: Dr. Charles Xintaras, (513) 684-4244 or Dr. Shiro Tanaka, (513) 684-2732.

6. I am free to terminate my consent and to discontinue participation in the project at any time without prejudice to myself.

7. My identity and my relationship to any information (1) disclosed by me in completing any project questionnaire and (2) reported by me or derived from me during my participation in the above named project shall be kept confidential and will not be disclosed to others without my written consent except as required by law and except that such information will be used for statistical and research purposes in such a manner that no individual can be identified. I understand that if any information is found out concerning me that can endanger the health and safety of others, this information will be given to the proper authority.

8. If any of my medical records are required for purposes of this project, a separate written consent for release of the records will be requested from me.

9. There will be questions that I will be asked to answer, and my inquiries concerning the questions will be answered by Dr. Charles Xintaras, (513) 684-4244, or Dr. Shiro Tanaka, (513) 684-2732.

10. A report of any significant information from the study that specifically concerns me, including medical information, will be furnished by the Project Director or his designated representative to me or to my designated physician(s) upon completion of the study or earlier if appropriate.

SIGNATURE _____ DATE _____
(Subject)

SIGNATURE _____ DATE _____
(Parent or Guardian)

INTERVIEWER _____ DATE _____

PROJECT DIRECTOR  DATE _____
Dr. Charles Xintaras
Chief, Support Services Branch
DSHEFS/NIOSH

ATTACHMENT A

A. Project Title: Velsicol Pesticide Study

B. Procedures and Tests: You may have been exposed to certain toxic substances while working in the pesticide industry. We are administering the following tests to determine whether these toxic substances have affected your health.

1. QUESTIONNAIRE: This is a set of questions related to your health. It will cover areas such as work experience, medications, family history and an assessment of neurological symptoms you may have experienced.

2. BLOOD, URINE, AND SEROLOGICAL TEST FOR SYPHILIS: Samples of blood and urine will be taken and analyzed to determine if any organ systems have been impaired.

3. PSYCHOLOGICAL PERFORMANCE TESTS:

   a. Digit Symbol - is a visual/motor learning test. The task is to associate numerical symbols with certain other symbols.

   b. Digit Span - is an oral test of short-term memory for numbers.

   c. Block Design - are tests for visual ability.

   d. Raven - Progressive Matrices - is a test for comparing geometric figures of varying complexity and matching similar figures.

   e. Neisser Letter Search - is a "vigilance", performance test which measures the speed of a visual search.

   f. Santa-Ana Dexterity Test - is a measure of finger dexterity that requires you to remove, rotate, and replace pegs into holes on a board.

   g. Reaction Time - is a test that measures your reaction to a visual stimulus.

   h. Dual Performance (Foot Tapping/Signal Monitoring) - measures how fast you can tap your foot while watching a flashing light at the same time.

4. MEDICAL EXAMINATION:

   a. A General Physical Examination - will be administered by a physician and a chest x-ray will also be taken.

b. A Neurological Examination - will be performed by a neurologist and includes tests for taste, reflexes, motor coordination of all limbs, muscle strength, and feelings of sensation.

c. Nerve Conduction Velocity Test - motor nerve conduction velocity will be performed using an electrical impulse on two nerves in the arm and three nerves in the leg. Skin temperature at the points of stimulation and recording will be determined after each set of nerve conduction measurements. The stimulus for nerve conduction testing is similar to the feeling experienced when you bump your "crazy bone."

d. Electromyographic Testing (EMG) - EMG testing is to be performed on several muscles in the arm, hand, and leg using needle electrodes. Slight discomfort, similar to a pin prick, may be experienced during these tests.

e. Eye Examination - includes such tests as color vision, eye movement and peripheral vision. The doctor will look also at the inside of your eye after the pupil is dilated.

5. END OF MEDICAL EXAMINATION: The physician, or other qualified person, will check your eyes to determine when the effects of the eye drops have worn off and it is safe for you to drive.

C. Rights under the Privacy Act of 1974, Title 5, United States Code, Section 552(a)(e)(3)

The information required to be given to me under the Privacy Act of 1974 is as follows:

1. Authority for collecting information is Occupational Safety and Health Act of 1970.

2. The principal purpose(s) is as stated in Section I, Item 3.

3. Routine use of this information is in developing criteria and programs for a safe and healthful place of employment or as published in the Federal Register, CDC - NIOSH 0129.01, September 20, 1976.

4. I do not have to furnish any information I do not wish to. Nothing happens to me as a result of my not providing information, whether all or in part of that requested, except that I may be terminated from the project.

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OMB No. 68-R1009

III. REQUEST AND AUTHORIZATION FOR RELEASE OF INFORMATION

I _____, hereby request and authorize the Project Director to inform the following physicians whose names and addresses I have entered below of any significant findings from the above name study concerning me. (Do not leave blank. Write "no" where you do not wish to give a name and address).

- PLEASE PRINT-

1. My personal physician(s):

   Dr. _____

   Street _____

   City/State _____ Zip_____

2. Company or Other Physician:

   Dr. _____

   Street _____

   City/State _____ Zip_____

_____ / _____
(Signature) (Date)

IV. If a project questionnaire is required, it will constitute this Part IV as a separate attachment to be retained by the Project Director. A copy of the questionnaire is not retained by the participants.

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Appendix C

FORM APPROVED OMB NO. 68-R 1009

Department of Health, Education and Welfare

Public Health Service

Center for Disease Control

National Institute for Occupational Safety and Health

VELSICOL PESTICIDE STUDY
QUESTIONNAIRE

ASSURANCE OF CONFIDENTIALITY: The United States Public Health Service hereby gives its assurance that your identity and your relationship to any information obtained by reason of your participation in the Velsicol Pesticide Study will be kept confidential in accordance with PHS Regulations (42 CFR 1.101-1.108) and will not otherwise be disclosed.

CDC/NIOSH (C) TF 2.148
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INTERVIEWER: ☐☐

DATE OF INTERVIEW: ☐☐ (MO) — ☐☐ (DAY) — ☐☐ (YR)

LABEL

SUBJECT IDENTIFICATION

CASE NO. ☐☐☐☐ ☐

LAST NAME: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

FIRST NAME: ☐☐☐☐☐☐☐☐☐☐☐☐

MIDDLE INITIAL: ☐

ADDRESS: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

CITY: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

STATE: ☐☐ ZIP CODE: ☐☐☐☐☐

PERSONAL DATA

1. TELEPHONE: ☐☐☐ (AREA CODE) — ☐☐☐ — ☐☐☐☐

2. RACE/ETHNIC CODE: ☐
   1. White, not of Hispanic Origin
   2. Black, not of Hispanic Origin
   3. Hispanic
   4. American Indian or Alaskan Native
   5. Asian or Pacific Islander
   6. Other

3. SEX: 1. Male 2. Female ☐

4. What is your date of birth? (month/day/year) ☐☐ — ☐☐ — ☐☐

5. What is the last grade of school you completed? ☐☐

   ELEMENTARY = 01 – 08 SECONDARY = 09 – 12 COLLEGE = 13 (1 year)
   14 (2 years)
   15 (3 years)
   16 (4 years)
   17 (5 years)
   18 (6 years)
   19 (7 or more years)

6. Under federal law, people participating in our surveys DO NOT have to tell us their social security number. However it is very useful and helps us do follow-up studies. May I have your social security number?

   REFUSAL: 2 ☐

   SOCIAL SECURITY NUMBER: ☐☐☐ — ☐☐ — ☐☐☐☐

OCCUPATIONAL HISTORY

The National Institute for Occupational Safety and Health has obtained copies of Velsicol's personnel records to determine exactly what jobs each employee had, and how long he held each job. I'm going to read the information we have, please tell me if there are any errors or things we may have left out.

(READ THE INFORMATION BELOW. DRAW A LINE THROUGH ANY INACCURATE INFORMATION AND WRITE IN THE CORRECTION BELOW. ENTER ADDITIONAL INFORMATION IN THE SPACE PROVIDED.)

VELSICOL EMPLOYMENT

OPERATION/DEPARTMENT	JOB TITLE	DATE STARTED/ENDED	PERM/TEMP	FULL TIME/ PART TIME
1.				
CORRECTION				
2.				
CORRECTION				
3.				
CORRECTION				
4.				
CORRECTION				
5.				
CORRECTION				

(AFTER READING LIST ASK:)

Is everything I've read accurate and complete?

IF NO: What is missing or incorrect?

1. Why did you stop working at the Velsicol plant? ..... CODE

VERBATIM RESPONSE_____ 1 ☐ MEDICAL

_____ 2 ☐ TERMINATED

_____ 3 ☐ OTHER

Now I'll read a list of jobs you held before you started working at Velsicol. Once again, tell me if there are any errors or things missing.

PREVIOUS EMPLOYMENT

COMPANY	LOCATION	DATE STARTED/ENDED	JOB TITLE
1.			
CORRECTION			
2.			
CORRECTION			
3.			
CORRECTION			
4.			
CORRECTION			
5.			
CORRECTION			
6.			
CORRECTION			
7.			
CORRECTION			

ADDITIONAL JOBS

COMPANY	LOCATION	DATE STARTED/ENDED	JOB TITLE
8.			
9.			
10.			
11.			

OCCUPATIONAL HISTORY SINCE VELSICOL

Now I'm going to ask you about the jobs you've held, since you stopped working at Velsicol.

1. Where did you start working after you left (Velsicol) ?
2. What kind of company is it; what do they do there?
3. In what month and year did you start working there?
4. In what month and year did you stop working there?
5. What was your occupation or job title?
6. What exactly was your main job or activity? (What kind of work did you do most of the time?)

(REPEAT Q. 1-6 UNTIL YOU HAVE OBTAINED CURRENT OR LAST EMPLOYER. IF PRESENT EMPLOYER, WRITE CURRENT IN COLUMN TITLED "ENDED". IF NO EMPLOYMENT AFTER VELSICOL, WRITE NONE UNDER "EMPLOYER" ON THE FIRST LINE. RECORD ALL EMPLOYMENT, INCLUDING SHORT-TERM EMPLOYMENT AND PART-TIME EMPLOYMENT.)

EMPLOYER	TYPE OF COMPANY	STARTED MO YR	ENDED MO YR	JOB TITLE	WORK DESCRIPTION
1.					
2.					
3.					
4.					
5.					
6.					
7.					
8.					

CHEMICAL EXPOSURE

Thinking back to all of the places where you've worked, except for Velsicol; have you worked with any of the following chemicals? Remember, this doesn't include the Velsicol Plant.

CHEMICAL	RESPONSE	DATE	CHEMICAL	RESPONSE	DATE
IF YES ASK: When did you work with this? (In what year?)			7. Trichloroethylene	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK	
1. Metallic mercury	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK	8 ☐ DK	8. Methyl bromide	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK	
2. Methyl mercury	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK		9. Carbon monoxide	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK	
3. Methyl chloride	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK		10. Lead	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK	
4. Arsenic	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK		11. Styrene	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK	
5.Thallium	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK		12. N-Hexane	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK	
6. Acrylamide	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK		13. Other solvents such as benzene	1 ☐ YES → 19 ☐☐ 2 ☐ NO 8 ☐ DK	

PESTICIDE EXPOSURE

1. Excluding your work at Velsicol, have you ever worked with pesticides or been exposed to pesticides? 1 ☐ YES

2 ☐ NO

8 ☐ DK

(IF YES: READ EACH PESTICIDE. IF YES TO A PESTICIDE ASK THE SECONDARY QUESTIONS BELOW.)

IF YES ASK: Which of the following did you work with? When did you work with this?					
IF NO: GO TO NEXT SECTION					
1. Carbaryl (Sevin)	1 ☐ YES → 19 ☐☐		6. Aldrin	1 ☐ YES → 19 ☐☐	
	2 ☐ NO			2 ☐ NO	
	8 ☐ DK			8 ☐ DK	
2. Parathion (ethyl)	1 ☐ YES → 19 ☐☐		7. Dieldrin	1 ☐ YES → 19 ☐☐	
	2 ☐ NO			2 ☐ NO	
	8 ☐ DK			8 ☐ DK	
3. 2-4 D	1 ☐ YES → 19 ☐☐		8. Malathion	1 ☐ YES → 19 ☐☐	
	2 ☐ NO			2 ☐ NO	
	8 ☐ DK			8 ☐ DK	
4. Atrazine	1 ☐ YES → 19 ☐☐		9. Guthion	1 ☐ YES → 19 ☐☐	
	2 ☐ NO			2 ☐ NO	
	8 ☐ DK			8 ☐ DK	
5. DDT	1 ☐ YES → 19 ☐☐		10. Ethion	1 ☐ YES → 19 ☐☐	
	2 ☐ NO			2 ☐ NO	
	8 ☐ DK			8 ☐ DK	
			11. Any other pesticides? SPECIFY_____ _____	1 ☐ YES → 19 ☐☐	
				2 ☐ NO	
				8 ☐ DK	

WORK HYGIENE

I'm going to ask you a few questions about things people sometimes do at work. These questions only refer to your work experience at the Velsicol plant. Please answer YES or NO to each question. Remember we're only talking about things you did at Velsicol.

1. Did/do you smoke at the worksite; that is, the place where you did/do most of your work? ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

2. Did/do you eat at the worksite? ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

3. Did/do you usually wash your hands before eating? ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

4. Did/do you drink beverages like soft drinks or coffee at the worksite? ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

5. Did/do you wear your work clothes home, more than twice a week? ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

6. Did/do you usually take your work clothes home? ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

7. Did/do you usually shower before leaving the plant? ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK
(USUALLY – three or more times a week.)

8. Did/do you usually wear any kind of protective devices or protective clothing? ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK 7 ☐ NOT APPLICABLE

IF YES ASK:

Which of the following did/do you usually wear?

(READ EACH ITEM. CHECK EITHER A YES, NO OR DK.)

9. Gloves ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

10. Hard Hat ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

11. Safety Glasses ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

12. Respirators ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

13. Aprons ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

14. While you were (have been) working at Velsicol, did (have) any chemical spills occur (occurred)? . . . . . 1 ☐ YES 2 ☐ NO 8 ☐ DK

IF YES ASK:

What chemical was involved?

Approximately when did this happen? (In what month and year?)

In what part of the plant did the spill occur?

Did any of this chemical get on your skin?

(RECORD REPORTED CHEMICAL AND PART OF PLANT IN APPROPRIATE COLUMN. IF RESPONDENT CANNOT REMEMBER WRITE DK. DO NOT WRITE IN CODE COLUMN.)

	CHEMICAL	CODE	PART OF PLANT	CODE	DATE	SKIN CONTACT
15.					MO YR	1 ☐ YES 2 ☐ NO
16.					MO YR	1 ☐ YES 2 ☐ NO
17.					MO YR	1 ☐ YES 2 ☐ NO
18.					MO YR	1 ☐ YES 2 ☐ NO

19. Did you (have you) worked with N-Hexane at the Velsicol plant? . . . . . 1 ☐ YES 2 ☐ NO 8 ☐ DK

20. What about styrene? . . . . . 1 ☐ YES 2 ☐ NO 8 ☐ DK

21. Did/do you work with EPN at Velsicol? . . . . . 1 ☐ YES 2 ☐ NO 8 ☐ DK

MISCELLANEOUS

1. In the past five years, have you been involved in a motor vehicle accident where you were found to be at fault? . . . . . 1 ☐ YES 2 ☐ NO

IF YES ASK:

2. How many accidents? . . . . . ☐☐ NO. OF ACCIDENTS

3. Where did the accident/accidents take place? (In what city and state?)

CITY_____ STATE _____

CITY_____ STATE _____

CITY_____ STATE _____

CITY_____ STATE _____

4. In the past five years, has your house been exterminated to get rid of termites? ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

IF YES ASK:

5. Who treated the house? ..... 1 ☐ SELF 2 ☐ SELF/OTHER 8 ☐ DK

6. What kind of chemical was used? ..... 8 ☐ DK ☐☐ CHEMICAL CODE

VERBATIM _____

_____

_____

HEALTH HISTORY

I'm now going to read a list of health conditions. Have you ever been told by a doctor that you had any of the following conditions. Please answer YES or NO to each one.

(READ EACH CONDITION AND RECORD A RESPONSE. IF YES, ASK THE SECONDARY QUESTIONS BELOW AND RECORD THE RESPONSES IN THE APPROPRIATE COLUMN. FOR MULTIPLE HOSPITALIZATIONS FOR A CONDITION, CHECK 3-MUL. RECORD FIRST HOSPITAL IN THE SPACE PROVIDED. RECORD SUBSEQUENT HOSPITALIZATIONS IN THE SPACE AT THE END OF THIS SECTION.)

SECONDARY QUESTIONS

IF YES ASK:

DATE	In what year were you first told about this condition?
DOCTOR	Who was your doctor? (What was his name?) Where is his office? (In what city and state?)
HOSPITALIZED	Were you hospitalized? (Were you a bed patient in a hospital?)
HOSPITAL	What is the name of the hospital? Where is the hospital? (In what city and state?)

CONDITION	RESPONSE	DATE	DOCTOR	HOSPITALIZED	HOSPITAL
1. Asthma	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
2. Bronchitis	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
3. Tuberculosis (TB)	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
4. Cancer (any type)	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
5. Skin rash or skin disease	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____

SECONDARY QUESTIONS

IF YES ASK:

DATE	In what year were you first told about this condition?
DOCTOR	Who was your doctor? (What was his name?) Where is his office? (In what city and state?)
HOSPITALIZED	Were you hospitalized? (Were you a bed patient in a hospital?)
HOSPITAL	What is the name of the hospital? Where is the hospital? (In what city and state?)

CONDITION	RESPONSE	DATE	DOCTOR	HOSPITALIZED	HOSPITAL
6. Heart Disease	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
7. Stroke	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
8. Meningitis	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
9. High blood pressure	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
10. Migraine Headaches	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
11. Head Injury or Concussion	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____

SECONDARY QUESTIONS

IF YES ASK:

DATE	In what year were you first told about this condition?
DOCTOR	Who was your doctor? (What was his name?) Where is his office? (In what city and state?)
HOSPITALIZED	Were you hospitalized? (Were you a bed patient in a hospital?)
HOSPITAL	What is the name of the hospital? Where is the hospital? (In what city and state?)

CONDITION	RESPONSE	DATE	DOCTOR	HOSPITALIZED	HOSPITAL
12. Thyroid trouble	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
13. Gall bladder trouble	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
14. Kidney or bladder trouble	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
15. Liver trouble or jaundice	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
16. Diabetes	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
17. Anemia	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____

SECONDARY QUESTIONS

IF YES ASK:

DATE	In what year were you first told about this condition?
DOCTOR	Who was your doctor? (What was his name?) Where is his office? (In what city and state?)
HOSPITALIZED	Were you hospitalized? (Were you a bed patient in a hospital?)
HOSPITAL	What is the name of the hospital? Where is the hospital? (In what city and state?)

CONDITION	RESPONSE	DATE	DOCTOR	HOSPITALIZED	HOSPITAL
18. Ulcers	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
19. Arthritis or rheumatism	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
20. Back trouble	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
21. Epilepsy	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
22. Poisoning SPECIFY _____ _____	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____
23. Nervous breakdown	1 ☐ YES → 2 ☐ NO 8 ☐ DK	19 ☐☐	DOCTOR _____ _____ CITY _____ STATE _____	HOSPITAL → 1 ☐ YES 2 ☐ NO 3 ☐ MUL.	HOSPITAL _____ _____ CITY _____ STATE _____

24. In the last five years, were you hospitalized for any other illness or injury? . . . . . 1 ☐ YES 2 ☐ NO

SECONDARY QUESTIONS

IF YES ASK:

CONDITION	Why were you hospitalized?
DATE	In what year were you hospitalized?
HOSPITAL	What was the name of the hospital? Where is the hospital? (In what city and state?)

CONDITION	DATE	HOSPITAL	CONDITION	DATE	HOSPITAL
25. _____	19 ☐☐	HOSPITAL _____	28. _____	19 ☐☐	HOSPITAL _____
_____	→	_____	_____	→	_____
_____		CITY _____	_____		CITY _____
☐☐		STATE _____	☐☐		STATE _____
26. _____	19 ☐☐	HOSPITAL _____	29. _____	19 ☐☐	HOSPITAL _____
_____	→	_____	_____	→	_____
_____		CITY _____	_____		CITY _____
☐☐		STATE _____	☐☐		STATE _____
27. _____	19 ☐☐	HOSPITAL _____	30. _____	19 ☐☐	HOSPITAL _____
_____	→	_____	_____	→	_____
_____		CITY _____	_____		CITY _____
☐☐		STATE _____	☐☐		STATE _____

31. Have you had a Swine flu shot? . . . . . 1 ☐ YES 2 ☐ NO 8 ☐ DK

IF YES:

When did you get your shot? . . . . . MO ☐☐ 19 ☐☐

In this part of the interview, I'll be asking you about your social habits.

SMOKING HISTORY

1. Do you now smoke cigarettes? ..... 1 ☐ YES 2 ☐ NO

IF NO:

2. Have you ever smoked cigarettes? ..... 1 ☐ YES 2 ☐ NO

IF NO TO Q. 1 AND Q. 2: GO TO ALCOHOL CONSUMPTION

ASK EX-SMOKERS:

3. How old were you when you gave up smoking cigarettes? ..... ☐☐ AGE 8 ☐ DK

4. How old were you when you started smoking cigarettes regularly? ..... ☐☐ AGE 8 ☐ DK
6 ☐ NEVER REGULARLY

5. On the average, how many cigarettes do/did you smoke a day? ..... ☐☐ CIG/DAY 8 ☐ DK

6. Do/did you inhale the cigarette smoke? ..... 1 ☐ YES 2 ☐ NO 8 ☐ DK

ALCOHOL CONSUMPTION

1. Have you drunk as many as 20 alcoholic beverages in your entire life? ..... 1 ☐ YES 2 ☐ NO

IF NO: GO TO MENSTRAL HISTORY

2. Do you now drink alcoholic beverages? ..... 1 ☐ YES 2 ☐ NO

IF NO:

3. How old were you when you gave up drinking? ..... ☐☐ AGE 8 ☐ DK

4. How old were you when you first started drinking? ..... ☐☐ AGE 8 ☐ DK

5. On the average, how many beers do you drink per day? ..... ☐☐ BEER/DAY ☐☐ BEER/WK
(IF DOES NOT DRINK A BEER PER DAY ASK: "HOW MANY PER WEEK") 7 ☐ LESS 1/WK 8 ☐ DK

6. About how many bottles of wine do you drink per week? ..... ☐☐ WINE/WK ☐☐ WINE/MO
7 ☐ LESS/1 MO 8 ☐ DK

7. About how many cocktails or drinks of other liquor do do you have per week? ..... ☐☐ DRINKS/WK ☐☐ DRINKS/MO
7 ☐ LESS/1 MO ☐ DK

REPRODUCTIVE SCREENING QUESTIONS

1. Have you ever been married? . . . . . 1 ☐ YES 2 ☐ NO

IF NO: GO TO NEXT SECTION

2. How many times have you been married? . . . . . ☐ NO MARRIAGES

3. Were you married when you worked at Velsicol? . . . . . 1 ☐ YES 2 ☐ NO

IF NO: GO TO NEXT SECTION

4. Are you and your wife still living together? . . . . . 1 ☐ YES 2 ☐ NO

IF YES: GO TO Q. 8

IF NO:

5. In what month and year did you stop living together? . . . . . MO ☐☐ YR ☐☐

6. What is her first name and maiden name?

FIRST NAME _____ MAIDEN NAME _____

7. Do you know her present address? . . . . . 1 ☐ YES 2 ☐ NO 8 ☐ DK

STREET _____ CITY _____ STATE _____ ZIP _____

8. In what year were you married? . . . . . 19 ☐☐

9. How many children do/did you and your wife have? . . . . . ☐☐ NO OF CHILDREN

IF NO CHILDREN GO TO Q. 11.

10. What are their birth dates?

	BIRTH DATE				BIRTH DATE		
1.	MO ☐☐	DAY ☐☐	19 ☐☐	5.	MO ☐☐	DAY ☐☐	19 ☐☐
2.	MO ☐☐	DAY ☐☐	19 ☐☐	6.	MO ☐☐	DAY ☐☐	19 ☐☐
3.	MO ☐☐	DAY ☐☐	19 ☐☐	7.	MO ☐☐	DAY ☐☐	19 ☐☐
4.	MO ☐☐	DAY ☐☐	19 ☐☐	8.	MO ☐☐	DAY ☐☐	19 ☐☐

11. Did/Has your wife have/had any miscarriages? . . . . . 1 ☐ YES 2 ☐ NO 8 ☐ DK

IF YES:

12. How many miscarriages? . . . . . ☐☐ MISCARRIAGES

Appendix D

Form Approved
OMB NO. 68-R1009

VELSICOL PESTICIDE STUDY
PHYSICAL EXAMINATION

HEIGHT_____ WEIGHT_____ BLOOD PRESSURE_____

PULSE RATE: _____/MIN.

PULSES

(B = BRUIT, N = NORMAL, D = DIMINISHED, A = ABSENT, NT = NOT TESTED)

	RIGHT					LEFT				
	B	N	D	A	NT	B	N	D	A	NT
CAROTID	—	—	—	—	—	—	—	—	—	—
TEMPORAL	—	—	—	—	—	—	—	—	—	—
RADIAL		—	—	—	—		—	—	—	—
DORS. PEDIS		—	—	—	—		—	—	—	—

ORGAN	NORMAL	ABNORMAL	DESCRIBE	OPERATIVE SCARS
SKIN:	_____	_____	_____	_____
EYE:(GROSS)	_____	_____	_____	_____
EAR:	_____	_____	_____	_____
NOSE:	_____	_____	_____	_____
MOUTH:	_____	_____	_____	_____
THROAT:	_____	_____	_____	_____
NECK:	_____	_____	_____	_____
THYROID:	_____	_____	_____	_____
CHEST(GEN.)	_____	_____	_____	_____

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VELSICOL PESTICIDE STUDY
PHYSICAL EXAMINATION (CONT.)

HEART: DESCRIBE

CARDIAC RHYTHM REGULAR:_____ IRREGULAR:_____ _____

MURMUR ABSENT:_____ PRESENT:_____ _____

AORTIC SOUNDS NORMAL:_____ ACCENTUATED:_____ _____

PULMONIC SOUNDS NORMAL:_____ ACCENTUATED:_____ _____

OTHER HEART ABNORMALITIES:_____

LUNGS:

BREATH SOUNDS: NORMAL: _____ ABNORMAL: _____

IF ABNORMAL, PLEASE CHECK:

DIMINISHED _____ _____

BRONCHIAL _____ _____

BRONCHO-VESICULAR _____ _____

ADVENTITIOUS SOUNDS:

RHONCHI(WHEEZES) SIBILANT ABSENT:____ PRESENT:____ _____

IF PRESENT, CHANGE WITH COUGH? YES____ NO____

RHONCHI(WHEEZES) SONOROUS ABSENT:____ PRESENT:____ _____

IF PRESENT, CHANGE WITH COUGH? YES____ NO____

RALES-FINE(CRACKLING) (End-Inspiratory) ABSENT:____ PRESENT:____ _____

MEDIUM RALES ABSENT:____ PRESENT:____ _____

PLEURAL FRICTION RUB ABSENT:____ PRESENT:____ _____

LUNG EXPANSION: NORMAL:____ ABNORMAL:____ _____

OTHER LUNG ABNORMALITY:_____

VELSICOL PESTICIDE STUDY
PHYSICAL EXAMINATION (CONT.)

ORGAN	PALPABLE	NOT PALPABLE (If palpable describe)	DESCRIBE
ABDOMEN			
LIVER	_____	_____	_____
KIDNEY	_____	_____	_____
SPLEEN	_____	_____	_____
ABDOMINAL MASS	_____	_____	_____

OTHER ABDOMINAL ABNORMALITIES: _____

_____

	NORMAL	ABNORMAL	DESCRIBE
UPPER EXTREMITIES	_____	_____	_____
LOWER EXTREMITIES	_____	_____	_____
LYMPH NODES	_____	_____	_____
JOINTS	_____	_____	_____

DESCRIBE OTHER ABNORMALITIES: _____

_____

_____

_____

EXAMINING PHYSICIAN'S SIGNATURE: _____ DATE: _____
KELSEY-SEYBOLD CLINIC

Appendix E

FORM APPROVED
OMB NO. 68-R1009

VELSICOL PESTICIDE STUDY
OPHTHALMOLOGICAL EXAMINATION

VISUAL ACUITY: WITHOUT CORRECTION RIGHT:_____ LEFT:_____

IF NEEDED, WITH CORRECTION RIGHT:_____ LEFT:_____

	RIGHT NORMAL	RIGHT ABNORMAL	LEFT NORMAL	LEFT ABNORMAL	DESCRIBE
PALPEBRA	_____	_____	_____	_____	_____

	RIGHT ABSENT	RIGHT PRESENT	LEFT ABSENT	LEFT PRESENT	
PTOSIS	_____	_____	_____	_____	_____
BULBUS:					
EXOPHTHALMOS	_____	_____	_____	_____	_____
NYSTAGMUS	_____	_____	_____	_____	_____
STRABISMUS	_____	_____	_____	_____	_____

	RIGHT NORMAL	RIGHT ABNORMAL	LEFT NORMAL	LEFT ABNORMAL	
EXTRAOCULAR MOVEMENT	_____	_____	_____	_____	_____
CONJUNCTIVAE	_____	_____	_____	_____	_____
SCLERA	_____	_____	_____	_____	_____
CORNEA	_____	_____	_____	_____	_____
IRIS	_____	_____	_____	_____	_____
ANTERIOR CHAMBER	_____	_____	_____	_____	_____
MEDIA	_____	_____	_____	_____	_____

PUPIL: PUPILLARY SIZE BEFORE STIMULI RIGHT:_____mm LEFT:_____mm

PUPILLARY SHAPE & POSITION	_____	_____	_____	_____	_____
REACTION TO LIGHT (DIRECT)	_____	_____	_____	_____	_____
REACTION TO LIGHT(CONSENSUAL)	_____	_____	_____	_____	_____
ACCOMODATION REACTION (NEAR POINT CONTRACTION)	_____	_____	_____	_____	_____

OTHER PUPILLARY ABNORMALITY_____

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VELSICOL PESTICIDE STUDY
OPHTHALMOLOGICAL EXAMINATION (CONT.)

FUNDUSCOPY:

OPTIC ATROPHY	ABSENT(R):____	PRESENT(R):____	ABSENT(L):____	PRESENT(L):____
PAPILLEDEMA	ABSENT(R):____	PRESENT(R):____	ABSENT(L):____	PRESENT(L):____
ARTERIES	NORMAL(R):____	ABNORMAL(R):____	NORMAL(L):____	ABNORMAL(L):____
VEINS	NORMAL(R):____	ABNORMAL(R):____	NORMAL(L):____	ABNORMAL(L):____
HEMORRHAGE OR EXUDATE	ABSENT(R):____	PRESENT(R):____	PRESENT(L):____	PRESENT(L):____

OTHER FUNDUSCOPIC FINDINGS - DESCRIBE_____

_____

CRITICAL FLICKER/FUSION TEST:

	ASCENDING	DESCENDING	
TRIAL ONE	__ __ . __	__ __ . __	
TRIAL TWO	__ __ . __	__ __ . __	MEAN _____
TRIAL THREE	__ __ . __	__ __ . __	ST. DEV. _____

AIMARK VISUAL PERIMETRY TEST (0° - 100°)

HORIZONTAL FIELD (RIGHT):	TEMPORAL _____	NASAL_____	
VERTICAL FIELD (RIGHT):	SUPERIOR _____	INFERIOR_____	
HORIZONTAL FIELD (LEFT):	TEMPORAL _____	NASAL_____	
VERTICAL FIELD (LEFT):	SUPERIOR _____	INFERIOR_____	

FARNSWORTH DICHOTOMOUS

PASS _____
FAIL _____

IF FAIL, SUBJECT'S ORDER:

TEST: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

RETEST: __ __ __ __ __ __ __ __ __ __ __ __ __ __ __

EXAMINING PHYSICIAN'S SIGNATURE:_____DATE_____
KELSEY-SEYBOLD CLINIC

Appendix F

Form Approved
OMB No. 68-R1009

VELSICOL PESTICIDE STUDY

PSYCHOLOGICAL EXAMINATION

TIME OF TEST (USING MILITARY TIME)

Time ended ____ ____ ____ ____

begun ____ ____ ____ ____

elapsed ____ ____ ____

DIGIT SYMBOL, WAIS

____ ____ Right

____ ____ Half

____ ____ Total

DIGIT SPAN, WAIS

____ Forward

____ Backward

____ ____ Total

NEISSER

1 ____ ____

2 ____ ____

3 ____ ____

4 ____ ____

5 ____ ____

6 ____ ____

Total ____ ____ ____

BLOCK DESIGN, WAIS

Item	Time			Accuracy	Score
1	___	___		___	___
2	___	___		___	___
3	___	___		___	___
4	___	___		___	___
5	___	___		___	___
6	___	___		___	___
7	___	___	___	___	___
8	___	___	___	___	___
9	___	___	___	___	___
10	___	___	___	___	___
				Total	___ ___

SANTA ANA

1 ____ ____ (R)

2 ____ ____ (R)

3 ____ ____ (L)

4 ____ ____ (L)

5 ____ ____ (B)

6 ____ ____ (B)

Total ____ ____ ____

ANALOG TAPE

Beginning Reading ____

Ending Reading ____

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VELSICOL PESTICIDE STUDY

PSYCHOLOGICAL EXAMINATION
(continued)

RAVEN MATRICES

A ___ ___

B ___ ___

C ___ ___

D ___ ___

E ___ ___

Total ___ ___

EXAMINER'S SIGNATURE: _____

DATE: _____

CHOICE REACTION TIME

___ ___ ___ (N)

___ ___ ___ (MEAN)

___ ___ ___ (ST.D)

DUAL PERFORMANCE

___ ___ ___ (B)

___ ___ ___ (L)

___ ___ ___ (CI)

Appendix G

Approved Form
OMB No. 68-R1009

VELSICOL PESTICIDE STUDY
NEUROLOGICAL EXAMINATION

HANDEDNESS: R_____ L_____ BLOOD PRESSURE _____/_____

MENTAL STATUS: (Check "Clear" or "Not Clear")

		DATE	PLACE	IDENTITY
CLEAR	☐			
NOT CLEAR	☐	_____	_____	_____

PAST MEMORY: (Check "Not Impaired" or "Impaired")

		AGE	DATE OF BIRTH	GRADE REACHED IN SCHOOL
NOT IMPAIRED	☐			
IMPAIRED	☐	_____	_____	_____

RECENT MEMORY: (Check "Not Impaired" or "Impaired")

		PAST ACTIVITY OF DAY	DOCTOR'S NAME
NOT IMPAIRED	☐		
IMPAIRED	☐	_____	_____

SERIAL 7's ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ ___ -

NO. CORRECT: _____

NO. INCORRECT: _____

6 DIGITS FORWARD

TRIAL #1 NO. CORRECT _____ NO. INCORRECT _____

TRIAL #2 NO. CORRECT _____ NO. INCORRECT _____

5 DIGITS BACKWARD:

NO. CORRECT _____ NO. INCORRECT _____

SENTENCE RETENTION:

IF THERE IS ONE THING A NATION NEEDS TO BE RICH AND STRONG IT IS A LARGE AND SECURE SUPPLY OF WOOD.

1ST _____ 2ND _____ 3RD _____ FAILURE _____

CDC/NIOSH (C) TF 2.14 C
12/76 EXP. 4-15-77

Approved Form
OMB No. 68-R1009

VELSICOL PESTICIDE STUDY
NEUROLOGICAL EXAMINATION (CONT.)

CRANIAL NERVES

I. SMELL

	NORMAL	ABNORMAL	NOT TESTED
LEFT	_____	_____	_____
RIGHT	_____	_____	_____

IF ABNORMAL, NASAL PASSAGE PATENT _____? OR BLOCKED _____?

II. VISION

VISUAL FIELD - CONFRONTATION

NORMAL _____ ABNORMAL _____ IF ABNORMAL INDICATE BY CHECKING NUMBER

LEFT

1 ____
2 ____
3 ____
4 ____

4 | 1
3 | 2

RIGHT

4 | 1
3 | 2

1 ____
2 ____
3 ____
4 ____

(FUNDUSCOPIC EXAMINATION WILL BE DONE BY OPHTHALMOLOGIST)

OCULAR MOVEMENTS

NORMAL _____ ABNORMAL _____ IF ABNORMAL INDICATE BY CHECKING NUMBER

LEFT

1 ____
2 ____ SR-6 IO-1
3 ____ LR-5 MR-2
4 ____
5 ____
6 ____ IR-4 SO-3

RIGHT

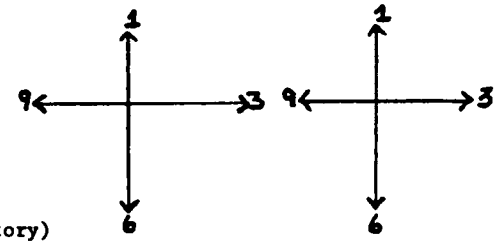
IO-6 SR-1
MR-5 LR-2
SO-4 IR-3

1 ____
2 ____
3 ____
4 ____
5 ____
6 ____

VELSICOL PESTICIDE STUDY
NEUROLOGICAL EXAMINATION (CONT.)

NYSTAGMUS:

ABSENT_____ PRESENT_____ IF PRESENT, INDICATE BY CHECKING NUMBER.

LEFT		RIGHT
1 ____		1 ____
3 ____		3 ____
6 ____		6 ____
9 ____		9 ____
0_____(Rotatory)		0_____ (Rotatory)

PUPILLARY REFLEXES

LEFT			RIGHT	
NORMAL____	ABNORMAL____	DIRECT	NORMAL____	ABNORMAL____
NORMAL____	ABNORMAL____	CONSENSUAL	NORMAL____	ABNORMAL____
NORMAL____	ABNORMAL____	CONVERGENCE	NORMAL____	ABNORMAL____

VIII. HEARING

LEFT	RIGHT
>BETTER ____	>BETTER ____
AIR COND EQUAL ____ BONE COND	AIR COND EQUAL ____ BONE COND
<WORSE ____	<WORSE ____
FINGER RUBBING AT SHOULDER HEARD____ NO____	HEARD____ NO____

VII, IX, X

TASTE: NORMAL____ ABNORMAL____ DESCRIBE_____

SPEECH: NORMAL____ ABNORMAL____ DESCRIBE_____

VELSICOL PESTICIDE STUDY
NEUROLOGICAL EXAMINATION (CONT.)

REFLEXES

CODE: 0=ABSENT 1=DECREASED 2=NORMAL 3=INCREASED 4=CLONUS 9=NOT TESTED

(Please Circle)

LEFT							RIGHT					
0	1	2	3	4	9	Corneal Cr. V.VII	0	1	2	3	4	9
0	1	2	3	4	9	Sucking	0	1	2	3	4	9
0	1	2	3	4	9	Pharynx Cr. IX.X	0	1	2	3	4	9
0	1	2	3	4	9	Jaw Cr. V	0	1	2	3	4	9
0	1	2	3	4	9	Biceps C56	0	1	2	3	4	9
0	1	2	3	4	9	Brachioradialis C56	0	1	2	3	4	9
0	1	2	3	4	9	Triceps C678	0	1	2	3	4	9
0	1	2	3	4	9	Hoffmann	0	1	2	3	4	9
0	1	2	3	4	9	Epigastric T6-9	0	1	2	3	4	9
0	1	2	3	4	9	Hypogastric T11-L1	0	1	2	3	4	9
0	1	2	3	4	9	Cremasteric L12	0	1	2	3	4	9
0	1	2	3	4	9	Quadriceps L234	0	1	2	3	4	9
0	1	2	3	4	9	Gastroc. Soleus L5S12	0	1	2	3	4	9
0	1	2	3	4	9	Clonus (ankle)	0	1	2	3	4	9
0	1	2	3	4	9	Hamstring int L45S12	0	1	2	3	4	9
0	1	2	3	4	9	Hamstring ext L5S12	0	1	2	3	4	9
0	1	2	3	4	9	Anal S34	0	1	2	3	4	9
0	1	2	3	4	9	Bulbocav. S34	0	1	2	3	4	9
0	1	2	3	4	9	Plantar	0	1	2	3	4	9

VELSICOL PESTICIDE STUDY
NEUROLOGICAL EXAMINATION (CONT.)

LEFT		GENERAL MOTOR SURVEY	RIGHT	
NORMAL	ABNORMAL	(PLEASE CHECK)	NORMAL	ABNORMAL
_____	_____	WALK ON TOES	_____	_____
_____	_____	WALK ON HEELS	_____	_____
_____	_____	HOPPING	_____	_____
_____	_____	SQUAT AND RISE	_____	_____
_____	_____	REACH OVERHEAD	_____	_____
_____	_____	ARM SWING	_____	_____

COORDINATION

CODE: N=NORMAL 1=SLIGHT IMPAIRMENT 2=MODERATE IMPAIRMENT 3=SEVERE IMPAIRMENT 9=NOT TESTED

LEFT					(PLEASE CIRCLE)	RIGHT				
					(Eyes Open)					
N	1	2	3	9	Nose-Finger-Nose	N	1	2	3	9
					(Eyes Closed)					
N	1	2	3	9	Heel-Knee	N	1	2	3	9

ALTERN. MOT. RATE (A.M.R.)

LEFT		(PLEASE CHECK)	RIGHT	
NORMAL	ABNORMAL		NORMAL	ABNORMAL
TONGUE: _____				
_____	_____	Hands (Pro-Sup)	_____	_____
_____	_____	Finger Tapping	_____	_____
_____	_____	Toe Tapping	_____	_____

VELSICOL PESTICIDE STUDY
NEUROLOGICAL EXAMINATION (CONT.)

GAIT & STANCE

	NORMAL	ABNORMAL	DESCRIBE
GAIT:	_____	_____	_____
STANCE:	_____	_____	_____

ATAXIA

STRAIGHTAWAY:	_____	_____	_____
ON TURNS:	_____	_____	_____
TANDEM:	_____	_____	_____
BACKWARD:	_____	_____	_____

MUSCLES

ABNORMALITIES

5 = NORMAL
A = ATROPHY
C = CONTRACTURE
F = FASCICULATION
P = PAIN OR TENDERNESS
R = RIGIDITY INCL. COGWHELL
S = SPASM
Y = OTHER, SPECIFY

STRENGTH GRADE

5 = FULL STRENGTH
4 = SLIGHTLY LESS THAN FULL
3 = CAN MOVE AGAINST GRAVITY
2 = CANNOT MOVE AGAINST GRAVITY
1 = FLICKER OR TRACE OF CONTRACTION
0 = NO CONTRACTION
9 = NOT TESTED

(PLEASE CIRCLE)

5 A C F P R S Y	5 4 3 2 1 0 9	TEMPORAL-MASSETER	CR.V	5 A C F P R S Y	5 4 3 2 1 0 9
5 A C F P R S Y	5 4 3 2 1 0 9	PTERYGOID	CR.V	5 A C F P R S Y	5 4 3 2 1 0 9
5 A C F P R S Y	5 4 3 2 1 0 9	FOREHEAD	VII	5 A C F P R S Y	5 4 3 2 1 0 9
5 A C F P R S Y	5 4 3 2 1 0 9	ORBIC. OCULI	VII	5 A C F P R S Y	5 4 3 2 1 0 9
5 A C F P R S Y	5 4 3 2 1 0 9	MOUTH	VII	5 A C F P R S Y	5 4 3 2 1 0 9
5 A C F P R S Y	5 4 3 2 1 0 9	PALATE-PHARYNX	X	5 A C F P R S Y	5 4 3 2 1 0 9
5 A C F P R S Y	5 4 3 2 1 0 9	STERNOMASTOID	XI	5 A C F P R S Y	5 4 3 2 1 0 9
5 A C F P R S Y	5 4 3 2 1 0 9	TRAPEZIUS	XII	5 A C F P R S Y	5 4 3 2 1 0 9
5 A C F P R S Y	5 4 3 2 1 0 9	TONGUE	XII	5 A C F P R S Y	5 4 3 2 1 0 9
5 A C F P R S Y	5 4 3 2 1 0 9	NECK FLEXORS	C1-6	5 A C F P R S Y	5 4 3 2 1 0 9
5 A C F P R S Y	5 4 3 2 1 0 9	NECK EXTENSORS	C1-T1	5 A C F P R S Y	5 4 3 2 1 0 9

VELSICOL PESTICIDE STUDY
NEUROLOGICAL EXAMINATION (CONT.)

MUSCLES (CONT.)

ABNORMALITIES

5 = NORMAL
A = ATROPHY
C = CONTRACTURE
F = FASCICULATION
P = PAIN OR TENDERNESS
R = RIGIDITY INCL. COGWHELL
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STRENGTH GRADE

5 = FULL STRENGTH
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3 = CAN MOVE AGAINST GRAVITY
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0 = NO CONTRACTION
9 = NOT TESTED

(PLEASE CIRCLE)

5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	EXT. ROTAT. (SUPRASCAP.)	C56	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	PECTOR MAJ. (PECTOR)	C5-T1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	DELTOID (AXILL.)	C56	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	BICEPS BRACH (MUSCULOCUT)	C56	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	TRICEPS (RADIAL)	C678	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	WRIST EXT. (RADIAL)	C678	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	WRIST FLEX. (MED & ULN)	C678T1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	THENAR (MED.)	C8T1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	HYPOTHENAR (ULN)	C8T1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	INTEROSSEI (ULN)	C8T1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	ABDOMEN	T6-L1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	RECTAL SPHINCT.	S34	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	ILIOPSOAS (FREMOR)	L234	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	ABDUCT THIGH (OBTUR)	L234	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	ABDUCT THIGH (SUP GLUT)	L45S1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	GLUTEUS MAX. (INF. GLUT)	L5S12	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	QUADRICEPS (FEMOR)	L234	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	HAMSTRINGS (SCIAT.)	L45S1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	ANTER. TIBIAL (PERON.)	L45	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	TOE EXT. (PERON.)	L45S1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	PERONEI (PERON.)	L5S1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	POST TIBIAL (TIB.)	L5S1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	TOE FLEX. (TIB.)	L5S1	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9
5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9	GASTROC. SOLEUS (TIB.)	L5S12	5	A	C	F	P	R	S	Y	5	4	3	2	1	0	9

COMMENTS: (FOR OTHER THAN LISTED ABNORMALITIES, PLEASE DESCRIBE)

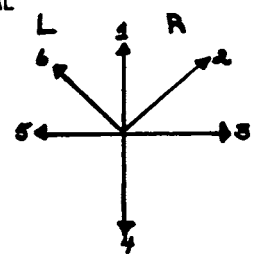
VELSICOL PESTICIDE STUDY
NEUROLOGICAL EXAMINATION (CONT.)

Terminal	Static	Resting	TREMOR ABSENT = 1 PRESENT= 2	Resting	Static	Terminal
			UPPER EXTREMITY			
			LOWER EXTREMITY			
			EYELIDS			
			FACE			
			HEAD			

SPINE MOTION

CERVICAL

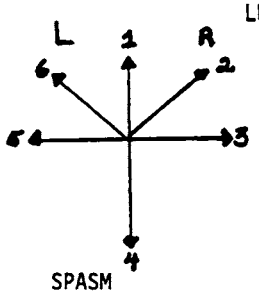
1_____
2_____
3_____
4_____
5_____
6_____



SPASM

LUMBAR

1_____
2_____
3_____
4_____
5_____
6_____



SPASM

VELSICOL PESTICIDE STUDY
NEUROLOGICAL EXAMINATION (CONT.)

SENSATION

TENDON PRESSURE[1]	VIBRATION[2]	POSITION SENSE[3]	TEMPERATURE[4]	PIN PRICK[5]	TOUCH[6]	NORMAL = ✓ SLIGHT LOSS = -1 MODERATE LOSS = -2 SEVERE OR TOTAL LOSS = -3 NOT TESTED = 9	Touch[6]	PIN PRICK[5]	TEMPERATURE[4]	POSITION SENSE[3]	VIBRATION[2]	TENDON PRESSURE[1]
						HAND						
						FOREARM						
						UPPER ARM						
						FOOT						
						CALF						
						THIGH						

[1]As Wrist or Heel Tendon Squeeze

[2]As Vibration at Medial Malleolus and Distal Ulna

[3]Great Toe and Index Finger

[4]Discs

[5]Pin Prick

[6]Cotton Whisp

VELSICOL PESTICIDE STUDY
NEUROLOGICAL EXAMINATION (CONT.)

CLINICAL IMPRESSION

0. Examinee is essentially asymptomatic and neurologically within normal limits. _____

1. Patient is symptomatic but able to carry out without difficulty all normal activities. _____

2. Patient has some difficulty or minor deficit but can care for himself and carry out his usual occupation or activity. _____

3. Patient is able to carry on in former occupation but needs assistance to live at home. _____

4. Moderate restriction of activity. Patient can care for himself, but has to work at job of lesser demand or responsibility than formerly. _____

5. Patient needs constant attention at home or in a nursing home. _____

6. Patient needs hospital care. _____

NARRATIVE SUMMARY:

_____

_____

_____

_____

Tentative or Working Diagnosis: _____

_____

_____

_____

_____

Examining Physician's Signature: _____ Date: _____

KELSEY-SEYBOLD CLINIC

NEUROLOGY HISTORY

Now I'm going to ask you about some health conditions people sometimes have. Have you had any of the following in the last five years, that is since 1971. Please answer YES or NO to each question.

(READ EACH QUESTION. CHECK A RESPONSE. IF YES, ASK THE SECONDARY QUESTIONS BELOW AND RECORD RESPONSE IN THE APPROPRIATE COLUMN. *CODE DURATION IN WEEKS, IF MORE THAN 6 DAYS)

SECONDARY QUESTIONS

IF YES ASK:

DATE	In what month and year did you first notice this?
DURATION	About how long did it last? (How many days or weeks?)
PRESENT CONDITION	Do you still have this condition?

QUESTION	RESPONSE	DATE	DURATION	PRESENT CONDITION
1. Did you have unexplained pain or stiffness in your neck?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
2. Did you notice any changes in your eyesight?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
3. In the last five years, have you ever had droopy eyelids, blurring of vision, or double vision?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
4. Have you had complete or partial loss of vision in one or both eyes?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
5. Have you noticed any change in your hearing?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
6. Have you had ringing or noise in your ears?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
7. Have you ever had difficulty speaking?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK

QUESTION	RESPONSE	DATE	DURATION	PRESENT CONDITION
8. Since 1971, have you had difficulty swallowing?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
9. Did you have frequent spells when you felt sick to your stomach?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
10. Did you have frequent vomiting?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
11. Did you lose your balance or stagger?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
12. Were there times when you had difficulty walking?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
13. Did you have spells of dizziness?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
14. In the last five years, have you fainted or "blacked out" (lost consciousness)?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
15. Did you have a convulsion or seizure?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
16. Did you have spells of uncontrollable tension or nervousness?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK

QUESTION	RESPONSE	DATE	DURATION	PRESENT CONDITION
17. Did you have difficulty getting to sleep or trouble staying asleep?	1 ☐ YES 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
18. Did you often feel drowsy or sleepy during the day?	1 ☐ YES 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
19. Did you have trouble with your memory or thinking ability?	1 ☐ YES 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
20. Was any part of your body paralyzed in the last five years?	1 ☐ YES 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
21. Did you notice any unexplained numbness or tingling in your hands or feet?	1 ☐ YES 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
22. Did you have trouble with your coordination?	1 ☐ YES 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
23. Did you experience muscle weakness or wasting of muscles?	1 ☐ YES 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
24. Did you frequently feel fatigued and without energy?	1 ☐ YES 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
25. Did you notice any change in your handwriting?	1 ☐ YES 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK

QUESTION	RESPONSE	DATE	DURATION	PRESENT CONDITION
26. Did you have spells of unexplained sweating?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
27. Did you have difficulty with urination?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
28. Did you have an unexplained weight loss or weight gain of more than five pounds?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
29. Have you had a decreased interest in sex?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
30. Did you have frequent headaches?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	☐☐ DAYS ☐☐ WKS 8 ☐ DK	1 ☐ YES 2 ☐ NO 8 ☐ DK
31. Have you been under the care of a psychiatrist in the last five years? When was this?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	MO ☐☐ YR ☐☐	DOCTOR _____ CITY _____ STATE _____	
32. During the last five years, have you taken any medicines prescribed by a doctor?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	What kind of medicines? Anything else? SPECIFY MEDICINE _____ _____ ☐☐☐		
33. During this time, did you have any special tests or examinations of the nervous system?	1 ☐ YES → 2 ☐ NO 8 ☐ DK	What kind of tests? SPECIFY TESTS _____ _____ ☐☐☐ DOCTOR _____ CITY _____ STATE _____		

Appendix H

Form Approved
OMB No. 68-R1005

VELSICOL PESTICIDE STUDY
NERVE CONDUCTION & LATENCY TESTING

NERVE	TESTED	SKIN TEMPERATURE (°C)			LATENCY (m-sec)			AMPLITUDE	DISTANCE (CM)	NCV	STANDARDIZED VELOCITY
		PROXIMAL	DISTAL	AVERAGE	PROXIMAL	DISTAL	TERMINAL DISTANCE	SENSORY (μV) MOTOR (MV)			
MEDIAN MOTOR (RECORD APB)	YES:___ NO:___				(Stimulate Below Elbow)	(Stimulate Wrist)					
MEDIAN SENSORY (13 CM)	YES:___ NO___										
ULNAR MOTOR (RECORD ADM)	YES:___ NO.___				(Stimulate Below Elbow)	(Stimulate Wrist)					
ULNAR SENSORY (11 CM)	YES:___ NO:___										
PERONEAL MOTOR (RECORD EDB)	YES:___ NO:___				(Stimulate Below Fibular Head)	(Stimulate Ankle)					
POST TIBIAL MOTOR (RECORD AH)	YES:___ NO:___				(Stimulate Knee)	(Stimulate Medial Malleolus)					
SURAL SENSORY Upr sec.	YES:___ NO:___										
SURAL SENSORY Lwr. sec.	YES:___ NO:___										

COMMENTS:

CDC/NIOSH(C) TF 2.14D
12/76 EXP. 4-15-76

TECHNICIAN _____
PHYSICIAN _____ DATE _____
KELSEY-SEYBOLD CLINIC

Appendix H (Cont'd.)

Form Approved
OMB No. 68-R1009

VELSICOL PESTICIDE STUDY
ELECTROMYOGRAPHY

EMG MUSCLE	TESTED	INSERTIONAL ACTIVITY	POSITIVE WAVE	FASCICULATIONS	FIBRILLATIONS	ABNORMAL MOTOR UNIT POTENTIALS				FIRING PATTERN	COMMENTS
Unit		1 = NORMAL 2 = DECREASED 3 = INCREASED	0 1+ 2+ 3+ 4+	0 1+ 2+ 3+ 4+	0 1+ 2+ 3+ 4+	1 = NORMAL 2 = ABNORMAL	1 = NORMAL 2 = DECREASED 3 = INCREASED Amplitude	Duration	Polyphasics	0-Full interference 1-Non-Specific Reduction 2-Diminished Recruitment 3-Single Unit 4-No Units Under Voluntary Control 5-Pattern Consistent With Lack of Voluntary Effort	
Extensor Digitorum Brevis	Yes:___ No:___										
Abductor Hallucis	Yes:___ No:___										
Tibialis Anterior	Yes___ No:___										
Gastrocnemius	Yes___ No:___										
Quadriceps	Yes:___ No___										
Abductor Pollicis Brevis	Yes:___ No:___										
First Dorsal Interosseus	Yes:___ No___										

Multiple Muscle Involvement Yes ___ No ___

CDC/NIOSH (C) TF 2.14H
12/76 4-15-77 EXP.

TECHNICIAN _____
PHYSICIAN _____ DATE _____
KELSEY-SEYBOLD CLINIC

Appendix I

NORMAL VALUES
(KELSEY-SEYBOLD CLINIC)

I. MOTOR	STIMULATE	RECORD	LATENCY	AMPLITUDE (Negative deflection)	CONDUCTION VELOCITY
MEDIAN	Wrist	Thenar	<4.6 msec	>4 mV	>49 M/sec
ULNAR	Wrist	Hypothenar	<3.5	>6	>47
	ERBS to midarm segment a) distance by Calipers				>50
	b) distance by Tape Measure				>58
RADIAL	6 cm above epicondyle	Brachio-radials	<4.0		>60
AXILLARY	ERBS	Deltoid (15 cm from ERBS)	<4.8		
PERONEAL	Knee	EDB	<7.3	>2	>41
TIBIAL	Knee	ADQ	<6.5		>41
	Knee	Abd. Hall.	<5.7	>6	>41
FEMORAL	Above Ing. Lig.	Vast. Med.	<8.4		>59
	Below Ing. Lig.	Vast. Med.	<7.5		>59
II. SENSORY					
MEDIAN	Digital	Wrist	<3.3 (40 y/o) <3.8 (75 y/o)		
ULNAR	Digital	Wrist 10 cm 12 cm	<2.8 <3.1		
RADIAL	Thumb	Radius	<2.8		
SURAL	14 cm	Lat. Mall.	<4.0		

III. FACIAL

	LATENCY	DIFFERENCE R-L
1.) DIRECT	<4.0 msec	<0.6 msec
2.) EARLY REFLEX	<13.1	<1.2
3.) LATE REFLEX	<43	<5

Appendix J

Normal Values

(St. Luke's Episcopal Hospital)

I. Motor

	Record	Latency	Amplitude	Conduction Velocity
Median	Thenar	<4.6 ms	>4 mv	50-65 M/sec
Ulnar	Hypothenar	<3.5 ms	>4 mv	49-65 M/sec
Peroneal	EDB	<6.5 ms	>2 mv	40-55 M/sec
Tibial	AHB ADQ	<7.0 ms (12cm) <7.3 ms (19cm)	>2 mv	42-55 M/sec

II. Sensory

Median	Wrist 13 cm (F-1→W	<3.5 ms to peak	
Ulnar	Wrist 11 cm (F-5→W)	<3.0 ms to peak	
Sural	Ankle 14 & 21 cm distances	<1.8 ms per segment	>5 μv at 21 cm

Appendix K

FORM APPROVED
OMB No. 68-R1009

Department of Health, Education and Welfare
Public Health Service
Center for Disease Control
National Institute for Occupational Safety and Health

VELSICOL

REPRODUCTIVE HISTORY QUESTIONNAIRE

CDC/NIOSH(C) TF 2.14 L
12/76 EXP. 4-15-77

INTERVIEWER: ☐☐

DATE OF INTERVIEW: ☐☐ – ☐☐ – ☐☐
MO DAY YR

LABEL

SUBJECT IDENTIFICATION

CASE NO. ☐☐☐☐ ☐

LAST NAME: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

FIRST NAME: ☐☐☐☐☐☐☐☐☐☐☐☐

MIDDLE INITIAL: ☐

ADDRESS: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

CITY: ☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐☐

STATE: ☐☐ ZIP CODE: ☐☐☐☐☐

PERSONAL DATA

1. TELEPHONE: ☐☐☐ – ☐☐☐ – ☐☐☐☐
AREA CODE

2. RACE/ETHNIC CODE: ☐
   1. White, not of Hispanic Origin
   2. Black, not of Hispanic Origin
   3. Hispanic
   4. American Indian or Alaskan Native
   5. Asian or Pacific Islander
   6. Other

3. SEX: 1. Male 2. Female ☐

4. What is your date of birth? (month/day/year) ☐☐ – ☐☐ – ☐☐

5. What is the last grade of school you completed? ☐☐

   ELEMENTARY = 01 – 08 SECONDARY = 09 – 12 COLLEGE = 13 (1 year)
   14 (2 years)
   15 (3 years)
   16 (4 years)
   17 (5 years)
   18 (6 years)
   19 (7 or more years)

6. Under federal law, people participating in our surveys DO NOT have to tell us their social security number. However it is very useful and helps us do follow-up studies. May I have your social security number?

   REFUSAL: 2 ☐

   SOCIAL SECURITY NUMBER: ☐☐☐ – ☐☐ – ☐☐☐☐

OCCUPATIONAL HISTORY

Now I'm going to ask you about the jobs you've held, since you started working regularly. I'd like to begin with your present job, here at _____ and go back to your first job.

POSITIONS WITH CURRENT EMPLOYER

1. In what year did you start working here?

_____

2. What department do/did you work in?
3. What is (was) your occupation or job title?
4. What exactly is (was) your main job or activity?
   (What kind of work do you do most of the time?)
5. How many years have you had (did you have) this job?
6. Have you held any other jobs at_____?
   (IF YES: REPEAT Q.'s 2, 3, 4 and 5;

_____

REPEAT QUESTION 6 UNTIL UNPRODUCTIVE)

YEAR STARTED 19____			
DEPARTMENT	JOB TITLE	WORK DESCRIPTION	TENURE YEARS

OCCUPATION CONT'D

7. Now; where did you work before you started working for _____ ?
8. What kind of company (was) is it; what do they (did) do there?
9. In what year did you start working there?
10. And, in what year did you stop working there?
11. What was your occupation or job title?
12. What exactly was your main job or activity?
    (What kind of work did you do most of the time?)
13. Did you work in any area where you were exposed to dust, fumes, gases, chemicals, or other substances?

    IF YES: 14. What were you exposed to? _____
    (REPEAT Q.'s 8-13 FOR EACH JOB. REPEAT Q. 7 UNTIL YOU ASCERTAIN THAT YOU HAVE RECORDED ALL OF THE SUBJECTS JOBS)

EMPLOYER	TYPE OF COMPANY	NO. YRS. FROM/TO	JOB TITLE	WORK DESCRIPTION	EXPOSURE

CONTROLS

Now I'm going to read you a list of health conditions which can only be diagnosed by a doctor. Have you ever been told by a doctor that you had any of the following conditions?

Secondary Questions

READ EACH PHRASE OR TERM MARKED WITH ●●. USE THE FOLLOWING SECONDARY QUESTIONS TO OBTAIN THE REQUIRED INFORMATION.

FOR DATE: "In what year were you first told about this condition?"

FOR TREATMENT: "What kind of treatment or medicine were you given?"

FOR CODING A TYPE OF CONDITION: "What kind of _____ ?
(EXAMPLE: "What kind of kidney condition?")

●●1. ANEMIA ..... 1 ☐ YES 2 ☐ NO IF YES: 19 ☐☐

●●2. SUGAR DIABETES 2 ☐ YES 2 ☐ NO IF YES: 19 ☐☐

●●3. THYROID CONDITION ..... 1 ☐ YES 2 ☐ NO IF YES: 19 ☐☐ TREATMENT _____

●●4. EPILEPSY ..... 1 ☐ YES 2 ☐ NO IF YES: 19 ☐☐ TREATMENT _____

●●5. ANY KIDNEY CONDITION OR BLADDER INFECTION 1 ☐ YES 2 ☐ NO

IF YES: CONDITION CODE → DATE 19 ☐☐

1 ☐ Urinary or bladder infection
2 ☐ Kidney stones
3 ☐ Other: Specify _____

●●6. ANY LIVER DISEASE OR CONDITION 1 ☐ YES 2 ☐ NO IF YES: CONDITION CODE

1 ☐ Hepatitus or yellow jaundice
2 ☐ Cirrhosis or scarring of liver
3 ☐ Enlarged liver
4 ☐ Other: Specify

DATE 19 ☐

●●7. ANY TYPE OF CANCER 1 ☐ YES 2 ☐ NO

IF YES: CONDITION CODE

1 ☐ Bone	7 ☐ Hodgkin's disease	13 ☐ Skin
2 ☐ Bowel	8 ☐ Kidney	14 ☐ Stomach
3 ☐ Brain	9 ☐ Leukemia	15 ☐ Throat
4 ☐ Breast	10 ☐ Lymphoma	16 ☐ Uterus
5 ☐ Cervix	11 ☐ Lung	17 ☐ Other cancer
6 ☐ Esophagus	12 ☐ Rectum	Specify _____

→ DATE: 19 ☐☐

●●8. ANY KIND OF HEART CONDITION 1 ☐ YES 2 ☐ NO

IF YES: Specify Type of Heart Condition _____

→ DATE: 19 ☐☐

In this part of the interview, I'll be asking you about your social habits.

SMOKING HISTORY

1. Do you now smoke cigarettes? . . . . . 1 ☐ YES 2 ☐ NO

IF NO:

2. Have you ever smoked cigarettes? . . . . . 1 ☐ YES 2 ☐ NO

IF NO TO Q. 1 AND Q. 2: GO TO NEXT SECTION

ASK EX-SMOKERS:

3. How old were you when you gave up smoking cigarettes? . . . . . ☐☐ AGE 8 ☐ DK

4. How old were you when you started smoking cigarettes regularly? . . . . . ☐☐ AGE 8 ☐ DK

6 ☐ NEVER REGULARLY

5. On the average, how many cigarettes do/did you smoke a day? . . . . . ☐☐ CIG/DAY 8 ☐ DK

6. Do/did you inhale the cigarette smoke? . . . . . 1 ☐ YES 2 ☐ NO 8 ☐ DK

ALCOHOL CONSUMPTION

1. Have you drunk as many as 20 alcoholic beverages in your entire life? . . . . . 1 ☐ YES 2 ☐ NO

IF NO: GO TO NEXT SECTION

2. Do you now drink alcoholic beverages? . . . . . 1 ☐ YES 2 ☐ NO

IF NO:

3. How old were you when you gave up drinking? . . . . . ☐☐ AGE 8 ☐ DK

4. How old were you when you first started drinking? . . . . . AGE 8 ☐ DK

5. On the average, how many beers do you drink per day? . . . . . ☐☐ BEER/DAY ☐☐ BEER/WK

(IF DOES NOT DRINK A BEER PER DAY ASK: "HOW MANY PER WEEK") 7 ☐ LESS 1/WK 8 ☐ DK

6. About how many bottles of wine do you drink per week? . . . . . ☐☐ WINE/WK ☐☐ WINE/MO

7 ☐ LESS/1 MO 8 ☐ DK

7. About how many cocktails or drinks of other liquor do you have per week? . . . ☐☐ DRINKS/WK ☐☐ DRINKS

7 ☐ LESS/1 MO 8 ☐ DK

MENSTRUAL HISTORY

Now I'm going to ask you a few questions about your menstrual periods.

1. How old were you when you had your first menstrual period? ..... ☐☐ AGE 8 ☐ DK

2. Are you still having periods at all? ..... 1 ☐ YES 2 ☐ NO

IF NO:

3. At what age did you have your last period? ..... ☐☐ AGE 8 ☐ DK

4. Did your periods: stop naturally? ..... ☐ 1
   stop due to surgery? ..... ☐ 2
   stop due to radiation? ..... ☐ 3
   stop due to other reason? ..... ☐ 4
   stopped for some unknown reason? ..... ☐ 5

IF "OTHER REASON": Specify _____

IF YES:

5. About how many days are there from the first day of one period to the first day of your next period? ..... ☐☐ DAYS 8 ☐ DK

6. About how many days does your period last, that is until the bleeding completely stops? ..... ☐☐ DAYS 8 ☐ DK

ASK ALL RESPONDENTS

7. Since leaving high school, have you noticed any of the following changes in your menstrual cycle?
   Irregular periods? ..... ☐ 1
   Skipping periods? ..... ☐ 2
   Increased flow? ..... ☐ 3
   Decreased flow? ..... ☐ 4
   Increased pain or cramping? ..... ☐ 5
   Some other change? ..... ☐ 6

IF "OTHER CHANGE": Specify _____

NO CHANGE ..... ☐ 7

IF NO CHANGE: GO TO NEXT SECTION

MENSTRUAL HISTORY (Cont'd)

IF ANY REPORTED CHANGE

8. In what year did you first notice this change? ..... 19 ☐☐ 8 ☐ DK

9. About how long did you have this? ..... ☐☐ MONTHS
☐☐ YEARS
☐ CURRENT
8 ☐ DK

10 When you first noticed this, were you taking birth control pills? 1 ☐ YES 2 ☐ NO

IF YES: 11. About how many months had you been taking the pill? .... ☐☐ MONTHS
8 ☐ DK

IF NOT TAKING THE PILL:

12. Did you have an IUD when you first noticed this change? ..... 1 ☐ YES 2 ☐ NO

IF YES: 13. About how many months had you had your IUD? ..... ☐☐ MONTHS
8 ☐ DK

PART I – PREGNANCY OUTCOME

In this part of the interview, we'll be talking about your family.

1. Have you ever been pregnant? ..... 1 ☐ YES 2 ☐ NO

IF YES: 2. How many times have you been pregnant? ..... ☐☐ No. of Preg.

3. Are you now:
married? ..... ☐ 1
divorced? ..... ☐ 2
separated? ..... ☐ 3
widowed? ..... ☐ 4
or have you never been married? ..... ☐ 5

IF NO PREGNANCIES AND NEVER MARRIED
END INTERVIEW

IF EVER MARRIED: 4. How many times have you been married? ☐☐ No. of Marr.

	PRESENT MARRIAGE	MARRIAGE	MARRIAGE
5. In what year were you and your present (2nd, 3rd) husband married?	19 ☐☐	19 ☐☐	19 ☐☐

PART I – PREGNANCY OUTCOME (Cont'd)

	PRESENT MARRIAGE	MARRIAGE	MARRIAGE
IF WIDOWED OR PREVIOUSLY MARRIED: 6. In what year did you stop living together? OR In what year did he pass away?	19 ☐☐	19 ☐☐	19 ☐☐
7. How many times were you pregnant during this marriage?	19 ☐☐ PREG.	19 ☐☐ PREG.	19 ☐☐ PREG.
IF NO PREGNANCIES: 8. Did you and your husband try to have children?	1 ☐ YES 2 ☐ NO	1 ☐ YES 2 ☐ NO	1 ☐ YES 2 ☐ NO
IF NO: GO TO NEXT MARRIAGE			
ASK ALL RESPONDENTS: 9. During this marriage, did you ever see a doctor because you had trouble getting pregnant?	1 ☐ YES 2 ☐ NO	1 ☐ YES 2 ☐ NO	1 ☐ YES 2 ☐ NO
IF YES: 10. What was doctor's diagnosis? CODE: 1 . . . . . Anatomical Defect 2 . . . . . Hormonal/Glandular 3. . . . . Other 4 . . . . . No Reported Abnormality	DIAGNOSIS CODE: ☐ IF "OTHER" (3): Specify _____ _____	DIAGNOSIS CODE: ☐ IF "OTHER" (3): Specify _____ _____	DIAGNOSIS CODE: ☐ IF "OTHER" (3): Specify _____ _____
11. Did your husband ever see a doctor because you had trouble getting pregnant?	1 ☐ YES 2 ☐ NO	1 ☐ YES 2 ☐ NO	1 ☐ YES 2 ☐ NO
IF YES: 12. What was the doctor's diagnosis? CODE: 1 . . . . . Anatomical Defeat 2 . . . . . Hormonal/Glandular 3 . . . . . Sperm Count 4 . . . . . Impotency 5 . . . . . Other 6 . . . . . No Reported Abnormality	DIAGNOSIS CODE: ☐ IF "OTHER" (5): Specify _____ _____	DIAGNOSIS CODE: ☐ IF "OTHER" (5): Specify _____ _____	DIAGNOSIS CODE: ☐ IF "OTHER" (5): Specify _____ _____

PART II – PREGNANCY OUTCOME

1. How old were you during your first (2nd, 3rd) pregnancy? . . . . . .

2. Did this pregnancy end in a:

   Live Birth? 1
   Miscarriage? 2
   Stillbirth? 3
   OR
   Abortion 4

FOR ABORTION:

3. Did a medical person suggest that you have an abortion? . . . . . .

   IF YES:

   4. What was the reason?

   GO TO NEXT PREGNANCY OR END INTERVIEW

FOR MISCARRIAGE:

5. How many weeks pregnant were you when you miscarried? . . . . . .

6. Did you see a doctor when you miscarried? . . . . . .

   IF YES:

   7. Were you hospitalized? . . . . . .

      IF YES:

      8. What was the name of the hospital? . . . . .

ASK ALL RESPONDENTS (EXCEPT ABORTION)

9. In what month and year:

   Was your baby born?
   OR
   Did you miscarry?

	1st PREGNANCY	2nd PREGNANCY
	1. ☐☐ YES	1. ☐☐ AGE
	2. RESULT OF PREG. CODE: ☐	2. RESULT OF PREG. CODE: ☐
	3. 1 ☐ YES 2 ☐ NO IF YES: Specify 4. _____ _____ 9 ☐ NA	3. 1 ☐ YES 2 ☐ NO IF YES: Specify _____ _____ 9 ☐ NA
	5. ☐☐ WEEKS	5. ☐☐ WEEKS
	6. 1 ☐ YES 2 ☐ NO	6. 1 ☐ YES 2 ☐ NO
	7. 1 ☐ YES 2 ☐ NO	7. 1 ☐ YES 2 ☐ NO
	8. NAME OF HOSPITAL _____ _____	8. NAME OF HOSPITAL _____ _____
	9. ☐☐ MONTH ☐☐ YEAR	9. ☐☐ MONTH ☐☐ YEAR

3rd PREGNANCY	4th PREGNANCY	5th PREGNANCY	6th PREGNANCY
1. ☐☐ YES	1. ☐☐ AGE	1. ☐☐ YES	1. ☐☐ AGE
2. RESULT OF PREG. CODE: ☐	2. RESULT OF PREG. CODE: ☐	2. RESULT OF PREG. CODE: ☐	2. RESULT OF PREG. CODE: ☐
3. 1 ☐ YES 2 ☐ NO IF YES: Specify 4. _____ _____ 9 ☐ NA	3. 1 ☐ YES 2 ☐ NO IF YES: Specify _____ _____ 9 ☐ NA	3. 1 ☐ YES 2 ☐ NO IF YES: Specify 4. _____ _____ 9 ☐ NA	3. 1 ☐ YES 2 ☐ NO IF YES: Specify _____ _____ 9 ☐ NA
5. ☐☐ WEEKS	5. ☐☐ WEEKS	5. ☐☐ WEEKS	5. ☐☐ WEEKS
6. 1 ☐ YES 2 ☐ NO	6. 1 ☐ YES 2 ☐ NO	6. 1 ☐ YES 2 ☐ NO	6. 1 ☐ YES 2 ☐ NO
7. 1 ☐ YES 2 ☐ NO	7. 1 ☐ YES 2 ☐ NO	7. 1 ☐ YES 2 ☐ NO	7. 1 ☐ YES 2 ☐ NO
8. NAME OF HOSPITAL _____ _____	8. NAME OF HOSPITAL _____ _____	8. NAME OF HOSPITAL _____ _____	8. NAME OF HOSPITAL _____ _____
9. ☐☐ MONTH ☐☐ YEAR	9. ☐☐ MONTH ☐☐ YEAR	9. ☐☐ MONTH ☐☐ YEAR	9. ☐☐ MONTH ☐☐ YEAR

ASK ALL RESPONDENTS (EXCEPT ABORTION)
(Cont'd)

	1st PREGNANCY	2nd PREGNANCY
10. In what city and state: Was your baby born? OR Did you miscarry?	10. CITY_____ STATE ☐☐	10. CITY_____ STATE ☐☐
11. Who was your doctor?	11. DOCTOR'S NAME _____	11. DOCTOR'S NAME _____

FOR MISCARRIAGE TO TO Q. 22

	1st PREGNANCY	2nd PREGNANCY
12. Was your baby born in a hospital?	12. 1 ☐ YES 2 ☐ NO	12. 1 ☐ YES 2 ☐ NO
IF YES: 13. What was the name of the hospital?	13. HOSPITAL _____	13. HOSPITAL _____
FOR STILLBIRTH GO TO Q. 22		
14. Was it a boy or a girl?	14. SEX: 1 ☐ M 2 ☐ F	14. SEX: 1 ☐ M 2 ☐ F
15. How much did he/she weigh at birth?	15. ☐☐ LBS. ☐☐ OZS.	15. ☐☐ LBS. ☐☐ OZS.
16. Did your doctor say your baby was born: . . . . . . Early? . . . . . 1 Late? . . . . . 2 OR On time . . . . . 3 IF EARLY OR LATE: 17. How many weeks early/late?	16. 1 ☐ EARLY 2 ☐ LATE 3 ☐ ON TIME 17 ☐☐ WEEKS	16. 1 ☐ EARLY 2 ☐ LATE 3 ☐ ON TIME 17. ☐☐ WEEKS
18. Was he/she born with any birth malformations?	18. 1 ☐ YES 2 ☐ NO	18. 1 ☐ YES 2 ☐ NO
IF YES: 19. What type of birth malformation?	19. MALFORMATIONS 20 _____	19. MALFORMATIONS 20. _____
20. Were there any other birth malformations?		

3rd PREGNANCY	4th PREGNANCY	5th PREGNANCY	6th PREGNANCY
10. CITY_____ STATE ☐☐☐	10. CITY_____ STATE ☐☐☐	10. CITY_____ STATE ☐☐☐	10. CITY_____ STATE ☐☐☐
11. DOCTOR'S NAME	11. DOCTOR'S NAME	11. DOCTOR'S NAME	11. DOCTOR'S NAME

3rd PREGNANCY	4th PREGNANCY	5th PREGNANCY	6th PREGNANCY
12. 1 ☐ YES 2 ☐ NO	12. 1 ☐ YES 2 ☐ NO	12. 1 ☐ YES 2 ☐ NO	12. 1 ☐ YES 2 ☐ NO
13. HOSPITAL	13. HOSPITAL	13. HOSPITAL	13. HOSPITAL
14. SEX: 1 ☐ M 2 ☐ F	14. SEX: 1 ☐ M 2 ☐ F	14. SEX: 1 ☐ M 2 ☐ F	14. SEX: 1 ☐ M 2 ☐ F
15. ☐☐ LBS. ☐☐ OZS.	15. ☐☐ LBS. ☐☐ OZS.	15. ☐☐ LBS. ☐☐ OZS.	15. ☐☐ LBS. ☐☐ OZS.
16. 1 ☐ EARLY 2 ☐ LATE 3 ☐ ON TIME	16. 1 ☐ EARLY 2 ☐ LATE 3 ☐ ON TIME	16. 1 ☐ EARLY 2 ☐ LATE 3 ☐ ON TIME	16. 1 ☐ EARLY 2 ☐ LATE 3 ☐ ON TIME
17 ☐☐ WEEKS	17. ☐☐ WEEKS	17 ☐☐ WEEKS	17. ☐☐ WEEKS
18. 1 ☐ YES 2 ☐ NO	18. 1 ☐ YES 2 ☐ NO	18. 1 ☐ YES 2 ☐ NO	18. 1 ☐ YES 2 ☐ NO
19. MALFORMATIONS 20 _____	19. MALFORMATIONS 20. _____	19. MALFORMATIONS 20 _____	19. MALFORMATIONS 20. _____

PART II – PREGNANCY OUTCOME (Cont'd)

	1st PREGNANCY	2nd PREGNANCY
21. Does he/she now have any problem with mental retardation?	21. 1 ☐ YES 2 ☐ NO	21. 1 ☐ YES 2 ☐ NO
• 22. During this pregnancy, were you regularly taking any medicines prescribed by a doctor or other health practioner?	22. 1 ☐ YES 2 ☐ NO	22. 1 ☐ YES 2 ☐ NO
IF YES: 23. What mediciens were you taking?	23. MEDICINES _____	23. MEDICINES _____
24. What about nonprescription medicines? Things that anyone can buy at the drug store or grocery.	24. 1 ☐ YES 2 ☐ NO	24. 1 ☐ YES 2 ☐ NO
IF YES: 25. What were you taking?	25. NONPRESCRIPTION _____ _____	25. NONPRESCRIPTION _____ _____

	1st PREGNANCY	2nd PREGNANCY
26. Were you a bed patient at home or in a hospital, at any time during your pregnancy? (DO NOT COUNT DELIVERY OF BABY)	26. 1 ☐ YES 2 ☐ NO	26. 1 ☐ YES 2 ☐ NO
IF YES: 27. What was the reason?	27. CAUSE _____	27. CAUSE _____
28. During this pregnancy, did you have any (any other) accidents or injuries? Things like falls or auto accidents.	28. 1 ☐ YES 2 ☐ NO	28. 1 ☐ YES 2 ☐ NO
IF YES: 29. What kind of injury?	29. INJURY _____	29. INJURY _____

3rd PREGNANCY	4th PREGNANCY	5th PREGNANCY	6th PREGNANCY
21. 1 ☐ YES 2 ☐ NO	21. 1 ☐ YES 2 ☐ NO	21. 1 ☐ YES 2 ☐ NO	21. 1 ☐ YES 2 ☐ NO
22. 1 ☐ YES 2 ☐ NO	22. 1 ☐ YES 2 ☐ NO	22. 1 ☐ YES 2 ☐ NO	22. 1 ☐ YES 2 ☐ NO
23. MEDICINES _____	23. MEDICINES _____	23. MEDICINES _____	23. MEDICINES _____
24. 1 ☐ YES 2 ☐ NO	24. 1 ☐ YES 2 ☐ NO	24. 1 ☐ YES 2 ☐ NO	24. 1 ☐ YES 2 ☐ NO
25. NONPRESCRIPTION _____ _____	25. NONPRESCRIPTION _____ _____	25. NONPRESCRIPTION _____ _____	25. NONPRESCRIPTION _____ _____

3rd PREGNANCY	4th PREGNANCY	5th PREGNANCY	6th PREGNANCY
26. 1 ☐ YES 2 ☐ NO	26. 1 ☐ YES 2 ☐ NO	26. 1 ☐ YES 2 ☐ NO	26. 1 ☐ YES 2 ☐ NO
27. CAUSE _____	27. CAUSE _____	27. CAUSE _____	27. CAUSE _____
28. 1 ☐ YES 2 ☐ NO	28. 1 ☐ YES 2 ☐ NO	28. 1 ☐ YES 2 ☐ NO	28. 1 ☐ YES 2 ☐ NO
29. INJURY _____	29. INJURY _____	29. INJURY _____	29. INJURY _____

PART II – PREGNANCY OUTCOME
(Cont'd)

	1st PREGNANCY	2nd PREGNANCY
30. As a result of your accident/injury, did you see a doctor?	30. 1 ☐ YES 2 ☐ NO	30. 1 ☐ YES 2 ☐ NO
31. While you were pregnant, did you have any kind of X-ray?	31. 1 ☐ YES 2 ☐ NO 8 ☐ DK	31. 1 ☐ YES 2 ☐ NO 8 ☐ DK
(IF DON'T KNOW OR NO:) What about a dental or chest x-ray? IF YES: 32. What kind of x-ray?	32. TYPE X-RAY _____	32. TYPE OF X-RAY _____
33. Why were you x-rayed?	33. REASON X-RAYED _____ _____	33. REASON X-RAYED? _____ _____
34. During the 12 months before this pregnancy, were you using any type of birth control? IF YES: 35. What kind of birth control?	34. 1 ☐ YES 2 ☐ NO 3 ☐ DK	34. 1 ☐ YES 2 ☐ NO 3 ☐ DK
	35. 1 ☐ PILL 2 ☐ IUD 3 ☐ DIAPHRAM 4 ☐ OTHER	35. 1 ☐ PILL 2 ☐ IUD 3 ☐ DIAPHRAM 4 ☐ OTHER

	1st PREGNANCY	2nd PREGNANCY
IF USED THE PILL: 37. Were you taking the pill when you become pregnant OR after you become pregnant? IF WHEN: 38. About how long was it between the time you stopped taking the pill and the time you became pregnant?	37. 1 ☐ WHEN 2 ☐ AFTER	37. 1 ☐ WHEN 2 ☐ AFTER
	38. ☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK	☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK

3rd PREGNANCY	4th PREGNANCY	5th PREGNANCY	6th PREGNANCY
30. 1 ☐ YES 2 ☐ NO	30. 1 ☐ YES 2 ☐ NO	30. 1 ☐ YES 2 ☐ NO	30. 1 ☐ YES 2 ☐ NO
31. 1 ☐ YES 2 ☐ NO 8 ☐ DK	31. 1 ☐ YES 2 ☐ NO 8 ☐ DK	31. 1 ☐ YES 2 ☐ NO 8 ☐ DK	31. 1 ☐ YES 2 ☐ NO 8 ☐ DK
32. TYPE X-RAY _____	32. TYPE OF X-RAY _____	32. TYPE X-RAY _____	32. TYPE OF X-RAY _____
33 REASON X-RAYED _____ _____	33. REASON X-RAYED? _____ _____	33. REASON X-RAYED _____ _____	33. REASON X-RAYED? _____ _____
34. 1 ☐ YES 2 ☐ NO 3 ☐ DK	34. 1 ☐ YES 2 ☐ NO 3 ☐ DK	34. 1 ☐ YES 2 ☐ NO 3 ☐ DK	34. 1 ☐ YES 2 ☐ NO 3 ☐ DK
35. 1 ☐ PILL 2 ☐ IUD 3 ☐ DIAPHRAM 4 ☐ OTHER	35. 1 ☐ PILL 2 ☐ IUD 3 ☐ DIAPHRAM 4 ☐ OTHER	35. 1 ☐ PILL 2 ☐ IUD 3 ☐ DIAPHRAM 4 ☐ OTHER	35. 1 ☐ PILL 2 ☐ IUD 3 ☐ DIAPHRAM 4 ☐ OTHER

3rd PREGNANCY	4th PREGNANCY	5th PREGNANCY	6th PREGNANCY
37. 1 ☐ WHEN 2 ☐ AFTER	37. 1 ☐ WHEN 2 ☐ AFTER	37. 1 ☐ WHEN 2 ☐ AFTER	37. 1 ☐ WHEN 2 ☐ AFTER
38. ☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK	☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK	38. ☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK	☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK

PART II – PREGNANCY OUTCOME (Cont'd)

	1st PREGNANCY	2nd PREGNANCY
IF HAD AN IUD:		
39. Did you have your IUD removed BEFORE or AFTER you became pregnant?	39. 1 ☐ BEFORE 2 ☐ AFTER 8 ☐ DK	39. 1 ☐ BEFORE 2 ☐ AFTER 8 ☐ DK
40. How about how long before/after you became pregnant?	40. ☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK	40. ☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK
41. Thinking back to around the time when you became pregnant, were you given any pills or or injections to start your period?	41. 1 ☐ YES 2 ☐ NO 8 ☐ DK	41. 1 ☐ YES 2 ☐ NO 8 ☐ DK
42. While you were pregnant, were you given any medicines to prevent miscarriage?	42. 1 ☐ YES 2 ☐ NO 8 ☐ DK	42. 1 ☐ YES 2 ☐ NO 8 ☐ DK
43. Did you work outside the home at any time during your pregnancy?	43. 1 ☐ YES 2 ☐ NO	43. 1 ☐ YES 2 ☐ NO
IF YES: 44. During which months of your pregnancy?	44. 1 ☐ 1-3 2 ☐ 4-6 3 ☐ 7-9 8 ☐ DK	44. 1 ☐ 1-3 2 ☐ 4-6 3 ☐ 7-9 8 ☐ DK
45. In what month of your pregnancy did you stop working?	45. ☐ MONTH 8 ☐ DK	45. ☐ MONTH 8 ☐ DK

	1st PREGNANCY	2nd PREGNANCY
46. During this pregnancy, did you have any illnesses where you had a fever or a rash?	46. 1 ☐ YES 2 ☐ NO 8 ☐ DK	46. 1 ☐ YES 2 ☐ NO 8 ☐ DK
IF YES: 47. What kind of illness?	47. ILLNESS _____	47. ILLNESS _____

3rd PREGNANCY	4th PREGNANCY	5th PREGNANCY	6th PREGNANCY
39. 1 ☐ BEFORE 2 ☐ AFTER 8 ☐ DK	39. 1 ☐ BEFORE 2 ☐ AFTER 8 ☐ DK	39. 1 ☐ BEFORE 2 ☐ AFTER 8 ☐ DK	39. 1 ☐ BEFORE 2 ☐ AFTER 8 ☐ DK
40. ☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK	40. ☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK	40. ☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK	40. ☐☐ WEEKS ☐☐ MONTHS 8 ☐ DK
41. 1 ☐ YES 2 ☐ NO 8 ☐ DK	41. 1 ☐ YES 2 ☐ NO 8 ☐ DK	41. 1 ☐ YES 2 ☐ NO 8 ☐ DK	41. 1 ☐ YES 2 ☐ NO 8 ☐ DK
42. 1 ☐ YES 2 ☐ NO 8 ☐ DK	42. 1 ☐ YES 2 ☐ NO 8 ☐ DK	42. 1 ☐ YES 2 ☐ NO 8 ☐ DK	42. 1 ☐ YES 2 ☐ NO 8 ☐ DK
43. 1 ☐ YES 2 ☐ NO	43. 1 ☐ YES 2 ☐ NO	43. 1 ☐ YES 2 ☐ NO	43. 1 ☐ YES 2 ☐ NO
44. 1 ☐ 1-3 2 ☐ 4-6 3 ☐ 7-9 8 ☐ DK	44. 1 ☐ 1-3 2 ☐ 4-6 3 ☐ 7-9 8 ☐ DK	44. 1 ☐ 1-3 2 ☐ 4-6 3 ☐ 7-9 8 ☐ DK	44. 1 ☐ 1-3 2 ☐ 4-6 3 ☐ 7-9 8 ☐ DK
45. ☐ MONTH 8 ☐ DK	45. ☐ MONTH 8 ☐ DK	45. ☐ MONTH 8 ☐ DK	45. ☐ MONTH 8 ☐ DK

3rd PREGNANCY	4th PREGNANCY	5th PREGNANCY	6th PREGNANCY
46. 1 ☐ YES 2 ☐ NO 8 ☐ DK	46. 1 ☐ YES 2 ☐ NO 8 ☐ DK	46. 1 ☐ YES 2 ☐ NO 8 ☐ DK	46. 1 ☐ YES 2 ☐ NO 8 ☐ DK
47. ILLNESS _____	47. ILLNESS _____	47. ILLNESS _____	47. ILLNESS _____

PART II – PREGNANCY OUTCOME (Cont'd)

	1st PREGNANCY	2nd PREGNANCY
48. Can you remember having any (any other) infections, contagious diseases, or any thing like that?	48. 1 ☐ YES 2 ☐ NO 8 ☐ DK	48. 1 ☐ YES 2 ☐ NO 8 ☐ DK
IF IF YES: 49. What was that?	49. ILLNESS _____	49. ILLNESS _____
Anything else?	_____	_____
50. What about high blood pressure or hypertension?	50. 1 ☐ YES 2 ☐ NO 8 ☐ DK	50. 1 ☐ YES 2 ☐ NO 8 ☐ DK
51. While you were pregnant, was your house exterminated to get rid of termites?	51. 1 ☐ YES 2 ☐ NO 8 ☐ DK	51. 1 ☐ YES 2 ☐ NO 8 ☐ DK
IF YES: 52. Who treated the house?	52. 1 ☐ PRO 2 ☐ SELF/OTHER 8 ☐ DK	52. 1 ☐ PRO 2 ☐ SELF/OTHER 8 ☐ DK
53. What kind of chemical was used?	53. 8 ☐ DK CHEMICAL	53. 8 ☐ DK CHEMICAL

FAMILY HISTORY

The next few questions are about members of your family and their health.

1. Have you ever been told by a doctor that any of your children had cancer? . . . . . 1 ☐ YES 2 ☐ NO

(RECORD RESPONSES TO THE SECONDARY QUESTIONS IN THE TABLE BELOW)

IF YES:

2. What kind of cancer?
3. How old was the child when you first learned about this condition?
4. Have any of your other children had cancer?

	TYPE OF CANCER	AGE AT ONSET
1.		
2.		

3rd PREGNANCY	4th PREGNANCY	5th PREGNANCY	6th PREGNANCY
48. 1 ☐ YES 2 ☐ NO 8 ☐ DK	48. 1 ☐ YES 2 ☐ NO 8 ☐ DK	48. 1 ☐ YES 2 ☐ NO 8 ☐ DK	48. 1 ☐ YES 2 ☐ NO 8 ☐ DK
49. ILLNESS _____ _____	49. ILLNESS _____ _____	49. ILLNESS _____ _____	49. ILLNESS _____ _____
50. 1 ☐ YES 2 ☐ NO 8 ☐ DK	50. 1 ☐ YES 2 ☐ NO 8 ☐ DK	50. 1 ☐ YES 2 ☐ NO 8 ☐ DK	50. 1 ☐ YES 2 ☐ NO 8 ☐ DK
51. 1 ☐ YES 2 ☐ NO 8 ☐ DK	51. 1 ☐ YES 2 ☐ NO 8 ☐ DK	51. 1 ☐ YES 2 ☐ NO 8 ☐ DK	51. 1 ☐ YES 2 ☐ NO 8 ☐ DK
52. 1 ☐ PRO 2 ☐ SELF/OTHER 8 ☐ DK	52. 1 ☐ PRO 2 ☐ SELF/OTHER 8 ☐ DK	52. 1 ☐ PRO 2 ☐ SELF/OTHER 8 ☐ DK	52. 1 ☐ PRO 2 ☐ SELF/OTHER 8 ☐ DK
53. 8 ☐ DK CHEMICAL	53. 8 ☐ DK CHEMICAL	53. 8 ☐ DK CHEMICAL	53. 8 ☐ DK CHEMICAL

FAMILY HISTORY
(Cont'd)

4. Are all of your children living? ..... 1 ☐ YES 2 ☐ NO

(RECORD RESPONSES TO SECONDARY QUESTIONS IN THE TABLE BELOW)

IF YES:

5. In what year did the child pass away?

6. What was the cause of death?

7. How old was he/she?

8. Are all of your other children living?

	YEAR OF DEATH	CAUSE OF DEATH	AGE
1.	19		
2.	19		

9. Did your mother have any miscarriages or stillbirth? ..... 1 ☐ YES/MISCARRIAGES
2 ☐ YES/STILLBIRTHS
3 ☐ YES/MISCARRIAGE & STILL.
4 ☐ NONE
8 ☐ DK

10. If you have sisters, have any of them had any miscarriages or stillbirths? ..... 1 ☐ YES/MISCARRIAGES
2 ☐ YES/STILLBIRTHS
3 ☐ YES/MISCARRIAGE & STILL.
4 ☐ NO STILLBIRTHS/MISCARRIAGES
5 ☐ NO SISTERS
8 ☐ DK

11. If you have any brothers, have any of their wives had any miscarriages or stillbirths? ..... 1 ☐ YES/MISCARRIAGES
2 ☐ YES/STILLBIRTHS
3 ☐ NO MISCARRIAGES/STILLBIRTHS
4 ☐ NO BROTHERS
8 ☐ DK

FAMILY HISTORY
(Cont'd)

12. Does any member of your family, including aunts, cousins, and grandparents, have a child with any of the following health conditions?. . . . 1 ☐ YES 2 ☐ NO 8 ☐ DK

A birth malformation?
Mental retardation?

OR

Any physical or mental condition requiring special care?

IF YES:

13. What kind of a condition?

14. How about any of your other relatives?

(RECORD RESPONSES IN THE TABLE BELOW. ASK Q. 14. UNTIL UNPRODUCTIVE)

	RELATIONSHIP TO RESPONDENT	CHILD'S HEALTH CONDITION
1.		
2.		
3.		

15. Does any member of your husband's family, have a child with any of these conditions? . . . . . 1 ☐ YES 2 ☐ NO 8 ☐ DK

(IF RESPONDENT DOES NOT UNDERSTAND OR REMEMBER READ LIST IN Q. 12.)

IF YES:

16. What kind of a condition?

17. How about his other relatives?

(RECORD RESPONSES IN THE TABLE BELOW. ASK Q. 17 UNTIL UNPRODUCTIVE. IF RESPONDENT HAS BEEN MARRIED MORE THAN ONCE INDICATE WHICH MARRIAGE; E. G., 1, 2, ETC.)

	RELATIONSHIP TO HUSBAND	CHILD'S HEALTH CONDITION	MARRIAGE NO.
1.			
2.			
3.			

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