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U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 78-95-596

JONAS BROTHERS TAXIDERMY CO.
DENVER, COLORADO

MAY 1979

I. TOXICITY DETERMINATION

It has been determined on the basis of interviews of employees and environmental breathing zone air samples taken on July 5-7, 1978, medical evaluations and biological tests performed August 1-4, 1978, and biological tests performed November 5-7, 1978, that the workers at Jonas Brothers Taxidermy Co., Denver, Colorado, have been exposed to a potential health hazard. This was determined in that on August 1-4, 1978, sixty-seven percent of the workers had elevated hair arsenic levels as compared to a maximum of only one control with a questionable, borderline hair arsenic level.

Depending on the normal level used, urinary phenol levels were elevated. Using the NIOSH normal value, 45% of the worker group had an elevated urinary phenol as compared to 13% of the control group. There was no statistically significant difference between the groups by the Student t-test. These hair arsenic tests indicate an increased exposure to arsenic. The urinary tests indicate elevated exposures to phenol and show the need for improvement of environment exposure and work practices.

Workers were exposed to the carcinogens asbestos and arsenic and also to a suspect carcinogen tetrachloroethylene (perchloroethylene). Long term health effects although not evident at this time cannot be completely discounted.

Personal hygiene and medical surveillance recommendations are provided in Section V of this report for the safe and proper handling of materials and protection of exposed workers.

II. DISTRIBUTION AND AVAILABILITY

Copies of this determination report are currently available upon request from NIOSH, Division of Technical Services, Information Resources and Dissemination Section, 4676 Columbia Parkway,

Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Services (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office, at the Cincinnati address.

Copies of this report have been sent to:

1. Jonas Brothers Taxidermy Co.
2. U.S. Department of Labor/OSHA - Region VIII
3. NIOSH - Region VIII

For the purpose of informing approximately 25 affected employees, a copy of this report shall be posted in a prominent place accessible to the employees for a period of 30 calendar days.

III. INTRODUCTION

Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

This hazard evaluation was requested by three or more workers at Jonas Brothers Taxidermy Co.

IV. HEALTH HAZARD EVALUATION

A. Process Evaluated

This taxidermy shop received skins and skulls of trophy type animals from the continental United States and Alaska, Canada, Africa, and other countries. The skins are stretched over paper forms representing the likeness of the animal being mounted. Ground asbestos is used to mix with plaster and dextrine in order to form a putty mixture. These ingredients are mixed while dry and with little or no ventilation. The asbestos itself is contained in an open vessel where workers use it by the handfuls. When this mixture has hardened, it is often times sanded to achieve proper contours. The resulting dust filters through the air. Since the NIOSH survey, a non-toxic compound has been substituted for asbestos. The animal skins are soaked in arsenic before the mounting process begins. Phenol is also an additive to this solution. During the process of mounting a skin, animal oils and fats are deposited on the animal fur. In order to remove this, the fur is hand rubbed with a mixture of crushed corn cobs and perchloroethylene. This is removed from

the animal's fur by blowing it with air at 60 pounds per square inch (psi). The entire mounting process is done without adequate ventilation.

B. Evaluation Design

All workers were monitored for asbestos, toluene, xylene, perchloroethylene, arsenic, and phenol. Results of environmental data indicated that medical examinations and biological monitoring are necessary.

C. Environmental Evaluation Methods

Asbestos samples were collected on AA filters and analyzed by NIOSH Method P&CAM 239. Perchloroethylene, toluene, and xylene were collected on charcoal tubes and analyzed according to NIOSH Method #127. Arsenic samples were collected on AA filters and analyzed by atomic absorption spectroscopy. Phenol samples were collected using impingers. They were analyzed according to NIOSH Method S-330.

D. Medical Evaluation Methods

The initial medical visit was conducted on July 6, 1978. At that time a tour was taken of the work area along with a description of the taxidermy process.

The work force of taxidermists and finishers at Jonas are a relatively young population except for a few persons who have been there for many years. Most of the workers have been with Jonas Brothers between 1 and 5 years. The worksite is on the third floor of a building in Denver, Colorado. Each worker has a bench - work station at which he works except for the times he uses a specialized instrument such as a saw or grinder which all the taxidermists share. In the areas were open bins of asbestos and fibrous glass. The floor and work tables were dusty with material identified by workers as arsenic, fibrous glass, asbestos, putty, and dust from bone sawing. The workers generally retrieve arsenic covered skulls or antlers, cut them to fit molds and recovered pelts soaked in an arsenic and phenol solution and fit them to molds. They use perchloroethylene to clean the fur. Finishers were exposed to less arsenic and asbestos but to more solvents either as perchloroethylene or paint solvents. Some workers had respirators of different models; however, none knew the proper cleaning methods or changed filters.

The company provided tetanus injections yearly to all workers.

Eleven members of the work force were interviewed on the initial visit. These eleven people were all taxidermists and finishers. They were asked non-directed, open questions about their health and work environment.

A second visit by the NIOSH medical personnel was conducted on August 2-3, 1978. At this time the primary medical survey was conducted. Fourteen employees were evaluated. These included taxidermists, head finishers, one janitor, one secretary, and one storage room worker. Two taxidermists were not available for any portion of the evaluation except the chest radiograph. Otherwise, all of the work force was evaluated.

A control population consisted of ten volunteers performing research at the Denver Medical Center. A control group was not available at the Company. All persons in the control group resided at the time of the study in the Denver vicinity. Their voluntary advised consent was gained. A venopuncture was performed on only nine volunteers. Pulmonary function studies were performed on all ten volunteers but one person had a respiratory infection so his pulmonary function test (PFT) values were not included.

The questionnaires were administered by a physician. The questionnaire elicited information concerning demography, work history, other activities which could provide exposures similar to those seen in the workplace, past and current medical history, and personal habits and hygiene. The physician then performed an examination of some skin areas, nervous system, eyes, nose and pharynx, and chest auscultation.

Laboratory studies included pulmonary function tests, chest x-rays, CBC, urinary phenol, and urinary arsenic.

CBC specimens were collected by venopuncture into anticoagulant vacuum tubes and transported to National Health Laboratories for analysis by mechanical counter. Normal values for hemoglobin, hematocrit, and white blood count were those given by the processing laboratory, National Health Laboratories. The normals are given on Table 11.

Urinary arsenic and urinary phenols were collected into a clean plastic container. Thymol preservative was added and the specimen split into two aliquots. One aliquot was transported to UBTL Division of University of Utah Research Institute for analysis. The analysis method reported by the laboratory was: "Twenty milliliter aliquots of urine samples were wet-ashed with nitric and perchloric acids and the residual perchloric acid was driven off by heating with sulfuric acid. The ashed samples

were diluted to 25 ml and analyzed in an automated flameless A.A. system which makes use of the arsenic generator principle." (Reference 1) These values were then corrected to a urine specific gravity of 1.024. There are multiple studies that report a normal range for urinary arsenic. Zenz reports "the majority of unexposed persons have urinary arsenic levels less than 0.1 mg/L" (100 micrograms (ug) per liter). (Reference 2) Tietz in Fundamentals of Clinical Chemistry reported levels of 50 ug/L to 100 ug/L. (Reference 3) The Poison Laboratory of Denver General Hospital uses 50 ug/L as the normal level. (Reference 4) The NIOSH physician combined these levels to say that below 50 ug/L is certainly within the normal range. Levels between 50 ug/L to 100 ug/L may indicate an increased exposure but not expected to cause toxic effects, and toxic effects may be seen at levels greater than 100 ug/L.

The second urinary aliquot was analyzed for phenol by the Clinical and Biochemical Support Section, NIOSH. The analytic method used was the gas chromatography method described by Sherwood and Carter. (Reference 5) The urinary phenol values were corrected to a urine specific gravity 1.024 and to grams urinary creatinine. (Reference 6)

The Biological Support Branch, NIOSH, reviewed two reported normal ranges and provided a normal observed range of their own for use in this study. These normals are for urinary phenol corrected to urine specific gravity. Dirmikis and Darbre reported a phenol range of 1 to 5 mg/L. (Reference 7) Roush and Ott reported a phenol range of 4 to 14 mg/L. (Reference 8) "Six non-exposed NIOSH employees were found to have a urinary phenol range of 2 to 7 mg/L." (Reference 9) This was performed by the group performing the urine phenol analysis. Although it is based on very few persons, it is between the two published normal ranges, so the 2 to 7 mg/L urinary phenol level was chosen as the normal range for this investigation.

The urine phenol corrected to grams urine creatinine also used the NIOSH range of 1.5 - 3.5 mg phenol per gram creatinine. (Reference 10)

Hair specimens for arsenic were collected. Pubic hair from each participant was used to decrease the amount of surface arsenic contamination. The hair specimen was placed in a glasene envelope and transported to UBTL Division of University of Utah Research Institute. The samples were analyzed by the method of Pierce, et al. (Reference 11) The hair arsenic test again had some discrepancy in the determining of a normal range. Boych and Hardy as reported in Zenz (ed.) Occupational Medicine reported a value of 1 ppm per gram of hair (ng/mg). (Reference

12) The Employment Medical Advisory Service of the Department of Employment of the British Government uses the level reported by Buchanan in Toxicity of Arsenic Compounds (1962). That level is 5 ppm per gram hair (5 ng/mg). (Reference 13) The NIOSH physician chose to use the level of 5 ng/mg hair for the investigation. The hair arsenic level is a specialized technique not usually employed for screening. Its major problem in the chemical analysis is the cleaning of external arsenic off of the hair surface thus possibly causing artifically elevated levels. This would only elevate the hair arsenic levels of the exposed workers and not the controls. It was therefore concluded that one of the higher reported acceptable levels be used. Because of these problems the urinary arsenic levels should be considered more carefully than the hair arsenic values.

On November 5-7, after the results of the initial urine arsenic and phenol values were examined, one phenol and seven arsenic values were performed. The urine phenol and six of the urine arsenic tests were repeat tests. All tests were collected over at least a 12 hour period the evening prior to work and were kept refrigerated. Aliquots were transported to UBTL for arsenic analysis. The single phenol aliquot specimen was transported to Robert A. Taft (NIOSH) Laboratories for analysis. Each specimen was analyzed by the same groups and by the same procedures as the original tests performed in July.

Pulmonary function studies were performed by the NIOSH clinical pulmonary nurse. A medistor* electronic pulmonary function unit was used. Each participant was allowed several attempts (at least three). The best FVC (forced vital capacity) and the best FEV_1 (forced expiratory volume in one second) value was used. The FVC and FEV_1 value did not have to be taken from the same attempt. These two values were used to calculate a FEV_1/FVC ratio. A "best attempt" was determined by adding the FEV_1 and FVC on each attempt. The attempt with the highest sum was used to determine the FEF (forced expiratory flow) 25-75 value. Predicted values for FVC, FEV_1, and FEF 25-75 were calculated considering height, age, sex, and race. The method of Morris et al was used. (Reference 14) The normal values were eighty (80) percent of predicted for FVC, FEV_1, and FEF 25-75, seventy-five (75) percent for FEV_1/FVC for persons under fifty. Seventy (70) percent was used for persons over fifty for FEV_1/FVC.

Posterior-anterior and lateral view chest radiographs were performed on participants at Porter Hospital, Denver. One participant had a recent chest radiograph performed at the Veteran's Administration Hospital, Denver, so this radiograph

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* Mention of trade names is for identification only and does not constitute endorsement.

was obtained for analysis. They were reviewed by a radiologist at The Department of Radiology, Los Angeles County Medical Center, University of Southern California, under contract to NIOSH.

E. Criteria for Assessing Workroom Concentrations of Air Contaminants

Three sources of criteria are generally used to assess workroom concentrations of air contaminants: (1) NIOSH criteria for recommended standards; (2) recommended Threshold Limit Values (TLVs) and their supporting documentation as set forth by the American Conference of Governmental Industrial Hygienists (ACGIH), 1977; (3) Occupational Safety and Health Administration (OSHA) standards (29 CFR 1910), January 1978. NIOSH criteria and ACGIH TLVs represent the most recent and relevant recommendations and are given prominence in this evaluation.

	Permissible Exposures 8-Hour Time-Weighted Exposure Basis (mg/M^3)		
Substances	NIOSH Criteria for Recommended Standard	TLV	Current OSHA Standard
Arsenic.....	0.002	0.5	0.01
Asbestos.....	0.1 fibers/cc and 0.5 fibers/cc peak exposure	From 0.2 fibers/cc 2.0 fibers/cc	2.0 fibers/cc
Perchloroethylene.....	339.0	670.0	670.0
Phenol.....	19.0	19.0	19.0
Toluene.....	375.0	375.0	375.0
Xylene.....	435.0	435.0	435.0

mg/M^3 = milligrams of substance per cubic meter of air

Occupational health standards are established at levels designed to protect individuals occupationally exposed to toxic substances on an 8-hour per day, 40-hour per week basis over a normal working lifetime.

E. Toxicology

Arsenic (References 15, 16, 17) -- Inorganic arsenic usually in the form of arsenic trioxide, is well known due to its notoriety as a criminal poison. Almost everyone is exposed to small amounts of arsenic primarily through food. Seafood contains the most arsenic of commonly consumed food. Industrial uses have included weed killers, fungicides, paints, wood preservatives, arsenic glass and insecticides.

Occupational exposure is due to inhalation, direct skin and mucous membrane contact, and ingestion. Once absorbed, inorganic arsenic can cause acute and/or chronic poisoning.

Manifestations of chronic inorganic arsenic poisoning include dermatitis, warts, hyperkeratoses of the palms and soles, conjunctivitis, respiratory tract irritation, ulceration and perforation of the nasal septum, headache, drowsiness, confusion, convulsions, anemia, decreased white blood cell count, and peripheral neuropathies (numbness, tingling, and burning of the hands and feet, muscle weakness, inability to walk or stand, muscle atrophy). The major neurologic symptoms have not been associated with arsenic poisoning of occupational origin. Arsenic has been implicated as a cause of skin cancer, and epidemiologic studies have associated arsenic with lung cancer. (References 18,19,20)

Asbestos (References 21,22,23,24,25,26) -- Asbestos is the name of naturally-occurring silicates with the property of great resistance to physical destruction. This material exists as particles. It is primarily used as insulation material. Workers are exposed through inhalation of airborne asbestos particles. Asbestos particles are able to penetrate deeply into lung parenchyma.

The onset of symptoms of asbestosis usually occurs 20-30 years after initial exposure. The first symptom is shortness of breath on exertion and usually a dry cough. Both symptoms continue to progress and the cough becomes productive of sputum. Stiffening of the lung tissue occurs causing the shortness of breath and eventually the heart is stressed and may fail.

X-ray evaluation and pulmonary function studies accompanied by a history of exposure are the primary methods of diagnosis.

Asbestos has been associated with an increased risk of lung cancer among asbestos workers in several studies. It has been recently shown that this increased risk is greatly increased by a combination of asbestos exposure and cigarette smoking.

Asbestos exposure has also been associated with a chest and abdomenal wall tumor called mesothelioma.

Phenol (References 27,28) -- Phenol is a white, crystalline material that when added to water forms a solution in concentration up to 8%. It is used in the production of a large variety of aromatic chemicals and has also been used in the leather tanning industry. At one time phenol was used to sterilize dressings for wounds and as an agent to prevent itching.

Phenol is primarily absorbed through inhalation and skin contact in industrial settings. Local damage to skin includes eczema, inflammation, discoloration, necrosis, sloughing, and gangrene. Phenol also causes corrosion of mucous membranes.

Systemic symptoms and signs after a large, acute skin or respiratory exposure, includes swelling of the bronchioles with bronchitis and pneumonia. The liver and kidney may be affected. Death may occur from respiratory failure.

Chronic effects are manifest in the nervous system, GI tract, liver, kidney, and skin. These include vomiting, difficult swallowing, diarrhea, loss of appetite, headache, fainting, dizziness, mental disturbances, and skin eruptions.

Phenol is not a known human carcinogen.

Tetrachloroethylene (Perchloroethylene) (References 29,30,31) -- Tetrachloroethylene is a colorless liquid hydrocarbon used as an industrial solvent particularly in dry cleaning and degreasing. Exposure is primarily through inhalation and skin absorption in industry. It has also been used to treat intestinal worms in animals and humans.

The most common acute effect is its action as a central nervous system depressant. Symptoms include dizziness, inebriation, incoordination, lightheadedness, tiredness, and headache. Irritation of the eyes, nose and throat are common. GI complaints are nausea and vomiting. Toxic effects on the liver and kidney may be seen in chronic exposures. NIOSH recommends that perchloroethylene be handled in the work place as if it were a known carcinogen.

Toluene (Reference 32) -- High concentrations of toluene above the TLV of 375 mg/M^3, may cause conjunctivitis and corneal burns, produces defatting dermatitis, causes fatigue and weakness, headache, dizziness, and irritability. The level

required to produce narcosis can exist without eye or respiratory tract irritation.

Xylene (Reference 33) -- Xylene is a depressant to the central nervous system (CNS). In concentrations over 435 mg/M^3 you may get damage to the liver and kidneys. The industrial hygienist and physician should always be aware that xylene is often contaminated with benzene. People with CNS, kidney, liver, and blood diseases should not work around areas exceeding 435 mg/M^3.

G. Environmental Results and Discussion

Workers in all areas of the plant were monitored for the particular toxic agent they were using. Overexposures were documented for arsenic, asbestos, and perchloroethylene. For results, refer to Tables 12-15. Workers perform the same task throughout the work shift; therefore exposures shown in Tables 12-15 are representative of 8 hour exposures.

H. Medical Results

Demographic information of the worker and control groups are given in Table 1; the parameters noted are age, sex and years engaged in taxidermy work.

The results of the questionnaire were very helpful in determining the presence of irritant effects of substances in the work environment. Tables 2 and 3 present the information elicited by the questionnaire. Table 2 displays past medical history; and Table 3 lists a review of symptoms which began since working at Jonas Brothers Taxidermy.

There is very little past history of respiratory disease. One worker had acute bronchitis eight years prior, and one worker had pneumonia as a child. The respiratory complaints not compiled in the table included two workers with a chronic cough. One of these workers has a smoking history of 37.5 pack years and a long history of a chronic debilitating illness. His vital capacity is reduced, but the FEV_1/FVC ratio and FEF 25-75 are all normal indicating good air flow. He has had only one year of exposure to the Jonas work environment. The other worker reporting a chronic cough is a non-smoker with no indication as to why the cough should exist. His pulmonary function parameters are all well within the normal expected values.

Five persons expressed what they called "wheezes" with respiratory infections but none reported any diagnosis of asthma. Two workers reported some shortness of breath with

exertion but none said that their activity was restricted. Six workers reported one cold per year while five reported two to five colds per year. These reports do not seem excessive. Only one worker reported more frequent respiratory infections.

The general symptoms of past medical history (Table 2) shows several interesting findings. Four persons (33%) reported some type of dermatitis or skin disorder. Three (25%) workers felt that they had allergic rhinitis at some time.

Table 3 shows those symptoms which have begun since beginning work at Jonas. Most complaints are due to skin and mucous irritation. They include rashes (42%), peeling or cracking skin on hands (33%), itching (25%), eye irritation or redness (42%), nasal irritation (58%) and hoarseness (33%). There were also some neurologic complaints including numbness (16%), tingling (25%), and weakness (16%).

Other complaints were easy bruising (16% - all female), swollen glands (25%), weight loss (25%), joint pain (25%), unusual fatigue (16%).

Physical examinations were performed on the twelve workers completing questionnaires. The parameters examined and the abnormal results are listed in Table 4. Three persons had dry hands and in one of the three the skin on the hands was red, thickened and cracked. One worker had a slight decrease in deep tendon reflexes and a slight sway in the Rhomberg test. One worker had ronchi which cleared with cough.

Pulmonary function observed values and predicted values for workers (Table 5) and controls (Table 6) and the percentage of produced values for both groups (Table 7) are presented. In review of Table 7, only one worker (number 4) has less than 80% of the predicted value for % FVC and % FEV_1. 75% was the lower limit of normal for the FEV_1/FVC ratio. Two persons had less than the 75%. In controls, no person had less than 75%. In controls, no person had less than 80% of predicted for FVE or FEV_1 and two had less than 75% for the FEV_1/FVC ratio.

The percent predicted values of FVC, FEV_1, and FEF 25-75, and FEV_1/FVC were compared to the control group using Student t-test with significance level of p less than or equal to .05.

The mean and median value for each parameter for both groups were similar. The worker and control groups means did not differ significantly (Student t-test). The "p" was always greater than .05.

The other pulmonary examination performed was the chest radiography. Radiographs were evaluated under the ILO/UICC classification which is a nationally accepted classification system. Thirteen persons had chest radiographs taken for this study and a recent chest radiograph was obtained. In two of the radiographs, visible opacities were noted in the lung fields by the radiologists. One worker had small rounded opacities type q, 1/0 perfusion in the upper and mid lung zields bilaterally. He is a young person with three years working at Jonas and no other exposure to asbestos. The other worker had small irregular opacities type S, 1/0 perfusion in the lower lung fields bilaterally. This person had been at Jonas for one year and had no other known exposure to asbestos. Many years (approximately 10-20) exposure to asbestos are required for the appearance of nodules. While it is extremely unlikely that the nodules seen on these two workers' radiographs are related to asbestos, they were, however, instructed to inform their physicans of the results.

The urinary arsenic values are presented in Tables 8 and 9. It must be remembered that these are single void specimens. Four of the exposed workers and six of the controls have values below the minimum detectable level on the initial sample collected. Four workers have measurable values but well within the acceptable range. Three exposed workers and one control have values in the initial sample collection that may be considered slightly elevated. They are not in a toxic range, but rather, they potentially indicate other sources of arsenic exposure present in the environment. These three elevated values were repeated along with repetition of the previous normal workers and one previously untested worker. All of these values were within the normal range for urinary arsenic (Table 9). Seven of the eleven (64%) workers have detectable urine arsenic levels as compared to four of nine (44%) of the controls.

The hair arsenic values are also given on Table 8. All control values had insufficient arsenic in the hair sample to be detectable. This lower range of detection, 20 ng, was divided by the mg hair provided and reported as ug arsenic per gram of hair. This was compared to the worker group in which only one person had a hair arsenic below the detectable level. Because of the large number of urine and hair arsenic concentrations below the detectable level in the control group and the few in the worker group, no statistical comparisons were performed.

Of the twelve workers, nine have exactly determined hair arsenic values and six of the nine (67%) were above the upper level of "normal" used. Of the nine controls, six were definitely below the level and one was of uncertain normality (control number 13)

since the exact value is not known. No control has a definite abnormal value. These elevated hair arsenic values and more detectable urinary arsenic levels in the worker group definitely indicate a greater exposure to arsenic in the worker group. Since the five values were elevated, this exposure has been over a large period of time. As previously reported, there were no physical examination abnormalities indicating clinical toxicity at these hair and urine arsenic levels.

The urinary phenol values are given in Table 10. One value was repeated and it is reported in Table 9. Five of eleven (45%) workers were above the 7 ng level of the Biological Support Branch, NIOSH, and only three of eleven (18%) were above the 14 ng level of Roush and Ott. Of the controls, one of eight (13%) was above the BSB level and one of eight (13%) was above the level of Roush and Ott. Using either control, a larger percentage of workers had abnormal values at the time of the initial urine collection using the urine phenol corrected to urine specific gravity of 1.024.

The worker and control groups were compared using Student t-test. There was no statistically significant difference between the groups (p less than or equal to .05 level) for urine phenol using the initial specimens for comparison. This was true for urine phenols either corrected or urine specific gravity 1.024 or grams urine creatinine.

Hemoglobin, hematocrit and white blood count results are given in Table 11. One worker had a slightly depressed white blood count which is considered insignificant. Three controls had elevated hemoglobin or hematocrit values or both. This could easily be attributed to the elevation of Denver. All other values were normal. The mean values for the two groups for each test were given separated by sex. Comparison between the two groups for each test was performed (using the Student t-test) for males since only two females were in each group. There was a statistically significant difference between the male workers and controls for hemoglobin (.05 greater than p greater than .02). Since no workers had "abnormal" values for this test, it was of questionable clinical significance. There was no difference for the hematocrit or the white blood counts (p less than or equal to .05).

I. Medical Discussion

The NIOSH physician noted frequent skin complaints such as rashs, and itchy, peeling and cracking skin. These were confirmed on examination. Also, irritation of the upper respiratory tract was a frequent complaint. In addition, the

same workers reported some sensory abnormalities, but no sensory abnormalities could be detected on examination.

These complaints are consistent with arsenic, phenol, and perchloroethylene exposure. Redness, cracking and peeling of the hands, and eye irritation are especially common with phenol contact. Neurological complaints are consistent with solvent and/or arsenic exposure.

Two pulmonary evaluations, chest x-rays, and pulmonary function tests were performed. Two persons had opacities on chest x-ray not consistent with the short history of asbestos exposure. These x-rays may, however, be very useful as baseline evaluations in the long-term evaluation of these workers. Only one worker, with a long smoking history, had an indication of restrictive disease. On pulmonary function tests, two workers had moderate obstruction, but there was no statistically significant difference between the control and exposed groups. There was no clear indication of any adverse pulmonary effect at this time.

The arsenic test indicates only some suggestion of exposure with three workers having between 50-100 ug/L urinary arsenic on the initial collection and multiple (6) elevated hair arsenic levels. These levels can be associated with the poor worker protection practices in the workplace and indicates that some improvement is needed in limiting arsenic exposure.

Urinary phenol tests also gave some indication of increased exposure to phenol. 45% of the workers were above 7 ug/L urine phenol. Again, one can relate these levels to worker hygiene practices and recommend that improvements may be made. Although some difference was seen between the workers and controls, they are all within normal and the difference is of questionable clinical significance.

During the course of this evaluation, the Company has taken steps to eliminate toxic exposure to asbestos by substitutuion of a cellulose material.

J. Conclusion

Based on medical and environmental data, a health hazard existed to workers at Jonas Brothers during the time of this evaluation. This conclusion is based on environmental levels of asbestos, arsenic, and perchloroethylene and elevations of hair arsenic indicating arsenic exposures. This conclusion is also based on the results of biological monitoring for phenol.

V. RECOMMENDATIONS

1. Workers should inform their personal physicians of their employment and the toxic agents to which they are exposed.

2. Since all urinary arsenic values were in the non-toxic range, they need not necessarily be repeated unless exposures change.

3. Urinary phenol levels should be repeated to determine continued exposure after corrections of improper storage and handling of phenol has been implemented. If all are normal at that time, they need not be repeated unless exposure conditions change.

4. Continue the substitution of other less toxic material in place of asbestos.

5. The Center for Disease Control recommends the need for booster tetanus inoculation every 10 years. Workers should be informed that yearly prophylactic inoculation is not necessary. If any questions arise, a physician should be consulted.

6. All eating, drinking and smoking should be prohibited in the work area. A clean, separate area, should be maintained for storage and consumption of lunches. Workers should wash prior to eating, drinking and smoking.

7. Persons with past exposure to asbestos or past or present exposure to arsenic should stop smoking and should have a posterior/anterior chest x-ray performed annually. They should also be checked for other forms of asbestos-related cancer yearly.

8. Respiratory protection should be used during the opening of arsenic contaminated crates. Special overalls should be worn while performing this job.

9. General ventilation should be installed for each work station to eliminate overexposures to air contaminants.

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TABLE 1

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Demography

Group	Workers	Controls
N*	12	10
Age (range)	20-60	21-37
Age (mean)	31.25	26.7
Age (median)	28.5	25.5
Males	10	8
Females	2	2
Mean Age Males	49.2	26.9
Median Age Males	28.5	24.5
Mean Age Females	31.5	26.0
Years in Taxidermy (range)	1-32.5	—
Years in Taxidermy (mean)	8.3	—
Years at Jonas (range)	1-32.5	—
Years at Jonas (mean)	5.8	—

* - not including 2 persons receiving chest radiograph only and one person receiving a chest radiograph and urine arsenic in November, 1978.

TABLE 2

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Worker Medical History
elicited by questionnaire

Respiratory (as informed to Worker by physician)	Number Positive Response N=12	% Positive Response
Bronchitis	1	0
Chronic bronchitis	0	0
Emphysema	0	0
Bronchial asthma	0	0
Pneumonia	1	8
Broncho-pneumonia	0	0
Tuberculosis	0	0
Histoplasmosis	0	0
Lung Surgery	0	0
Cancer of Lung	0	0
General Symptoms (as described by worker or informed to worker by physician)		
Arthritis	0	0
Stomach trouble	1	8
Bowel difficulties or colitis	1	8
Kidney trouble	1	8
Liver trouble	0	0
Heart trouble	1	8
High blood pressure	0	0
Diabetes	0	0
Dermititis/skin disorders	4	33
Harding of Arteries	0	0
History of elevated blood triglyceride in self or family	1	8
History of heart attack or strokes in self or family	3	25
Hay fever or other nasal allergy	3	25
Trama	1	8
Back injury, operation or pain	2	16

TABLE 3

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Symptoms reported since beginning work at Jonas

	Number Positive Responses	% Positive Responses
SKIN		
Rashes	5	42
Discoloration or darkening of skin	0	0
Development of acne since starting taxidermy	0	0
Peeling or cracking of skin on hands	4	33
Unusual itching	3	25
Changes in hair or nails (color, texture, thickness, etc)	0	0
GI		
Frequent nausea or vomiting	0	0
Change in bowel habits? (constipation, diarrhea, bloody stools)	0	0
Abdominal pain or cramps	1	8
ENT		
Eye irritation or redness	5	42
Nasal irritation, soreness or nosebleeds	7	58
Hoarseness (laryngitis)	4	33
NEUROLOGIC		
Sensory		
Numbness	2	16
Tingling	3	25
Abnormal sensations	1	8
Pain or burning	1	8
Motor and Coordination		
Weakness	2	16
Lack of coordination	1	8
Muscle twitch	1	8
Tremor	0	0
Dizziness	0	0
Giddiness	1	8
History of any neurological ("nervous") condition?	0	0
BLOOD		
Do you bruise or bleed easily?	2	16
Were you ever told by a physician that you had a low bood count?	0	0
Swollen glands?	3	25
OTHER		
Unusual weight loss	3	25
Joint pain	3	25
Unusual fatigue	2	16
Muscle cramps	0	0

TABLE 4

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Physical Examination Findings

	# Abnormal
SKIN:	
Redness	1
Swelling	0
Dryness	3
Thickening	1
Rashes	0
Pigmentation	0
Bruising/bleeding	0
Hair	0
Nails	0
NEUROLOGIC:	
A. Motor and Coordination	
Gait	0
Heel walk	0
Toe walk	0
Romberg	1
Finger to nose	0
RAM (diadokinesis)	0
Muscle strength	0
a) Extensors	0
b) Flexors	0
Tremor	0
Other	0
DTR's (0 - 4+)	0
Knee	1
Ankle	0
Biceps	0
B. Sensory	
Touch	0
Pinprick	0
Joint position	0
Vibration	0
ENT	
Eyes	0
Nose	0
Throat	0
RESPIRATORY	
Cyanosis	0
Clubbing	0
Chest expansion	0
Ausculation	0

TABLE 5

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Pulmonary Function Results (Workers)

Worker	Forced Vital Capacity	Forced Expiratory Volume 1 sec	Forced Expiratory Flow 25-75
1 observed	5.18L	4.31L	4.42 L/sec
1 predicted	5.08L	4.59L	4.73 L/sec
2 observed	4.36L	3.34L	3.11 L/sec
2 predicted	4.34L	3.45L	4.37 L/sec
3 observed	4.22L	2.56L	1.36 L/sec
3 predicted	4.32L	3.08L	3.01 L/sec
4 observed	2.45L	2.17L	3.76 L/sec
4 predicted	4.32L	3.29L	3.49 L/sec
5 observed	3.60L	2.89L	2.97 L/sec
5 predicted	3.86L	3.09L	3.58 L/sec
6 observed	5.68L	4.82L	5.73 L/sec
6 predicted	5.15L	4.08L	4.38 L/sec
7 observed	5.79L	4.79L	5.23 L/sec
7 predicted	5.59L	4.50L	4.86 L/sec
8 observed	3.52L	2.73L	3.13 L/sec
8 predicted	3.39L	2.66L	3.18 L/sec
9 observed	4.75L	3.75L	4.22 L/sec
9 predicted	5.13L	4.07L	4.38 L/sec
10 observed	5.29L	4.10L	3.50 L/sec
10 predicted	5.36L	4.38L	4.82 L/sec
11 observed	5.41L	4.20L	3.73 L/sec
11 predicted	5.59L	4.51L	4.86 L/sec
12 observed	6.66L	4.14L	2.57 L/sec
12 predicted	5.37L	4.27L	4.56 L/sec

TABLE 6

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Pulmonary Function Results (Controls)

Control	Forced Vital Capacity	Forced Expiratory Volume 1 sec	Forced Expiratory Flow 25-75
13 observed	6.35L	4.44L	3.36 L/sec
13 expected	5.67L	4.55L	4.88 L/sec
14 observed	6.34L	5.33L	5.42 L/sec
14 expected	6.06L	4.72L	4.82 L/sec
15 observed	5.45L	4.82L	6.75 L/sec
15 expected	5.67L	4.52L	4.81 L/sec
16 observed	4.34L	3.29L	2.62 L/sec
16 expected	5.00L	3.94L	4.22 L/sec
17 observed	4.54L	3.49L	3.91 L/sec
17 expected	3.86L	3.09L	3.58 L/sec
18 observed	5.25L	4.49L	5.40 L/sec
18 expected	5.52L	4.46L	4.83 L/sec
19 observed	6.11L	4.21L	2.85 L/sec
19 expected	5.42L	4.13L	4.21 L/sec
20 observed	6.25L	4.90L	4.78 L/sec
20 expected	6.28L	4.92L	5.03 L/sec
21 observed	4.18L	3.19L	2.97 L/sec
21 expected	4.34L	3.47L	3.87 L/sec

TABLE 7

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Pulmonary Function Values as Percent of Predicted

Worker	FVC %	FEV_1 %	FEF 25-75 %	FEV_1/FVC (x100) %
1	88	94	93	83
2	100	96	71	76
3	97	83	45	61
4	56	66	108	88
5	93	94	83	80
6	110	118	131	84
7	104	106	108	82
8	104	102	99	78
9	93	92	96	79
10	99	94	73	78
11	97	93	77	78
12	124	97	56	62
Mean	97	95	87	77
Median	97	94	88	78.5
S.D.	16.0	12.4	24.1	8.1
Control				
13	112	97	69	69
14	105	113	112	84
15	96	107	140	88
16	87	84	62	76
17	118	113	109	77
18	95	101	112	86
19	113	102	68	69
20	100	100	95	78
21	96	92	77	76
Mean	102	101	94	78
Median	100	101	95	77
S.D.	10.2	9.4	26.5	6.8

TABLE 8

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Urinary and Hair Arsenic

	Urine As µg/L	Corrected to Urine Sp. Gr. 1.024 µg/L	Hair As µg/gn
Normal Workers		<50	<5
1	60	45	13.16
2	<10	**	<1.49
3	<10	**	54.82
4	12	17	1.40
5	59	52	2.48
7	12	9	6.28
8	<10	**	1.21
9	28	25	21.84
10	14	13	7.27
11	62	62	9.48
12	<10	**	Insufficient Sample
Median	12	9	6.78
Controls			
13	72	54	<1.61
14	<10	**	<.47
15	15	12	<.75
16	<10	**	Insufficient Sample
17	<10		<.83
18	14	12	<.96
19	<10	**	<.93
20	<10	**	<.82
21	24	17	Insufficient Sample
22	<10	**	Insufficient Sample
Median	<10	--	--

** - Uncorrectable due to lower limit of detection.

TABLE 9

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Urine and Arsenic Results Collected
11/5-6/78

Worker	Test	Value	Corrected to Urine Sp. Gr. 1.024
1	arsenic	38 ug/L	33.8 ug/L
4	arsenic	5 ug/L	Uncorrectable*
5	arsenic	15 ug/L	17.1 ug/L
8	arsenic	<5 ug/L	* *
10	arsenic	19 ug/L	18.2 ug/L
11	arsenic	17 ug/L	31.4 ug/L
23	arsenic	6 ug/L	5.1 ug/L
4	phenol	11 mg/L	Uncorrectable*

* - Urine too dilute to allow correction
* * - Uncorrectable due to lower limit of detection

TABLE 10

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Urinary Phenol

	Urine Phenol mg/L	Corrected to Urine Sp. Gr. 1.024 mg/L	Corrected to gm Urine Creatinine mg/gn
Normal		2-7	1.5-3.5
Workers			
1	10.0	9.6	4.1
2	3.0	2.8	1.8
3	8.4	9.6	3.9
4	108.0	113.0	68.0
5	5.1	4.5	2.0
7	8.4	6.1	3.4
8	18.0	11.0	6.3
9	48.0	46.0	18.0
10	5.0	5.2	3.7
11	2.0	2.0	1.4
12	1.0	2.0	1.3
Mean	19.7	19.3	10.4
Median	5.1	5.2	3.4
Controls			
13	7.5	6.0	2.1
14	3.8	3.4	1.9
15	20.0	17.0	9.2
16	0.8	1.9	1.2
18	4.1	3.9	1.9
19	3.4	7.0	3.5
20	1.0	2.0	1.5
21	7.8	6.0	2.7
22	3.0	*	4.5
Mean	5.7	5.9	3.2
Median	3.8	5.0	2.1

* - Urine too dilute to allow correction

TABLE 11

Jonas Bros. Taxidermy
Denver, Colorado
HE 78-95

Hemotologic Laboratory Results

Laboratory	Normal		Hemoglobin	Hematocrit	White Blood Count
		Male	14-18 gm/dl	42-52%	4,800-10,800 cells/mm^3
		Female	12-16 gm/dl	37-47%	4,800-10,800 cells/mm^3
Worker (N=12)	Sex				
1	M		16.2	55.9	8,000
2	M		14.9	46.9	8,400
3	M		17.2	50.8	4,500
4	M		16.0	48.9	9,400
5	F		13.6	40.1	6,000
6	M		16.5	48.8	7,000
7	M		16.1	47.7	8,300
8	F		15.1	45.9	9,500
9	M		16.8	47.4	7,100
10	M		15.2	45.3	8,100
11	M		17.4	50.7	7,600
12	M		15.7	47.8	7,200
Mean M	N=10		16.2	49.0	7,560
Mean F	N=2		14.35	43.0	7,750
Control (N=9)	Sex				
13	M		16.7	49.5	7,900
14	M		18.3	53.6	5,700
15	M		17.0	49.0	8,700
16	M		19.2	56.9	10,500
17	F		13.0	40.2	5,300
19	M		15.8	46.7	7,800
20	M		16.6	48.3	6,600
21	F		15.7	47.3	8,700
22	M		17.8	53.0	8,500
Mean M	N=7		17.34	51.0	7,957
Mean F	N-2		14.35	43.75	7,000

TABLE 12

BREATHING ZONE AIR CONCENTRATIONS OF ASBESTOS

Jonas Brothers Taxidermy
Denver, Colorado

July 7, 1978

Sample Number	Location	Job Classification	Sampling Time	Asbestos Fibers/cc
6	Paint-Makeup	Head Finishing	8:47 AM - 9:20 AM	0.12
7	Taxidermy Shop	Fish Taxidermist	8:55 AM - 11:20 AM	0.04
8	Taxidermy Shop	Mixing Asbestos	8:45 AM - 11:20 AM	0.09
15	Taxidermy Shop	Taxidermist	1:30 PM - 4:24 PM	*
17	Taxidermy Shop	Janitor	2:40 PM - 4:24 PM	0.03
20	Taxidermy Shop	Taxidermist	8:30 AM - 12:12 PM	0.03
23	Taxidermy Shop	Taxidermist	8:35 AM - 12:20 PM	*
			EVALUATION CRITERIA	0.1 8-hour TWA
			LABORATORY LIMIT OF DETECTION 4500 fibers/filter	0.5 Ceiling

* = below 4500 fibers per filter

TABLE 13

BREATHING ZONE AIR CONCENTRATIONS OF
TOLUENE, XYLENE, AND PERCHLOROETHYLENE

Jonas Brothers Taxidermy
Denver, Colorado

July 6-7, 1978

Sample Number	Location	Job Classification	Sampling Time	Toluene (mg/m^3)	Xylene (mg/m^3)	Perchloroethylene (mg/m^3)
1	Paint-Makeup	Head Finishing	8:35 AM - 12:25 PM	*	*	*
2	Paint-Makeup	Head Finishing	9:18 AM - 12:20 PM	*	*	*
3	Drycleaning	Cleaner (Fur Coats)	9:21 AM - 12:10 PM	*	*	767
4	Paint-Makeup	Head Finishing	1:31 PM - 4:16 PM	7	*	*
5	Paint-Makeup	Head Finishing	1:35 PM - 4:28 PM	9	2	*
6	Drycleaning	Cleaner (Fur Coats)	1:36 PM - 2:20 PM	*	*	1546
10	Drycleaning	Cleaner (Fur Coats)	8:43 AM - 12:28 PM	*	*	1025
11	Paint-Makeup	Head Finishing	1:31 PM - 3:30 PM	*	*	125
12	Paint-Makeup	Head Finishing	1:33 PM - 3:30 PM	2	*	168
			EVALUATION CRITERIA	375	435	339
			LABORATORY LIMIT OF DETECTION mg/sample	0.01	0.01	0.01

* = below laboratory limit of detection

TABLE 14

BREATHING ZONE AIR CONCENTRATIONS OF
ARSENIC AND MAGNESIUM

Jonas Brothers Taxidermy
Denver, Colorado

July 5-6, 1978

Sample Number	Location	Job Classification	Sampling Time	mg/m^3 Arsenic	mg/m^3 Magnesium
1	Taxidermy	Taxidermist	8:32 AM - 11:20 AM	*	0.007
2	Taxidermy	Taxidermist	8:35 AM - 11:20 AM	0.32	0.008
3	Taxidermy	Taxidermist	8:37 AM - 11:20 AM	0.30	0.008
4	Taxidermy	Taxidermist-Grinding	8:40 AM - 11:20 AM	1.16	0.03
5	Taxidermy	Taxidermist	8:37 AM - 12:20 PM	0.21	0.006
9	All Over Plant	Supply Room	8:55 AM - 11:45 AM	*	0.004
10	All Over Plant	Supply Room	1:25 PM - 4:20 PM	*	0.004
11	Taxidermy	Taxidermist	1:30 PM - 2:40 PM	*	0.04
12	Taxidermy	Taxidermist	1:30 PM - 4:22 PM	*	0.004
13	Taxidermy	Taxidermist	1:30 PM - 4:20 PM	*	0.004
14	Taxidermy	Taxidermist	1:30 PM - 4:18 PM	0.60	0.004
16	Taxidermy	Taxidermist	1:35 PM - 4:18 PM	0.33	0.008
18	Taxidermy	Taxidermist-Grinding	8:16 AM - 12:10 PM	0.25	0.009
19	Taxidermy	Taxidermist	8:16 AM - 12:10 PM	0.68	0.006
21	Taxidermy	Foreman	8:31 AM - 11:48 AM	0.22	0.006
22	Taxidermy	Taxidermist	8:33 AM - 12:12 PM	0.55	0.006
24	Taxidermy	Taxidermist	8:36 AM - 12:12 PM	0.43	0.01
25	Taxidermy	Taxidermist	8:38 AM - 12:15 PM	*	0.009
26	Taxidermy	Fish Mounting	12:20 PM - 3:28 PM	*	0.007
27	All Over Plant	Supply Room	1:29 PM - 3:45 PM	0.39	*
28	Taxidermy	Skin Mounting	1:30 PM - 3:28 PM	0.04	*
29	Taxidermy	Head Mounting	1:35 PM - 3:29 PM	*	*
30	Taxidermy	Skin Mounting	1:40 PM - 3:29 PM	*	0.01
31	Secretary's Office Area		1:43 PM - 3:29 PM	*	*
			EVALUATION CRITERIA	0.002**	10.0
			LABORATORY LIMIT OF DETECTION mg/sample	0.05	0.001

* = below laboratory limit of detection

** = NIOSH recommends 0.002 mg/m^3 as a Ceiling which should never be exceeded.
OSHA Standard is 0.010 mg/m^3.
OSHA action level is 0.005 mg/m^3.

TABLE 15

BREATHING ZONE AND GENERAL ROOM AIR CONCENTRATIONS OF PHENOL

Jonas Brothers Taxidermy
Denver, Colorado

July 6-7, 1978

Sample Number	Location	Job Classification	Sampling Time	Phenol mg/m^3
I-1	Taxidermy	Fish Mounting/Area Sample	9:00 AM - 11:10 AM	0.31
I-2	Taxidermy	Area Sample	1:45 AM - 4:00 PM	0.77
I-3	Taxidermy	Taxidermist	1:50 AM - 4:20 PM	0.20
			EVALUATION CRITERIA	19
			LABORATORY LIMIT OF DETECTION mg/sample	0.02