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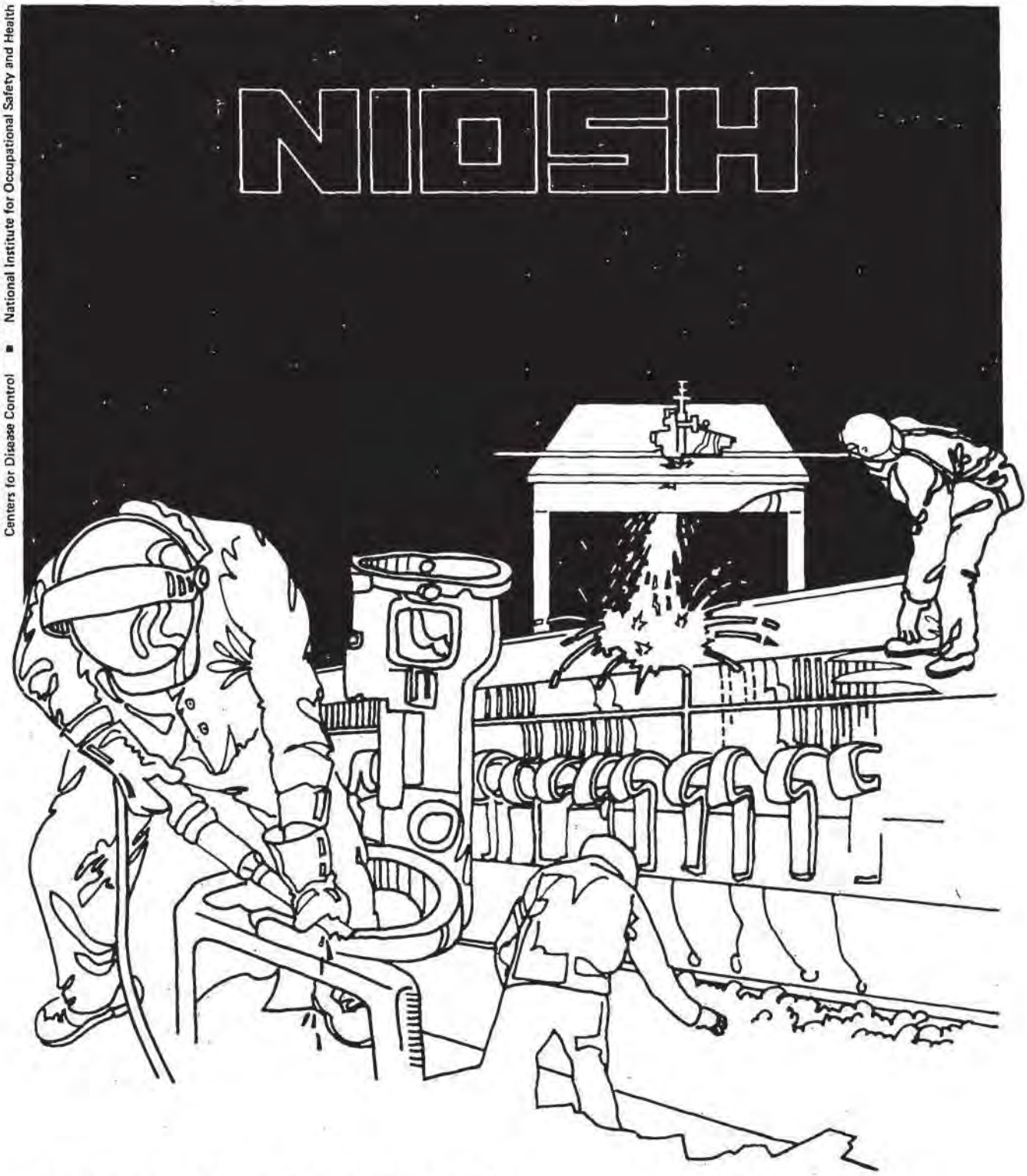

Health Hazard Evaluation Report

HETA 82-107-1444
TORRINGTON COMPANY
TORRINGTON, CONNECTICUT

PREFACE

The Hazard Evaluations and Technical Assistance Branch of NIOSH conducts field investigations of possible health hazards in the workplace. These investigations are conducted under the authority of Section 20(a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669(a)(6) which authorizes the Secretary of Health and Human Services, following a written request from 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.

The Hazard Evaluations and Technical Assistance Branch also provides, upon request, medical, nursing, and industrial hygiene technical and consultative assistance (TA) to Federal, state, and local agencies; labor; industry and other groups or individuals to control occupational health hazards and to prevent related trauma and disease.

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I. SUMMARY

In January 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request to evaluate high reported incidence of dermatitis among employees in grinding operations at the Torrington Company, Torrington, Connecticut, a metal rod and pin manufacturing facility. The epidemic of dermatitis began in 1980, with the addition of greater amounts of biocide to the metal fluids in order to control bacterial contamination.

In January, May, and September 1982, investigators from the Yale University Occupational Medical Program, under contract to NIOSH, conducted medical and industrial hygiene evaluations at this facility. The industrial hygiene investigations included the evaluation of grinding machine operations and relevant work practices which might contribute to the occurrence of dermatitis. The medical evaluation included a questionnaire and dermatologic examination of 49 workers in grinding departments and a comparison group of 45 workers from other departments in the plant. In addition, nine workers with more severe dermatitis were patch tested to determine possible sensitization to components of grinding fluids.

The industrial hygiene survey found that there was much more skin contact in the grinding department where the dermatitis outbreak occurred than in another grinding department where dermatitis had not occurred as frequently. Inadequate aerosol containment on the grinding machines, poor compliance with the protective gear program, absence of standard procedures for dealing with skin contamination and limited workers awareness of potential hazards associated with metal fluid exposure were noted in the grinding department where the dermatitis outbreak occurred.

The medical survey found that 31 (63.3%) of 49 workers in the grinding department reported itching and burning skin of the hands, compared to only 9 (20%) of 45 workers in the comparison group ($p<.001$ Chi Square). Eighteen (36.7%) of 49 of the grinding department workers had moderately severe dermatitis at the time of the examination compared to only 4 (8.9%) of the 45 other workers. Other factors such as past history of atopy (allergy) or use of hand cleaners did not account for these differences. Two of the 10 workers with severe dermatitis who were patch tested were found to be strongly allergic to formaldehyde, which can be released by some of the biocides used in the coolant systems.

Based on the results of this evaluation, NIOSH determined that an occupational health hazard of dermatitis from exposure to coolant fluids used in grinding operations existed at the Torrington Company. Recommendations to help alleviate this problem are included in Section VIII of this report.

KEYWORDS: SIC 3443, grinding operations, coolant fluids, dermatitis, contact dermatitis, formaldehyde, biocides.

II. INTRODUCTION

In January 1982, the National Institute for Occupational Safety and Health (NIOSH) received a request for a Health Hazard Evaluation from the local union (UAW) at the Torrington Company, Torrington, Connecticut. This request concerned the occurrence of dermatitis among workers in the grinding department at this facility.

The Yale University Occupational Medical Program, under contract to NIOSH conducted medical evaluations at this facility in April 1981 and in January, May, and September 1982. Preliminary results of this evaluation were provided to the company and workers as the evaluation proceded.

III. BACKGROUND

1. Dermatitis Outbreak

The grinding operations based in the Broad Street Plant of the Torrington Company employed approximately 85 workers during the summer and fall of 1980. These operations comprise one of several departments engaged in the production of solid metal cylinders. The cylinders are marketed for a wide range of applications including the auto transmission and the aerospace industries among others. Workers in the Centerless Grinding Department (CGD) began to develop skin rashes late in the summer of 1980. Many received care from a local dermatologist while others were referred to the Yale University Occupational Skin Disease Clinic. By April of 1981, 8 workers had been evaluated at Yale, 7 of whom presented with allergic or irritant contact dermatitis.

Despite suggestions and attempts to implement preventive measures, the continued occurrence of new cases prompted the request for an on-site occupational dermatology consultation (April 13, 1981). Observations during the initial survey did not reveal the extent of the dermatitis problem among the employees nor did it confirm the causal agent with any degree of certainty.

2. Description of Process: Conditions of Use

The Broad Street Plant of the Torrington Company is engaged in the manufacture of metal rods and pins which are marketed as machine components (Figure 1). There are several discrete work areas in the plant, including: (a) cutting and shaping processes; (b) grinding operations; (c) tumbling, and; (d) inspection and packaging. The overall scope of the manufacturing process is extensive and for the purposes of this evaluation we focus upon phases of production which involve the Centerless Grinding Department (Department 76) (CGD).

High carbon steel wire is the basic raw material of rod and pin manufacture. Initially, the steel wire is fed from large shipping spools into a series of units, termed "chopper," "header," "blanker," and "broach" machines. During these processes, the wire is cut into cylindrical segments and the coarse edges are shaped according to various design specifications. Then, some of the parts are washed in large tumblers and undergo degreasing. Other parts are placed in tumblers with emery (radius tumble) for crude reductions in outside diameter. Some parts are sent through another tumbling operation (small tumble) to remove metal burrs; others are tempered by heat treatment. The cylindrical rods and pins are subsequently placed in grinding machines which further shape and reduce them to a desired tolerance. The grinding operations, "End Grind," "Pin and End Grind," "Centerless Grind," and "Precision Grind," are functionally similar but workers and machines have been placed in separate geographic and organizational subdivisions within the plant (Table 1). At various points in grinding, the parts may return to another department (e.g., tumble, heat treatment) combining a number of material flow patterns before moving on to the final inspection and packaging areas. Within and among these operations there is a wide range of metal working fluids, chemical additives, solvents and other process chemicals.

The Centerless Grinding Department (CGD) is the largest single operation in the Broad Street facility. The CGD consists of 38 grinding machines for "routine" production and a separately housed area with fewer machines for precision grinding. Each grinding machine has two revolving, abrasive-coated drums which are continuously flooded with large volumes of metal working fluid (MWF) (Figure 2). The MWF reduces friction, flushes away metal fillings and generally prolongs tool life. Typically, parts are conveyed from a hopper which feeds the rods or pins along a slide and onto a blade, set between the grinding drums. Each part "walks" the length of the blade and is ejected with a stream of MWF through a port on the side of the machine (Figure 3).

All machines engaged in the more routine CGD production schedules are supplied with MWF from a recirculating, Central Coolant System. There is a separate recirculating system for the precision grind area. The main Central Coolant System requires 12,000 to 13,000 gallons of MWF to be fully primed. A network of pits and trenches under the floor is used to drain the spent coolant and return it to a filtration unit. The latter consists of 3 settling tanks and a series of 40 cyclones which remove particles of greater than 10 microns. A large holding tank for clean MWF serves as a reservoir for the entire system.

The MWF for the Central Coolant System arrives at the plant in the form of a concentrate. Prior to 1981, the system was primed with Van Straaton (VS) 537 ™, a semi-synthetic MWF. Between August 1980 and July 1981, the working solution was frequently mixed with an additional biocide conditioner (VS Conditioner 5). Another biocide material used during this period was VS biocide conditioner 11. Since July 1981, the

system has been primed with a completely synthetic MWF, VS 39-100A. An anti-sludging additive, VS 51-180 is used infrequently. VS biocide conditioners 5 and 11 are no longer used. The system is replenished daily with 10 gallons of VS 39-100A and 500 gallons of fresh water. Underground pits and trenches are cleaned every 7 to 8 weeks and sludge is removed from the filtration and settling tanks continuously. Approximately 36 cubic feet of sludge are removed each day from the system.

IV. EVALUATION DESIGN AND METHODS

A. Industrial Hygiene Survey

Each machine in the routine and precision grind areas was examined during normal working conditions. The focus of the industrial hygiene survey was upon operating conditions which might contribute to worker dermatitis, such as the degree of machine splatter, severity of cut, type of alloy, size of job, wheel speed, and frequency of contact with parts and MWF.

B. Medical Evaluation

All workers involved in the Centerless Grinding Department operations and other phases of production were invited to participate in an occupational health study of "exposure to metal working fluids" (MWF). Each worker was interviewed privately by a Yale University physician or nurse. Information was entered on a questionnaire form which included a demographic profile, original dates of employment at the Torrington Company (and in the most current job) as well as responses about potential health effects relevant to known toxic effects of MWF's. Workers were examined and a description of cutaneous findings was also recorded on the form. Data concerning the frequency of hand washing and patterns of soap use were documented for every participant.

The information obtained from physical examinations showed varying degrees and extent of dermatitis. For the purposes of statistical analyses, the skin findings were graded according to severity and location of the eruption (Table 2).

In order to explore the underlying cause(s) of skin reactions among the CGD workers, a testing program ("patch testing") for chemical allergy was undertaken. At the outset, direct irritation (irritant contact dermatitis) was considered the most likely explanation for the skin findings. As additional workers with severe skin conditions were identified during the initial phases of this study, a more in-depth patch test investigation was planned.
More than 20 chemical agents were provided by the Van Straaton Chemical Company (suppliers of the MWF products used in the Broad Street Plant operations). These chemicals included all components of Van Straaton products: VS 537, VS 39-100A. Each chemical was prepared in

petrolatum or an aqueous delivery vehicle or used "as is" for patch tests. In most instances the test agents were prepared according to published (recommended) concentrations for allergy testing. Several additional chemicals frequently associated with allergic contact dermatitis among machinists were included in the test series. A total of 25 chemicals comprised the full patch test program, otherwise referred to as the "VS Tray" (Table 3).

Fourteen workers with relatively severe dermatitis (grades 3 or higher) were invited to participate in the patch test study. Chemicals were applied under occlusive patches (A1-Patch, Hollister-Stier) and left in place for 48 hours. Participants were provided with instructions concerning the test program. Interpretation of the test results was delayed 30 to 45 minutes following removal of the patches. All patients were examined at the 48-hour reading. A final examination of the test sites was performed at 120-hours by the plant nurse.

V. EVALUATION CRITERIA

A. Environmental Criteria

As a guide to the evaluation of the hazards posed by workplace exposures, NIOSH field staff employ environmental evaluation criteria for assessment of a number of chemical and physical agents. These criteria are intended to suggest levels of exposure to which most workers may be exposed up to 10 hours per day, 40 hours per week for a working lifetime without experiencing adverse health effects. It is, however, important to note that not all workers will be protected from adverse health effects if their exposures are maintained below these levels. A small percentage may experience adverse health effects because of individual susceptibility, a pre-existing medical condition, and/or a hypersensitivity (allergy).

In addition, some hazardous substances may act in combination with other workplace exposures, the general environment, or with medications or personal habits of the worker to produce health effects even if the occupational exposures are controlled at the level set by the evaluation criterion. These combined effects are often not considered in the evaluation criteria. Also, some substances are absorbed by direct contact with the skin and mucous membranes, and thus potentially increase the overall exposure. Finally, evaluation criteria may change over the years as new information on the toxic effects of an agent become available.

The primary sources of environmental evaluation criteria for the workplace are: 1) NIOSH Criteria Documents and recommendations, 2) the American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values (TLV's), and 3) the U.S. Department of Labor (OSHA) occupational health standards. Often, the NIOSH recommendations and ACGIH TLV's are lower than the corresponding OSHA standards. Both

NIOSH recommendations and ACGIH TLV's usually are based on more recent information than are the OSHA standards. The OSHA standards also may be required to take into account the feasibility of controlling exposures in various industries where the agents are used; the NIOSH-recommended standards, by contrast, are based primarily on concerns relating to the prevention of occupational disease. In evaluating the exposure levels and the recommendations for reducing these levels found in this report, it should be noted that industry is legally required to meet only those levels specified by an OSHA standard.

A time-weighted average (TWA) exposure refers to the average airborne concentration of a substance during a normal 8- to 10-hour workday. Some substances have recommended short-term exposure limits or ceiling values which are intended to supplement the TWA where there are recognized toxic effects from high short-term exposures.

VI. RESULTS

A. Environmental

There were several departures from good work practices observed in the CGD which deserve emphasis:

(1) With one exception, grinding machines did not have permanent splash guards. In order to contain aerosol generated during the process, cloth rags were draped over the machine housing (Figure 4). This was rather inefficient and allowed for repeated skin contamination with MWF (Figure 5). At best, even the clean rags were somewhat oily and these were used by all workers to wipe their hands.

(2) The employee protective gear program was less than optimal. Although workers were provided with gloves, sleeves and in some cases, aprons, compliance with the protective gear program was minimal. Some workers had no work gear other than their work clothes, while others wore contaminated gear (i.e. gear impregnated with MWF).

(3) There was no standard procedure(s) for dealing with skin contamination regarding MWF. Workers in some instances washed hands every 60 minutes using any of several different cleansers (SaniFresh™, Calgon Charger™, Barricade™, and personal soaps).

(4) Hazard warning signs were not posted to identify potential skin irritation or the development of allergy resulting from MWF exposure.

The findings of the survey did not reveal substantial differences in the physical parameters of machine set-up and use or process materials in the routine and precision grind areas. Nonetheless, there were striking differences in working conditions encountered in the two areas, including: (a) The assignment of one worker to operate two machines in routine grinding, compared to one worker per machine in

precision grinding; (b) Machine maintenance in precision grinding was approached with much greater care than that observed in routine grinding. Cloth containment rags were changed more frequently, reducing splatter and sludge build-up on the precision grind equipment. Aerosol generation as well, appeared far less in the precision grind areas; (c) There were also contrasting methods of retrieval and preparation of parts for micrometer measurements. In both areas measurements were taken as often as every 30 to 60 seconds, however, in routine grinding, parts were usually laden with MWF and the opportunity for contact with MWF was virtually continuous. Alternatively, for precision grinding it was necessary to have clean, dry hands and parts in order to obtain the highest degree of accuracy in measurements.

A major conclusion of the industrial hygiene survey was that all phases of precision grinding required extremely meticulous work practices which, in turn, reduced skin contamination with MWF to a minimum.

B. Medical

Worker population

A total of 94 workers participated in this evaluation. Forty-nine(49) workers in the CGD comprised the main study group with regular exposure to MWF used in the Central Coolant System. There were 45 workers in other departments (controls): Machine Maintenance and Tooling (Department 34); Heading (Department 48); Plant Maintenance (Department 52); Chopping (Department 59); Inspection (Department 72); Tumbling (Department 77); and, End Grind (Department 82). The mean age of 47 males in the CGD was 44.8 years compared to a mean age of 44.4 years for the 40 males in other departments. There were only 2 females (ages 28 and 45 years) in the CGD and 5 females in other departments (mean age 44.6 years). There was only 1 black worker in the study population.

Employment Data

The mean duration of employment (considering number of years at the most recent job) was 11.4 years (n=48) for workers in the CGD whereas those in other departments reported a mean of 8.7 years (n=45). While the trend was toward longer employment in the CGD, these differences were not statistically significant ($p>.05$). Moreover, total years of employment at The Torrington Company was quite similar for both groups (CGD: 15.1 years; other departments: 13.6 years).

Medical History

Symptoms reported by the workers in all departmental areas are presented in Table 4. Thirty-one of 49 workers (67%) in the CGD described itching and burning skin of the hands, part or all of the time. By comparison, only 9 of 45 workers (20%) in other departments

had any symptoms. Using a Chi square analysis, skin discomfort (symptoms) was found to be significantly more frequent among those in centerless grinding ($p<.001$). None of the workers described symptoms or previous episodes suggestive of systemic disease.

Cutaneous Examinations

A total of 66 workers (70%) showed objective signs of dermatitis (Table 5). Many workers in both the CGD (38.8%) and other departments (55.6%) showed mild redness on the dorsum of the hands which was consistent with seasonal dry skin (Figure 6). The more pronounced skin changes (Figures 7-9) indicative of chronic irritation or allergic contact dermatitis were encountered almost exclusively among workers in the CGD. Eighteen of the 49 grinder operators (36.7%) had findings of advanced skin disease while there were only 4 workers (8.9%) in all other departments with moderately severe dermatitis. The most severe and extensive skin eruptions (grade 4) were observed only in the CGD workers; almost one-fourth of the CGD group showed redness, scaling and fissuring of the hands, forearms and other sites. Many had dystrophic nail changes often associated with long-standing dermatitis of the fingertips.

One worker in the CGD had a dermatitis condition in combination with psoriasis. Another worker in plant maintenance (an electrician) with moderately severe dermatitis described regular exposure to a cleaning solution. This worker also reported washing his hands more than 12 times a day (see below).

Patch Test Studies

Nine of the 14 workers with dermatitis patterns of grade 3 or 4 volunteered for the patch test studies. The studies were conducted and interpreted for these 9 workers during a single 5-day period (in-plant). One participant who had severe dermatitis in the preliminary office consultations developed a flare of his condition a number of months after the in-plant tests; he underwent the same patch test program at the Yale Occupational Skin Disease Clinic. This worker was included with the in-plant test group for purposes of the analysis.

There were no substantial positive reactions among the group of workers who completed the testing program at the plant (Table 6). One of those workers had a markedly positive reaction to formaldehyde in an earlier office consultation. This chemical (formaldehyde) was omitted from the VS Tray, in this one instance only, to avoid an untoward reaction. The other worker with a strongly positive reaction to formaldehyde was tested several months after the initial patch test studies. Each of the workers with allergic contact dermatitis to formaldehyde was immediately informed of the condition. Sensitivity patterns were not

determined for 5 workers with severe dermatitis and such testing may have revealed other formaldehyde-sensitive workers. It is noteworthy that 2 of the 15 workers in the test group (20%) reacted positively to formaldehyde (see Discussion).

Other Analyses

During the worker interviews at the time of administering questionnaires , data were obtained regarding improvement of skin discomfort or rash when away from the plant (weekends, vacations, leave). Of the 66 workers with any evidence of dermatitis, 40 (60%) reported improvement when out of the usual work environment. Twenty-seven of the workers with signs of dermatitis (40.9%) had visited a physician for the condition; 24 of these workers (seeking medical attention) were in the CGD. This indicates that one out of every two workers in the CGD perceived a need for and sought medical skin care preceding or during the conduct of this evaluation.

In order to further explore causal mechanisms of presumptive occupational dermatitis, several potential contributory factors were studies. Multiple Chi square analyses revealed no significant associations between severity of dermatitis and history of atopy (i.e. eczema, hay fever or asthma), frequency of hand washing or choice of hand cleanser (Sani-Fresh, Calgon Charger, Barricade, or personal soap).

VII. DISCUSSION

While definitive cause and effect relationships are always difficult to establish, the major causal factors associated with an epidemic of dermatitis among centerless grinding operators in the Broad Street facility of The Torrington Company appears to be a combination of exposure to MWF additives and work practices. The evidence which implicates these factors is as follows:

(1) The epidemic of dermatitis was first recognized following repeated problems with bacterial contamination of the Central Coolant System late in the summer of 1980 through the fall of 1981. In order to deal with the contamination problem an alkaline, triazine-containing chemical aditive* or an isothiazolone-containing additive** was used with the MWF, VS 537. Both additives are highly corrosive to skin and mucous membranes at low concentrations(1,2). The presence of these additives in excess of the usual biocide concentration in the working solution of VS 537 may have been a major contributory factor in the expression of worker dermatitis.

(2) With few exceptions, only workers in contact with centerless grinding machines (used in conjunction with the Central Coolant System) developed severe dermatitis. Severe skin rashes did not occur among workers in other plant areas despite exposure to a variety of MWF's and degreasing agents. It must be emphasized, that biocide conditioners were never used consistently in other areas.

(3) While the epidemic proportions of the dermatitis problem have declined since August 1981, newer cases persisted through early 1982. That 2 of 10 workers (20%) were strongly reactive (allergic) to formaldehyde is most significant. The triazine- and isothiazolone-type biocides are recognized formaldehyde-releasing agents (3,4). Equally important, however, the quaternary ammonium boicides added to the MWF that is in use currently, VS 39-100A, also release formaldehyde in aqueous solution (4,5). Since formaldehyde is a well known sensitizing agent (4,6), it is likely that new cases will arise from time to time, particularly if good work practices are not maintained.

(4) Work practices in the CGD are less than optimal. MWF aerosol containment on CGD machines is inefficient, compliance with the protective gear program is erratic, there are no standard procedures for dealing with skin contamination, and worker awareness of potential hazards associated with MWF exposure is lacking.

* Conditioner 5 contains 1,3,5-Tris (2 hydroxyethyl)-S-triazine (Grotan™, Lehn and Fink).

** Conditioner 11 contains equal parts 5-chloro-2-methyl-4-isothiazolin-3-one and 2-methyl-4-isothiazolin-3-one (Kathon™, Rohm and Haas).

Synthetic and Semi-synthetic MWF's have been described as skin irritants since they were introduced several decades ago to replace the less effective 'straight cutting oils' (7). While the potential for these agents to induce allergy was originally thought to be minimal, it is becoming increasingly clear that many of the biocide, detergent and rust prevention additives are strong sensitizers (5).

In this study group, 2 of 10 workers (20%) were found to have formaldehyde allergy. The importance of this finding is underscored by comparison with large-scale investigations where the prevalence of formaldehyde sensitivity in persons with eczema conditions, ranges from only 3.2 to 6.3% (9-12). Other chemicals frequently responsible for allergic contact dermatitis among workers exposed to MWF include nickel, chromate, ethylenediamine, and various fragrance compounds. None of the Torrington workers who participated in the patch testing evaluation had such allergies.

The data obtained during this study indicate that centerless grinding workers who were regularly exposed to MWF and additives in a large, recirculating, Central Coolant System developed irritant and allergic contact dermatitis. A number of departures from good work practices in the Centerless Grinding Department were likely predisposing factors for the dermatitis problem. While the frequency of hand washing was not statistically associated with the severity of dermatitis, excessive hand washing practices (4 or more times per shift) undoubtedly contributed to skin irritation in a large proportion of the entire work force (study population).

VIII. RECOMMENDATIONS

Regarding the epidemic of hand dermatitis among workers in the CGD, the introduction of a non-irritating and non-sensitizing MWF would seem an obvious and desirable alternative. It should be appreciated that there is no product with these qualities currently available. To a large extent, skin irritation and allergic contact dermatitis may be prevented by improving work practices and the medical assessment of workers at risk for dermatitis (12). The following program is recommended:

Industrial Hygiene

(1) Machinery. Permanent splash guards on grinding machines tend to minimize employee exposure to metal working fluids. It would be highly desirable to modify centerless grinding machines accordingly. Nonetheless, contact with contaminated machinery, aerosol and fluid-laden cylinders is inevitable. "CAUTION" signs posted in grinding areas will heighten worker awareness and reinforce the importance of protective measures (outlined below). For example:

CAUTION

METAL WORKING FLUIDS

REPEATED SKIN CONTACT WITH COOLANTS AND/OR CUTTING OILS
MAY CAUSE IRRITATION AND ALLERGIC CONTACT DERMATITIS.
CONTAMINATED SKIN SHOULD BE WASHED THOROUGHLY.

(2) Protective Clothing. The current practice of providing work clothes daily is essential but additional measures should be required. A wide variety of protective apparel, such as aprons, impervious sleeves and gloves is available commercially. Of course, garments should be designed to afford the greatest comfort possible and should not interfere with movements of the worker. If protective clothing and devices are too heavy and uncomfortable, workers will tend to discard them and adequate, continuous protection becomes impossible. It is clearly desirable for employees to be clad in short sleeve shirts but regardless of sleeve length, workers should wear plastic or paper sleeves. Those who prefer short sleeve garments should be provided with cotton tube gauze as a lightweight, absorbant material under the impervious sleeves (tube gauze is available through surgical supply outlets).

Where manual dexterity is important, a two-stage protection program is suggested. The inner glove consists of a thin, disposable "cotton liner" and the outer layer is a disposable vinyl plastic glove. Latex or rubber gloves are less preferable in that they are occasionally the cause of allergic contact dermatitis.

Workers should be educated in the proper use of protective clothing, particularly removal of contaminated gear. Gloves should always be removed last and in a way that avoids skin contact with the contaminated portion.

Ample supplies of fresh, clean rags should be accessible to workers in all areas of the CGD. The use of dry, unsoiled rags should be strongly encouraged. CGS workers should be instructed to wipe hands and parts dry before each micrometer measurement (as is the practice in Precision Grinding areas).

(3) Production Schedules. In order to develop a working environment conducive for the maintenance of good work practices, it would be most desirable to reduce job pressure associated with the prescribed incentive program of the CGD. This type of payment schedule tends to replace a cautious attentive approach to skin care (and larger issues of safety) with an imperative to enhance productivity (n.b. This may be the most important difference between operators in the CGD and Precision Grinding Department). In this context, it would be particularly worthwhile to consider the assignment of one worker per machine in the CGD.

(4) Personal Hygiene. The use of harsh soaps (such as the liquid germicidal preparation and the abrasive soap) is most unsatisfactory. Nonetheless, abrasives are often necessary to facilitate removal of oily materials and dirt. Finely granulated cornmeal is reasonably effective for this purpose and rarely irritating. We strongly advise its use in combination with a neutral pH soap. Whatever the agent used, it should be readily available in adequate amounts at each washing station. For hand drying, paper towels are suitable. A skin care information sheet which can be posted in locker areas or distributed to workers should be available.

(5) Worker Education. The utility of and compliance with any health and safety program usually parallels the effort placed in worker education. Employees should fully understand the reasons for introducing safety measures (eg. traffic patterns, housekeeping, work apparel, protective clothes, hand washing, etc.). A worker safety committee is particularly useful for disseminating this information.

(6) While it was not our intention to perform a complete occupational health survey of the facility, there was one health hazard that should be addressed. Background noise levels in the plant are undoubtedly higher than 85 dBA in many areas (header, grinding and perhaps tumble departments). Several employees were observed wearing protective ear covering but the majority were not using any type of protection at the time of our evaluation. The need for ear protection should be emphasized to workers. The use of ear protection should be required in high risk areas.

Medical

(1) Pre-employment Screening. It may be possible for the Medical Department to identify certain individuals who would be likely to develop skin problems in the setting of frequent exposure to chemicals. Persons with a history of certain skin diseases or allergic conditions might be especially predisposed to irritant or allergic reactions. The following questions could be directed towards employee applicants as well as the current force:

> Do you have any medical problems which require the attention of a doctor on a regular basis? If so, please identify the problem (indicate medications).
>
> Do you have or have you ever had a skin condition? If so, what?
>
> Do you have skin allergies to rubber, adhesives, other chemicals or metals?
>
> Do you have or have you ever had asthma, hay fever, or skin eczema?

Those answering affirmatively in the latter category are generally considered to be so-called, "atopic" individuals and at the least, they are more prone to develop dry skin. Certain occupational settings in the plant would be quite undesirable for them. Where questions arise about the disposition of a particular individual, dermatological advice should be sought.

(2) Periodic Dermatological Evaluation. Newly hired workers are disinclined to report medical complaints because of the adverse impact it might have on their employment. All newly hired employees should be evaluated after 6 and 12 weeks on the job for the presence of dermatitis involving the hands. Employees in high risk areas should be evaluated every 3-5 months thereafter. An interview and skin examination (limited to hands and forearms) can be performed by knowledgeable medical personnel in 3-5 minutes.

(3) Assessment of workers with dermatitis. Employees with dermatitis should be interviewed in more detail. If skin irritation is likely, the worker should receive further education regarding proper protective measures and skin care. If irritation does not clear promptly or allergy is suspected, the worker should be referred for consultation with a skin specialist.

Referral of all dermatologic problems to one dermatologist or medical facility has obvious potential benefits. Medical consultants should have some familiarity with occupational factors which are operative in the plant. Unusual skin conditions, particularly allergic hypersensitivity related to materials in the work place could be explored as they evolve (i.e. prospectively). Likewise, preventive approaches would be developed at the earliest possible time.

(4) Disposition of workers with dermatitis. The treatment of occupational dermatitis must be tailored to the circumstances underlying the disorder. Mild irritation can often be treated while the employee continues usual work activities; more severe cases of irritation and allergy require a period of convalescence away from the job. Where poor work practices have led to the skin condition, it is often possible to alter the work setting and return the affected person(s) to the same job. However, in most instances of allergic hypersensitivity, it is necessary to transfer the worker to a new location where exposure to the causal agent would be unlikely.

Assistance in implementing any phase of the recommendations can be provided, especially education of workers, medical, safety and other Torrington Company personnel about this specific problem. It is most important to emphasize the potential consequences of severe dermatitis and the need for development of an effective preventive program.

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XI. DISTRIBUTION AND AVAILABILITY OF REPORT

Copies of this report are currently available upon request from NIOSH, Division of Standards Development and Technology Transfer, Publications Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days, the report will be available through the National Technical Information Service (NTIS), 5285 Port Royal, Springfield, Virginia 22161. 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. The Torrington Company
2. NIOSH, Region I
3. OSHA, Region I

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

Table 1

Production Departments: Broad Street Plant

The Torrington Company

Department Number	Description	Chemical Exposure
15	Storehouse	NA[a]
16	Shipping	NA
26	Heat Treat	NA
34	Machine Maintenance and Tooling	Variable
48	Heading	WIT 10 (MWF)[b] Bruko D269 (MWF) Mobil Vactra Oil #2 (MWF) VS 39-100A (Broach only)
52	Plant Maintenance	Chloroethene VG[c]
59	Chopping	(See Heading)
64	Inspection	-
72	Inspection	-
76	Centerless/Precision Grind	VS 537 (MWF) VS Conditioners 5/11 VS 39-100A (MWF)
77	Tumble	Chemex 94[d]
78	Blanking	(See Heading)
82	End Grind	(See Centerless/Precision)

a/ NA: Not Available.
b/ MWF: Metal Working Fluid.
c/ Chloroethene VG: degreasing agent
d/ Chemex 94: detergent

Table 2

Severity of Dermatitis Observed Among Workers

Exposed to Metal Working Fluid in a Grinding Operation

Grade 0:	No active dermatitis[a].
Grade 1:	Minimal redness and/or scale formation on the dorsum of the hands only.
Grade 2:	Pronounced redness and scale formation on the dorsum and palmar surfaces of the hands.
Grade 3:	Pronounced redness, scale formation and fissuring on the dorsum and palmar surfaces of the hands.
Grade 4:	Dermatitis (redness, scaling, fissuring) of the hands plus involvement of other skin sites and/or nail changes.

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a/ Dermatitis: Redness, scale formation, fissuring and in extreme cases, blistering of the skin.

Table 3

PATCH TEST SCHEDULE: The Torrington Company

September 20,22, 1982. VS TRAY

1. Carboxylic Acid Ester(unspecified) 10% pet.
2. Petroleum oil 20% pet.
3. Alkanolamide 10% pet.
4. Petroleum Sulfonate 20% pet.
5. Fatty Acid Soaps and Esters (unspecified) 5% pet.
6. same listing (per Van Straaton)
7. same listing (per Van Straaton)
8. Triazine-type preservative 0.25% pet.
9. Sodium Carbonate 10% aq.
10. Nonionic Surfactants (a) 20% pet. Mix
    (b) 20% pet.
11. Dye 2% aq.
12. Boric Acid 'as is'
13. Triethanolamine 5% pet.
14. Diethanolamine 5% pet.
15. Monoethanolamine-fatty acid condensate 5% acet.
16. Mixed Carboxylic Acid Amine Salt (unspecified) 10% aq.
17. Polyoxyalkylene 'as is'
18. Boramide 1% pet.
19. Preservative (quarternary ammonium type) 2% pet.
20. Perfume 2% aq.
21. Quaternary-15 2% pet.*
22. Ethylenediamine dihydrochloride 1% pet.*
23. Formaldehyde 2% aq.*
24. Potassium Dichromate 2% pet.*
25. Nickel Sulfate 5% pet.*

* Commercially prepared patch test material (American Academy of Dermatology)

Table 4

Symptoms of Skin Disease Reported by 94 Workers

in the Broad Street Plant of the Torrington Company

Symptoms	Department 76 (N=49)	Other Departments (N=45)
Itching	25 (51%)	5 (11%)
Burning	8 (16%)	1 (2%)
Paresthesias	-	2 (4%)
Unspecified	3 (6%)	4 (9%)
None	18 (37%)	36 (80%)

Table 5

Dermatitis Patterns Among 94 Workers in Metal Cylinder Manufacture

The Torrington Company

Department (Total)	Severity of Dermatitis[a]					% Workers With Pronounced Derma (Grades 2 - 4)
	Grade 0	Grade 1[b]	Grade 2	Grade 3	Grade 4	
54 (3)	2	-	1	-	-	-
48 (4)	4	-	-	-	-	0.0
52 (16)	3	14	-	1	-	6.3
59 (1)	1	-	-	-	-	-
72 (12)	6	5	1	-	-	8.3
76 (49)	12	19	5	1	12	36.7
77 (5)	1	4	-	-	-	0.0
82 (3)	-	2	1	-	-	-
Totals (94)	28	44	8	2	12	50.0

a/ Severity of Dermatitis: See Table 2.

b/ Grade 1: Mild skin changes consistent with seasonal dry skin (Table 1/Text).

Table 6

Patch Testing Study Results[a]

The Torrington Company

Worker Study Number	Results[b] 48-Hour Reading	Comment
001	#3 (1+)[c]	negative at 120-hours
004	#1 (1+)	negative at 120-hours
008	#3 (1+) #18 (1+)	negative at 120-hours negative at 120-hours
011		NS[d]
015	#9 (1+)	negative at 120-hours
016	#3 (1+) #15 (1+)	negative at 120-hours negative at 120-hours
023	#3 (1+) #14 (1+)	negative at 120-hours negative at 120-hours
038		NS
058	#23 (3+)	positive at 120-hours
059		NS
067	-	all negative
082		NS
086	-	all negative
087		NS
089	#3 (1+)	negative at 120-hours #23 positive during earlier study

a/ Patch test studies employed the 'VS Tray' (see table 3).
b/ Results were obtained during parallel studies in all but one case (Study No. 058).
c/ Reactions interpreted on scale of 1-3+; 1+ readings (negative at 120-hours) were considered to be mild irritant reactions.
d/ NS: No show (declined participation in study).

FIGURE LEGENDS

Figure 1. Metal pins and rods manufactured in the Broad Street Facility operations.

Figure 2. Metal working fluid floods the abrasive surfaces of centerless grinding wheels.

Figure 3. Metal rods emerging from port on the side of a centerless grinding machine along with a stream of metal working fluid.

Figure 4. Aerosol containment on centerless grinding machine is achieved by hanging rags over grinding wheels; staining is due to impregnation of rag with metal working fluid.

Figure 5. Hands of grinding machine operator who declined to wear protective gloves.

Figure 6. Hands of worker with mild, patchy redness and scale formation over knuckles and joints of fingers(Grade 1).

Figure 7. Hands of worker with marked redness over most of the skin surface on the dorum; note thickened, scaling skin over some finger joints (Grade 2).

Figure 8. Palmar surface of hands showing multiple areas of skin thickness and fissuring (especially involving right thenar eminance)(Grade 3)

Figure 9A. Severe dermatitis on fingers of grinder operator. Deep fissures and extensive crusting is present. Nail on forefinger is cracked and split from chronic dermatitis condition(Grade 4).

Figure 9B. Dermatitis involving the forearm of a grinder operator. Fingers also show fissuring and crusting (slightly out of focus)(Grade 4).

Figure 9C. Active dermatitis on the abdomen of a grinder operator(Grade 4).

◀ Figure 1

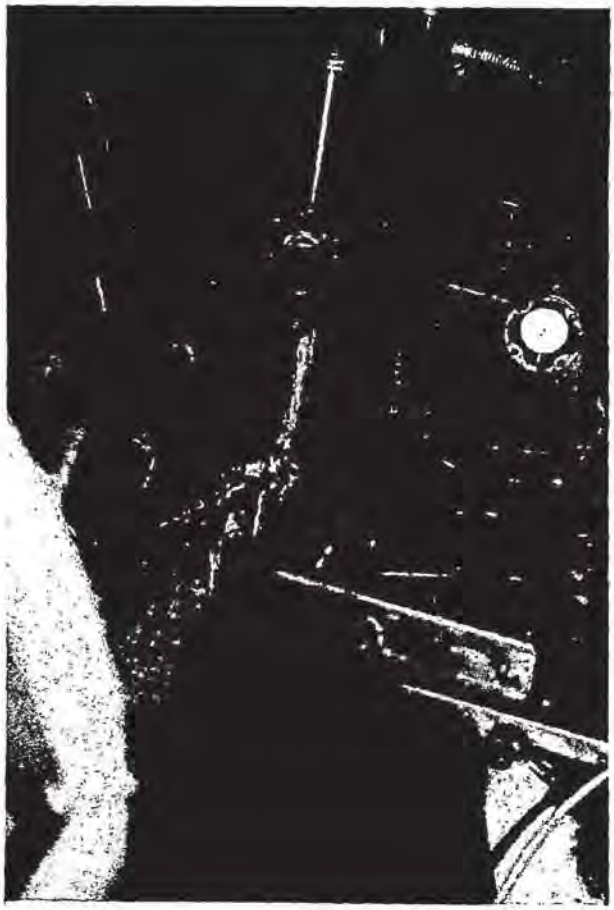


Figure 2 ▲

◀ Figure 3

Figure 4

Figure 5

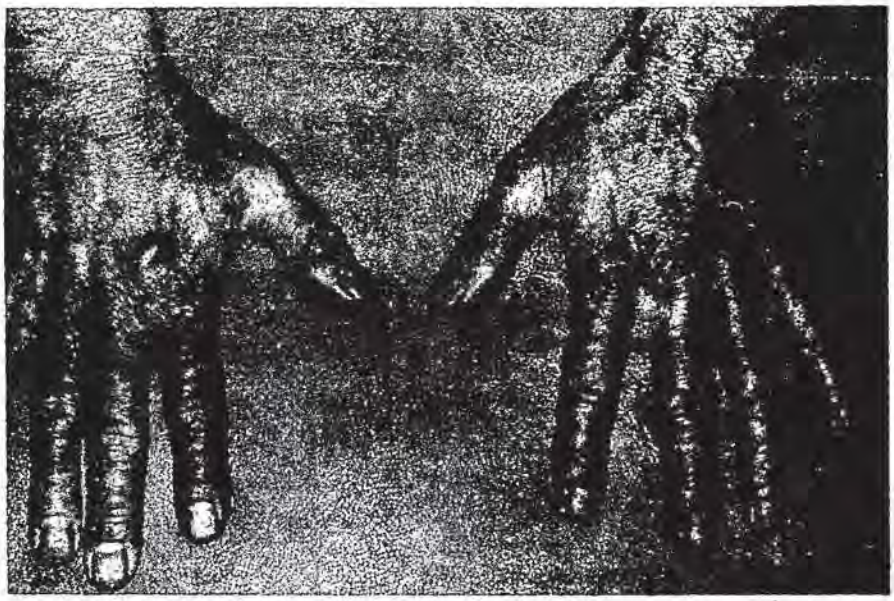


Figure 6

Figure 7

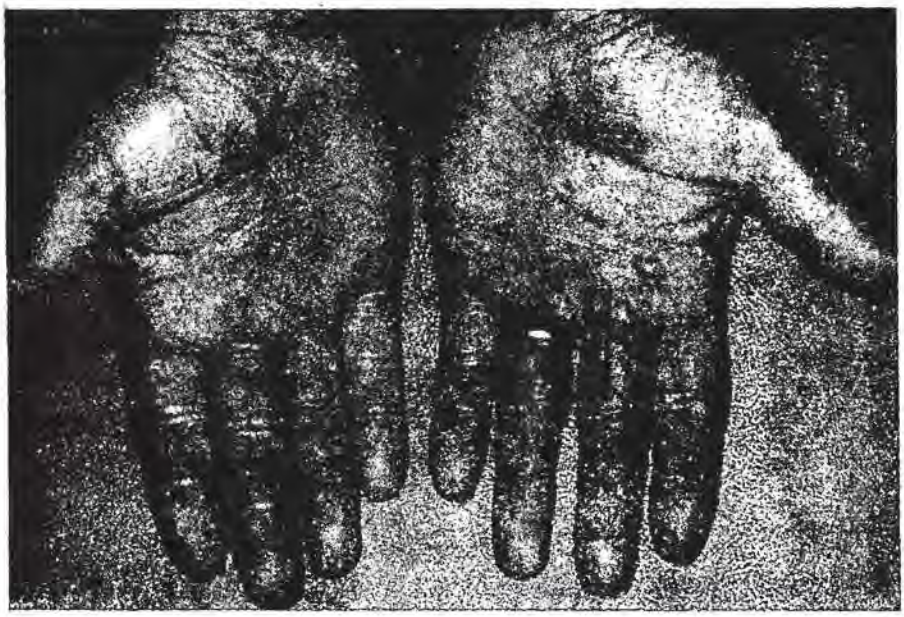
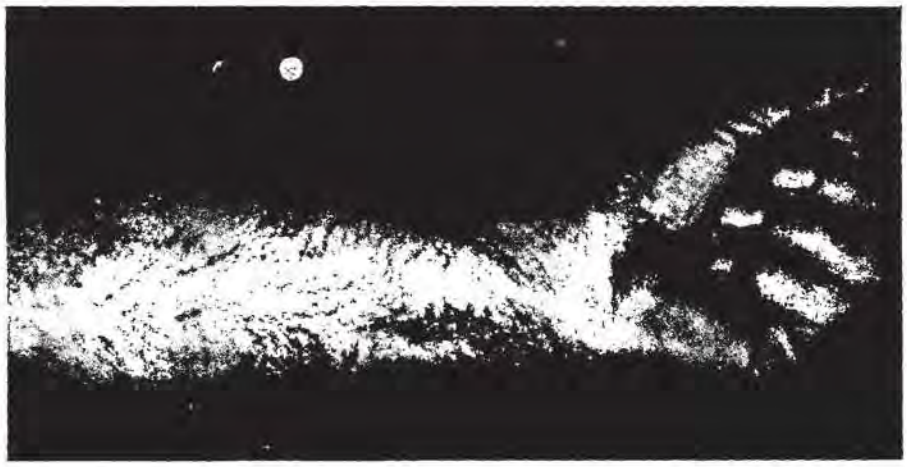


Figure 8

Figure 9A

Figure 9B



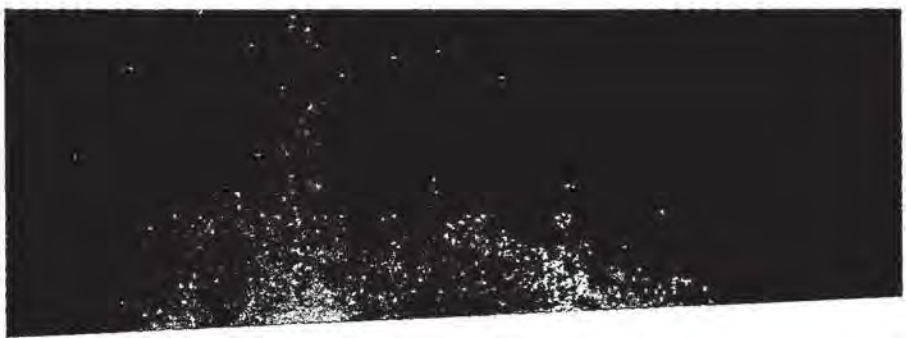


Figure 9C