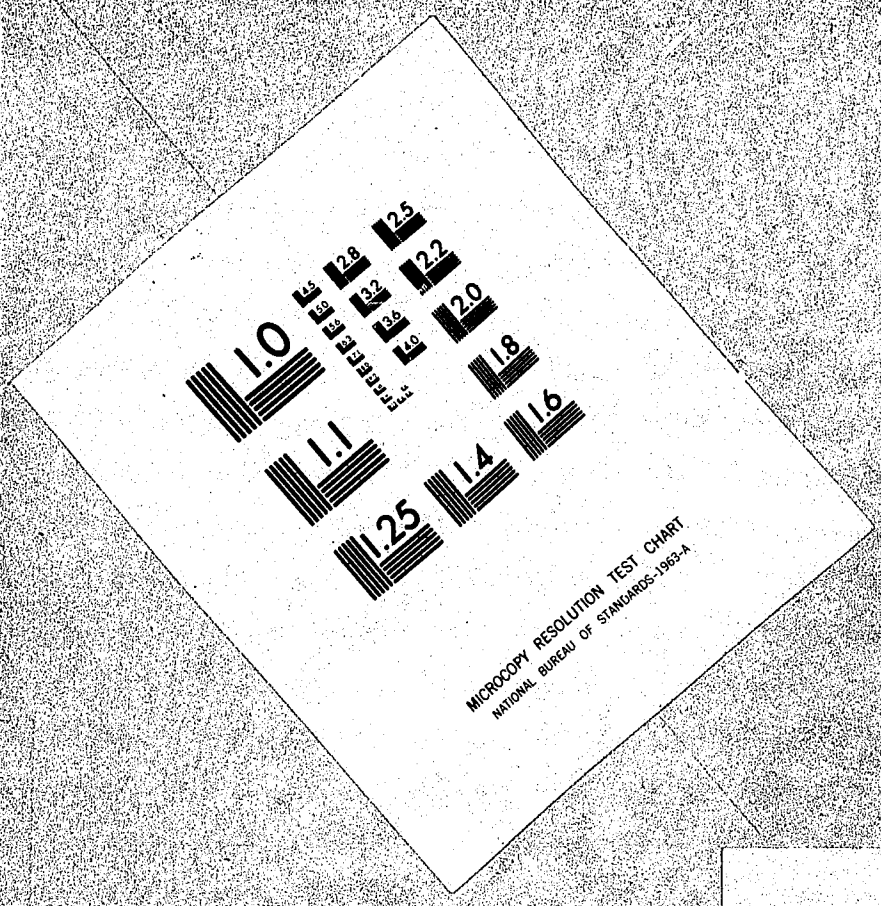
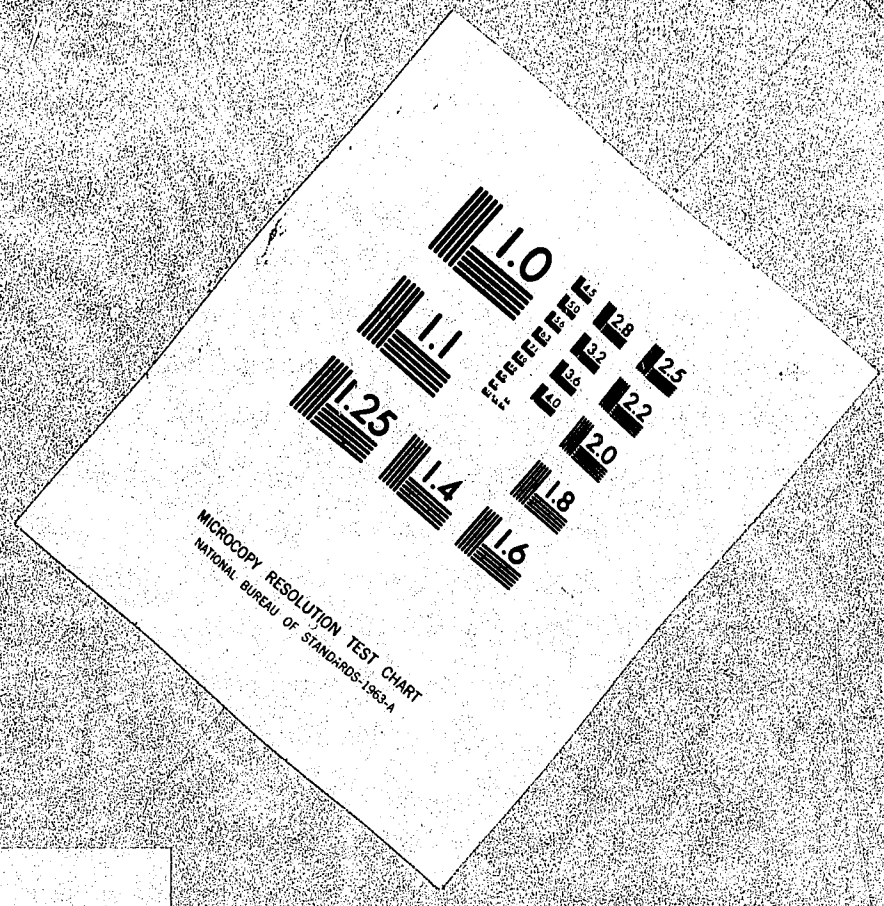
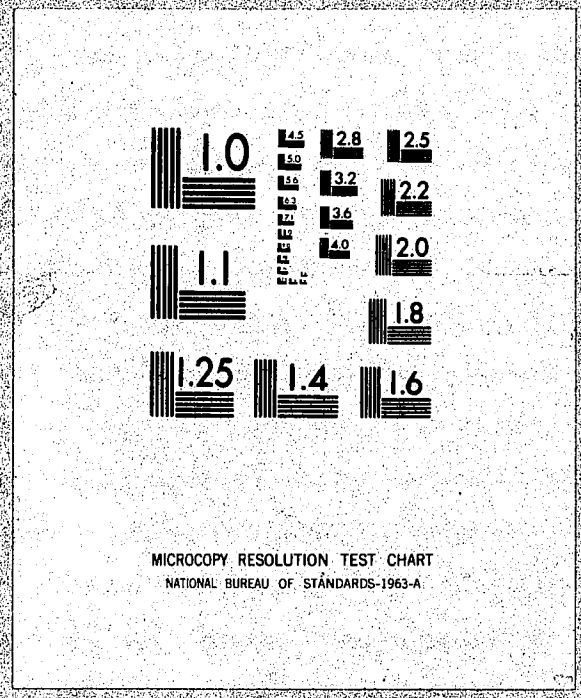
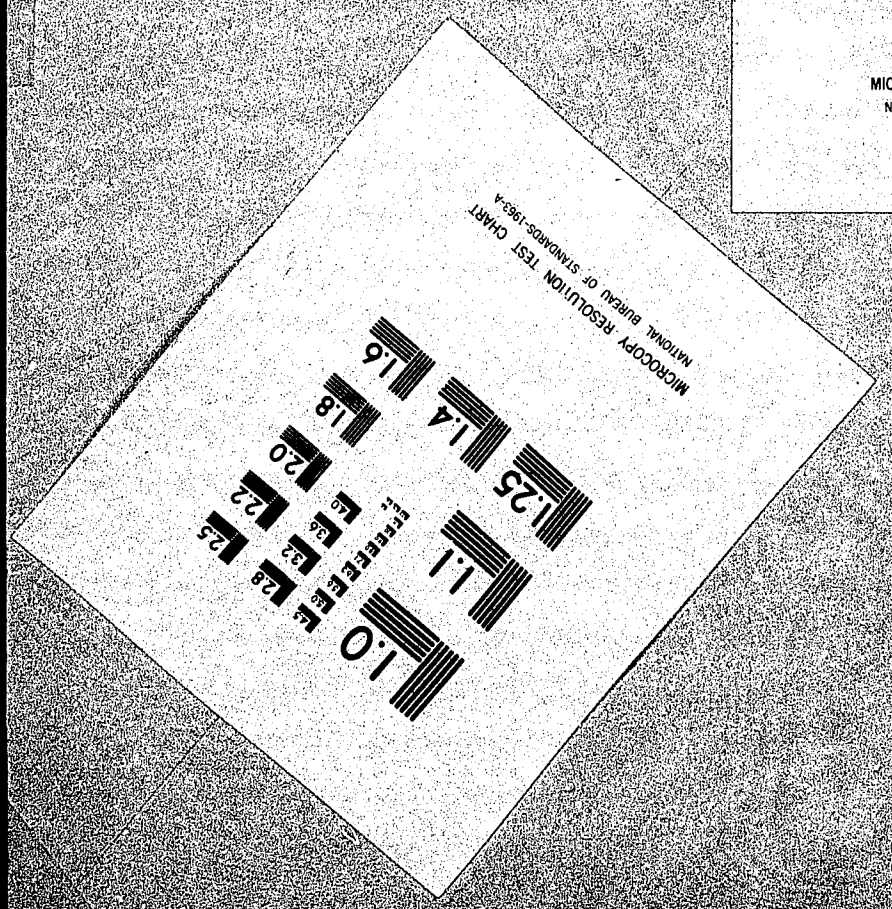
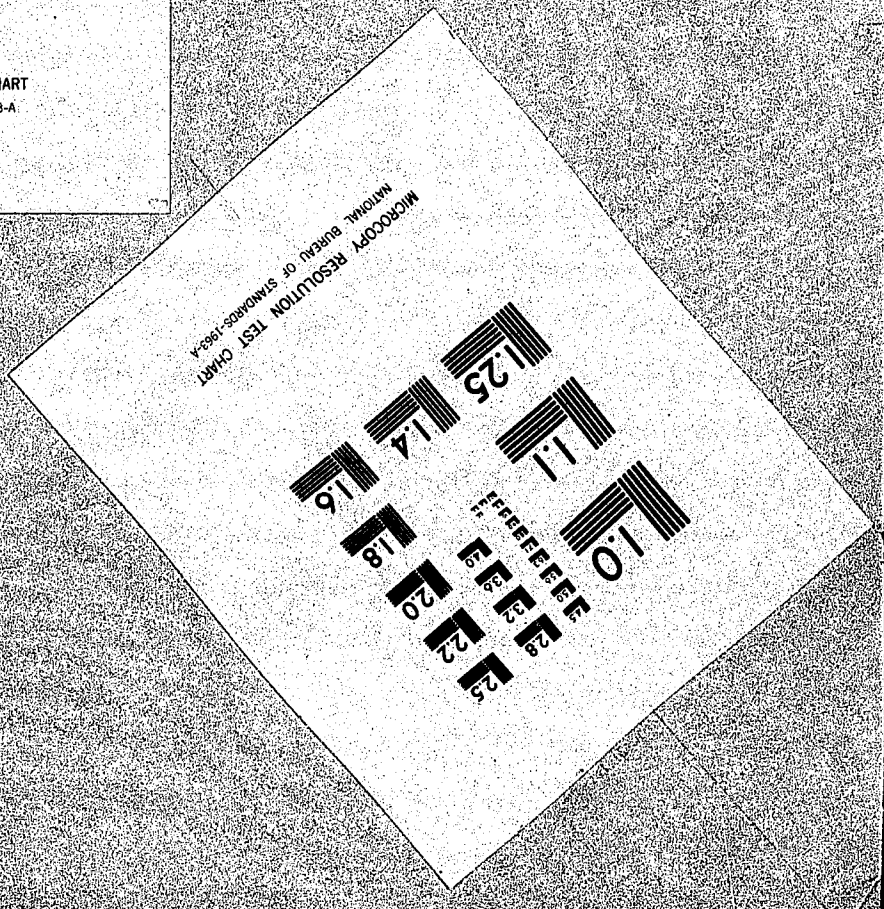

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NIOSH:00066910

A STUDY PREPARED FOR THE NATIONAL INSTITUTE
FOR OCCUPATIONAL SAFETY AND HEALTH

DEVELOPMENT AND PRESENTATION OF A LECTURE SERIES ON OCCUPATIONAL MEDICINE FOR MEDICAL STUDENTS

November 1975

99-72-90

UNIVERSITY OF WASHINGTON
DEPARTMENT OF ENVIRONMENTAL HEALTH

University of Washington
Department of Environmental Health

DEVELOPMENT AND PRESENTATION OF A LECTURE SERIES ON OCCUPATIONAL MEDICINE FOR MEDICAL STUDENTS

by

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November 1975

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This educational development project was performed under the provisions of HEW Contract HSM-99-72-90 issued to the Board of Regents of the University of Washington, Seattle, Washington 98195, by the National Institute for Occupational Safety and Health, Procurement Branch, Room 3-44, 5600 Fishers Lane, Rockville, Maryland 20852.

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ABSTRACT

- Incomplete -

Will be submitted at a later date.

Lecture 1

AGRICULTURAL HEALTH ISSUES

OBJECTIVES

1. To sensitize the medical student to a specific societal problem which affects the practice of medicine.

2. To demonstrate by means of a videotape the myriad environmental problems in a nonurban way of life, particularly as they impinge upon the farm worker and his family. (A self-examination tool is provided to reinforce the message.)

3. To discuss health services to migrant farm laborers as a particular problem.

4. To discuss the environmental health program elements for the agricultural work force.

5. To provide suggested readings, including some specific summary statements on six important areas of occupational diseases of agricultural workers.

Lecture 1: Agricultural Health Issues

Materials Description

Student Materials	To be developed by Instructor from Instructor's Guide
Teaching Materials	Videotape, "Health Risks of Farm Workers"
Instructor's Guide and Reference Materials	Script to Videotape, "Health Risks of Farm Workers"
	Student Problems
	Discussion Topics
	Suggested Readings

Instructor's Guide:

Script to Videotape "Health Risks of Farm Workers"

Health Risks of Farm Workers

Agriculture is one of the great American success stories. Throughout our history, the farm worker has become more and more efficient at providing for the entire population. This progress has been especially notable in the last 30 years. In 1940, one farm worker could produce enough food and fiber for 10.7 persons. By 1972 this increased to 52.4 persons. Greater mechanization and the widespread use of fertilizer, pesticides and other agricultural chemicals have helped make this abundance possible. But this technology is, to a large extent, also responsible for a high rate of occupational illness and injury in agriculture, a rate exceeded only by mining and construction. The farmer himself is not the only one subject to these high risks. Migrant or seasonal labor is often used to supplement or replace machinery where technology proves inadequate or too expensive. These laborers may be settled residents of the area, school age or college kids looking for summer money, or those migrants who still pass through annually from Texas, California, Canada, Oregon and Arizona, among other places. A spectrum of problems ranging from age to education to living conditions make these people quite susceptible to illness and injury. It is this population, the farmer and the migrant, in a dangerous and somewhat isolated environment that can best profit from rural public health programs in preventive medicine and education. Although the problems are national, we will examine only that portion here at home.

Washington is one of the more important agricultural states. About 25% of the state's economic activity is related directly or indirectly to agriculture. In western Washington, the farms tend to be small. Dairy, poultry, truck crops and berries predominate. The crops requiring the most seasonal or migrant labor are strawberries, raspberries and cucumbers. In eastern Washington dry land farming and irrigation predominate. Crops vary from small grains in the dry land areas to fruit trees and truck vegetables in the irrigated areas. Asparagus, apple, grape and sugarbeet acreage is increasing. All degrees of mechanization can be

observed here, from the almost total mechanization found in the grain and beet fields to the low degree of mechanization and high degree of hand labor found in the orchards and vineyards. Much of this hand labor is provided by migrants and other seasonal laborers.

For convenience, one may divide agricultural work and life into four major components that affect health: technological exposure, exposure to the elements, exposure to animals, and housing. Technological exposure may take many forms. Typically, workers using mechanized equipment are subject to noise, dust, vibration and moving parts such as belts, pulleys and blades. They may be exposed to excessive carbon monoxide and other gases, as well as high concentrations of naturally occurring noxious gases, such as nitrous oxides and carbon dioxide in the confines of silos and storage pits. There is a high potential for exposure to agricultural chemicals such as fertilizers, herbicides, insecticides and chemically treated seeds as well as strong detergents and disinfectants. Pesticide residues on crops and fumigants used during storage are easily contacted inadvertently. Environmental health hazards may include excessive heat, sunlight, and, to a lesser extent, cold. Although drinking water and sanitary facilities in the field are required by Washington law, they are largely absent. The presence of livestock such as cattle, sheep, swine and poultry may lead to the transmission of infectious diseases, such as leptospirosis, anthrax, brucilosis, ornithosis and tetanus. Being kicked or crushed is always a possibility with large animals, and bites, scratches and the like may be incurred from any animal. Farm housing in general suffers the hazard of remoteness from medical care. For migrant workers, who are often transient and exist on a poverty level, housing is very much a health problem.

During 1973 there were 14 agricultural work fatalities and 6400 claims for injuries for which at least medical attention was required in Washington. Farm machinery and other vehicles play an important role in the more

serious of these injuries. Both engineering and attitude contributed a great deal to the incidence of injury, so control depends primarily on attitude changes on the part of the farmer and design changes on the part of the farm equipment manufacturers. The isolation of the accident victim from medical treatment compounds the severity of most farm accidents.

High noise levels have accompanied mechanization to the farm. The number of workers that risk noise-induced hearing loss may be greater than with any other hazard. The extent to which noise levels in agriculture are responsible for hearing loss is unknown, however, because audiometric testing of this population is seldom done. Twenty-five workers were tested for hearing acuity in Yakima during the summer of 1973. Of these 25, 5 were found to have early hearing loss which was attributed to occupational exposure. The sample is small, but the pattern is similar to that seen in other populations that use heavy equipment, such as construction workers. In addition to hearing loss, noise may trigger changes in the cardiovascular, endocrine, neurologic and other physiologic functions, all of which are suggestive of a general stress reaction. With the exception of hearing loss, the ultimate effect of these physiologic changes on the people involved is not yet clear.

Another recent study indicates that all equipment with a power source exposed operators to excessive noise levels. The major source of this noise was the tractor. Operations may last 12 hours per day for 4-6 weeks during the late summer and early fall, exposing the workers to noise levels up to 110-112 decibels. OSHA standards permit a worker to be exposed to no more than 90 dB in an 8-hour work day.

Control measures for noise emanating from agricultural equipment follow the same principles as for other industrial equipment, and consist of attempting to isolate the source of noise or to isolate the person from the source of noise. The use of tractor cabs to isolate the person from the noise source does not always reduce the noise level to within permissible levels. While motor noise is often reduced by the cab, noise from the gearbox often is not. Even with effective cabs, equipment pulled behind the tractor often necessitates opening the windows for control lines or levers, thus reducing the efficiency of the cab. Cabs will also be

opened on a hot day if they are not provided with air conditioning, again reducing their effectiveness.

Engineering or maintenance personnel are available in other industries to maintain the safety equipment, but the farmer doing his own maintenance usually does not have the time or know-how for such technical jobs. Thus, much shielding and soundproofing may fall to disrepair and be discarded. The simplest effective noise control measures are the use of ear muffs or ear plugs, but their use has not yet become accepted practice among farmers.

Closely related to the problem of noise is the problem of vibration. There is little information concerning the effects of vibration on farm workers who use heavy equipment. One study of 371 tractor drivers, made to assess whether vibration and shocks cause damage to health, revealed a particularly frequent incidence of stomach troubles and premature degeneration of the thoracic and lumbar vertebrae. HEW studies on the disabling condition of workers awarded disability pensions under Social Security have shown farm workers to have a high proportion of disabilities in categories in which vibration is a possible factor.

Further studies are badly needed in this area. Standards for control of vibration are not yet available. It is likely that control methods, when or if developed, will need to be accomplished by the manufacturer. But first the engineers must learn from medical research what the damaging frequencies are. To attempt to dampen all vibration could be excessively and needlessly expensive.

As noted earlier, exposure to a wide variety of chemical substances also may put the agricultural worker at risk. The most common exposures in both degree and duration are the substances in the form of dust, or aerosols. The greatest danger from these substances occurs when they are inhaled, although some are contact health hazards also. Exposures may be as simple as inhalation of dust from a bag of treated seed or fertilizer, or may be as severe as direct contact with a spray pattern.

The organic phosphate pesticides with few exceptions such as malathion, are among the most hazardous materials used in agriculture. They are highly toxic and may be absorbed through the unbroken skin as well as by inhalation and ingestion. Parathion, Systox®-7, TEPP, Phosdrin®-22,

and Thimet®-3 are among the more toxic of these compounds. The quantity of these compounds used in Washington is unknown.

The other major class of pesticides is the halogenated hydrocarbons. This class includes methobromide and similar compounds, and the chlorinated hydrocarbons such as DDT, Chlordane, Lindane, Dieldrin and Endrin. With the exception of ethyl-bromide, Dieldrin and Endrin, pesticides in these groups cause less acute illness than do the organic phosphate pesticides.

Other agricultural chemicals that can cause serious problems include herbicides, fertilizers, phenolic compounds, and sulfur.

Most farmers are well aware of the hazard of inhaling chemicals such as pesticides and maintain some sort of personal protective device for this purpose, but due to the high incidence of exposure, accidents can be expected.

Topical exposure to many different substances is common in agriculture and not well controlled. Severe eye damage is sometimes associated with the use of highly caustic substances such as ammonium hydroxide for sterilizing mild transfer equipment and the like.

Although other conditions are more severe, skin conditions are far more common than most, and cause a great deal of discomfort. They are more frequent than the other diseases, both because the skin is first contacted by noxious agents, and secondly due to the wide variety of materials that may cause skin conditions. These include not only agricultural chemicals such as dusts, solvents, and detergents, but also soil, crops, animals, and a host of other agents. In the factory it is often possible to find suitable substitute agents when skin contact is found to be a problem, but the farmer has fewer alternatives. Controlling skin exposure is then largely dependent upon the use of protective clothing, and this may present secondary problems of heat stress during hot weather.

The problem of plant and soil dusts is related to both mechanization and the environment. Depending on weather, soil moisture, types of soil, equipment used and farming practices, agricultural dust levels range from very low to well above the limits established for nuisance dust.

The application of threshold limit values to agriculture may not have meaning because activities and exposures vary throughout the day, the week, and the year. A worker may receive significant exposure to a contaminant over a period of several weeks on one farm or area, then move on to another area and again receive significant exposure to the same contaminant. Dust exposure in agriculture can also be a higher exposure to a constant contaminant on an hourly basis than that found in industries limited to an 8-hour day.

By far the most common and prolonged exposures come with soil dust. The highest dust concentrations encountered in the Washington Department of Labor and Industries study were those caused by crawler-type tractors, D4 and D6 caterpillars, drawing planting drills. Dust exposures during potato planting where the planter-tender rides behind the seed bin watching for planting misses are comparable.

Crop-related dusts with especially high silica contents are often found during crop processing. If this exposure is sufficiently long, the worker faces the risk of acquiring silicosis. Organic dusts, such as those from grain, hay, vegetables, wood, feed, manure, feathers and so on are also very common. Although vegetation dust consists mostly of nonrespirable fibrous material, many spores and pollen grains can be observed.

There is little information on what health effects, if any, most of the vegetation dusts have on agricultural workers, but the acute and chronic effects of inhalation of moldy hay dust have been described. The acute effects include short dry cough with little or no expectoration, malaise, weakness, slight fever and, most important, a distressing dyspnea produced by exertion. Removal from exposure is followed by complete recovery. With successive seasonal recurrence, the disease tends to become chronic; fortunately, this is a rare occurrence. Signs and symptoms include productive cough, marked physical weakness and dyspnea, pulmonary fibrosis with emphysema, and sometimes bronchiectasis, which is finally irreversible. Similar acute local reactions have been triggered by other grains and dusts.

The preferred method of dust or particulate control is the application of engineering methods, such as local exhaust ventilation when the problem

is indoors, or the provision of air-conditioned cabs on large tractors. The most common effective device available is the respirator, shown here, which when fitted with the proper filter will purify the air. Unfortunately, inhalation of dust may be considered a normal part of the job and may go uncontrolled or be minimally combatted with a bandana tied around the nose and mouth. This procedure does not remove an appreciable fraction of the respirable particulates, and consequently provides little protection.

Due to the seasonal nature of most field work, strictly environmental hazards are most commonly associated with exposure to heat and sunlight. Heat stress may be a major agricultural hazard, but many variables make it difficult to determine the extent of the risk involved. It is useful to try to predict those conditions that may be dangerous. Prediction criteria have been proposed employing three easily obtained measurements: dry bulb air temperature, wet bulb air temperature, and black ball globe temperature or radiant heat load.

Environmental heat affects both psychological and physiological performance. Learning and doing skills tasks are impeded. This results in an increased number of accidents. Mortality increases during prolonged hot spells, as does the frequency of illness. Aside from frank heat and illness, problems include non-specific complaints, general malaise, and even psycho-neurotic illness. Early reactions to environmental heat include increased cardiovascular and respiratory activity, increased body heat content and sweating. If heat is excessive or prolonged, then frank heat disorders appear.

Lesser heat disorders are heat syncopy, heat rash, hydratic heat exhaustion and both transient and chronic heat fatigue.

The first major heat disorder is heat cramps, caused by loss of salt and a dilution of tissue fluid. Workers who sweat profusely in the heat and drink large volumes of water without replacing salt loss often suffer painful spasms in skeletal muscles. The onset of spasms may be during or after working hours. The muscles involved may be in the arms, legs, or abdomen, and are usually the muscles used in performing the tasks.

The second major heat disorder is heat exhaustion. This is caused by the depletion of body water and/or salt. Signs include weakness or

extreme fatigue, giddiness, nausea, and headache. The skin is clammy and moist, the complexion pale, muddy or flushed. Oral temperature may be normal or low, but rectal temperature is usually elevated. The patient may faint on standing if sitting, and exhibit a weak thready pulse and low blood pressure.

Of the three major clinical disorders caused by excessive heat, heat stroke is the most serious and constitutes a medical emergency. The signs are hot, dry skin which may be red, mottled or cyanotic, hypothermia with a temperature which is greater than or equal to 106°F and rising, mental confusion, delirium, loss of consciousness, convulsions and coma. The major complications of heat stroke are renal failure, hepatic failure, hemorrhage or myocardial impairment. Permanent brain injury is a frequent result and death occurs in a high proportion of cases.

Control of the onset of heat stress problems has not yet received serious attention on the farm. A variety of control measures can be implemented, depending upon the nature of the work and the heat load imposed. Ideally, workers just starting work under hot conditions would be allowed several days of relatively light work or a reduced duration of exposure to become acclimated. In addition, protective clothing which allows free circulation of air should be worn and rest periods should be more frequent on hotter days. Both ample water and salt should be provided and used in the fields.

Heat and sunlight tend to go together. The effects of sunlight on farm workers is largely the effect of ultraviolet rays on the skin. Burn reactions may include normal sunburn reaction, degeneration of collagen and elastic tissue from long exposure to the sun, dyspigmentation of the skin, photosensitivity, often brought about by chemical compounds and most commonly triggered by fungus in agricultural workers, sun keratosis or sun cancer and xeroderma pigmentosum, a rare and fatal disease characterized by brown spots and ulcers of the skin with muscular and cutaneous atrophy and telangiectasis. Although there is little statistical data on the incidence of these conditions, in the two years during which the effects from the sun were classified separately in California Occupational Disease Surveillance, over 1/4 of the 649 reports were attributed to agricultural

workers. One of the higher risk groups are students on summer jobs attempting to achieve very dark tans.

Prevention is best accomplished through educating these workers. Cover-up measures to prevent heat stress will obviously prevent UV exposures.

Rural living and housing present isolation as a health care problem. Isolation of the laborer, of the home, and often of the community with respect to quality medical care facilities. Beyond this, many agricultural laborers, especially the seasonal labor force, suffer from problems of adequate housing, sanitation, and diet. This in turn is directly related to education and income. During 1972 the average hired farm worker in the western states earned approximately $2400. Many earned less. Ex-migrants, those who have decided to establish a residence in Washington, have a problem in finding adequate housing at a price they can pay. As a result, many live in housing that is either inadequate, overcrowded, or both.

Migrants moving into an area for a season's work face even more severe shortages. Growers have no obligation to provide housing. Agricultural housing and labor camps that meet the Department of Health requirements are often extremely overcrowded. Poor housing, sanitation, and diet, hazardous working conditions, low income, inadequate education, social prejudice, and for many the lack of the rights and protection afforded residents, are all factors that contribute to inadequate treatment of the medical problems of this group.

Some practitioners and clinics make a special effort to direct their services toward agricultural workers - Yakima Valley Clinic in Grandview, for example. Because of the scarcity of private medical services in rural areas, public efforts have been made to extend services. Such an effort is the Farm Worker's Clinic in Toppenish, funded by federal and local matching monies.

Six factors to be considered in improving occupational health conditions for farm workers are: surveillance, research, enforcement, education, prevention, and treatment. The first four, surveillance, research,

enforcement of work standards, and education, by and large fall into the federal, state, and local domain. These are the agricultural, labor, public health, welfare, and education agencies. Prevention and treatment are largely left in private hands, although there may be overlap in practice and much of the funding may be public. Manufacturers, housing contractors, solo practitioners, private clinics, voluntary agencies are the purveyors of prevention and treatment.

It is recommended that some of the following questions, based on information contained in the video tape Health Risks of Farm Workers, be selected for student self-evaluation. The purpose of these questions is to focus the student's attention on specific health concerns he might encounter if practicing rural medicine.

After viewing the tape, it would be beneficial to include a discussion session to consider questions raised and to introduce topics not covered. Suggested discussion topics follow the student problems.

Student Problems

More than one answer may be possible for each question.

1. OSHA standards for industrial noise exposure permit an agricultural worker to be exposed to no more than:

   a) 55 dba/12-hour day

   b) 70 dba/12-hour day

   c) 90 dba/12-hour day

   d) 95 dba/12-hour day

2. Based on studies to date evaluating occupational exposures and their effects on agricultural workers, which of the following is/are true?

   a) All equipment with a power source exposes operators to excessive noise levels.

   b) The use of tractor cabs for noise control does not always reduce the level of noise exposure to within permissible limits.

   c) The amount of early hearing loss attributable to occupational exposure detected in agricultural workers is similar to the amount found in other occupations using heavy equipment such as construction, mining, transportation.

3. Which of the following is/are true concerning noise controls for agricultural equipment?

   a) Farmers must depend primarily on manufacturers for noise controls on farm equipment.

   b) Maintenance and engineering personnel are readily available to maintain equipment.

   c) Ear plugs or muffs are ineffective protection against equipment noise.

4. Which of the following is/are true concerning the vibration effects on farm workers using heavy equipment?

   a) Little information on vibration effects is known.

   b) Vibration control standards are not available.

   c) Operators of heavy equipment determine methods of vibration control.

5. Early reactions to environmental heat include:

   a) increased cardiovascular and respiratory activity

   b) increased body heat content

   c) nausea

   d) sweating

6. Exposure to excessive heat causes three major clinical disorders. Which of these is most serious and constitutes a medical emergency?

   a) heat exhaustion

   b) heat stroke

   c) heat cramps

7. The signs of heat stroke include:

   a) hot, dry skin which may be red, mottled, or cyanotic

   b) mental confusion, delirium, loss of consciousness

   c) clammy, moist skin with a pale, muddy or flushed complexion

   d) hypothermia with a temperature of 106^{o}F or greater and rising

8. In addition to the risk of heat exhaustion, profuse sweating in the heat followed by the consumption of large volumes of water without replacement of salt often results in:

a) heat stroke

b) sun keratosis

c) heat cramps

d) heat rash

9. The signs of heat exhaustion include:

a) weakness or extreme fatigue, giddiness, nausea

b) clammy, moist skin with a pale, muddy or flushed complexion

c) slightly elevated rectal temperature

d) a weak thready pulse, low blood pressure, fainting upon standing

10. Preventive measures that can be taken to avoid the onset of heat stress problems include:

a) ample water and salt supplies in the fields

b) rest periods -- more frequent on hot days

c) workers just beginning work under hot conditions would be allowed to follow a schedule of 2-3 days of light duty to become acclimatized before being assigned to heavy or full duty

d) protective clothing, allowing for adequate free circulation

11. Sunlight effects on farm workers are due to overexposure to ultraviolet light. Ultraviolet light produces the following effect(s) on man:

a) sunburn

b) skin collagen and elastic tissue degeneration

c) skin cancer

d) aggravation of a genetic disease, xeroderma pigmentosum

12. Agricultural chemicals, such as most organic phosphate pesticides, can be toxic to man by means of being:

a) ingested

b) absorbed through the unbroken skin

c) inhaled

13. The application of threshold limit values to health standards for agricultural workers exposed to chemicals is difficult because:

a) agricultural workers are more susceptible to chemical intoxication.

b) activities on the farm and exposures to chemicals vary throughout the day, month, and year

c) chemical exposures in farm work are limited to registered pesticide applicators, not farm hands

d) exposures are often beneficial to the worker by protecting him from infectious diseases

14. Based on studies to date, which of the following statements is/are true concerning exposure to agricultural dusts?

a) Dust exposure in agriculture can be greater than that found in other industries.

b) Inhalation of moldy hay dust has acute effects consisting of a short, dry cough with little expectoration, malaise, weakness, slight fever and dyspnea produced by exertion; chronic effects are similar and include pulmonary fibrosis with emphysema and sometimes bronchiectasis.

c) The health risks associated with most vegetable dust inhalation are not well known.

d) The most common exposure is to inorganic dusts with especially high silica content.

15. Which of the following statements is/are true concerning agricultural dust control?

a) Engineering methods (i.e., local exhaust ventilation for indoor problems, air-conditioned tractor cabs for outdoor problems) are the preferred method.

b) The most common personal protective control device available is the respirator.

c) No control is practical since dust inhalation is often considered a normal part of agricultural work and is not viewed as a health problem.

d) A bandana tied around the nose and mouth is an effective method of protection against respirable particulates.

16. Based on studies to date, which of the following statements is/are true concerning pesticides and other organic chemicals?

a) With the exception of ethyl-bromide, Dieldrin, and Endrin, pesticides in the halogenated hydrocarbon group cause a greater amount of acute illness than the organic phosphate pesticides.

b) Organic phosphate pesticides may be absorbed through unbroken skin as well as by inhalation and ingestion.

c) Parathion, Systox, TEPP, Phosdrin and Thimet are among the most toxic organic phosphate pesticides.

d) Herbicides, fertilizers, sulfur and phenolic compounds can cause health problems.

17. Which of the following statements is/are true concerning agricultural work skin conditions?

a) Skin conditions are the most common of all occupational diseases.

b) The major control of skin exposure is the use of protective clothing rather than substitution.

c) Chemicals and sunlight interact in producing some cases of dermatitis.

18. The rate of both fatal and non-fatal work injuries for agriculture is:

a) among the lowest of all industries

b) comparable to most industries

c) among the highest of all industries

19. Development and implementation of control measures to minimize agricultural work injuries are dependent upon:

a) attitude changes on the part of farmers

b) increased mechanization to maximize worker isolation from the environment

c) design changes on the part of the farm equipment manufacturers

d) farm worker education in equipment use, proper work procedures, and occupational hazards

e) exhaustive testing of agricultural chemicals by manufacturers and clear labeling of their usage and dangers

Suggested Discussion Topics

I. A major health problem of the migrant worker (and family) is the availability of high quality health care services. Medical facilities in rural areas are usually scarce and, when available, not always accessible to the migrant workers, nor do they provide all the services workers require.

Students could be asked to propose a medical clinic model that could provide comprehensive health services to the people in a rural location. Consideration should be given to cultural and educational backgrounds which would influence the ability to deliver health services, particularly to migrants.

The model should include:

Clinic Services

Medical: physicians, nurses, paramedics

Dental: dentist

Nutritional: dietician

Social: social worker

Medical records division: clerks

Laboratory: technician

Pharmacy: pharmacist

Outreach Services

Public health nurses, paramedics, and/or outreach workers would:

1) perform basic diagnosis, treat common infections and injuries;

2) act as liaison between clinic physician and patient;

3) do follow-up of clinic services;

4) instruct in health education, preventive medicine.

Transportation (to and from clinic) and child care

Environmental Services

Sanitation (housing, zoonosis control, insect control, food service, wastes, etc.): sanitarian

Land conservation: extension agent

Safety: safety engineer

Industrial hygiene: hygienist

Special Requirements to be Given Consideration:

1. All services should emphasize patient health education and preventive measures.

2. Each service should have access to bi- or multi-lingual people.

3. Satellite clinics could be located in remote areas (equipped with physicians, nurses, and laboratory) to supplement a main clinic.

4. The transient and often impoverished nature of the migrant worker population should be considered.

II. Agricultural exposures to farm workers are a relatively new concern of occupational safety and health. Investigation of work conditions and defining health risks will probably result in a major impact on this industry when the public becomes aware of the situation. To become familiar with the problems of establishing agricultural exposure controls, students should address themselves to the following issues.

1. How does an environmental health specialist rate work exposures?

2. What is the meaning of threshold limit value (TLV) and how is farm work difficult to apply to that concept?

3. What are the difficulties of writing and enforcing work standards?

4. What are the difficulties of designing, installing and maintaining control devices?

In a typical industry many types of environmental problems are encountered. Some problems are not necessarily health-related, but are controlled to reduce nuisance or to maintain the aesthetics; for example, slag heaps are removed and buried in solid waste fills and perhaps landscaped into lush vegetation. The health implications relate to accident prevention, chemical, biological, or physical health hazard controls, and sanitation.

Prevention and control of work environmental problems require careful examination of work areas and production processes. The environmental health specialist is trained to evaluate areas and operations for both actual and potential hazards. The conditions which must be examined will vary from industry to industry and plant to plant. Several that apply to agricultural work as well as to other industries include the following: 1) ladder usage (stability); 2) machinery (guards and maintenance); 3) use and care of tools; and 4) use and handling of hot materials.

When surveying a plant's conditions and processes, the physical and mental requirements of each job should be carefully noted. This will enable the specialist to associate each job's biomechanical and mental demands with each worker's physical and mental attributes. This information may be developed into a work classification system. Such a system identifies the physical/mental limitations that would hinder a worker's performance of a specific task, and that may lead to worker injury. A work classification system may include the following:

1. Hazardous Machinery. The hazards of working with machinery such as rotary saws, punch presses, power trucks, cranes, etc., would be increased by handicaps of visual defects, deafness, inadequate height or reach, heart disease, diabetes, hypertension and epilepsy. Machine-paced procedures may become difficult for aged workers or for those convalescing from physical illness or emotional stress. These procedures may also be unsuitable for child workers. Although there is no child labor in industry, the opportunity exists for children of various ages and abilities to be involved with machinery in agricultural work.

2. Lifting, Carrying, Pulling, Pushing or Reaching. Workers with various disabilities (e.g., back injuries, hernias, heart disease, arthritis, bursitis, or emphysema) may aggravate their existing conditions or cause serious injury to fellow workers by their inability to perform these tasks.

3. Climbing. Workers with dizziness, limitations of the extremities or deformities which prevent safe working on ladders and tank car platforms should be restricted in climbing activities.

4. Prolonged Standing or Excessive Walking. Limitations should be placed on workers with chronic arch disabilities, back lesions, muscular atrophies, heart disease, varicose veins, etc.

5. Twisting, Stooping, Squatting, Bending or Kneeling. Limitations may be necessary on the activities of individuals with certain musculo-skeletal disabilities which hamper these movements.

6. Driving Vehicles. Workers with vision problems or conditions which decrease normal reaction time should not operate vehicles such as cranes, payloaders and trucks, or work in areas where there is a risk of bodily injury from an exposure to moving equipment and falling objects.

A work classification system should also include the environmental factors involved with the work site and precaution processes. In order to evaluate the health effects of these factors, the environmental health specialist must be familiar with work operations and must understand the effect of their various stresses and exposures on the worker's health. He must also determine what raw materials enter the plant; they should be followed through the production procedure to the completed product. By-products produced as a result of production processes may also have adverse effects on the worker's health.

Environmental health hazards may exist in the following forms: 1) chemical - in the form of liquids, dusts, fumes, mists, vapors, or

gases; 2) biological - for example, insects and mites, molds, yeasts and fungi, bacteria and viruses; and 3) physical energy - such as noise and extremes of temperature, humidity, and pressure.

Investigation of production operations and environmental conditions may disclose operations where hazardous material usage requires institution of control measures. In other cases, the hazard may not be that well defined. Control measures may be costly and management may be reluctant to incur such expense for worker protection, especially when competitors may not be adding such an expense to the cost of their product. Such situations may be handled best by professional plant survey services which may include tests for atmosphere contaminants or analyses of exposed worker's urine or blood, and recommendations for hazard control methods based on technical findings.

Once the hazards have been evaluated, both engineering and medical control measures should be followed to maintain a healthy work force and environment. Medical control may require pre-placement and periodic examinations of workers in occupations involving exposure to hazardous materials.

The environmental health specialist must also be concerned with sanitation in the industrial plant. Adequate maintenance and proper use of sanitation facilities should be emphasized. Proper cleaning agents should be provided to help prevent skin conditions resulting from use of solvents and harsh, abrasive cleaners. Often the skin cleansing agents being used are unsuitable for such purposes and contribute to or aggravate an adverse skin reaction.

The category of sanitation also includes food handling and garbage disposal. Refrigeration and hot food preparation methods should be noted. Inquiry should be made into the disposal method of food and industrial wastes. Waste products from industrial processes and such things as unused pesticides in agricultural work require special treatment for both environmental and worker protection.

It should be noted that while working on an agricultural survey,

the environmental health specialist must also investigate the potential environmental hazards of the labor camp. These include housing conditions, pest infestation controls, and fire safety and prevention measures.

Returning now to the question of environmental health hazards, we indicated earlier that the principal forms of such hazards are chemical, biological, and physical energy. We should note that most of the activity in industry is related to chemical and physical energy. Special standards are established to control exposures to these forms. Frequent evaluations of work conditions are conducted to insure that exposures conform to these standards.

Evaluation of industrial hazards, however, is not easily accomplished. The patterns of exposure in the work place and during work time periods are variable; they are not readily accomodated by standardized exposure control levels. However, basic guidelines have been established to help the environmental health specialist maintain a healthful work environment. These are known as threshold limit values.

The threshold limit value (TLV) represents environmental conditions under which it is believed that nearly all workers may receive repeated exposure day after day without adverse effects. TLV's are guidelines for the exposure to chemical and physical agent levels in the work environment. Each TLV is based on a specific property of the chemical or physical agent, e.g., toxicity, irritation or nuisance. Consequently, TLVs are not intended for use as a relative index of hazard or toxicity. For example, ammonia, benzene and nitropropane all have threshold limit values of 25 ppm. Each TLV is based on a different effect.

TLVs for chemical exposures such as pesticides are usually average (time-weighted) concentrations; they define a condition on the basis of a 40-hour work week. It is difficult to apply this concept to an agricultural work situation due to the extended hours farm workers labor relative to most other industrial workers (a farm worker's day is usually 12 hours long and a work week during harvesting may be in excess of 80 hours). Due to this exposure-duration discrepancy, threshold limit values, derived from studies of workers exposed for 40-hour work weeks, may not be stringent enough for

the agricultural work environment.

Application of threshold limit values to farm work is further complicated by the unusual variation in farm activities and exposures throughout the day, month and year. Exposures to pesticide mixtures, for example, may be intermittent. At times they may even exceed recommended ceiling values for one or more specific pesticide chemicals. Many of these substances can be absorbed through the skin as well as inhaled.

Another point to consider is the openness of the field environment, when does not lend itself to control of these exposures. In a closed structural situation (for example, in a silo or storage bin), it is possible to implement control measures such as exhaust fans; however, in an open field situation the best controls are protective clothing, use of respirators and specially designed occupant enclosures on agricultural heavy equipment. Variances in climate, weather, soil type and other conditions from farm to farm also complicate the development of standards.

It should also be noted that agricultural chemical exposures often involve mixtures of substances. It is difficult to assess a threshold limit value relative to a mixture because any mixture may have a potentiating, synergistic, or antagonistic effect.

A potentiating effect is observed in the combination of carbon tetrachloride with alcohol. The toxicity of the carbon tetrachloride is increased by combining with alcohol. The combination of two organic phosphate pesticides, such as parathion and systox, may result in a synergistic effect. The total effect of this combination is greater than the sum of the two effects taken independently. An example of an antagonistic effect is the combination of certain organic phosphate pesticides with certain drugs. Certain organic pesticides are cholinesterase inhibitors which exhibit a parasympathomimetic action. In the presence of certain drugs, such as siperidolate (Dactil), a parasympatholytic action is exhibited, which is an antagonistic effect relative to the pesticide's original effect.

Due to the problems in applying threshold values and other industrial exposure (health and safety) standards to the agricultural work

environment, it is difficult to write contaminant control standards for farms. NIOSH in HEW is required by the OSHA in the Department of Labor to conduct research leading to better health standards and to help educate personnel to carry out the Occupational Safety and Health Act. Enforcement of the standards is the responsibility of various government agencies. (In the State of Washington, for example, the Department of Labor and Industries enforces standards on behalf of the Federal Department of Labor, conducts surveillance of work conditions, and conducts a safety educational program directed twoard agriculture. Research and surveillance are also conducted through the State of Washington Department of Public Health's pesticide and epidemiology programs. The country agricultural extension agents assist in bringing information to farmers and farm workers.)

Health and safety measures that are now being implemented are largely personal protection and engineering protection. The responsibility for personal protection (use of protective clothing, gloves and respirators) lies primarily with the farm workers. Development and installation of engineering protection is dependent upon the manufacturers of agricultural equipment. Once engineering control measures (for example, rollover bars) are installed, it is necessary to maintain them properly. This creates another problem in that engineering and maintenance personnel are not as readily available on the farm as they are in other industries. The farmer usually does not have the time or expertise for such maintenance work. Consequently, many control devices fall into disrepair and become ineffective.

Perhaps the most effective agricultural controls are achieved at this time through education of farm workers and farm owners. Workers should be aware of agricultural health hazards and of protective measures against them. Farm owners should know the hazards to which their workers are subjected and should assume responsibility for worker protection. Physicians in rural areas can be instrumental in sensitizing the community to the importance of information of health and safety.

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The six summaries beginning on the following page are on Allergic Airway Diseases, Infectious Pulmonary Diseases, Farmer's Lung, Noise, Toxic Chemicals Producing Respiratory Disease, and Whole Body Vibration, and were prepared from reports provided us by the University of Utah Research Institute. Additional information on these subjects as well as other reports and bibliographies, including those on skin diseases, organophosphorus insecticides, and cancer epidemiology, can be obtained from the Institute by requests addressed to:

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Allergic Airway Diseases

Asthma is a term used to designate patients who have recurrent episodes of shortness of breath usually accompanied by wheezing and relieved either spontaneously or by therapy. The disease is basically identified by a characteristic history and an occupational connection is also dependent on a careful comparison between pattern of response and materials to which the subject is exposed; for instance, animal dander, particularly cats or horses, moldy foodstuffs, feathers, weevils, mites and roaches, and grasses and ragweed, particularly rye grass.

Based on the generally accepted premise that 10-15% of the people in the United States are atopic and thus potentially susceptible to clinical asthma or hay fever and that pollens are a major allergen, then farm workers should perhaps show a high active asthma-hay fever rate. Thus, if the farm population is 2.6 million, then at least 260,000 workers would be involved to make this the most prevalent respiratory disease or problem among agricultural workers. It has been the tenor of these papers to consider that asthma is different from the allergic alveolitis and farmer's lung which have been considered in another complete paper. This classification may leave a certain small number of airway responses which are due to fungi. If, however, these occur in allergic individuals, then we are in the proper category and if they are not, the magnitude of the error will be relatively small. Asthma can be considered as due to pollens, products of insects including the grain weevil, the cockroach, house mite, etc. and animal products, particularly animal proteins from dander, feathers and serum included from cat, horse, pigeon, parakeet, turkeys and chickens. Ragweed is the principal pollen source in the United States, followed by fescue, rye and other grasses. Probably one-third of the asthmatic population have continuous symptoms. Becuase these have not been relatable to any particular inhalant, they will not be given special attention. Berrens has presented the interesting idea that allergens are basically denatured proteins which are not digestible with common proteases and which do not produce IgG antibodies. Most of them are thermostable in contrast to antigens which are native proteins which lose their antigenicity when heated, and finally that they have conjugated lysine sugar sites.

On a nationwide basis, clinical bronchial asthma has been estimated to have a rate of 23 cases per 1,000 population, or 1/4 of the potential group. This was based on a national health survey during a 52 week period ending in June, 1958 on a sample of 115,000 people from 36,000 households in every state. The estimated fatality rate of asthma in the general population is 1.5 deaths per 1,000 asthmatics giving about 6,000 deaths due to asthma annually. Thus it appears that 10-15% of the potentially asthmatic (atopic) population has clinical disease based on the national survey. The country is divided into west, north central, northeast, and south. The west has the highest rate in both urban and farm dwellers having rates around 75/1000 with asthma and hay fever together. Mortality varied from 120 to 165% of expected figures, except for those persons with history of multiple severe attacks of asthma where it was between two and three times the expected.

Finally, care should be taken in considering that the epidemic asthmas associated with Minneapolis, New Orleans and Yokohama are indeed asthma. The evidence summarized by Horton and by Shy indicates that although wheezing is present, these are probably episodes of bronchitis characterized by cough, sputum production, and shortness of breath, with wheezing as an occasional feature. The original description makes this quite clear (Huber et al., 1954). Thus, although the Minneapolis type has been attributed to dust from grain mills over the entire city, that this is producing asthma is less than clear.

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Farmer's Lung

Farmer's lung disease is characterized by a history of bouts of dry cough and dyspnea without wheezing, with or without fever, caused or aggravated by exposure to moldy hay, straw, or grain. Symptoms usually develop or increase in severity a few hours after exposure. Pathology of the acute stage shows a bronchopnuemonia and proliferative bronchiolitis (Barrowcliff and Arblaster, 1968). Chronic lesions are granulomatous and fibrotic with honeycombing (Seal, et al., 1968). Although farmer's lung has been described by the classic students of occupational medicine including Ramazzini (1705) and Thackrah (1835), there have been no adequate studies of its prevalence or its incidence. There is no data for prevalence or incidence in the United States. However, available data suggests that it is a disorder found in practically all farming areas where foodstuff, fodder, or fiber is stored. It is increased in frequency when the storage is of moist material. Although it is in general a disorder producing temporary symptoms as defined above, there have been a few instances of death from apparently overwhelming quantities of spores of Micropolyspora faeni, also known as Thermopolyspora polyspora. Such fatal incidents are more easily understood when one considers that concentrations of up to 1,600,000,000 spores per cubic meter of air have been recorded in farm buildings where hay was shaken (Lacey and Lacey, 1964). Spores of these two fungi are approximately 1 micron in diameter so that they are ideal for alveolar deposition in the human lung.

A large number of agricultural diseases have been grouped together in the farmer's lung syndrome. These are listed in Table 1. The first group are those which have definitely been attributed to the inhalation of fungal spores. The next group, including bird breeder's lung or pigeon breeder's disease and pituitary snufftaker's lung and small pox worker's lung is attributable to the inhalation of serum. In this category, one may also place the disorder of turkey farmers. The final group consists of responses to metals, polymers and the material in cotton in which no antibodies have been demonstrated and the effect appears to be due to the chemical agent itself. This leads to the obvious question: "What is the pathogenesis of the farmer's lung group of diseases?" Although inhalation

of spores produces precipitin antibodies in human subjects, it appears more likely that the disease is due to the poorly digestible nature of the spores which produce chronic inflammation through interaction with macrophages which are trying to digest and detoxify the alveolar burden. Farmer's lung disease has been responsible for deaths only infrequently and after massive inhalation of spores. Many farmers have probably discovered discomfort following exposure to moldy feed and avoid re-exposure. In perspective, lung disease due to asthma and to cigarette smoking should be more important in farmers than diseases due to inhalation of fungal spores. Control measures which might be instituted include 1) education of farmers and farm families to the hazards, 2) drying of fodder before storage in tight barns, 3) outdoor storage of fodder, 4) mechanical removal or manipulation of such fungal infested products, and finally, 5) the use of worker protection devices including filters and air sources. Because of the small size of the spore particles (less than 1 micron) ordinary filter media is likely to be unsuccessful because if it is tight enough to remove most spores, the resistance to airflow will be excessive to the worker while wearing the mask.

Table 1. Etiologic Agents in Alveolitis

Clinical Syndrome	Exposure	Antibodies Against
Farmer's lung	Moldy crops	Micropolyspora faeni Thermoactinomyces vulgaris T. saccharii
Bagassosis	Moldy bagasse	Same as above
Mushroom worker's lung	Moldy compost	Same as above
Humidifier or air conditioner lung	Contaminated ventilation system	Same as above
Maple bark stripper's lung	Moldy bark	Cryptostroma corticale
Malt worker's lung	Moldy malt	Aspergillus sp.
Sequoiosis	Moldy sawdust	Graphium sp.
Cheese washer's lung	Cheese mold	Penicillium sp.
Paprika splitter's lung	Moldy paprika	Mucor stolonifer
Wheat weevil disease	Wheat flour weevils	Sitophilus granarius
Suberosis	Moldy cork	Penicillium sp.
Coffee worker's lung	Coffee bean	Coffee-bean extract
Tobacco grower's lung	Moldy tobacco	Unknown
Wood joiner's lung	Contaminated water	Unknown
Mummy disease	Moldy mummies	Unknown
Bird breeder's lung	Pigeons, parakeets, budgerigars, etc.	Avian serum proteins
Pituitary snufftaker's lung	Porcine, bovine pituitary	Porcine, bovine proteins
Polymer fume fever	Teflon	None
Metal fume fever	Zinc or brass fumes	None
Urethane foam worker's	Toluene diisocyanate	None
Cardroom fever	Cotton dust-endotoxin	None
Acute berylliosis	Beryllium	?

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Infectious Pulmonary Diseases

Agricultural workers had a higher risk for certain infectious diseases, particularly brucellosis, anthrax, tuberculosis, cholera and leptospirosis, in years past. However, except for sporadic outbreaks, none of these is estimated to be important at present. There was an outbreak of brucellosis in a Virginia meatpacking plant reported in 1974, and inhalation anthrax was reported in workers dealing with goat hair imported from the Middle East into North Carolina and Virginia ten years ago. Effective control for cholera, tuberculosis and brucellosis together with anthrax by public health measures in cooperation with veterinary medicine programs have practically eliminated the spread of disease from infected animals to man. Thus, infectious diseases of agricultural workers in the next decade will probably consist largely of diseases to which they may have greater risk because their occupation is outdoors in special sections of the country rather than from handling animals. Examples would include coccidiodomycosis (southwest United States) from airborne exposure to Coccidioides immitis, blastomycosis in the southeast United States, particularly the Arkansas and Ohio River Valleys, histoplasmosis in the Mississippi-Missouri River Valley, and tularemia and Rocky Mountain spotted fever, both of which are now nationwide from their origins in the San Joaquin Valley of California and in Arizona and in west Texas and in the Bitter Root Valley of Montana respectively. Although prevalence and incidence rates are not available for farm workers as a special group, the low national rates for the infectious disease make it unlikely that there is a substantial difference between the farm population and the urban population. Certainly the zoonoses, or diseases spreaded from domesticated animals to man, have practically ceased to be human health problems in this country.

The data from Great Britain show that farmers and agricultural workers have lower incidences of bronchitis, respiratory tuberculosis and cancer of the lung than do all similarly occupied males. Rates for influenza and pneumonia show no difference. Asthma was higher, 138% of the mean (Gilson, 1969). One is lead to the conclusion that cigarette smoking may still be the most important factor in chronic pulmonary disease, certainly of having greater effect than occupational exposures, especially in farmers (Higgins, 1970).

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NOISE

The most important hazard posed by noise is the danger of producing damage to the hair cells of the inner ear, thereby causing a partial loss of hearing. In the presence of noise above about 70 dBA, it is true that the autonomic nervous system does produce certain measurable changes: dilation of the pupils of the eyes, changes in cardiac pattern, and vasoconstriction of the extremeties. But these effects, produced by many other changes in the environment, are temporary and reversible, according to present knowledge. While there is suggestive evidence (G. Jansen, Lärmbekampfung 6,126-128, 1962) that steel workers exposed to noise so severe as to produce hearing loss relatively rapidly may also display an incidence of circulatory problems that is significantly higher than in a control group of non-noise-exposed workers. The noise-exposed workers concerned were also exposed to higher temperatures and a greater concentration of fumes from the steel-making process. The difference in circulatory problems is at the moment considered to be due primarily to the stress induced by fumes and temperature; although there remains the possibility of a synergistic interaction among the various stressors, this is still speculative, so in the absence of conclusive data, we shall ignore such interactive influences in this document. A similar conclusion applies to the combination of noise and vibration, especially in operators of tractors, which is the most ubiquitous source of potentially hazardous noise to American farmers; although some specualtion exists that vibration may enhance the effects of a given noise exposure, the evidence is both meager and inconclusive.

Noise may also occasionally be a contributing factor in accidents due to failure to hear warning signals of one sort or another. In the agricultural realm, however, such situations will only seldom arise, so the effect of noise on the communication process may probably be safely ignored.

Finally, although the popular press and some anti-noise extremists have contended that high-intensity noise may impair task performance, possibly increasing the probability of error in judgment on the part of

tractor operators, again the evidence is at best equivocal, despite dozens of experiments designed to show such effects, if they existed. By the same token, speculation linking noise with such things as insomnia (or, amusingly enough, abnormal somnolence), mental illness, sexual potency, and the like are not buttressed by any firm evidence.

Thus the primary, if not the only, result of noise on the farmer is its effect on hearing. Present evidence indicates that steady exposure (8 hr/day, 5 days/wk, 50 wk/year) to industrial noise whose level is 85 dBA and which has an "average" spectrum (not unlike that of a tractor) will just produce, after 10 or more years, a measurable hearing loss -- i.e., a 10 dB hearing loss at the frequency most sensitive to damage by noise, 4000 Hz. If the level is 90 dBA, this loss will be about 20 dB. Inasmuch as noise levels generated by tractors, combines, chain saws, grinding mills, elevators, and most other powered farm implements exceed 90 dBA very often, if is not nearly always, it is clear that a potential hazard exists. On the other hand, the exposure of the typical farmer is anything but regular. In the spring he may spend 16 or even 18 hours a day on his tractor, but in the winter his weekly exposure to levels of 90 dBA or above may total less than an hour. The eventual effects of such variable exposure have to date not been adequately determined, but there are two extreme points of view: the "integration of microtraumata" and the "critical incident" theories. According to the microtrauma theory, every bit of acoustic energy entering the ear contributes its share to the gradual breakdown of the sensory elements, a situation analogous to that generally assumed to hold for radiation damage. The critical-incident hypothesis, on the other hand, contends that there is a tolerable daily acoustic dose, perhaps peculiar to the ear concerned, below which no lasting effect whatever is produced, so that the hearing losses that accrue over a long period of time can be attributed to a few separate days in which an unusually severe exposure was experienced. (Although the Environmental Protection Agency, in its so-called Levels Document [EPA Report No. 550/9-74-004, 1974] has accepted the microtrauma theory, no persuasive evidence for its validity has yet been uncovered.)

It can be seen that the degree of "hazard", particularly in terms

of the number of farmers judged "exposed", depends critically on which of these hypotheses the truth is nearer. If the total-immission (micotrauma) theory is correct, then everyone nearly everywhere -- and of course, each farmer -- is "at risk". However, if (as seems to us more likely) the critical-incident schema is the more accurate, then hazard must be estimated from empirical hearing-loss data obtained on farmers directly.

The determination of hearing losses associated with any particular occupation is beset by numerous problems, but probably the chief block to an accurate determination of risk is the fact that hearing loss progresses in the average population of the USA, even in the complete absence of noise exposure associated with one's livelihood. The overall deterioration of auditory sensitivity with time can be broken into four more or less distinct components:

(1) The loss due to occupational noise, which is what we want to determine;

(2) Sociacusis: hearing loss that can be ascribed to the noises to which an individual voluntarily subjects himself, quite apart from the working situation (gunfire, rock music, power tools, etc.);

(3) Presbyacusis: the hearing loss that is attributed to the general process of aging as such; and,

(4) Nosoacusis: the loss in auditory sensitivity caused by diseases, drugs, blows to the head, industrial chemicals, and the like.

The problem is this: How much worse is the hearing of the hypothetical "typical farmer" than that of someone the same age who is exposed to the same amount of gunfire, recreational noise and otological hazards, but to no occupational noise whatsoever? It is clear that epidemilogical studies of farm-noise-induced hearing loss must use exceedingly meticulous controls if a valid result is to be obtained. Merely showing that some farmers have severe hearing losses is of course pointless. Even demonstrating that farmers have worse hearing than city dwellers is not sufficient to establish occupational hazard unless one can also show that their exposure to gunfire is no greater. Finally, testing of even large numbers of farmers at State or Provincial Fairs or exhibitions cannot be expected to prove anything, either. Fair surveys

have been shown to be often misleading because of both the possibly non-random nature of that group of farmers who are fair-goers, and the self-selection processes that influence the determination of who gets tested.

Unfortunately, no large random sample of farmers has ever been studied; most extant data are either based on haphazard selection processes (i.e., fair surveys) or involve such a small number of farmers that once one breaks the sample into groups with equal years of exposure, comparison with some other non-farm sample is of dubious meaning. For this reason, our answers to the standard set of exploratory questions will generally be tentative and somewhat speculative. There is no doubt that some farmers have severe hearing losses, and that there are occupational farm noises that could produce such losses. Beyond these general statements, little can be said with confidence.

8. References: The most recent review of the literature appears to have been compiled by J.B. Bozung (reference 3 below). The following list of 14 annotated references include all the formal and semi-formal reports bearing on noise-induced hearing loss in farmers of which we are aware.

1. L.D. Baker and R.H. Wilkinson, Occupational Health Survey of Michigan Farmers; Dept. of Agricultural Eng., Michigan State Univ., East Lansing, MI., Jan. 1974. Not seen; probably same data as Ref. 3.

2. Alan Bell, Effects of Noise on Tractor Drivers; New Zealand Journal of Agriculture 94, 350 (1956). Not seen.

3. J.B. Bozung, Noise Induced Hearing Losses of Michigan Farmers, Part II; (Study conducted in cooperation with Dept. of Audiology and Speech Science of Michigan State Univ.);

Of farmers attending Farmers' Week at Michigan State University, volunteers (inducement not stated) were screened against non-farm-related loud-noise exposure (including service in the armed forces), gunfire other than during hunting season, excessive ("more than 2 hours, often") snowmobiling, and tractor noise exposure more than 2 hours in duration on the preceding day. Air and bone-conduction audiograms were administered to those passing the screening, and individuals with more than a 5-dB air-bone gap were discarded. This left 80 farmers aged 26-65 years with 10 to 39 years of full-time farming. An attempt was made to analyze results for different types of farming (dairy, swine, poultry; area in field crops) but with such small numbers, this was fruitless. When broken down by age groups, HLs are clearly greater than the presbycusis norms advocated by NIOSH (criteria for a recommended standard ... Occupational Exposure to Noise, National Institute of Occupational Safety and Health, 1972) at frequencies above 1000 Hz: about 10 dB worse (relatively independent of age) at 2000 Hz, and 25 dB worse at 3000, 4000 and 6000 Hz. About 17 dB worse at 3000, 4000 and 6000 Hz than the PHS medians. Thus, hazard clearly established; only randomness of the sample is in question.

4. C.A.R. Dennis, A Survey of Hearing Levels of Saskatchewan Farmers; Saskatchewan Occupational Health Report No. 1, Saskatchewan Department of Health, June 1969.

484 farmers were interviewed and examined at 8 agricultural farms and 2 "mexabitions" (agricultural exhibitions) in Saskatchewan. Subjects were rejected if: exposed to tractors or combines within 18 hours of test (33); over 65 or under 25 years in age (19); prior known hearing loss from early childhood (5); audiometric error (10); ear operation (4); or some combination of the foregoing (2). The remaining audiograms (412) were analyzed in terms of: (A) Area of land farmed (tendency for more loss in farmers with more land, but no statistical test for significance; difference less than 5 dB in the aggregate, it appears); (B) shooting habits (no effect); (C) military service (no effect). Breakdown by age shows losses 10 to 15 dB worse than PHS medians at 3000, 4000 and 6000 Hz (no comparisons with controls were made by the author). Sampling unknown, as is the method of inducement to participate. Only other weakness is lack of statistical analysis.

5. J.B. Gregg, Noise Injuries to Farmers, Agricultural Engineering, 12-15, March 1972. Not seen.

6. R.S. Karlovich et al., A Survey of Hearing Sensitivity in an Unselected Rural Wisconsin Population; (Outline of talk dated 3/11/74). Brief uninformative account of analysis of 116 audiograms done at Farm Progress Days at Fond du Lac, Wisconsin in October 1973. Worthless data.

7. D.M. Lierle and S.N. Reger, The Effect of Tractor Noise on the Auditory Sensitivity of Tracotr Operators; Ann. Otol. Rhinol. Laryngol. 67, 372-387, 1958. Old article; scant data.

8. T.L. Martus, A Review of Research on Farm Machinery Noise as a Cause of Deafness and Some Possible Solutions for the Problem; Unpublished Technical Report for AE 811, Department of Agricultural Engineering, Michigan State University, 1972. Not seen.

9. J.W. Ouzts, Auditory Tempory Threshold Shift (TTS) Following Esposure to High-Intensity and Variable-Peaked Farm Machinery Noise; J. Auditory Res. 9, 64-70 (1969).

Study of temporary hearing losses produced by exposure to some farm noises, with emphasized and de-emphasized peak factors. However, the relation between such temporary losses and eventual permanent loses is not know; therefore, the data are only peripherally relevant.

10. E.W. Simpson, Jr. and I.L. Deshayes, Tractors Produce Ear Damaging Noise; J. Environmental Health 31, 1969.

In addition to a table showing sound levels (dBC) produced by a variety of farm implements measured at the University of Nebraska, brief mention is made of testing of 146 employees of the university experimental station. No meaningful analysis of the data is made.

11. Southwest Research Institute, A Study of Noise-Induced Hearing Damage Risk for Operators of Farm and Construction Equipment; Tech. Rep. SAE Research Project R-4, Society of Automotive Engineering, Inc., New York City, 1969.

Study of possible risk criteria and empirical determination of typical exposure patterns to farm noise in order to estimate noise doses.

12. E.J. Stone, Occupational Deafness and Hearing Acuity of Employees in the Agricultural Industry. Paper presented to National Institute of Agricultural Eng., Silsoe, Bedfor, U.K. (1967). Not seen.

13. H.R. Weston, A Survey of Tractor Noise and the Effects on Hearing; J. Australian Inst. Agricultural Science 29, 15-22, 1963. Not seen.

14. Dick Willsey, Hearing Test Results -- Indiana Farmers National Institute of Farm Safety Meeting, October 31, 1972.

"Fifty-one farmers from around Lafayette (Indiana) participated in a special hearing study" (method of selection not mentioned) performed at Purdue University Hearing Clinic. Breakdown by age (N in each decade not indicated) shows HLs indistinguishable from the PHS medians at all frequencies except at 4000 Hz. At 4000 Hz, about 10 dB more loss in the 30-39 and 40-49 age groups, but not in the 20-29, 50-59, and 60-69 groups. This study therefore implies very little

hazard from occupational farm noises -- no more than exists in the average American occupation.

9. Current Research: Unknown. Presumably interest in the problem will persist at those institutions sponsoring the auditory described in the more recent of the bibliographic references (Nebraska, Michigan, Purdue, Saskatchewan).

10. Case Data Sources: Such data are essentially irrelevant unless the sample is either complete or carefully randomly selected. Further accumulation of audiograms from farmers who come to fairs constitutes a waste of time and effort. There is no prospect of information about the average risk of hearing loss in the foreseeable future unless someone is willing to attempt an audiometric survey of either a random sample of farmers, or all the farmers in, say, a given township.

Toxic Chemicals Producing Respiratory Disease

This broad category includes gases, mineral dusts, metals, vegetable dusts and hydrocarbons. Gases include nitrogen dioxide and its related NO_x, silo gases: ammonia, hydrogen sulfide, methane, the manure-generated gases and carbon dioxide and carbon monoxide resulting from combustion, and important mainly because they either displace oxygen or combine with hemoglobin. The nitrogen oxides are generated from silage fermentation. A small number of workers each year are exposed when they open silage and are greeted by a dark brown, heavy acrid gas which may produce death from pulmonary edema or protracted disability from non-fatal bronchiolitis. Adequate venting of the silos would dissipate the gas and avoid the problem. There is also a problem in some dehydrated feed factories in which nitrogen oxides are generated in large quantities and vented to the atmosphere. Work areas may become high in these chemicals.

Ammonia, hydrogen sulfide and methane are basically problems of the feed lot preparation of cattle, pigs and sheep for market. Gases are generated from urine and manure which accumulate in large quantities in underground pits and undergo anaerobic decomposition by the activity of bacteria. The most dangerous is hydrogen sulfide which has been found at levels of 800 ppm in liquid manure pits. Death may be due to respiratory arrest at these levels. At lower levels, there may be vascular effects after protracted exposure. Although the disagreeable odor of "rotten egg" usually provides a warning, it may not do so in company with other gases especially when work must be continued in environments so the stimulus is ignored or adapted to. Methane and carbon dioxide may also be generated in manure pits, but are not toxic by themselves. They exert their lethal effects by the displacement of oxygen, producing suffocation.

Carbon monoxide, the result of incomplete combustion of fuels, probably affects more farm workers largely because of defective space heating or the operation of internal combustion engines indoors without proper venting. Although these are important risks, they are not specific for agricultural work, but rather with socioeconomic level and ignorance of risk or its deliberate courting.

The mineral dusts which agricultural workers are likely to inhale are ordinary soil which they are working plus ground and crushed fertilizers, mainly phosphates, lime, calcium carbonate and nitrates. None of these is thought to constitute an inordinate risk, and pneumonconiosis among farmers is almost unknown. Practically all cases that have been observed among those who have given their occupation as farmers can be attributed to brief periods of exposure in mining, foundry work, sandblasting, etc. before undertaking farming as a second occupation. Vegetable dusts may be of the greatest importance of this entire group. This includes the dust from cotton containing agents which give rise to tightness in the chest and shortness of breath, which would involve particularly gin workers working in semi-enclosed or enclosed gins, and wood dust products, particularly from western red cedar, black walnut, oak, and mahogany, which would involve workers in logging and furniture making. Thus, unless workers in gins or lumbering are considered agricultural, there is little evidence that workers in the open air are at any risk for either byssinosis or the similar pulmonary disorder due to the western red cedar or other lumber.

The last category is disease due to fuels, kerosene, gasoline, and other hydrocarbons. It appears that because of careless storage and occasional deliberate exposure by adolescents that kerosene and gasoline sniffing, like glue sniffing, is an important poisoning problem in adolescents. The magnitude of the problem is estimated at about 100 deaths in the United States from 1960 to 1970. That rates may be higher than this is suggested by a study of 72 children attending a Pueblo Indian Village school, 62% of whom had sniffed gasoline at least once, suggesting that this may be an important problem in some special populations. The effect is generally to produce either pulmonary edema or a delayed pneumonitis resembling that from hydrocarbon aspiration. The same effect can be produced by ingestion of hydrocarbon. The lung, in other words, seems to be a sensitive organ for showing membrane effects. Fuel additives, the most important of which is tetraethyl lead, may also be important to agricultural workers, although the major risk seems to be that of lead poisoning from exposure to fuel combustion as along interstate highways or heavily traveled freeways, or of food crops grown there.

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Whole Body Vibration

The biomechanical response of the human body to whole body vibration has been studied in the laboratory by a variety of investigators. Typical of this work is the mechanical model of figure 1 and the frequency response diagram of figure 2 (1). Much of the literature relevant to exposures to whole body vibration in agriculture has been written by agricultural engineers concerned with comfort and performance of tractor drivers and is in the biomechanical spirit. Their approach relies principally on frequency domain analysis. Matthews is probably the principal exponent of this approach and has written a series of papers of importance to defining the spectral characteristics of the vibration exposure of tractor drivers and the factors influencing the intensity of their exposure (2) (3).

Guignard (4) has stated that the physiological effects of vibration fall broadly into two categories, those attributable to the differential vibratory movement or deformation of the organs and tissues of the body and those responses to this stress which are more generalized and non-specific. The former category of responses are frequency-dependent and can be related to body resonance phenomena suggested by the model of figure 1, whereas the second category appear to be less frequency dependent but more closely related to the intensity and the duration of the exposure.

A variety of physiological responses to whole body vibration have been observed in the laboratory ranging from increased oxygen consumption to effects on neuromuscular regulation, but usually at levels experienced only in military or spacecraft environments (1). There is little data relating long term exposure to whole body vibration at levels typical of industrial or agricultural exposures to any particular disease condition. One of the few studies reported in the literature concluded that prolonged tractor driving was associated with harmful effects on the digestive process and also that spinal x-rays of this population showed pathological changes far in excess of those expected for the age groups studied (5). Spinal problems were also suggested by American investigators studying tractor drivers. Musculoskeletal problems among heliocopter pilots are

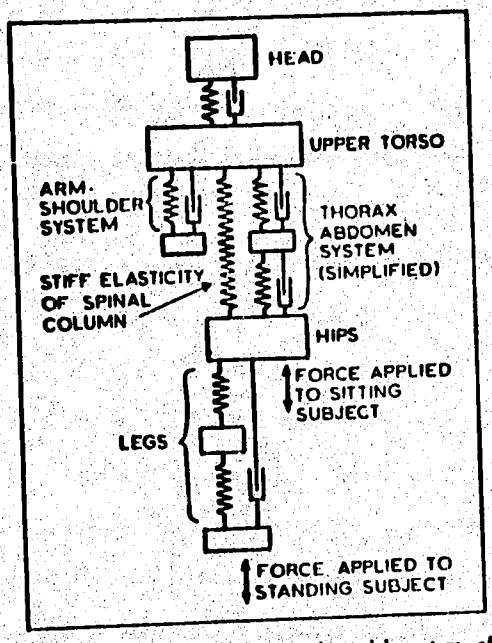


Figure 1. Simplified mechanical model system of masses interconnected by elastic and viscous couplings representing the human body standing or sitting on a vertically vibrating platform at low frequency (44).

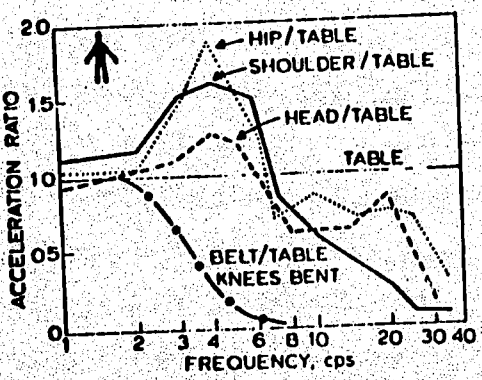


Figure 2. Transmissibility of vertical vibration, as a function of frequency, from a supporting surface to various parts of a human body standing on it (49, 81, 172).

currently being studied at Wright Patterson Air Force Base by Von Gierke's group.

Recently two NIOSH funded epidemiological studies of populations exposed to whole body vibrations have appeared (6) (7). One of these studies concerned motor coach drivers and the other, heavy equipment operators. Insofar as a rough tractor ride has been reported to subject the driver to twice the average acceleration of that experienced in a poor truck ride, it seems sensible to assume that the heavy equipment study is of greater relevance to the agricultural exposure situation (2). Without going into detail, the diseases that appeared to be associated with heavy equipment operation were: diseases of the male genital organs, certain endocrine diseases, ischemic heart disease and certain musculoskeletal diseases. Only in the case of prostatitis does the association appear to be particularly strong. However, this investigation produced indirect evidence of a selection phenomena in which workers afflicted with certain painful or severe diseases leave jobs subjecting them to high levels of whole body vibration. If such a process is confirmed to exist, then there will be a much stronger case for investigating the hazards of exposure to whole body vibration in agriculture.

A final complication that must be considered in assessing the overall hazards associated with whole body vibration is the possible link between exposure and increased accident liability. First, there exists a considerable body of literature devoted to investigations of the decrements in various performance measures observed in vibration environments (8). There are three types of performance effects: those attributable to mechanical interference with normal operating functions, those influencing psychomotor performance, and those central effects which may be manifested as fatigue. The first class is probably not of great importance in agriculture, since the intensity of vibration involved would be quite uncomfortable and unlikely to be sustained. Effects of vibration on psychomotor performance are not clear. In some cases there seems to be a positive effect as with low noise levels, perhaps due to an arousing influence (4).

The influence of vibration as one of a number of factors contributing to fatigue has been studied for some years, particularly with regard to

pilot and air crew performance. Guignard (4) cites the work of Drew who, more than 30 years ago, studied 140 pilots using a Link-type trainer simulator and observed that the signs of flight-time fatigue include the deterioration of work strategy, lapses of attention, the making of stereotyped, unthinking responses to displays, increasing irritability and increasing awareness of physical discomforts. Further, Guignard suggests that Mohler's work indicates that continuous vibration and noise in flight appear likely to aggravate some, if not all, of these effects. These effects of noise and vibration exposure have been suspected by some experienced construction industry safety personnel as contributing to "bonehead" mistakes by experienced machine operators which have resulted in severe personal injury accidents. Interestingly, some of the strongest statistical associations between vibration exposure and morbidity found in the heavy equipment operators study cited above were associated with traumatic injuries. Hence, whole body vibration may be an agent implicated in both disease causation and traumatic injury and, as such, a candidate for close scrutiny in a developing program of occupational safety and health in agriculture.

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Lecture 2

TAKING AN OCCUPATIONAL AND SOCIAL HISTORY: A CASE STUDY OF A MIGRANT WORKER

OBJECTIVES

1. To interview a farm worker and demonstrate the key elements of an occupational and social history.

2. To discuss handout materials which provide a background for several of the history elements that contrast this farm worker from a similar history that might be done on other workers.

Lecture 2: Taking an Occupational and Social History: A Case Study of a Migrant Worker

Materials Description

Student Materials	Handouts Agricultural Work Force--A Profile U.S. Senate Testimony on the Migrant Farm Labor Problem in the United States
Teaching Materials	None
Instructor's Guide and Reference Materials	Lecture Outline (not included) Suggested Readings (incomplete)

NOTE

The data used in this profile of the agricultural labor force may not always be comparable and figures may not always agree, but the pattern is consistent. (See SUMMARY) There are a number of reasons for the lack of conformity.

1. All the information was not available for the same recent year; therefore, data obtained were for the most recent year. For example, Table 1 shows the average monthly employment in agriculture for 1973, Table 4 the proportion of farm operators who also worked off their farms in 1969.

2. Similar totals may differ because the data were gathered differently. For example in Figure 1, average monthly farm labor force for 1973 is given as 3,295,000; in Table 1 it is 4,395,100. In Figure 1, the estimates for the farm labor force were prepared by the U.S. Department of Labor based on a monthly sample in which respondents are classified according to their major activity the week before. A respondent who spent 10 hours at farm work, and 25 hours driving a taxi cab could be classified as a taxi cab driver. In Table 1, the estimate was prepared by the U.S. Department of Agriculture. According to the U.S. Department of Agriculture definition, farm labor includes everyone who worked at least 1 hour for cash or 15 hours for free (unpaid family labor) in agriculture during the last week of the month. The U.S. Department of Agriculture estimate was more comparable to that issued by the Department of Employment Security for Washington and was therefore, used in Table 1.

3. Census figures concerning occupation are based on major activity for one week in April of 1970. Since agricultural activities are still at a low point in April, the annual farm labor force is undercounted in the census. Nevertheless, the census data was used to compute median years of education completed and the sex ratio for farm operators and hired workers (Table 2); comparisons with available data obtained elsewhere indicate that the averages and ratios based on census data are similar to those obtained in various samples.

SUMMARY

NO MATTER WHERE THE ESTIMATES COME FROM AND HOW THEY ARE DERIVED, THEY LEAD TO THE FOLLOWING CONCLUSIONS:

FARM OPERATORS are older, predominantly white and male, better off financially and better educated than their hired workers (TABLES 2, 3, 4).

FARM WORKERS are poor, young, predominantly male, undereducated, white in general, but among the migrants, minorities are disproportionately represented. (TABLES 2, 5)

FARM WORKERS are excluded in whole or in part from most social legislation. (TABLE 6)

FARM WORKERS have problems obtaining adequate health services. (Section 3)

Traditionally low wages of FARM WORKERS are even lower in the areas bordering Mexico, where aliens entering illegally are working in agriculture. (Section 1)

FARMING is the third most hazardous industry in the United States following mining and construction. (TABLES 7, 8, 9, 10)

Agricultural Labor - Foreign Nationals

Legal Aliens

Temporary immigrants are permitted to enter the United States for a period not exceeding 120 days. In 1968, less than 15,000 workers from the British West Indies and Canada were admitted to the United States for seasonal work in agriculture.

Permanent immigrants (green carders) are entitled to up to 3 years' residence in the United States with the ultimate option of citizenship; these include some 631,000 Mexicans, of which 39,000 were employed in agriculture. Many of these workers (about 40 percent of those employed in agriculture) retain residence in Mexico while commuting to the United States to work.

Comment - About 90 percent of the commuters (green carders) work in 8 border areas in Texas, Arizona and California. Alien commuters work most often in the lowest skilled, most menial and lowest paid jobs. Even so, they tend to depress these already low paying jobs. Wages for seasonal farmwork in the Texas border areas are 30 percent lower than for similar work in the rest of the State. California farm wages are lowest in the border areas where the bulk of farm labor is composed of commuters.

Illegal Aliens - Estimates of the number of Mexicans in this country illegally range from 100,000 to 200,000. In the year from July 1, 1967 to June 30, 1968, 41,425 Mexicans working in agriculture were apprehended for illegal entry. Some unknown number of illegal aliens from Mexico work in the State of Washington. Officials in the Department of Employment Security and the local district office of the Immigration and Naturalization Service believe that this number is increasing in Eastern Washington. In 1972, they estimated that there may have been from 1,000 to 1,500 illigal aliens in Wenatchee and possibly double that for the State. Prior to 1973, the illegal aliens were largely men who left their families in Mexico, but in 1973 a trend towards entire families of illegal aliens was noted in Eastern Washington. In 1972, a large number of illegal aliens were engaged in tree planting in Western Washington; but this problem was greatly eased in 1973 when the company involved agreed to monitor their labor contractors more closely.

Source: U.S. Senate Committee on Labor and Public Welfare, Subcommittee on Migratory Labor, Federal and State Statutes Relating to Farmworkers, A Compilation, U.S. Government Printing Office, Washing, DC; Dec. 1972, p. 203, 253-257.

U.S. Immigration and Naturalization Service - discussion with District Director.

State of Washington, Department of Employment Security, discussion with official in Farm Labor and Rural Manpower Service.

Working Conditions

To a large extent the following characteristics serve as the basis for the high work-related injury and illness rates in agriculture.

1. Most work is done outdoors and working hazards are more difficult to control than those indoors. Try turning off the wind or lowering the temperature.

2. Seasonal and casual employment leads to a higher degree of labor turnover and less opportunity for a worker to become familiar with the surroundings, thus increasing the possibility of accidents or ill health.

3. There is a great deal of physical and manual labor, often repetitive and very strenuous.

4. The work day is long and tiring, often starting at dawn and ending at dusk or later. Long periods of travel to and from the fields are frequently involved.

5. The prevalence of piece work encourages work at high speeds over long hours.

6. The available evidence indicates that farm workers in the field frequently do not have access to toilets, drinking water or handwashing facilities.

   a. Such occupational diseases as heat strokes, poisoning by agricultural chemicals and skin conditions may be prevented or ameliorated by the availability of water for drinking and washing.

   b. The absence of toilet facilities in the fields leads to urinary and gastrointestinal complaints on the part of workers who do not relieve themselves when necessary or to the possible contamination of produce when they do.

7. Management tends to have a low level of professional training so that engineering and scientific viewpoints regarding safeguards are not very prominent.

SECTION 3

Health Care for Migrant and Other Seasonal Workers

Generally, rural dwellers have more difficulty obtaining health care than their urban counterparts because of shortages of medical services in rural areas and the distances which must be travelled to reach the services that do exist. Farmworkers have additional difficulty in obtaining entry to hospitals because they lack funds for precare deposits. Migratory farmworkers are usually ineligible for categorical welfare assistance (Medicaid) because of residence requirements.

The Migrant Health Act, passed in September 1962 to alleviate these disabilities, provides funding for local projects aimed at improving health services and health conditions. In order for these local projects to be successful, they need to overcome many basic problems: lack of knowledge on the part of migrants and their special problems relating to health care; lack of knowledge on the part of health professionals about ways to serve migrants effectively; poverty of migrants which makes it unrealistic to expect them to pay for own health care; lack of community funds for expensive care and decentralization of health services to serve migrants; lack of adequate health resources in many rural areas and the need for innovative programs to reach migrants (such as outreach workers, location of health services, mobile units, evening hours, transportation); need to provide continuity of services to migrants as they move from place to place; negative attitude of community towards migrants.

A sample of medical conditions among patients reported by migrant health projects during 1968 was compared with a sample of medical conditions among patients seen in private physicians' offices during a comparable period. Infective and parasitic diseases, diseases of the respiratory system and digestive system diseases were from two to five times as large a proportion of total conditions seen among migrants as among the general population. Tuberculosis was seen 17 times, venereal disease 18 times and infestation with worms 35 times as often among migrants as among patients in offices of private physicians.

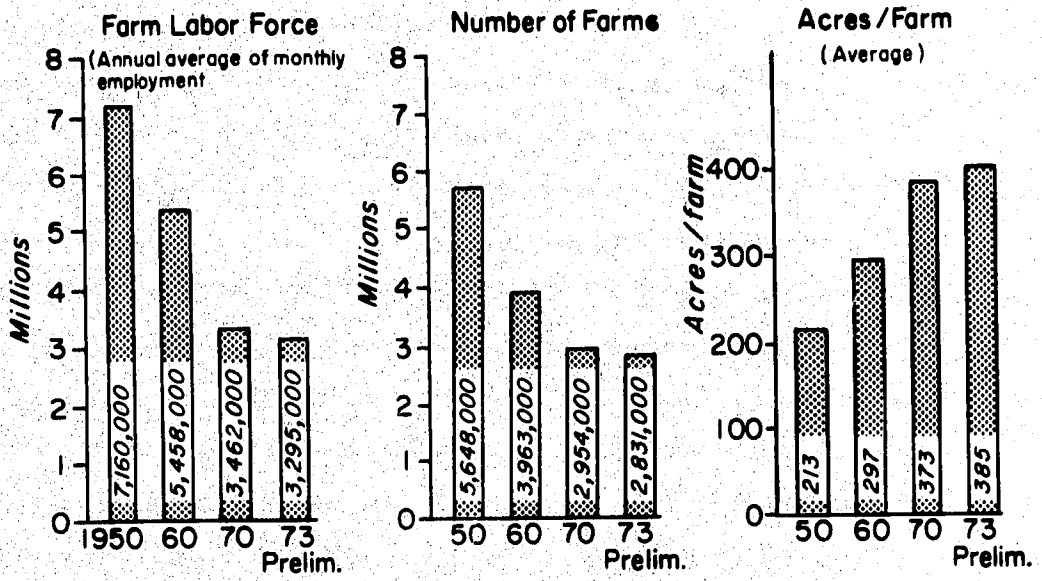
By January 1, 1969, there were 116 single or multi-county projects in 36 states and Puerto Rico; 170 hospitials in 25 states had signed agreements with migrant health projects to accept migrants as patients.

In the State of Washington, of seven projects funded by the Migrant Health Act, four are funded through the Health Services Division of the Washington State Department of Social and Health Services and administered by three local health departments and a non-profit community organization; two are funded through and administered by local health districts; and one by a non-profit organization.

Source: U.S. Senate Committee on Labor and Public Welfare, Senate Subcommittee on Migratory Labor; Federal and State Statutes Relating to Farmworkers, A Compilation, U.S. Government Printing Office, Washington D.C., December 1972, p. 216-233.

Washington State Migrant Health Program, Migrant Health Project 1971-1972, Olympia, Washington.

U. S. Agricultural Trends



U.S. Bureau of Census – Statistical Abstract of the United States 1973 (94th ed.) Wash. D.C. p. 219, 585

AVERAGE MONTHLY EMPLOYMENT, AGRICULTURE 1973

Agriculture	United States	Washington
TOTAL	100.0% (4,395,000)	100.0% (62,900)
Self-employed (and unpaid family labor)	73.5%	49.1%
Hired	26.5%	50.9%
Year Round	N/A	15.6%
Seasonal	N/A	35.3%
Local	N/A	26.2%
Migrant	N/A	9.1%
(Intrastate)		3.0%
(Interstate)		6.0%

COMMENTS:

1. Washington farm operators rely on seasonal labor to a greater extent than U.S. farm operators.

2. In Washington, proportion of year round farm workers (those working at least 150 days on one farm) is increasing with increase in size of farm and use of more sophisticated technology.

3. In Washington, seasonal farm employment is increasing slowly. Increased acres of sugar beats, grapes, asparagus, and fruit have more than offset decrease in employment due to mechanization.

Source: U.S.D.A. Statistical Reporting Service, Crop Reporting Board Farm Labor, 1-14-74
Washington Department of Employment Security - Rural Manpower Report, 1971, 1972, Unpublished data for 1973.

TABLE 2

Demographic Characteristics[1]
Agricultural Labor Force, United States and Washington

Demographic Characteristics	United States	Washington
FARM OPERATORS		
Average Monthly Employment 1973	3,232,100 (7)	30,900 (9)
Median Age	51.2 (4)	50.8 (3)
Sex	95% male, 5% female (5)	93% male, 7% female (6)
Education, Years Completed	10.2 (5)	12.2 (6)
Size of Family	---	---
Workers Per Family	---	---
Race	96% white, 4% black and other (4)	---
HIRED FARM WORKERS		
Average Monthly Employment 1973	1,163,000 (7)	32,000 (9)
Median Age	23 (8)	---
Sex	84% male, 16% female (5)	82% male, 18% female (6)
Education, Years Completed	< 8 (5)	10.0
Size of Family	---	---
Workers Per Family	---	---
Race	85% white, 15% black and other (8)	---
MIGRANTS		
Average Monthly Employment	114,000 (1969) (1)	5,700 (9) (1973)
Median Age	< 25 (2)	---
Sex	75% male, 25% female (1)	---
Education, Years Completed	6.7 (2)	< 9 (9)
Size of Family	5.9 (1)	---
Workers Per Family	2.2 (1)	---
Race	60% Mexican American 30% Black 8% White 2% Other (2)	--- --- --- ---

[1] for the most recent year available

Note: --- means information not available

References:

(1) U.S. Senate, Committee on Labor and Public Welfare, Subcommittee on Migratory Labor, Federal and State Statutes Relating to Farmworkers, A Compilation, U.S. Government Printing Office, Washington, D.C. 1972, p. 196, 197, 389.

(2) U.S. Senate Committee on Labor and Public Welfare, Subcommittee on Migratory Labor, Farmworkers in Rural America, 1971-1972, Part 1, U.S. Government Printing Office Washington, D.C. 1972, p. 295.

(3) U.S. Department of Commerce, Bureau of the Census, Census of Agriculture, 1969, Vol. I Area Reports, Part 46 Washington, U.S. Government Printing Office, Washington D.C. 1972.

(4) U.S. Department of Commerce, Bureau of the Census, Census of Agriculture, 1969, Vol. II, Chapter 2.

(5) U.S. Bureau of Census, Census of Population, 1970: Detailed Characteristics, Final Report PC(1) - D1, U.S. Summary, U.S. Government Printing Office, Washington, D.C. 1973, Table 231.

(6) U.S. Bureau of Census, Census of Population: 1970, Detailed Characteristics, Final Report, PC(1) - D49, Washington, U.S. Government Printing Office, Washington, D.C. 1972, Table 179.

(7) U.S. Department of Agriculture, Statistical Reporting Service Crop Reporting Board, Farm Labor January 14, 1974, (Release), Washington, D.C. 20250.

(8) U.S. Department of Agriculture, Economic Research Service, The Hired Farm Working Force of 1972, Agricultural Economic Report No. 239, Washington, D.C., March 1973.

(9) State of Washington, Department of Employment Security, As yet, unpublished data from Research and Statistics.

TABLE 3

Farm Income of Farm Operators
(Total Net Income Per Farm)

Year	United States	Washington
1973	N.A.	N.A.
1972	$7,089	$9,898
1971	5,817	6,048
1969	5,620	8,238
1962	3,579	4,069

Note: N.A. means not available

Source: U.S. Department of Agriculture, Economic Research Service (FIS-222) Farm Income Situation, July 1973, Table 3H, August 1973, Supplement, Table 5.

TABLE 4

Days of Work Off Farms - Farm Operators, 1969

Days Per Year	United States	Washington
Total	100.0 (2,730,250)	100.0 (34,033)
None (or no response)	45.7	41.1
1 - 99	14.3	13.0
100 - 199	8.0	8.6
≥ 200	31.9	37.2

In 1969, more than half the farm operators augmented their income by working off their farms as well.

Source: U.S. Department of Commerce, Bureau of the Census, 1969 Census of Agriculture, Vol. 1, Area Reports Part 46, Washington, U.S. Government Printing Office, Washington, D.C. 1972, Table 3.

TABLE 5

Average Number of Days Worked and Wages Earned at
Farm and Non Farm Wage Work, for All Farm Workers, by Selected Characteristics, 1972

Selected Characteristics	Number of Workers (000)	Farm & Non Farm			Farm		
		Days Worked	Wages Earned		Days Worked	Wages Earned	
			Year $	Day $		Year $	Day $
Western United States	710	139	2,360	17.00	99	1,666	16.85
United States	2,809	136	2,019	14.85	88	1,160	13.20
White	2,380	140	2,132	15.25	88	1,188	13.50
Black and Other	429	117	1,387	11.85	87	1,001	11.50
Male	2,169	153	2,375	15.50	101	1,367	13.55
Female	641	79	813	10.30	45	459	10.20
Migratory	184	141	2,179	15.45	96	1,391	14.50
Non Migratory	2,625	136	2,007	14.75	88	1,143	13.00

Note 1: Excluded from these data are children < 14, residents of Puerto Rico, foreign nationals who come in legally to perform agricultural work. Illegal foreign nationals are, of course, excluded.

Note 2: In 1972, farm workers in the Western States earned more than their counterparts in the U.S.; farm workers in the State of Washington are said to be among the highest paid in the nation, having received on the average $2.35 an hour in 1972.

Even though many farm worker families have more than one breadwinner, they are still poor.

Source: U.S.D.A., Economic Research Service, Agricultural Economic Report No. 239, The Hired Farm Working Force of 1972 , Table 7, Appendix B for inclusions.

TABLE 6

SOCIAL LEGISLATION

Agricultural labor is by and large excluded from protection and beneficial Federal and State legislation. Even when nominally included, exceptions and actual circumstances of agricultural labor operate to limit effectiveness of inclusions. This list gives the highlights, but is not an exhaustive discussion of all legislation and of all exclusions and discrimination under the laws and in fact. For full discussion, read Seminar of Farm Labor Problems cited under Source.

United States	Washington	Comment
MINIMUM WAGE LAWS		
Fair Labor Standards Act Partial coverage of farmworkers beginning in 1966 at lower minimum wage than set for other workers. All farmworkers excluded from overtime provisions. Sugar Act - guarantees minimum wage set by Secretary of Agriculture after hearings attended by farmers but not usually by farmworkers. Wagner-Peyser Act- wages offered an interstate migrant must not be less than prevailing wage for local workers, thus indirectly supporting a minimum wage. Eight states include farmworkers in their minimum wage laws with	Agriculture exempt from Minimum Wage Act	The grower may further decrease wages by a. withholding part of wages until end of season - known as bonus system. b. charging high rents for inadequate housing c. not paying workers for the time spent waiting for fields to dry, for equipment to arrive, etc.

some qualifications; but in all, farm-workers are exempt from overtime provisions of the laws.		
FARM LABOR CONTRACTORS		
Any contractor transporting 10 or more workers interstate is required to obtain an annual certificate of registration. Contractor must submit information concerning method of operations and proof of liability insurance for vehicles. Some other requirements relate to payment of moneys and maintenance of wage and hour records.	Migrant farm labor contractors are required to be licensed by the State.	There is little evidence of the effectiveness of these laws. The Department of Labor estimates that between 8,000 and 12,000 farm labor contractors have failed to register as required.
COLLECTIVE BARGAINING LEGISLATION		
Agriculture is exempt from the coverage under the protections and procedures of the National Labor Relations Acts except those of Hawaii and Wisconsin.	There is no state labor relations act. The Labor Disputes Act gives workers the right to organize a union and protects them from employer reprisals. But according to the State Supreme Court, once the union is formed there is nothing in the Act requiring employers to bargain with the union.	Exemption means that employers are under no obligation to bargain even when the majority of workers want to be represented by a union. Letters sent to growers by worker representatives asking for meetings are returned unopened, or employers may conclude contracts with those unions they think will be more malleable.

UNEMPLOYMENT COMPENSATION

Farmworkers are excluded from unemployment compensation in all States except Hawaii	Agricultural labor is exempt	Reasons for exclusions are: 1. Administration and recordkeeping onerous for farmers 2. agricultural employment seasonal 3. and, therefore, cost prohibitive Counter argument: 1. Major legislative proposals include only large commercial farms (_ 300 man days of agricultural labor in any one of four preceeding quarters) recordkeeping not unusual for large farms. 2. 67% of agricultural employment is year round; many other farmworkers have non farm employment out of season and are, therefore, not eligible for unemployment compensation. 3. Cost under proposed legislation is estimated at a 0.2 percent increase of total farm expenses or an average payroll tax of $800 per covered farm.

DISABILITY BENEFITS

Six jurisdictions (California, Hawaii, New Jersey, New York, Rhode Island, Puerto Rico) provide for non work related disability. Only California included farm labor under its disability benefit law.

No such legislation

SOCIAL SECURITY

Farm workers included under Social Security Act since 1956 if the worker receives cash wages of $150 or more from one employer for four quarters or if he works for an employer for 20 or more days at a time rather than a piece rate basis.

Not applicable

Many farm workers excluded because:

1. work short periods for a number of employers for low wages.
2. much farm work is performed on a piece rate basis.
3. fraud and failure to pay social security tax on part of farmer and crew leaders (crew leaders are considered employers under the Act).

WORKMEN'S COMPENSATION

As of December 1973, only 13 States and Puerto Rico included agricultural workers in their Workmen's Compensation coverage on the same basis as other workers.

Starting January 1972, workmen's compensation coverage was extended to all farm workers, except those who earn less than $150 per calendar year from one employer or any child under 18 employed by his parents on the family farm.

The National Commission on State Workmen's Compensation Laws has recommended that agricultural workers be universally covered on the same basis as other workers by July 1, 1975; i.e., full medical care for employees accidentally injured or made ill because of or during the course of employment.

CHILD LABOR

Child labor regulated under Fair Labor Standards Act and the Sugar Act. The Fair Labor Standards Act established 16 year minimum age for employment in agriculture, and does not apply to farm labor performed outside of school hours unless work performed is particularly hazardous (e.g., use of pesticides and herbicides, operating mechanical equipment, and working with large animals).

No minimum age for employment in agriculture outside of school hours; min. age for employment during school hours is 15, unless school authorities exempt students from attendance.

Number of children working in agriculture is unknown. The Department of Employment Security estimates that in 1973 75% of strawberry harvest picked by children under 15 a large proportion between 6 and 10. In 1972, strawberry pickers under 16 averaged $1.57 per hour compared to $2.81 for adult. Pickers are paid by flat, but total earnings are converted into hourly rate. Differential in pay does not necessarily mean that children pick less because rates per flat vary among growers.

Large numbers of children work in asparagus in early hours before school starts. Children pick raspberries and are involved in all fruit tree harvesting.

800,000 children under 16 work in agriculture, nearly half between 10 and 13. 400,000 of these children work less than 25 days a year (mainly students).

50,000 migrant children travel with their parents during the school year; many do agricultural work.

Survey of accidents in agriculture show large involvements of young workers under 16.

According to Dr. Charles Handee Smith, Professor Clinical Diseases of Children, Columbia Univ., long hours of tiring work are harmful to children:

1. A child must grow and gain weight. Agricultural labor (thinning, topping, picking) requires constant bending, stooping, and frequent lifting. This excessive muscular activity should be used in the natural process of growth. Consequently children engaged in arduous labor become undernourished and undersized.

2. Chronic fatigue lowers resistance to disease.

3. Child labor detracts from time normally spent as part of educational process.

Source: U.S. House of Representatives, Committee on Education and Labor, Subcommittee on Agricultural Labor: Seminar on Farm Labor Problems, U.S. Gov't. Printing Office, Washington, D.C. 1970, pp. 4-32.

U.S. Senate Committee on Labor and Public Welfare, Subcommittee on Migratory Labor, Federal and State Statistics Relating to Farm Workers, A Compilation, Gov/t. Printing Office, Washington D.C., December 1972, pp. 47-49; 268-270.

State of Washington, Department of Employment Security, Conversations with research personnel and unpublished tabulations.

TABLE 7

First Payment Records[1] for Reports of Occupational Injuries
Among Agricultural Workers
Washington 1972, 1973 (Percent)

Source of Injury	1972	1973
Total	100.0 (1298)	100.0 (1599)
Working Surfaces (floors, ramps, roofs)	28.3	30.8
Wood Items (logs, poles, trees)	10.4	8.5
Vehicles	10.1	8.1
Metal Items	7.6	7.0
Hand Tools (axe, hoe, knife)	7.3	7.7
Machines	5.8	6.1
Other	30.5	31.8

[1]Work incurred illness or injury resulting in 3 or more days lost from work.

Note:

The Department of Labor and Industries does not process for statistical purpose those claims with less than 3 days lost from work, but they estimate 4 such claims for every 1 resulting in 3 or more days lost from work. Therefore, the estimated total number of claims for 1972 was about 5,200 and for 1973, about 6,400.

Source: Washington Department of Labor and Industries, Division of Industrial Insurance, First Payment Claims, Unpublished Data.

TABLE 8

First Payment Records[1] for Reports of Occupational Disease
Among Agricultural Workers
Washington 1972, 1973

Condition	1972	1973
Total	45	54
Chemical Burns	5	5
Infectious Disease	--	1
Dermatitis	11	10
Effects of Cold	1	1
Effects of Heat	--	1
Bursitis, Synovitis and Tenosynovitis	15	22
Systemic Poisoning	12	10
Pneumoconiosis	1	4

[1]Work incurred illness resulting in 3 or more days lost from work.

Source: Washington Department of Labor and Industries, Division of Industrial Insurance, First Payment Claims, Unpublished Data.

TABLE 9

FARM FATALITIES, WASHINGTON

Type of Farm	Area	Occupation	Age	Date of Death	No. of dependents	Injury	Cause of Injury
General	Warden	Farm Laborer	67	3/30/73	1	Multiple Injuries	Deceased was driving a pick-up truck across a railroad crossing and was struck broadside by a train engine.
Fruit	Cashmere	Orchard Foreman	45	3/31/73	1	Multiple Injuries	Deceased was working from the elevated platform of a trump girette pruning a tree when the main supporting pin of the boom arm broke through its supporting member. The platform and the deceased both crashed to the ground where the deceased was pinned beneath the platform railing.
Truck Farm	Pasco	Truck Driver	19	4/13/73	0	Skull Fracture	Deceased was operating a truck tractor with a semi-trailer loaded with potatoes. He lost control of the vehicle, failed to negotiate a turn and went off the road to the right. The tractor and trailer rolled over in an up-side down position. The body of the deceased was found facing backward in the cab of the tractor, indicating he wore no seat belt.
General	Clarks-ton	Farm Laborer	34	5/30/73	0	Crushing	The deceased was attempting to hook a John Deere double disc to the rubber tired tractor he was operating. When he found that the tractor was not close enough to hook up, he went to the side of the tractor and engaged the clutch handle to back the tractor up. The deceased was pinned between the tractor and framework of the disc draw bar.

(Table 9, continued)

Type of Farm	Area	Occupation	Age	Date of Death	No. of dependents	Injury	Cause of Injury
General	Grandview	Farm Laborer	46	5/31/73	5	Crushed Head	Deceased was operating an Allis-Chalmers One-Ninety tractor, pulling a hay baler. For undetermined reasons, the deceased fell from the tractor. The left rear wheel of the tractor passed over the deceased's head.
General	Mabton	Farm Laborer	17	6/14/73	0	Electrocution	Deceased was changing sprinkler pipe in a pasture. For undetermined reasons, upended one 23 foot length of pipe. The pipe contacted an overhead power line and the lateral pipe just laid. The overhead lines carried 7200V to the ground.
Dairy & Row Crop Farm	Othello	Farm Laborer	18	6/28/73	0	Multiple	Deceased was driving a jeep, pulling a trailer loaded with 40 foot sprinkler pipe on a washboard gravel road. Trailer jack-knifed, caused the jeep to veer off the road and roll over. The deceased was pinned beneath the jeep.
General	Prosser	Farm Laborer	21	7/24/73	2	Drowning	Deceased was operating a rubber-tired tractor, discing between rows of grape vines. Apparently did not throttle down to make a turn to the next row, causing the tractor to go over a waste water ditch bank, overturn and pin the deceased under the tractor in the ditch.
General Row Crop	Moses Lake	Farm Laborer	28	7/30/73 (accident occurred on 7/26/73)	4	Internal	Deceased was driving a tractor on the road from one ranch to another. Deceased was distracted momentarily and the tractor pulled to the side of the road, crashed head-on into a bridge abutment. Impact threw him against the steering wheel and gear shift, causing internal injuries.

(Table 9, continued)

Type of Farm	Area	Occupation	Age	Date of Death	No. of dependents	Injury	Cause of Injury
General	Prosser	Farm Laborer	24	10/14/73	0	Crushed	Deceased was driving a truck along a roadway. At an intersection, another truck ran a stop sign and collided with claimant's vehicle. Both vehicles overturned, deceased was pinned in the wreckage.
Grain and Livestock Ranch	Thorton	Ranch Worker	69	11/21/73	1	Head Injuries	During a snowstorm with 6"-8" of snow on ground, deceased was passenger in a jeep. When driver missed a left turn into a driveway, he backed across 2 lanes of freeway. A loaded log truck struck the jeep, throwing claimant from vehicle.

Source: State of Washington, Dept. of Labor and Industries, Workmen's Compensation Claims.

TABLE 10

Disabling[1] Work Injury Rate and Work Death Rate by Industry Group, United States, 1972

Industry Group	Workers (000)	Disabling Work Injury Rate /1,000	Work Death Rate Per 100,000
Total	82,300	29	17
Mining, Quarrying	600	67	117
Construction	4,000	65	70
Agriculture	3,600	56	61
Transportation, Public Utilities	4,700	43	36
Manufacturing	19,200	28	9
Government	13,400	25	13
Service	18,100	23	10
Trade	18,700	23	7

[1]Disabling beyond day of accident

Note: Agriculture is the THIRD most hazardous industry in the United States. The disabling work injury rate per 100 agricultural workers is nearly twice that for all industries; the work injury death rate is three and a half times that of all injuries.

There are no comparable data for Washington.

Source: National Safety Council, Accident Facts, 1973, Chicago, Illinois 60611.

91ST CONGRESS } SENATE { REPORT
1st Session } { No. 91-83

THE MIGRATORY FARM LABOR PROBLEM IN THE UNITED STATES

FEBRUARY 19, 1969.—Ordered to be printed

Mr. WILLIAMS of New Jersey, from the Committee on Labor and Public Welfare, submitted the following

REPORT

together with

INDIVIDUAL VIEWS

BACKGROUND FACTS

CHARACTERISTICS OF MIGRATORY FARMWORKERS

The need for large-scale migration of farmworkers has come to characterize the American agricultural scene. Every year farmworkers and their families numbering more than 1 million leave their home counties to fill the continuing and fluctuating seasonal demand for farm labor that is so vitally important in our society.[1]

Migratory workers performed over 9 percent of this Nation's seasonal farmwork in 1968, working in significant numbers in 900 counties in 46 States. For the most part, migratory farmworkers are employed for the harvest of fresh fruits and vegetables, but they also do preharvest work, such as thinning and weeding. Most migratory workers are employed in agricultural areas requiring large numbers of hired workers for brief periods when the local supply of workers is not sufficient to meet peak seasonal demands. Although most crops can be grown with the use of a relatively small labor force most of the season, they may require large numbers of workers during the harvest period. Many of these crops, especially in our Western States, are grown under irrigation in sparsely populated areas where very little local labor is available. The seasonal fluctuation in demand has been intensified by mechanization and crop specialization.

frequently made about the "laziness" of farmhands. On the contrary, most of these people display an initiative and desire for work in striking contrast to their poor brethren in cities, many of whom are unemployed and on relief, some of whom are unable to work, and some eventually uninterested in looking for any possibility of work. Migrant farmworkers, almost by definition, show a remarkable capacity and desire to travel far and wide in search of work.

But the issue is psychological, too—or rather, in the broadest sense, terribly human. As a physician and psychiatrist who has been working with migrant workers and observing them and studying them for 6 years now, I can only repeat once again, and much more emphatically, what I first said in 1965 in a paper addressed to medical colleagues, then adapted for more general publication. Put briefly, migrants go to make up a nation within a nation. Not only are they poor, and weak, and isolated, and ignored, and afflicted with all sorts of severe medical and psychiatric problems, but in addition they are wanderers, who are cut off even from what Oscar Lewis calls "the culture of poverty." In other words, they cannot even take a rural shack or ghetto tenement for granted. They fall under no one's jurisdiction. They move along our rural backroads, out of everyone's sight and mind—until an accident of one kind or another makes their presence "news." They are rootless, and for that reason sadder and more desperate than the sharecroppers I've studied or the mountain people of Appalachia. Everything is at once strange to them and familiar. In the words of one migrant: "We go everywhere and we don't belong nowhere."

It is rather obvious that migrants live demeaned, undignified and impoverished lives, as do many poor people in our rural areas or our cities. I would emphasize here that they are also very much different from any other group of American citizens, because they lack a place of residence—with all that goes with membership in a community—and ironically, they give up that rather ultimate possession in order to seek out and find work. It is rather incredible that such stubborn jobseekers have to go to such lengths for a dollar, and indeed are willing to do so. I believe they would work even harder if they didn't have to travel; and I believe their ranks would be filled by many others, who want to work but cannot—some have tried for a while—survive "life on the road." The man who used that expression added something that makes the best summary possible of my findings: "Life on the road is no life. You're near dead, moving here and there." Still, he persists. I am not so sure that his Government—with respect to its actions in behalf of him and others like him—can match his persistance.

In sum, many migrants seem to have constructed a split in their personalities which results in two distinct personality styles. With their children and husbands or wives they will often be warm, open, and smiling. At work, with strangers, and often with one another while traveling or even walking the streets, they are guarded, suspicious, shrewdly silent, or sullenly calculating in what they do have to say; and sometimes clearly apathetic, humorless or even bitter, resentful, and touchy. Such alterations in mood and attitude appeared to me as grim and striking examples of the capacity of the human mind to respond to its environment and keep itself intact by developing a high order of ability to divide itself severely and categorically.

The constant movement, the threat of social chaos, the cramped living and traveling, make for common problems and remarkably similar responses to them which separate to some extent migrant behavior from that of the rest of the poor. Migrant farmers once were mostly poor farmers. They still are poor and they still are farmers, but they are also migrants. As such, there is a specific social and cultural condition to their lives, and a specific psychological stress and challenge too. If poor people have their own culture grounded in the life and laws of the slum or the rural village, migrants do not share in it, though they may of course carry some of it with them in what they do possess, a life of mobility that calls forth its own variation of habits and practices, surely more resembling the way poor people than middle-class people live, but different from both.

What is the psychological effect of living the migrant life in a land where others seem well able to live a more settled and comfortable one? There is a tendency to feel not only weak and hard pressed but responsible for that fate.

Particularly unfortunate is such self-accusation when, in point of fact, these migrant families are willing to move about so far and wide, working so hard. Many poor are now called "unemployables," and many others rely upon welfare payments to keep them from hunger until jobs are more plentiful. Migrant farmers try to work, often go far to work. What psychological insistence makes them travel to work, rather than to a city to go on relief, cannot be described by any one generalization. The explanation rests in a combination of such factors as fear of the city, a genuine attachment to the land, a sometime enjoyment of movement, a depression that sets in for many of them when they do stop traveling and working, and a fear of that depression.

In a way, the issue is social and economic, not psychological: the American farmhands I have studied and observed are motivated toward work, want to work, and will work. Other workers may well be preferred by farmowners, but psychiatric observations do not support many of the claims

for their own children; they have settled into the curious combination of industry and initiative (needed to keep moving over such distances, to keep working at such back-breaking work) and lethargy and despair (reflected in their faces, their gestures, their way of slow movement, flattened speech, infrequent merrymaking). "We keeps going," said the father of one of the ten families, "but it ain't a good time like we once thought."

At this point migrants often develop a variety of "symptoms" or ways of thinking and feeling which indicate their response to the cumulative stresses of their kind of existence. They may drink heavily before or after work, using the cheap wine and beer they can afford to dull their senses in the face of, or in the wake of, their long hours of harvesting. They may become nasty and violent with one another, just as when children they were allowed to be toward neighbors. They often become careless and hurtful toward the homes furnished them by farmers, destroying screen doors, stopping up the central plumbing facilities of a camp. Some may call such behavior "accidental"; but many farmers are correct in sensing the barely submerged hostility and resentment at work in these people.

The migrants don't specifically "intend" to damage property, but are aware of feeling overworked and underpaid, and carry those feelings around with them fairly constantly.

Again and again one hears that migrants are unreliable, unkempt, lacking in thrift and tidiness. Worse, they tend to be willfully destructive of property, heavy drinkers, quarrelsome with one another, and generally a discouraging and depressing lot, unresponsive to aid, sullen before advice, ill-suited even for more money or better working and living conditions. And their employers make a sound case, not only for this, but for their own precarious position in our economy.

Such assertions and complaints lodged by many intelligent growers and hardworking officials in the fields of migrant health and education are hard to dispute. It is very trying for a dietician to work with a family daily surrounded by citrus fruits yet unwilling to serve them to their children. Potato chips, cokes, perhaps canned and stewed corn, fried fat: "yes" for these. Fresh fruit and vegetables, the very harvest of their hands, are ignored or rejected. Migrants often are suspicious when mobile units come almost to their very door offering nearby free medical diagnosis and treatment. Many migrant families don't want their children to go to school, don't care whether they receive their "shots," and don't, certainly, pay attention to the amenities of property care or civil behavior with one another, to the value of moderation in alcoholic intake, sexual indulgence, and child bearing, to the conventions of marriage and divorce, or to the refinements of budgeted expenditures for sensible, and hopefully useful, "permanent" possessions.

certain soundness of mind, self-confidence and self-esteem in one set of circumstances, in company with a rigid, anxious, fearful way of engaging with another set of circumstances. Thus, there is little to no childhood schizophrenia in migrant children, very few of the temper tantrums and bed-wetting complaints commonly seen in middle-class child guidance clinics. There are few if any specific "learning problems," again so frequently seen in those clinics, because the entire culture of the migrants has a "learning problem" built into its whole way of life, work taking precedence over residence, let alone schooling, and parents, basically tired and illiterate, having no capacity to stimulate a taste for education in their young.

On the whole, these children at 5 or 6 seem cheerful, spontaneous, affectionate to one another, and relaxed, in spite of their frequently poor physical health and the comparatively hard life they and their parents must live. There are positive forces at work in their family life that give them initial psychological strength to face the world.

Bit by bit over time this initial stamina faces challenges and threats. Physical health deteriorates: the first sight of some of the teeth, squinting eyes, infected skin, and bent backs of "young" migrants in their twenties confirms that fact. The tight-knit, isolated protection that migrant living offers children yields to the demand that the child, in his early teens establish his own livelihood, marriage, and capacity to "keep going" (literally as well as metaphorically).

At 10 to 12 the children start becoming adults physiologically; many of them have already been working for several seasons. It is not long before they are marrying and having children. Brides of 14 and 15 are common, and their husbands are likely to be the same age or not very much older.

Migrant children become migrant adults with no ceremony, or time to be not quite either, so as to consolidate the one before taking up the other. There are two elements that mark the beginning of adulthood in the migrant, and, when both are fulfilled, he or she is an adult and so treated by parents, brothers and sisters, and neighbors. These are experienced in working the fields and the onset of puberty.

Married and parents, workers and housekeepers, young migrant men and women (at 16 or 18, for example) have their "platter parties" when they can join record machine with a source of electricity. On their way to work at 6 in the morning they can be seen literally dancing in the streets or pathways, often with a beer or two before they get on the buses which take them to the fields.

Finally, I noticed a gradual change in mood or spirit in youthful migrants. At 20, at 22, they are full-fledged adults; we would call them "older" migrants. They have lost much of their interest in the possibilities of another kind of life; they often move about by themselves, no longer attached to their families, and little interested in seeing and visiting them even when near them or migrating with them; they are caring

someday for a word or a few days with the rest of the family far away. Phones are not customary, and mail is rare indeed. There may be church services brought to them by ministers themselves migrant in order to reach them. There may be "platter parties," records played in a cabin to hard dancing and soft and hard drink. Television is not rare, bringing all of America into the lives of those who look at it and, because watched by neighbors, a kind of rallying instrument. More accurately, television sets come and go, purchased by some for small downpayments, often quickly taken away when payments are not forthcoming.

And so there is no comparing the unstable, disorganized social life of migrants with that of the large majority of Americans. They are separated from us by their hand-to-mouth existence, their migratory habits which deprive them from intimacy with any solid residential condition and, in the case of the majority of them, Negroes or Puerto Ricans or Mexicans, by their racial handicaps in our country.

On the basis of my observations I would first emphasize the isolation that specially characterizes migrant farm life.

The extreme poverty, the cultural deprivation and social fragmentation, in sum the uprootedness which characterizes their lives, falls not suddenly upon them (as it does upon the observer who tries to comprehend their manner of survival) but is a constant fact of life from birth to death, summoning, therefore, a whole style of life, a full range of adaptive maneuvers.

In order to adapt to such unusual facts of environment, migrants turn their isolated, mobile life inward, becoming guarded and suspicious toward outsiders but, in compensation for a rootless life, exceptionally close-knit with their young children. They tend to be unusually warm and stimulating with their infants, and rather lax about disciplining them. They so treat them that there appears to be significantly less hostility among the children; in contrast, hostility and suspicion are channeled toward other families as well as the world in general, which is seen as unfriendly and punitive. Families thus become separated from families, even within the migrant culture, so that the price for cohesion within the family is isolation and alienation from others.

Moreover, migrant children progressively learn a sense of their own weakness and inadequacy in comparison with the rest of the population, whose existence they comprehend and see from the distance of the traveler or television viewer. Their drawings and their play in games as well as their words indicate that they see themselves as smaller, less able to make decisions affecting their own lives and, for some reason not clearly understood by them, stained, crippled, or paralyzed. For that matter, migrant children do not have the cultural accompaniment to physiological adolescence that we call "youth." They go directly into adulthood, with its work, marriage, and parenthood, in their early teens.

What we see in migrant children, to some extent as a result of this, is a preservation over the generations of a

No report on the problems of the migrant farmworker is complete without consideration of the total forces at work; psychological, anthropological, sociological, as well as historical which have developed a social system with its own culture and frame of mind.

Dr. Robert Coles, a psychiatrist at Harvard University, has been engaged in a study of what he describes as "the migrant subculture," and here follows excerpts from his findings: [8]

> In a very real sense the migrant farmers form a "subculture" in this Nation. They live apart from the rest of us in a number of ways. By definition they are on the move, regularly or irregularly living each year in several States and in the process usually managing to lose the many advantages of a permanent residence in any one of them.
>
> To view the more formally psychiatric disorders seen in migrants, we must see much of their behavior, as with all of us, as an attempt to adapt to (cope with) the particular kind of life which is theirs. There is little sense in taking middle-class social and cultural standards and transposing them to migrant families as measurements of their "normal" or "abnormal" behavior. While it is true that migrants share an American citizenship with us all, their living conditions and habits have a quality all their own.
>
> This said, we can, however, take notice of the breakdown of adjustment in these people, and try to indicate when it seems to happen and why.
>
> They come and they soon leave. They not only do this but they know they do, and they feel the implications of their behavior, the facts of their arrival, work, and departure in isolation from the life of the various communities whose fields they infiltrate and work. Whether they travel in caravans of trucks and buses, as many do, or by their own cars, they ignore most of the roadside stopping places as they move along from State to State. They have their own places to eat and sleep, to stop and obtain service for themselves and their cars; there are a few stations, or there are simply fields along the highways. Migrants know their "place," they know the houses to seek out when they arrive in a county, the stores which are theirs, offering their kind of food for their kind of cooking, and if you haven't lived in their homes and tasted the food, seen it being prepared and eaten, it is hard with words alone to do justice to the grease and starch, the common lack of utensils, the consequent vitamin deficiencies suffered by people whose diet ignores food picked by their very hands and rich as is possible in vitamins.
>
> Most of the activities which Americans of different classes and regions call upon for their leisure time are not typically chosen by migrants. They usually have no neighborhood churches or movie houses. They join no social clubs and take no countryside trips or picnics. Their children do not go to Scout meetings nor do they launch charity drives or attend book club meetings. Family visits are a matter of seeing the part of the family also on the road and hoping

TABLE 7.—ESTIMATED MAN-MONTHS[1] OF FOREIGN AGRICULTURAL LABOR BY STATE AND CROP, UNITED STATES AND SELECTED STATES,[2] 1968, AND CHANGE FROM 1967

State and crop	Thousands of man-months of foreign-worker employment[1]	
	1968	Change from 1967
United States	40.6	−17.2
Sugarcane	35.0	−4.8
Tomatoes	0	−6.4
Apples	4.3	+.1
Potatoes	1.3	−1.6
Citrus fruits	0	−3.7
Other crops	0	−.7
Florida (total)	35.0	−8.4
Sugarcane	35.0	−4.8
Citrus fruits	0	−3.7
California (total)	0	−7.1
Tomatoes	0	−6.4
Other crops	0	−.7
Maine (total)	.7	−2.6
Potatoes	1.3	−1.6
Apples	.3	−.1
Virginia-West Virginia (apples)	1.3	−.3
New York (apples)	1.4	+.1
New Hampshire (apples)	.4	+.1
Massachusetts (apples)	.5	+.2
Vermont (apples)	.2	0
Rhode Island (apples and potatoes)	(3)	−.1
Connecticut (apples)	.2	+.1

[1] Based on in-season farm labor reports for the middle and end of each month.
[2] States which used foreign workers in 1968 and/or 1967.
[3] Less than 50 man-months.

Note: Due to rounding, figures may not add to totals.

Source: U.S. Department of Labor, Bureau of Employment Security.

THE MIGRANT SUBCULTURE

The preceding sections of this report present statistical data on the background, the number, and some general characteristics of migrants. The causes of migration, the migrants' work routes and area of residence, certain household characteristics, and the fruits and vegetables that they harvest are discussed. In subsequent sections, legislative accomplishments and continuing needs are outlined, along with a discussion of those areas where basic legislation is needed; and in a concluding section, an overview and possible plan for ending the necessity for the migrant way of life as we know it today, is presented.

The above-described summary of this report, however, tells only part of a story, for political, economic, social, and cultural facts affect the lives of migrants, influencing the way they act, their view of themselves in relationship to others around them, and the assumptions they make about the world. And, such facts become psychological forces that help shape the thinking of children, the behavior of parents, and the experiences of both. These environmental forces determine the way migrants grow and develop, and these "external" facts become translated into internal ones, of fantasy, dream, action, and personality development.

In the month of the survey, three-quarters of a million people were living in households headed by migratory workers, an average of four persons per household. Approximately 300,000 children under 14 years of age were included, an average of 1.7 children per household. Generally, Mexican-American migrants from the Southwest averaged larger families than Negro migrants who worked along the east coast. One authority [6] reported an average household size of 6.5 persons for migratory households in southern Texas in 1957 and 2.8 persons for Negro migratory households in Florida in 1955.

One-fourth of all migratory workers were members of families with cash incomes of less than $2,000 in 1965, and the median income of households headed by migratory workers was $2,735 in 1965. Annual family incomes of less than $3,000 were characteristic of nearly three-fifths of household heads and wives who did farm wage-work on the road.[7]

Foreign Workers.—In 1968, less than 15,000 foreign workers, all from the British West Indies and Canada, were admitted to the United States for seasonal work in agriculture. Most of them were British West Indians who worked in the planting and harvesting of sugarcane in Florida and harvesting of apples in Connecticut, Massachusetts, New Hampshire, Vermont, New York, Virginia, and West Virginia. The Canadians harvested apples in Maine, Massachusetts, New Hampshire, Rhode Island, Vermont, and New York, and potatoes in Maine and Rhode Island. Of significance is the fact that, for the first time since World War II, not a single Mexican national was admitted to the country for the purpose of performing seasonal work in U.S. agriculture.

The numbers represent a significant change from 1964, the last year of the bracero program, when approximately 200,000 foreign workers (including 178,000 Mexican nationals) were admitted. While the situation of the domestic farmworker, and the migrant in particular, has improved sharply as a result of this, a continuing problem arises from the fact: (1) that many Mexican nationals who have been admitted as permanent immigrants retain their residence in Mexico while working in the United States; and (2) there has been a sharp increase in illegal entries. Approximately 40,000 of these individuals commute daily across the border to jobs in adjacent areas in the United States, with 16,000 (40 percent) working in agriculture. Some undeterminable number have extended periods of employment in the United States and frequently travel long distances from the border. They do, however, return to their permanent homes in Mexico. The implications of this are discussed in detail in the section on Green Card Commuters beginning on page 61.

TABLE 6.—ESTIMATED EMPLOYMENT OF SEASONAL HIRED AGRICULTURAL WORKERS BY ACTIVITY OF WORKER, UNITED STATES, JANUARY-DECEMBER 1969

[Thousands of workers]

Crop activity	Employment											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec. [1]
All activities	256.6	271.8	288.4	374.1	611.2	930.5	976.8	1,007.9	814.4	696.6	391.9	295.9
General	42.8	52.9	64.9	127.1	158.3	74.7	72.0	52.4	83.5	64.7	47.7	38.1
Cultivating	67.3	65.8	69.1	71.5	174.3	271.2	255.3	125.2	53.3	50.5	41.4	45.5
Cotton	3.4	6.4	10.3	10.3	45.9	87.1	66.8	23.3	7.8	.9	.2	.7
Fruits	49.9	43.9	29.2	33.8	57.9	39.0	26.1	19.1	15.2	12.9	19.9	34.8
Other crops	14.0	15.5	29.6	27.4	70.5	145.1	162.4	76.8	30.3	36.7	21.3	10.0
Harvesting	111.7	110.2	105.2	116.4	206.6	493.1	564.1	731.0	586.7	494.0	244.5	171.4
Cotton	4.7	.5				.5	.3	19.8	35.2	74.7	64.8	42.9
Vegetables	49.2	53.2	56.6	68.7	97.2	154.2	145.1	276.5	221.7	156.9	76.3	53.6
Beans	3.1	3.3	3.7	4.3	4.0	25.9	12.4	75.9	16.9	9.5	4.1	4.1
Tomatoes	11.3	11.2	11.1	8.6	9.1	17.2	19.0	66.3	83.6	24.1	6.6	12.7
Potatoes	.8	1.9	1.3	1.1	3.5	10.8	10.5	12.6	31.4	52.5	10.5	.4
Other vegetables	34.0	36.8	40.5	54.7	80.6	100.3	103.2	121.7	89.8	70.8	55.1	36.4
Fruits	33.6	33.0	25.9	29.8	80.6	220.3	183.3	137.0	131.8	118.5	31.2	23.5
Citrus	31.1	31.2	23.4	19.2	23.0	16.7	10.6	4.8	4.2	5.3	18.1	21.4
Strawberries	1.6	1.0	1.6	9.1	47.8	117.6	13.4	2.5	1.6	.5	1.3	.3
Other fruits	.9	.8	.9	1.5	9.8	86.0	159.3	129.7	126.0	112.7	11.8	1.8
Tobacco	1.9	3.2	1.0	.4	5.1	21.1	130.9	195.3	160.8	47.2	12.6	3.9
Hay and grain	.3	.6	.3	2.8	11.6	83.1	77.8	77.5	68.7	52.3	23.4	7.3
Other crops	22.0	19.7	21.4	14.7	12.1	18.9	26.7	25.9	28.5	44.4	36.2	40.2
Activity unspecified	34.8	42.9	49.2	59.1	72.0	86.5	85.4	99.3	90.9	87.4	58.3	40.5

[1] Preliminary data.

Note: Due to rounding, figures may not add to totals.

Source: Bureau of Employment Security, in-season farm labor reports for the 15th of each month.

Of the 276,000 persons who did migratory farmwork in 1967, nearly 30 percent were heads of households in December 1967.

Besides household heads and wives, migratory workers included persons under 18 years of age who were living with their families at the time of the survey. Some of these young persons may have traveled and worked alone during the year; others migrated and worked with their families. This group, mostly boys, comprised one-fourth of all migratory workers.

The remaining fourth of the migrant workers were adults living in households in which they were neither the head nor the wife of the head.

Household size was determined only for migratory workers who were heads of households. The data refer to all persons living in a household in December 1965 when the survey was taken. Since most of the migratory workers had returned to home base by December, the information on household size does not necessarily give the number of persons who traveled with the head during the year.

TABLE 5.—ESTIMATED EMPLOYMENT OF MIGRATORY AGRICULTURAL WORKERS, BY STATE AND MONTH, 48 STATES, JANUARY-DECEMBER 1968

(Thousands of workers)

State	Migrant-worker employment											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.[1]
U.S. total	35.9	38.5	40.7	59.8	115.2	203.9	208.3	235.6	202.3	134.9	48.1	44.9
Alabama	0	0	0	0	0.4	1.7	1.2	0.8	0.2	0.1	0.3	0.1
Arkansas	0	0	0	0	1.5	0	.1	0	.3	0	0	0
Arizona	3.1	3.0	3.5	4.2	2.5	2.7	1.5	.9	1.2	2.4	3.6	4.2
California	11.2	12.2	14.0	20.2	37.9	38.3	35.5	51.5	62.5	38.7	14.6	12.7
Colorado	0	0	0	.6	2.2	7.8	6.9	5.8	4.7	3.1	.3	0
Connecticut	.2	.2	.1	1.1	1.7	1.7	5.7	5.1	2.0	1.4	.6	.2
Delaware	0	0	0	0	1.8	1.9	1.6	2.0	1.1	.5	0	0
Florida	20.2	21.5	19.2	19.0	18.7	7.3	1.8	.5	.9	5.0	12.0	18.6
Georgia	0	0	0	0	.5	0	.1	0	0	0	0	0
Idaho	0	0	.2	1.0	3.7	6.4	5.5	3.9	3.6	3.0	1.0	0
Illinois	0	0	0	0	2.0	3.9	2.1	3.4	4.0	.7	0	0
Indiana	0	0	0	0	1.7	2.4	2.9	5.0	9.0	.6	0	0
Iowa	0	0	0	0	0	.4	.4	.6	.5	.3	.1	0
Kansas	0	0	0	.6	2.0	3.3	2.7	1.3	1.7	1.7	.7	0
Kentucky	0	0	0	0	.6	.2	.2	.2	0	.1	0	0
Louisiana	0	0	0	.8	.7	0	0	0	.4	.4	.4	.2
Maine	0	0	0	0	0	0	0	0	.4	.1	0	0
Maryland	0	0	0	.4	.7	.8	2.3	2.6	1.5	.8	0	0
Massachusetts	0	0	0	0	.8	1.0	2.2	2.9	1.8	.6	.2	(2)
Michigan	0	0	0	.7	3.7	23.2	27.3	40.0	13.6	10.3	.6	0
Minnesota	0	0	0	0	.3	6.3	6.1	.2	.2	.4	(2)	0
Mississippi	0	0	0	0	0	0	0	0	0	0	0	0
Missouri	0	0	0	0	0	0	.1	0	.2	.1	0	0
Montana	.1	.3	.7	1.4	1.5	5.4	5.8	6.4	4.0	2.3	1.1	.4
Nebraska	0	0	0	0	0	3.5	3.8	.4	.1	.1	0	0
Nevada	0	0	0	0	0	0	0	0	0	0	0	0
New Hampshire	0	0	0	0	0	0	.1	.1	.2	.2	0	0
New Jersey	0	0	0	1.3	6.5	9.8	10.6	12.1	9.6	5.5	.2	.1
New Mexico	0	0	0	0	.5	1.1	.8	.7	.9	.5	.4	.1
New York	0	0	0	0	2.1	4.0	7.0	9.3	14.8	13.1	0	0
North Carolina	0	.2	.1	.1	2.3	2.8	8.7	8.3	4.7	3.4	1.8	0
North Dakota	0	0	0	1.4	2.2	4.1	4.6	5.6	5.8	5.1	0	0
Ohio	0	0	0	0	2.6	5.1	7.5	13.6	18.5	2.5	0	0
Oklahoma	.1	.1	.1	.3	1.0	13.0	2.3	1.7	2.4	1.4	1.2	.7
Oregon	.1	.4	.6	1.3	3.3	12.1	7.9	13.3	5.9	3.7	.1	.1
Pennsylvania	0	0	0	0	.5	.8	1.7	3.6	5.9	4.9	1.4	0
Rhode Island	0	0	0	0	0	0	0	.1	.1	0	0	0
South Carolina	0	0	0	0	0	4.1	1.9	2.0	.6	0	.1	0
Tennessee	0	0	0	0	.4	.1	(2)	(2)	(2)	.1	0	0
Texas	.1	(2)	.2	1.3	2.2	10.0	19.8	14.7	6.4	6.2	6.1	7.5
Utah	0	0	0	0	.3	1.5	2.7	.8	1.5	1.2	0	0
Vermont	0	0	0	0	0	0	0	(2)	.1	.1	0	0
Virginia	0	0	0	0	.8	1.1	4.4	3.3	2.8	3.2	.5	0
Washington	.2	.8	1.9	4.0	6.6	12.5	7.8	5.8	7.9	9.8	.7	0
West Virginia	0	0	0	0	0	0	.1	.3	.5	.7	.3	0
Wisconsin	0	0	0	0	.6	.8	2.4	6.9	1.1	.6	0	0
Wyoming	0	0	0	0	.5	2.9	2.3	.1	0	0	0	0

[1]Preliminary data.
[2]Less than 50 workers.

Note: Due to rounding, figures may not add to totals.
Source: U.S. Department of Labor, Bureau of Employment Security.

Among the harvests in which migratory workers participated most actively were tomatoes, beans, lettuce, grapes, cherries, strawberries, peaches, plums, apricots, melons, and tobacco.

A decline of 40,700 man-months of migratory labor between 1967 and 1968 was associated primarily with a reduction in overall labor requirements. In Michigan, where the biggest decrease occurred, migrants, as well as local workers, were affected by the decrease in vegetable production and increase in cherry harvest mechanization. Another contributory cause was the fact that, in 1967, growers had created extra jobs for migrants who arrived in Michigan too early in order to hold them for later crops. In 1968, the influx of migrants was more nearly in line with labor demand.

New York needed fewer itinerant workers as cherry and vegetable production was smaller. Also, a housing shortage limited the use of nonresident labor. Both Oregon and Washington experience a cutback in most of their major fruit crops.

Contrary to the general trend, a few States made greater use of out-of-area workers. In California, migrants as well as local workers benefited from expanded fruit and vegetable production. In September 1967, many local school systems had delayed their opening dates to enable local youths to finish the summer fruit harvests. In September 1968, schools started on schedule and growers relied more heavily on migratory labor.

Supply factors dominated the uptrend in migrant-worker employment in Florida and Texas. Growers in the Lake Okeechobee area of Florida were unable to recruit as many local workers in the spring of 1968 as they had in the spring of 1967. Therefore, they needed more supplementary help from outside the area. Similarly, fewer local workers were available in the High Rolling Plains area of Texas during the spring. (Table 6.)

Household Characteristics.—A characteristic of migratory farmworkers is that they often travel as family groups with several members of a family working together in the fields. Although there are no statistics showing the worker's relationship to persons he may have been living with while on the road, some indication of the household makeup is gained from surveys of migrants taken in winter when migrants return to home base.

TABLE 4.—ESTIMATED MAN-MONTHS OF MIGRATORY LABOR, BY STATE, UNITED STATES, 1968, AND CHANGE FROM 1967

State	Thousands of man-months of migratory worker employment [1]	
	1968	Change from 1967
United States	1,368.9	−40.9
California	349.4	+36.9
Florida	144.7	+15.2
Michigan	119.4	−17.4
Texas	74.4	+2.4
Washington	58.2	−10.9
New Jersey	55.7	−1.9
New York	50.3	−11.8
Ohio	49.9	−2.2
Oregon	48.7	−8.7
Other States	418.2	−43.5

[1] Based on midmonth employment. The 1968 figures include preliminary data for the month of December.

Note: Due to rounding, figures may not add to totals.

Source: U.S. Department of Labor, Bureau of Employment Security.

In December 1965, 40 percent of the migratory workers were living in the geographic region extending from Texas east to the Atlantic Ocean and north through Maryland and Delaware. The remaining workers were about equally distributed in the northern and western regions of the United States. This geographic distribution represents a change from that prevailing only 4 years earlier when a larger proportion (60 percent) of the migrant workers lived in the South.

In contrast to the migratory worker, the person who did hired farmwork without temporarily changing his place of residence was more likely to live in the South and less likely to live in the West.

Migrants Active in Fruits and Vegetables.—Migratory farmworkers were active in every month of 1968 with employment levels of less than 40,000 in the winter, rising to a peak of 235,000 in August. Nearly 70 percent of the total 1,368,800 man-months of migratory-worker employment in 1968 was concentrated in the nine States shown in Table 4.

During the winter and early spring, employment of migrants was confined largely to southern areas where the cultivation of cotton, sugar beets, fruits, and vegetables was in progress and early fruits and vegetables were being harvested. In May and June, when fruit harvesting was beginning further north, migrants moved up the Atlantic and Pacific coasts and fanned out from the South Central States. After moving from place to place to harvest a succession of summer fruit and vegetable crops, they headed home in the fall—sometimes stopping to gather fall fruits and vegetables on the way.

TABLE 3.—MOBILITY RATES OF MALE WAGE AND SALARY WORKERS, MARCH 1966-MARCH 1967

[Persons 14 years old and over. In percent]

Wage and salary workers	All movers	Within-county movers	Intercounty movers (migrants)				
			Total	Within a State	Between States		
					Total	Contiguous	Non-contiguous
Total	20.1	13.0	7.0	3.6	3.5	1.3	2.2
White collar	20.4	11.8	8.6	4.1	4.5	1.8	2.7
Manual	20.0	13.8	6.2	3.2	3.0	1.1	1.9
Service	17.9	13.3	4.6	2.4	2.2	.6	1.6
Farm	24.9	16.0	9.0	6.1	2.9	1.3	1.6

Source: U.S. Bureau of the Census, series P-20, No. 171, "Mobility of the Population of the United States, March 1966-March 1967."

Higher rates of mobility and migration stem, to a large extent, from characteristics of the hired-farmworker occupation. Among these are a: (1) seasonality of employment with associated nonfarm-to-farm and farm-to-farm moves. About 74 percent of the hired farmwork force lived in nonfarm places in December 1967, a month of low farmwork activities. Yet many of these workers have moved from a nonfarm place to a farm for a period of employment and have returned to a nonfarm place, but not necessarily to the same house or even the same city or town; (2) a high proportion (about 40 percent) of the workers have more than one employer in the year, involving farm-to-farm moves in many cases; and (3) probably most important, however, is the significant proportion of workers who travel about the country while engaging in and looking for farmwork. Another factor that might be mentioned is the high proportion of workers who lived in rented or rent-free houses, from which moves can be made with relative ease.

Despite their travel, about two-fifths of both interstate and intrastate migrants did nonfarmwork during the year in addition to their farmwork.

Migratory Work Routes and Area of Residence.—Migratory farmworkers varied considerably in work routes followed, distances traveled, travel with children, work outside the home State, earnings, and other ways.

Although some migratory farmwork was done in almost every State, half of the total man-months of migratory worker employment in 1967 occurred in five States: California, Florida, Michigan, Texas, and Washington. (Table 4.) (See appendix A for the estimated population by State and county of migrant workers and family dependents.)

nearly the same proportion they comprised of the total work force (17 percent).

The migratory farm wage force of 1967 was predominantly male in all age groups. Only one-fourth of the migrants were female. Participation by women varied by age and was greatest for those between the ages of 25 to 54. Nearly half of all female migratory workers were in this age group (46.5 percent). Among workers aged 14 through 17, boys outnumbered girls three to one.

The large number of Spanish-speaking Americans performing migratory farmwork in the central and western areas of the United States, together with the English-speaking white migrants from the South, make the migratory work force predominantly white. The nonmigrant farmwork force is also predominantly white, but it contains a slightly larger proportion of nonwhites. Although nearly three-fourths of the nonwhite migratory workers lived in the South in 1967, they comprised only about a third of the migratory workers living in the South. Of the migrants whose permanent homes were elsewhere in the United States, less than 8 percent were nonwhite.

Mexican-American migrant farmworkers appear to stand out among all migrants because of their distinct cultural identity, regional concentration, notably poor living conditions, and the recent emergence of organizing efforts that have drawn the spotlight of national attention. Although the 3.5 million Americans with Spanish surnames constitute a relatively small proportion of the total population, they made up 12 percent of the State population in Arizona, California, Colorado, New Mexico, and Texas. Approximately 1.4 million Mexican-Americans live in California, and another 1.4 in Texas. Forty-six percent of the rural Mexican-Americans are employed as farm laborers, a large proportion of whom are migratory farmworkers. In 1960, 103,000 of the 261,000 Mexican-American farmworkers (about 40 percent) did some migrant farm wage work. Twenty-five percent of the 409,000 migrant farmworkers in 1960 were Mexican-Americans; they were 7 percent of over 3 million nonmigratory farmworkers.[5]

Causes of Migration.—Migratory workers travel because of economic necessity. For some workers, the amount of farmwork available locally is limited; for others, migratory work is a way of obtaining higher wages. The latter is particularly true for farmworkers along the southern border of the United States, where wage rates are depressed by competing Mexican labor.

According to the latest report on mobility of the population published by the Bureau of the Census, male-hired farmworkers have the highest mobility rate of all civilian male wage and salary workers in major occupational groups. (Table 3.) About 25 percent of male wage and salary farmworkers lived in a different house in March 1966 than the house they lived in a year earlier. This percentage compares with mobility rates of around 20 for male wage and salary workers in white collar, manual, and service jobs. Also, the migration rate (based on workers who lived in a different county from that lived in a year earlier) was higher for hired farmworkers than for other major civilian occupational categories.

TABLE 1.—ESTIMATED EMPLOYMENT OF SEASONAL HIRED AGRICULTURAL WORKERS, BY TYPE OF WORKER, UNITED STATES, JANUARY-DECEMBER 1968

[Thousands of workers]

Type of worker	Employment											
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.[1]
All types	256.6	271.8	288.4	377.1	611.2	930.5	976.8	1,007.9	814.4	696.6	388.9	295.9
Total domestic	247.9	264.4	282.1	374.1	611.2	930.5	976.8	1,007.9	812.7	692.8	384.5	287.4
Local	212.5	225.9	241.4	314.3	496.0	725.6	768.5	772.3	610.3	557.8	336.7	242.5
Migrant	35.3	38.5	40.7	59.8	115.2	203.9	208.3	235.6	202.3	134.9	48.0	44.9
Intrastate	16.0	17.6	20.1	26.0	42.1	54.6	62.6	65.9	60.6	46.5	24.8	27.3
Interstate	19.3	20.9	20.7	33.8	73.1	149.3	145.8	169.7	141.7	88.4	23.1	17.6
Total foreign	8.6	7.3	5.0	0	0	0	0	0	1.7	3.8	4.4	8.5
British West Indian	8.6	7.3	5.0	0	0	0	0	0	1.3	2.7	4.4	8.5
Canadian	0	0	0	0	0	0	0	0	.4	1.1	0	0

[1] Preliminary data.

Note: Due to rounding, figures may not add to totals.

Source: U.S. Department of Labor, Bureau of Employment Security, in-season farm labor reports for the 15th of each month.

During the years since the end of World War II, the number of domestic migratory workers remained relatively stable, fluctuating around 400,000 until 1967. (Table 2.)

TABLE 2.—FARM WAGE WORK: NUMBER OF PERSONS EMPLOYED FOR ANY PERIOD DURING SPECIFIC YEARS, BY MIGRATORY AND NONMIGRATORY STATUS, SELECTED YEARS, 1949-67

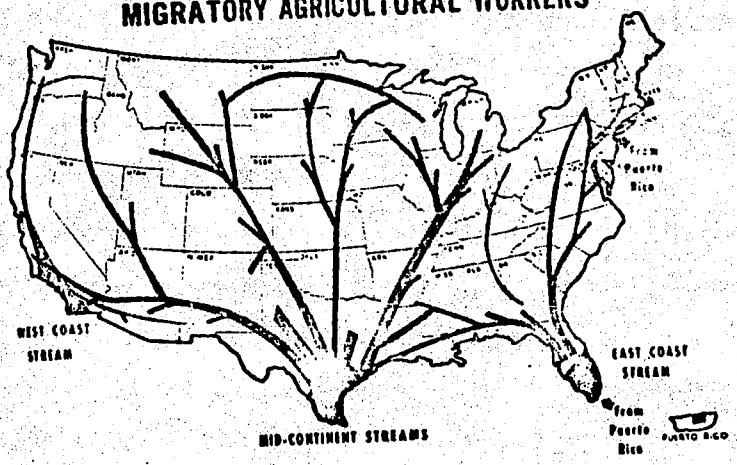
[In thousands]

Year	Domestic farmworkers		
	Total	Migratory	Nonmigratory
1967	3,078	276	2,802
1966	2,763	351	2,412
1965	3,128	466	2,662
1964	3,370	386	2,984
1963	3,597	386	3,212
1962	3,622	380	3,242
1961	3,488	395	3,094
1960	3,693	409	3,284
1959	3,577	477	3,100
1957	3,962	427	3,535
1956	3,575	427	3,149
1954	3,009	365	2,644
1952	2,980	352	2,628
1949	4,140	422	3,718

Source: U.S. Department of Agriculture, September 1968.

Migratory workers differ little in age and sex from other hired farmworkers. They are a young work force; in 1967 half were under 25 years of age. A fourth were teenagers 14 through 17 years old. This is in contrast with the Nation's total work force, in which persons under 25 years of age accounted for only one-fifth of the 16- and 17-year group for a mere 3 percent of the total. Only 38,000 people past the age of 54 continued doing farm wage work. Persons in this age group accounted for only 14 percent of all migratory workers in 1967,

TRAVEL PATTERNS OF SEASONAL MIGRATORY AGRICULTURAL WORKERS



an area in which more desirable jobs drain away the labor. Workers may be housed, fed, transported, and worked in gangs with a minimum of thought given to their comfort.[3]

A crop guide gives a good indication of what is expected of the migrant worker on the job: [4]

> **Beans:** The picker must have the judgment to pick the mature beans and leave the younger beans for later picking. Crawling, crouching, stooping, walking, and kneeling are the physical demands.
>
> **Tomatoes:** The picker * * * works in a stooping position.
>
> **Potatoes:** The potato digger * * * must exercise care not to leave potatoes in the rows. Works in a kneeling position and progresses along the rows by crawling * * *. A good worker should pick from 75 to 150 field crates (60 pounds each) per day.

Number and Characteristics.—Of the 3.1 million persons who during 1967 did farmwork for wages at any time, 276,000, or 9 percent, left their home county to do such work. These migratory workers were a small proportion of the total farm wage force in the United States, but they were a large proportion of the hired farmworkers employed on labor-intensive crops in areas were local labor was not available in the quantity demanded. (Table 1.)

Despite their vital role in modern agriculture, particularly in filling the crucial needs at harvest time, our migrant citizens have been grossly neglected by society. More often than not, in addition to especially low living standards, the influx of migrants to supplement the local labor force creates problems in the areas of health, education, sanitation, and housing which the community is not equipped to meet.

The statistics throughout this report indicating the low wages, unemployment, lack of education, poor housing, malnutrition, disease, and lack of adequate medical and dental care tell only part of the story of the shocking degree of impoverishment of the migrant. Migrant workers and their families have been expressly excluded, or at best only minimally included, in all conventional citizen worker benefits enacted by Federal and State law such as unemployment insurance, workmen's compensation coverage, social security insurance, general welfare assistance, minimum wage standards, child labor protections, and coverage under the National Labor Relations Act.

Travel Patterns.—The distinguishing characteristic of the migrant farm laborer is the practice of leaving his home county to work in areas beyond a normal range of daily commuting. The day haul worker, on the other hand, is one who commutes, usually from a large metropolitan area, to a nearby farming area, and is able to return to a place of permanent residence each day. Under either case, the migrant's year "is like a string of beads—a week of employment here, another there, uncertainty tied together with travel in search of work".[2]

The bulk of the domestic migratory workers travel in three major routes northward from States along the southern border of the country. (See map below.) The main stream flows north and west from Texas, beginning in the spring and covering most of the North Central, Mountain, and Pacific Coast States before the season ends around December. The crops involved are fruits and vegetables, sugar beets, and cotton. Many of the workers in this migratory stream are Americans of Mexican descent traveling with their families.

A smaller stream draws workers from Florida and other Southeastern States for the Florida citrus and winter vegetable harvest. The migrants then work northward during the spring and summer through the Atlantic Coast States, sometimes as far north as New England. Negroes constitute a large proportion of the east coast stream.

Workers following a third major migratory route start in southern California and work northward through the Pacific Coast States. A large number of Mexican-Americans work along this route.

The migrant's job is unattractive. Farmwork may require continual stooping or lifting, be dirty and exhausting, or be monotonous and boring. It may call for continuous effort under conditions of extreme heat or cold. The work may be in an isolated area away from town, and away from the customary paths of migrant and casual labor, or in

Suggested Readings (Taking an Occupational and Social History: A Case Study of a Migrant Worker)

Terkel, Studs, Working, New York, Avon, 1975.

Lecture 3

SIX CASE STUDIES

OF

OCCUPATIONAL DISEASE DUE TO CHEMICAL AGENTS

OBJECTIVES

1. To present six occupational disease occurrences and demonstrate the manner in which people are affected by exposure to environmental chemicals.

2. To discuss with the students following each of the six some of the implications that they see regarding the specific agent of disease of problems they see in controlling the hazard.

Lecture 3: Six Case Studies of Occupational Disease Due to Chemical Agents

Materials Description

Student Materials: Handout - Six Case Studies

Teaching Materials: Appendix C:

- Slides 146-150 (arsenic)
- Slides 46-51 (mercury)
- Slides 16-25 (crab asthma)
- Slides 40-45 (cadmium)
- Slides 1,122-130 (lead)
- Slides 108-113 (asbestos)

Other slide material that could also be used:

- Slides 168-180 (byssinosis)
- Slides 2-7 (pneumoconioses)
- Slides 181-218 (dermatoses)
- Slides 137-145 (styrene)

Instructor's Guide and Reference Materials

Appendix B:

Slide text and Suggested Readings for slides listed in Teaching Materials (Note: Slides contained in Appendix C)

Appendix A:

Supplementary Pamphlets and Quizzes

The Reference Materials (Suggested Readings) for the following slides are not included in Appendix B. They will be submitted at a later date.

Slides 146-150	(arsenic)
Slides 168-180	(byssinosis)
Slides 181-218	(dermatoses)
Slides 137-145	(styrene)

Case #1 -- The Price of Gold

School teacher reported to County P.H. Nurse
many students with skin problems; started
in October and got worse during November
and December
Gold Mine and Smelter Community
Sulfur oxide and high arsenic particulate
Inversion and fumigation
School survey -- 16 of 31 affected
Plant survey -- 12 of 54 affected
Community survey -- 20 of 45 affected

Implications: Arsenic trioxide was a marker.
Arsenic and lung cancer.
Sulfur oxide on upper respiratory tract.
Smog health effects -- Smelter or industrial communities, urban centers, and rural agricultural areas.

Case #2 -- Quicksilver Shakes

State Inspector saw a workman having difficulty drinking cup of coffee.
Cinnebar mill and mercury vapors.
Plant survey: Spectrum of acute and chronic signs and symptoms
Urine tests for protein and mercury
Community survey: Tracking it home
Theft of ore

Implications: Other mines. Dentists
Organic mercury and methylation.
Minamata.

Case #3 -- King Crab Asthma

Cold Storage Company employee went to a local physician with coughing and breathing difficulty.
Plant survey: Symptoms and spirometry.
Skin testing -- transfer.

Implications: Physician's recognition of environmental disease -- the occupational history as a tool.
Asthmatics as a hypersusceptible group for air pollution effects.
New technology and resulting health risk evaluations -- toxic substances legislation.

Case #4 -- Pathologist as a Casefinder

Diagnosis of pneumonia -- Chest symptoms and X-ray.
Autopsy -- alveolar cells, bronchiolar metaplasia, and interstitial collagen changes.
Exposure: Silver soldering task; cadmium.

Implications: Chronic cadmium disease and other acute cases
Consumer Product Safety Commission
Itai-Itai disease in Japan
Possible relationship to hypertension and heart disease.

Case #5 -- Where is the exposure?

Newspaper publisher.
Plumbism -- Symptoms, blood lead, Ventilation, Ingestion, skin absorption?

Implications: Idaho survey of print shops -- subtle effects on motor performance.
OSHA inspector -- "acute abdomen" in a lead burner.
Pb-based paints and pica -- sensitivity of children.
Mexican pottery glazing -- lemonade as a leeching agent.
Lead additives to gasoline -- community air pollution risk?
Prophylaxis and Intravenous chelation as a diagnostic tool.

Case #6 -- Insulation Sprayer's Dyspnea

Mixing asbestos and rock wool insulation and spraying walls and ceilings.

Clinical course: X-ray
Pulmonary function
Pathology

Implications: Lung cancer, etc.
Smoking interactions.
Other dust diseases.
Asbestos in urban air -- brake linings, building remodeling, etc.
Asbestos in water -- Duluth drinking water.
Shipyards during World War II.

Lecture 4

CASE STUDY OF WORK INJURIES

ARISING FROM POORLY PLANNED PHYSICAL ENVIRONMENT

OBJECTIVES

1. To familiarize the students with biomechanics using a videotape. To discuss a checklist of items regarding the work environment.

2. To present three other occurrences where workers were affected by unsafe environments or poor work practices.

3. To discuss the implications of each occurrence.

Lecture 4: Case Study of Work Injuries Arising From Poorly Planned Physical Environment

Materials Description

Student Materials

Handout - Four Case Studies

Teaching Materials

Videotape "A Case Study of an Assembly Line"

Slides 9-15 (noise)

Slides 34-39 (heat)

Other slide material that could also be used:

Slides 120-121 (pesticides)

Slides 28-33 (polyester)

Slides 135-136 (carbon monoxide)

Slides 165-167 (accidents)

Instructor's Guide and Reference Materials

Script to Videotape "A Case Study of an Assembly Line"

Discussion Topic

Suggested Readings

Appendix B:

Slides text and Suggested Readings for slides listed in Teaching Materials
(Note: Slides contained in Appendix C)

Appendix A:

Supplementary Pamphlets and Quizzes

The Reference Materials (Suggested Readings) for the following slides are not included in Appendix B. They will be submitted at a later date.

Slides 135-136 (carbon monoxide)

STUDENT HANDOUT

Case #1 -- Tendonitis on the Assembly Line

Recycling of telephones.
34 cases of tendonitis and ? accidents related to the work place deficiencies.
Biomechanics for repetitive motion.

Implications: Job enrichment.
Women who work.
Work classification for placement of the cardiac.

Case #2 -- The Deaf Planer Operator

Audiometry and the clinical workup.
Exposure to noise.
Disability evaluation.

Implications: Hearing conservation in industry.
Socio-acousis and our way of life.
Non-auditory effects of noise.
Vibration effects.

Case #3 -- A Drunk Employee from the Hospital Laundry?

Presenting symptoms and signs of heat exhaustion.
Recommendations to reduce the heat stress.

Implications: Mortality during heat waves.
Alcoholism and diabetes in industry.
Hospital environmental health and safety.

Case #4 -- The De-climatized Potroom Worker

Emergency room diagnosis and immediate treatment.
Radiant heat load from molten bath.

Implications: Mechanisms of acclimatization.
Employment of the older worker.
Hypothermia as a medical modality.

Instructor's Guide:

Script to Videotape "A Case Study of an Assembly Line"

A Case Study of an Assembly Line

With the beginning of the Industrial Revolution, man moved from the farm to the factory. Here, large numbers of employees came into contact with new and complicated machines as manufacturing and other industries flourished. This man-machine interface gave birth to the new science of ergonomics...the designing of equipment, tools, displays, controls, and other machine components, in a manner compatible with human anatomy and physiology. Very rarely has a machine system been designed or automated such that major interaction by the worker is not required. The worker's interaction with the machine must be such that it does not lead to physical injury or mental disturbance.

In order to design work so that man is protected from the machine, one must not only understand the human body, but appreciate the environment's impact upon the body. These environmental factors include thermal, auditory, tactile, olfactory, and visual stimuli, as well as psycho-social elements including work team organization, problem-solving work intervention, employee-supervisor training, and work shift planning.

At the turn of the century, American industry became remarkably productive, and ideas such as the assembly line played a key role in our position in the international marketplace. In a repair or assembly operation, the product travels from one work station to another where groups of machines, equipment and workers perform various tasks until the product is assembled or repaired. Biomechanics plays a key role here. The work at each station in an assembly line should be balanced to achieve an even flow from station to station and should be designed with consideration for the biomechanical attributes of the worker.

This means that physical size, limits of movement, muscle strength, natural functioning of limbs and joints, response time of the nervous system, and a variety of other physiological functions should be considered. Work places should be tailored to the individual worker and certain medical selection factors should be used to assure that the work functions are within the capability of those assigned to specific stations.

Biomechanics, therefore, deals with work design, individual work environments and the medical requirements for individual workers. Both the biomechanics and the organizational components must be considered to insure a successful assembly line of productive and satisfied workers. When these elements have not been integrated, job dissatisfaction, labor unrest, high turnover, absenteeism, lowered morale, and a wide variety of medical problems can occur.

One of the most common classes of problems arising from assembly line production tasks is orthopedic problems from repeated motion, unnatural movements, straining activities, and excessive work of certain muscle groups. If sound biomechanics is not adhered to, an employer can expect work complaints of painful joints and muscle aches. These may be symptomatic of chronic conditions such as tendonitis, tenosynovitis, arthritis and bursitis.

(Introduction)

This case study involves an assembly process with six stations, each with one worker. Over a period of a year, many employees were assigned to work in one of three such assembly lines. Although there were 18 employees at any one time, during the course of the past year approximately 50 different individuals worked at least one day at one or more of these stations. Of these 50 at this particular plant, 34 at various times had been restricted from routine assignment by the plant physician on the basis of an orthopedic problem.

The association of these medical problems with activities on the assembly line was at first not recognized. But as a greater number of employees reported to the medical department, it became more evident that a biomechanical problem in the assembly process was leading to tendonitis and other related orthopedic problems of the elbow, wrist, and shoulder regions.

Concurrently, there was a heavy turnover, a high absence rate, a number of morale problems, and a low production rate, compared to similar facilities.

When the impact of the problem was finally realized, a study was begun of each of the work positions along the conveyor belt, medical records were reviewed, and employees and supervisors interviewed. This study showed how important it is for the physician treating assembly line workers to understand what the assigned tasks are, not only to better understand the possible causes of this particular musculo-skeletal condition, but also to help prevent recurrences in patients when they are reassigned to the task. The physician working in the plant has a better opportunity to do this because he can observe the processes firsthand. But even the physician in his office can, by taking a careful occupational history, contribute a great deal to his own understanding of the condition and its prevention.

It is not uncommon for biomechanical principles to be overlooked when assigning and evaluating a work environment. We will observe these workers at their stations in an attempt to understand the causes and prevention of these particular problems.

(Task Descriptions)

The first worker is responsible for dusting the telephone base, loosening screws in the base at rewiring sites and replacing the base feet with new feet. Her job is dusty and involves handling rough edges; she wears gloves.

The work area for these tasks is quite extensive. Telephones are removed from a basket at the left side of the station and placed on a counter in front of the worker where she operates the automatic brush to dust the telephone and automatic screwdriver to loosen the base screws. The worker uses a lever-operated punch to remove the rivets holding the telephone feet. She then employs a foot-operated device to attach the new feet. To the right are trays linearly arranged on a moving conveyor belt. Cleaned telephones that have passed inspection are placed right side up in the trays. Telephones that will be discarded are placed on a second conveyor belt moving in the background of the station.

Trays of cleaned telephones pass to Station 2 where the worker attaches the dial to the telephone chassis. The worker is seated and works from left to right. She begins to attach the dial on top of the chassis using a magnetic-tip screwdriver. Screws are easily placed on the tip and then positioned into the appropriate holes.

The worker must tip the chassis in order to reach certain attachment points for the dial. At the conclusion of this task she operates the dial to test the attachment. She does not wear gloves even though she reaches into a container for sharp-edged metal pieces.

After the dial has been attached, its electromechanical functioning is further inspected at Station 3. An electrical connection made to the telephone monitors the dialing activity on a visual display in front of the worker. If the display indicates the dial apparatus is not working properly, the worker makes adjustments on the underside of the unit using a screwdriver or pliers. (She also has an automatic screwdriver for dial wire attachments.)

If the dial works properly, it is passed down the conveyor belt. If it does not register correctly, a variable amount of time is required to make the proper adjustment. Meanwhile, a backlog of telephones results. Occasionally, a unit may require too much time and is rejected.

The worker wears cotton gloves as protection against continuous turning and sharp edges underneath the dial. She sits on a swivel chair with a back support up to the base of her scapula. A pillow, probably her own, cushions her back against the chair back. Not visible is a footplate on the chair.

At Station 4 the wires of the receiver and mouthpiece unit are attached to the chassis. Using screws from a container in front of her, the worker places them into various positions on the chassis; she attaches the wires, then tightens the screws.

The worker uses the hand and automatic screwdrivers. She does not wear gloves; they could easily get caught in the screwdriver and would interfere with the fingertip action the task requires.

After the mouthpiece/receiver unit is connected to the chassis, the telephone bell is tested. At times the bell hammer needs adjustment or the bells need tightening.

To test the bells' operation, the worker muffles the sound on each bell alternately and listens to check that the tone is adjustable and the two bells are synchronized. She adjusts the bell hammers by bending them with her finger or with a pair of pliers. An automatic screwdriver is available for tightening the main screws on either side of the bell(s). Occasionally the worker finds it necessary to make adjustments by hitting the bell frame with a hammer.

Having passed bell inspection, the telephone is ready for the final attachment of wires. Both the final wires and the dial are attached to the base with an automatic screwdriver.

Occasionally the telephone is tipped to reach wire and dial connection points. The worker reaches in front of the work area for a piece of identification tape which is placed on the bottom of the unit. The wiring is then placed on top of the telephone. The worker does not wear gloves.

(Health Hazards)

We will now consider the health hazards of each particular operation.

The first worker incurs several extremity stresses while performing her job. Operating the lever requires considerable force. She raises the lever to approximately eye level and pushes very hard from the perpendicular to the below horizontal position while still holding the telephone.

The foot pedal for attaching the new feet is located at an elevated position requiring an excessive amount of leg raising, even though it appears to operate with nominal force.

Wrist and palm stresses are also common. The worker tightly grasps the automatic screwdriver and twists her wrist inward while pressing down. This unnatural act is stressful to the extensor tendons.

It should also be noted that the screwdriver handle is in the palm of her hand while she applies pressure, rather than on the hypothenar or thenar eminences. Pressure damage to the compressed tendons in the palm easily occurs when the wrist is twisted.

Moving on to the second worker, we see the same traumatic twisting action with the screwdriver deeply embedded in the palm of the hand. An ulnar deviation of the wrist occurs as the worker stretches her arm to reach underneath the chassis.

It should be noted that a handrest is missing on one of the two automatic tools. When properly constructed, the handrest increases the ease of applying pressure without requiring the worker to tighten her grip on the tool. This puts the pressure on the muscular eminence rather than in the palm itself.

The worker increases the probability of laceration when she uses a sharp tool in close proximity to her fingers and when she hits her left palm on rough-edged metal while positioning the pieces underneath the dial.

At the third station, the visual display is brightly lit and placed directly in front of the worker. This is an appropriate arrangement for dial testing.

This worker, as with those preceding her, incurs considerable strain on her hand tendons through improper handling of tools. It is quite evident that the pliers are embedded in her palm and her wrist undergoes ulnar deviation.

Her motions are awkward as she holds the dial pieces and simultaneously bends and turns a metal piece with the pliers. Dial adjustment is also difficult because she cannot steady herself while using the tools. She wears gloves for protection against sharp edges.

By now it is quite evident that each worker generates a great deal of palm tension with a wrist in a flexed or ulnar deviated position. Consequently, the strained tendons and muscles from the palm to the extensor origins at the elbow may become inflamed. This is part of the condition commonly seen in "tennis elbow."

Tendon injury can be compounded by stretching the thumb to reach the reverse button on the automatic screwdriver...the button is not easily reached from the normal hand position.

The fifth worker follows the precedent of her co-workers; the handle of the screwdriver is forced into her palm and she uses a great deal of strained turning action.

Not only have the workers not received training in using the tools, but their performance is impaired by environmental conditions. The work level is too high considering the amount of strength required for many tasks. There is considerable background noise which in this case interferes with the tonal quality of the bells being tested. Although not evident, the work area becomes very warm during the summer months. The resulting perspiration adds to the chance of slippage when handling tools and increases the possibility of physical injury.

It should be noted that on occasion the fifth worker does use the automatic screwdriver correctly.

Vibrating tools may lead to soft tissue damage in which the vasculature is damaged. The individual will develop painful and cold hands when exposed to the vibration or cold. Some vibrating tools also cause bond destruction.

The last worker works mostly on the back side of the telephone; this requires awkward arm positions to reach the area. She bends forward over her work which elevates her from the chair. She uses a tool to forcefully bend a wire clamp in this poorly visible area. The automatic screwdriver again is not operated properly. Excessive pressure is applied to the palm.

(Conclusion)

We must find solutions to the problems depicted in this case study. The work place studies point to a variety of biomechanical deficiencies and call for a redesign of the assembly line. A comprehensive report was submitted covering the needs in training and work practices, the

deficiencies in medical records, and the problems in medical/nursing procedures. Work began which led to resolution of the tendonitis epidemic.

Automatic and hand tools were needed to reduce the likelihood that unnatural movements or positions are used.

Biomechanical chairs and adjustable footrests were needed. Special equipment was recommended for testing the ringer using a visual display, for turning the dial, for applying the feet to the telephone bases, and so forth.

Movement of the belt and the height of the work place were both dealt with in an alternate work flow scheme of bringing work to each station. Even ways of consolidating stations, rotating workers, and establishing short rest periods were proposed so as to reduce boredom and vary muscle activity.

Discussion and training sessions involving the assembly line workers were outlined as part of a better management plan. This also entailed more supervisor education in biomechanics, tendonitis, balancing assembly tasks, video tape analysis of worker tasks, and related subject matter.

Development of a problem-oriented medical record system, physical medicine equipment and procedures, and the involvement of the plant physician and nurses in the education program were all cited as keys to the resolution of this important problem.

This case report is not unique; the problems illustrated can be found in many work places. Prevention of musculo-skeletal conditions by a good work task analysis is a basic skill that can have a dramatic payoff for the worker on the assembly line and for industry. Ergonomics is good business.

After viewing the Videotape, it would be beneficial to include a discussion session to consider questions raised and to introduce topics covered. A discussion topic suggestion follows.

Suggested Discussion Topic

A basic approach to industrial safety relates the physical attributes and capabilities of the worker to the design of his equipment and his work environment. In order to coordinate these variables, different kinds of information are needed, specifically: a job description, an understanding of the kinds of equipment to be used, a description of the people who will use the equipment, and an understanding of the biological capabilities of these people. Once this information has been compiled, it is possible to design work environments and machines to accommodate the demands made upon the worker.

What sort of questions should an occupational physician (or environmental health specialist) ask in order to evaluate the suitability of the job's demands and the worker's capabilities?

The following questions are a checklist of the kinds of issues with which an occupational physician must be concerned. They are from Ergonomics System Analysis Checklist, International Ergonomics Association, Dortmund 23-26, West Germany, September 1964. (Copies may be obtained from the American Industrial Hygiene Association Technical Committee on Ergonomics, 25711 Southfield Rd., Southfield, Mich. 48075.)

1. Is the work space sufficiently spacious?
2. Is a favorable work posture promoted by the location of instruments, work piece and controls?
3. Is sitting promoted by the location of instruments, work piece and controls?

4. Is the height of the work surface adapted to the posture, and correct in regard to viewing distance?

5. Are the properties of the work surface correct in regard to:

   -- hardness

   -- elasticity

   -- color

   -- smoothness

   etc.

6. Is correct control by hand or feet promoted by the location of instruments, work piece and controls?

   a. Does the positioning of controls demand a static component in the muscular load?

   b. Are tools and work piece located within the physiological range of movement?

   c. Are the controls located within easy reach in regard to the work posture?

   d. Are the grips correctly positioned (location, direction), in regard to required forces and movements?

   e. Does the positioning of instruments, work piece and controls correspond with sequence and frequency of the required action?

7. Is foot control by means of pedals necessary or desirable?

   a. Are the location, size and construction of the pedals correct?

   b. Have pedals been avoided in standing work and limited to two in sitting work?

   c. In standing work if the use of pedals is imperative, must the worker stand almost continuously on one and the same leg or is alternating use of left and right foot possible?

   d. Can the pedals be used while sitting, and can the feet be alternated?

   e. If the work is done in a sitting position, is a variation in posture of the rest of the body hampered by the use of one or more pedals?

f. Does the type of pedal used correspond with required force, range and rate of movement?

g. Is the counterpressure of the pedals correctly chosen?

8. Is foot control by means of push buttons necessary or desirable?

9. Is finger control by means of push buttons necessary or desirable?

10. Are the shape, size, surface and material of the hand controls correct in regard to the required forces?

11. Are the required forces acceptable?

a. Can the degree of loading be decreased by:

-- decrease of weight of the objects to handle?

-- use of counter weights?

-- use of electric, hydraulic or pneumatic devices?

-- conveyors?

-- cranes, pulleys?

b. Can the degree of loading be decreased by:

-- changing the direction of forces?

-- use of stronger muscle groups?

-- limitation of the time of muscle contraction?

c. Are jigs used as much as possible?

d. Are moving work pieces correctly conveyed and stopped (use of gravitation, conducting chutes, etc.)?

e. Is the movement and the force required for handling controls acceptable?

f. When force is required is the control located so that this can be applied without undue strain and without the need to maintain static load?

12. Are chairs and supports available to obviate unnecessary standing?

a. Is the chair or support correct in regard to:

-- dimensions of the worker?

-- upholstering?

-- back rest?

-- work height?

-- adjustability?

-- possibility of standing up?

-- variation in work posture?

b. Is a (horizontally or vertically) adjustable chair required?

c. Is the use of a one-legged stool desirable?

13. Is a foot rest necessary?

14. Is a support for elbows, forearms, hand, back necessary?

15. Is the floor of the work space correct?

16. Are hand tools used?

a. Is the weight of the tool too great, too small or correct?

b. Is the hand grip correct in dimension and shape?

c. Does the tool used for fine manual work provide sufficient contact surface with the hand?

d. Is the operational part of the tool correct in dimensions and shape?

e. Is the length of the shaft correct in regard to work posture and performance?

f. Has the shaft a correct elasticity?

g. Is the surface of the tool correct in regard to:

-- friction between hand and grip?

-- thermal conductance?

h. Have different tools been combined if possible into one tool?

i. Is the length of the tool correct in regard to fine manual work in order to avoid or diminish the effects of tremor?

j. Have the tools a planned location?

17. Are the containers used (boxes, etc.) appropriate in regard to:

    -- weight?

    -- dimensions?

    -- safety?

    -- location?

18. Can the speed of the machine be adjusted in accordance with the skill of the performer?

19. Has the variability of performance time been taken into account?

20. Does the machine construction allow for good maintenance and repair (accessibility, risk of accidents, lighting, tracing of technical troubles)?

21. Is there any risk of burns?

22. Are any parts of the body exposed to undue constant or intermittent mechanical pressure?

23. Does the work require the use of personal protection devices:

    -- clothing?

    -- shoes?

    -- gloves?

    -- eye protection?

    -- ear protection?

    -- masks?

24. Does the machine cause significant vibration?

25. Does the work imply high visual demands?

26. Does the work require a high illumination level?

27. Is general artificial illumination necessary?

28. Is local illumination necessary?

29. Does the work layout imply exposure to different illumination levels?

30. Are the visual data easy to discriminate among in regard to variable daylight, reflection, etc.?

31. Is there a great, medium, or negligible difference in brightness (contrast) between the object and its surroundings?

32. Is there any glare from the work space or surroundings?

33. Are there any special requirements in regard to color perception?

34. Are the objects to be distinguished

    -- very fine?

    -- fine?

    -- coarse?

35. Do the objects to be distinguished

    -- move at all?

    -- move slowly?

    -- move rapidly?

36. Does the location of instruments, work pieces, controls, etc., aid good vision?

37. Does the location of instruments, work pieces, controls, etc., restrict the necessity of accommodation?

38. Are the controls located in front of the worker within optimal visual range and reach?

39. Are warning lights attention-getting, and are they placed in the central part of the visual field?

40. Is it possible for the man also to see the surroundings of the work piece?

41. Is the distance adequate for vision?

42. Is binocular vision essential?

43. Are the use of optical aids required?

44. Does the work imply high auditory demands?

45. Does the task imply verbal communication?

46. Is normal verbal communication impeded by the noise level at the work space?

47. Can auditory signals easily be distinguisned from the normal noise of the work space?

48. Does the task require a reduced noise level?

49. Can auditory signals with different meaning easily be distinguished from each other?

50. Have the auditory signals the right physical qualities?

51. Does the work imply high tactile demands?

52. Can different parts, control knobs and tools easily be recognized by touch?

53. Can parts, control knobs and tools be recognized by their position?

54. Does the work imply high demands on equilibrium?

55. Does the work involve position movements or precise force application (proprioception)?

56. Does the work imply high demands on olfactory abilities?

57. Are dials/panels/displays in use?

58. Are the instruments legible?

59. Can each measuring instrument be located easily?

60. Can measuring instruments easily be distinguished from each other?

61. Does the work imply a large muscular load?

62. Are large (heavy) or small (light) muscles or muscle groups involved?

63. Does the work imply an insignificant muscular load?

64. Is the work done sitting, standing upright or walking, or is there a combination?

65. Does the work imply peak loads?

66. Are loads to be lifted and carried?

67. Is the muscular load predominantly dynamic or static?

68. Is the muscular load predominantly on:

-- arms?

-- legs?

-- neck?

-- trunk?

-- small muscles of hand, fingers?

69. Are small and/or large groups of muscles subject to static exertion induced by holding of the material or the tools?

70. Are large groups of muscles subject to static exertion induced by the work posture?

71. Is the work posture such that the muscles take the load correctly?

72. Is variation in work posture possible?

73. Does the work provide for a good alternation of work and rest and or static and dynamic elements in regard to muscular load?

74. Do secondary activities inherent in the work methods provide for changes in muscular loading?

75. Is the pattern of movement correct?

76. Does the control of movement require much muscular exertion?

77. Can undesirable displacement of center of gravity and rotation of the body be avoided?

78. Have the patterns of movement exactly been prescribed?

79. Is the relation between the direction and the effect of control movement compatible?

80. Does the work imply high demands on accuracy of movements?

81. Must the data be processed before the required action can be taken?

82. Is the use of tables (lists, etc.) required and is this efficient?

83. Must different data be compared before action can be taken?

84. Is the action to be taken rigidly prescribed or should it be improvised?

85. Must data be estimated?

86. Are standards of comparison (control norms) actually present and regularly used?

87. Are the parts to be assembled supplied in a correctly pre-adjusted way?

88. Can signals easily be confused?

89. Can accessories, objects easily be confused?

90. Can movements easily be confused?

91. Have signals always the same meaning?

92. Are the controls positioned in the sequence of task performance?

93. Can the controls easily be recognized by shape, size, labeling, color, for normal use and for emergency?

94. Are the controls located as near as possible to the corresponding sources of information?

95. Does the worker use unofficial signals?

96. Do the workers receive the necessary information (qualitative and quantitative) regarding the process flow and the output (production) with sufficient notice?

97. Is there any possibility for pauses in monitoring tasks?

98. Is the task adapted to the capacities of older workers in regard to:

    -- pacing?

    -- visual demands?

    -- short-term (transitory) memory?

99. Are the data required to carry out the task obvious, unequivocal, and to the point?

100. Are all these data necessary for performance?

101. Is the rate of information likely to exceed the mental capacity of the operator and to overload him?

102. If any of the sensory channels is likely to be overloaded, can the load be more evenly spread?

103. Is the rate of information likely to underload the operator?

104. Is the correct sense to be used in regard to the meaning of the signal (danger, alarm--ear; normal machine performance--eye; discrimination of controls, etc.--tactile sense)?

105. Is it possible that signals from different sources occur simultaneously?

106. Have signals to which preference has to be given the highest attention-getting value?

107. Do identical or similar signals occur for a long time, and are they frequently repeated?

108. Are different answers possible to one and the same signal whereas only one is the most suitable?

109. Are all the factors relevant to a decision presented at the right time and in the right sequence?

110. Is adequate time allowed in machine or process cycle for decisions and resulting action?

111. Can rapid feedback of the effects of adjustment to a system be given?

112. Are the climatic conditions within the comfort zone?

113. If climatic conditions are not within the comfort zone, is this especially due to:

-- air temperature?

-- humidity?

-- air movement?

-- radiation?

114. Is the man during his daily work exposed to rapid changes in climatic conditions?

115. Does the noise in the work environment cause inconvenience to the worker and/or does it interfere with his performance?

116. Is there any risk of hearing loss due to noise?

117. Does the work method imply the emission of other radiating energies inconvenient or harmful to the worker (UV, ionizing radiation, etc.)?

118. Does the work method imply exposure to chemical agents and/or dust?

119. Is the use of personal protective devices necessary because of the environmental load?

120. Is the work performed in shifts?

121. What are the official working times:

-- per day?

-- per week?

122. What are the official paid rest pauses?

123. What is the average overtime in house:

-- per day?

-- per week?

124. Are there definite rest pauses included in the work method itself?

125. Is the work rigidly paced?

126. To what extent can the load be decreased by modifying work layouts and job distribution?

127. Is the work physically

-- light?

-- moderately heavy?

-- very heavy?

128. Does the work cause continuous visible sweating?

129. Can a considerable rise in body temperature be expected during working hours?

130. Is there any reason to expect either short term or long term effects on well-being and health of the workers?

a. Evaluate the number and reasons of transfers and dismissals.

b. Evaluate occupational health data:

-- symptoms and signs.

-- medical transfers.

-- sick absence.

131. Is the work suitable for men, women, young workers, older workers in regard to physical and/or mental load?

132. Does a combination of physical and mental loads impede performance either by asking simultaneous action or by causing a too heavy combined stress?

133. Does an analysis of performance or production errors exist?

Suggested Readings

Murrell, K. H. F., Ergonomics: Man in his Working Environment, London, Chapman and Hall, 1971.

Olishifski, P. E., and McElroy, Frank E., eds., Fundamentals of Industrial Hygiene, Chicago, National Safety Council, 1971, Ch. 9.

Vancott, H. P., and Kinkade, R. G., Human Engineering Guide to Equipment Design, Washington, D.C., U.S. Government Printing Office, 1972.

Lecture 5

EPIDEMIOLOGY

OBJECTIVES

Option 1

1. To discuss three cases where the epidemiologic implications can be easily recognized by the students. From this discussion one can appreciate the need to bring together population data in order to better understand the clinical disease problem in the individual patient.

2. To discuss a specific morbidity study of potroom workers and thereby provide the student a general understanding of the industrial prevalence study approach.

Option 2

To discuss benzidine bladder cancer in a small work force as an example of a small retrospective and prospective cohort study. From this discussion the student should understand the basics of a longitudinal study in industry.

Option 3

To discuss a hypothetical study of smelter worker lung cancer. From this discussion the advanced student should become familiar with the methodology in mortality and morbidity studies.

Lecture 5: Epidemiology

Materials Description

Student Materials

Handout - Three Case Studies

Teaching Problems:

- Hematuria in a Factory Work Force
- A.B.C. Chemical Company 1950-1990

Teaching Materials

Appendix C:

Slides 97-98	(morbidity)
Slides 52-96	(potroom worker study)
Slides 114-116	(hematuria study)
Slides 117-119	(A.B.C. Chemical Company)

Other slide material that could also be used:

Slides 26-27	(wood industry)
Slides 168-180	(byssinosis)
Slides 131-134	(plastics industry)

Appendix F: Six Vuegraphs

Instructor's Guide and Reference Materials

Teaching Problems:

- Hematuria in a Factory Work Force
- A.B.C. Chemical Company 1950-1990

Appendix B:

Slide text and Suggested Readings for slides listed in Teaching Materials
(Note: Slides contained in Appendix C)

Appendix A:

Supplementary Pamphlets and Quizzes

The Reference Materials (Suggested Readings) for the following slides are not included in Appendix B. They will be submitted at a later date.

Slides 168-180 (byssinosis)

Slides 131-134 (plastics industry)

STUDENT HANDOUT

Case #1

32-year old Chicano county employee is brought into emergency treatment room of the central employee health service. Reported acute onset of dyspnea, chest tightness, cough, and wheezing while inspecting a polyurethane foam operation in a chemical plant. Prolonged expiratory phase, hyperresonance, musical rales, and slight cyanosis on examination, and $FEV_{1.0}$ = 85% of predicted. Diagnosis: TDI asthma. Dispensation: bronchodilators, oxygen, and work restrictions. Second admission: Same symptoms and signs following entry into a laboratory. (TDI experiment had been performed several hours prior to entry, but none was detected in an air sample.)

Dispensation: treatment and consultant evaluation.

Consultant: $FEV_{1.0}$ = 60% ⟶ 75% post-bronchodilator.
Exercise tolerance affected by smog.
Retraining in programming and computer operations.

Implications: Subclinical measurements ($FEV_{1.0}$) and diary
Epidemiologic diagnosis
Medical records as a data base

Case #2

A 54-year old white male heliarc welder and a 30-year old white male welder apprentice employed by the same small metal fabrication firm have been examined by a clinic chest physician over the past year. The presenting symptom was dyspnea in both cases. Chest X-rays on both showed a diffuse interstitial infiltration, and the FVC's showed moderate restriction (80% and 76%). Diagnosis: Interstitial Fibrosis in two welders due to chronic exposure to ozone. Dispensation: Presentation of both cases to Industrial Accident Commission. Both cases were rejected.

Implications: What is Workmen's Compensation Insurance? Industrial Accident Commission?
What is industrial hygiene? What exposures are involved in welding operations?
Employer's logs versus claims for workmen's compensation as data bases for occupational injuries and occupational diseases.

Case #3

A 34-year old aluminum pot-room worker developed a cough, phlegm, and chest constriction gradually over a period of several months beginning about six weeks after starting on the job. Prior work was as a long-haul truck driver (10 years), followed by ranch hand work (2 years), and 4 years in the Navy as a seabee after graduating from high school. No childhood respiratory disease problems; non-smoker; and no relevant exposures associated with hobbies or other job exposures. $FEV_{1.0}$ decrement 200 cc within 6 months.

Implications: What is the pot-room exposure
What are the presumed risks? CRD, Cancer, Fluorosis, Heat Stress, Heart Disease, Hearing Loss?
Susceptibles? α-antitrypsin? Aryl hydrocarbon hydroxylase?
Air pollution implications of aluminum plants.

The materials for Lecture 5 include two epidemiologic teaching problems: Hematuria in a Factory Work Force, and A.B.C. Chemical Company 1950-1990. The following are the student copies of these exercises.

Hematuria in a Factory Work Force

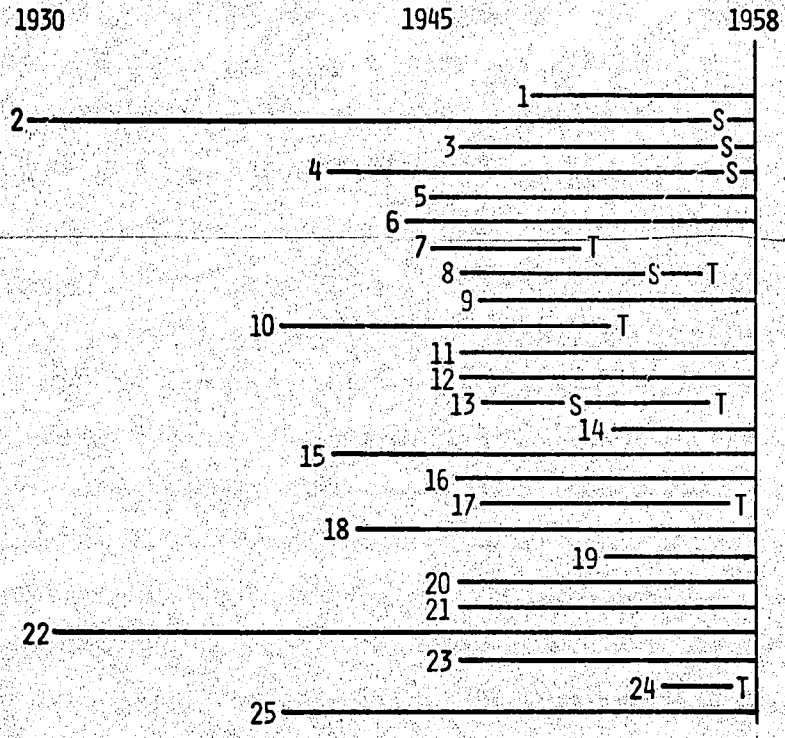
Teaching Problem

This factory began as a small plant with the first worker (No. 2) joining in 1929 and another worker (No. 22) joining a year later. It began to expand about 1940 when several more workers joined, and again right after World War II when additional workers joined. In 1950 the factory was bought by a larger company but was kept unchanged. Subsequently, however, a few of the workers (No. 7, 8, 10, 13, 17 and 24) were transferred (T in Figure 1) elsewhere within the larger company between 1951 and 1958. Because of the small size of the factory, it did not have its own medical director or plant physician. However, hematuria in one of the workers alerted the medical director in the larger company that something serious was affecting the health of the workers in this small plant. Therefore, a consultant in occupational medicine from a nearby medical school was sent out to the plant.

The first figure shows the situation as of 1958 when this consultant was called in. It can be shown that the six workers previously mentioned were working elsewhere and nothing after transfer (T) is known about them in this plant's records. However, it was known that five of the workers, including two that were later transferred, had been ill (with the illness unspecified). The plant records did not give any information other than that these men had been ill (S in Figure 1) at that time and had lost considerable work time as a result of these illnesses.

1. Do you see any indications from Figure 1 that something unusual is going on in terms of health hazards? What pathology might the hematuria indicate?

FIG. 1



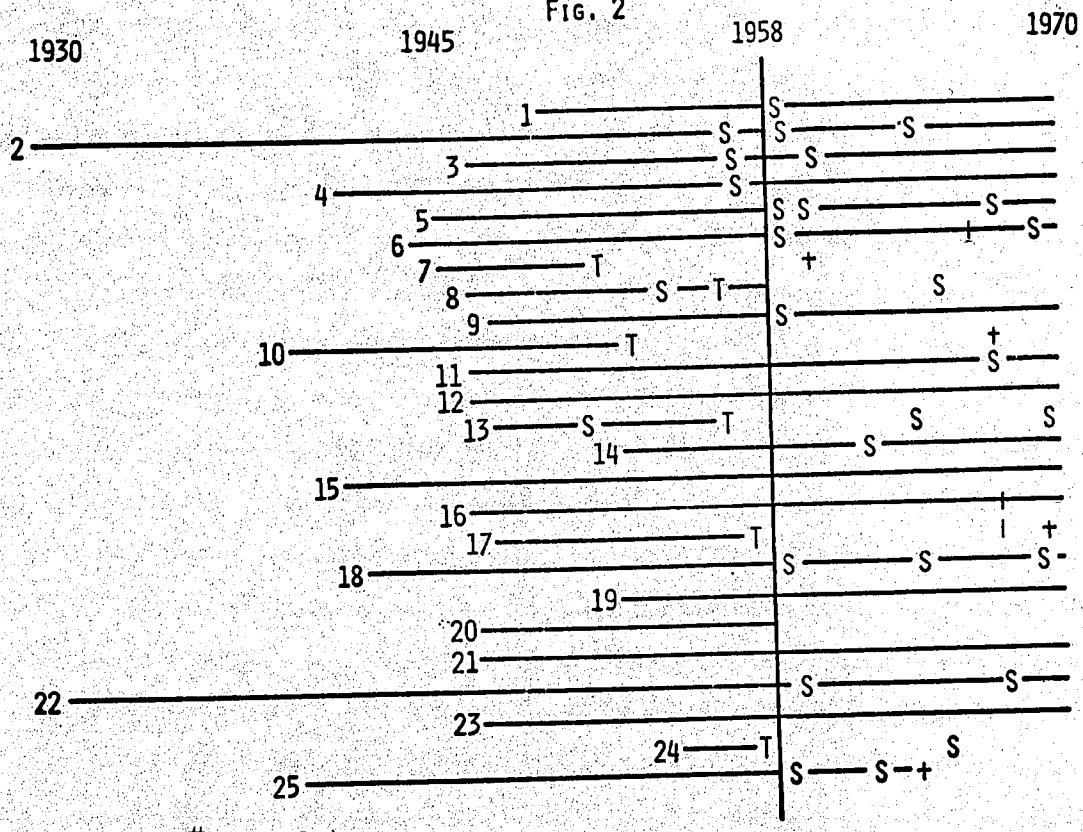
#1-25 = B
#3, 4, 7-9, 20, 22 = D
#4, 7, 22 = T
#5, 6, 7 = N

CHEMICALS IN EXPOSURE RECORD

Information on the exposure was obtained from interviewing the workers. From this, it can be seen that all 25 were exposed to Chemical B. In addition, seven of the workers (No. 3, 4, 7-9, 20 and 22) were exposed to Chemical D. Similarly, three of the workers can be shown to have been exposed to Chemical T, and three others were exposed to Chemical N. For those workers who have transferred to other plants in the same company, the company records showed where they had been transferred so that they could be tracked down for interviews, but not for examination. Workers 2,3, and 4 had hematuria. Other symptoms (in No. 8 and 13) were not related to hematuria.

2. What does this suggest to you? Is B the only important factor based on evidence to date?

FIG. 2



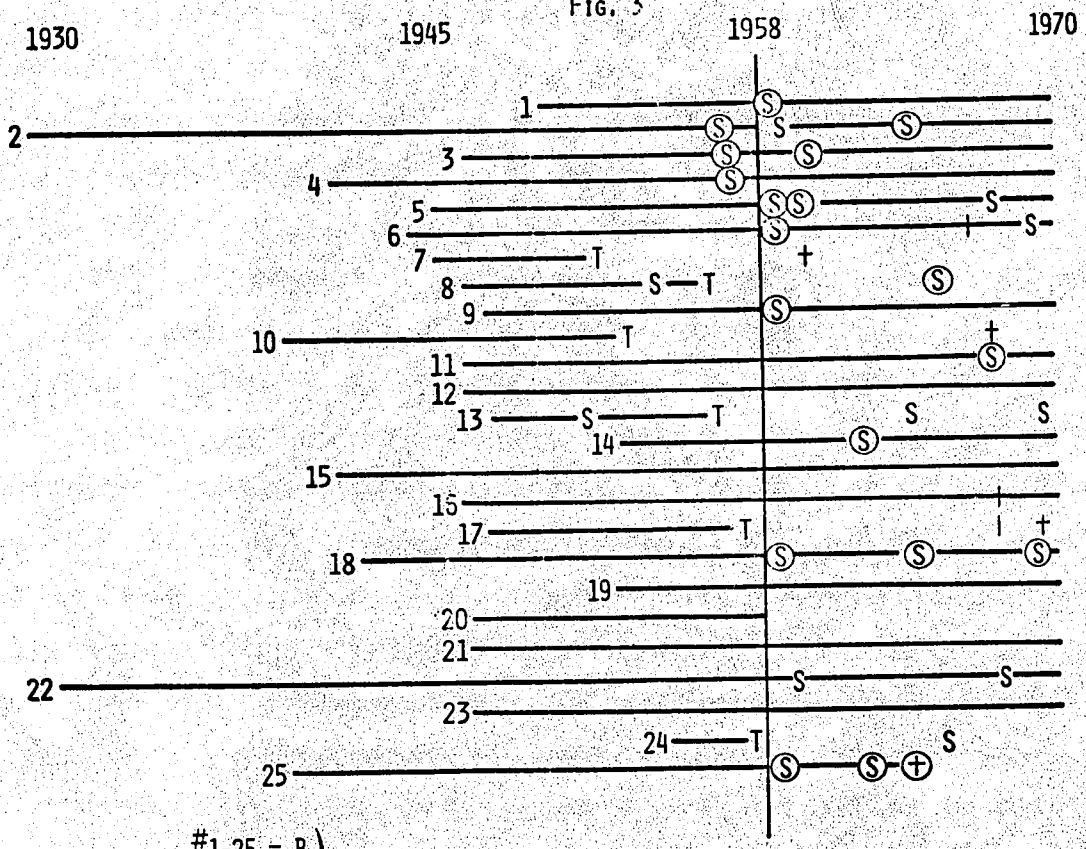
#1-25 = B
#3, 4, 7-9, 20, 22 = D
#4, 7, 22 = T
#5, 6, 7 = N

CHEMICALS IN EXPOSURE RECORD

At the same time the consultants were called in, all of these 25 workers were cystoscoped. Six (No. 1,5,6,9,18 & 25) of the 25 were found to have bladder tumors; four had cancer of the bladder and two had papilloma of the bladder. Chemicals B and N are known bladder carcinogens, based on animal studies.

The second figure shows the workers cystoscoped and followed until 1970. This was done through company records. Three of these workers (No. 6,16, & 17) had their 65th birthdays before 1970 and are listed as retiring (|) at that point. The large company had very good pension, death, and health benefits for retired people, so that the company was notified of the illness of worker No. 6 occurring after retirement. For the same reasons the company was also notified of the death of worker No. 17 which occurred after retirement. The deaths of workers No. 7, 10 and 25 occurred before age 65, so these were ascertained

FIG. 3



#1-25 = B
#3, 4, 7-9, 20, 22 = D
#4, 7, 22 = T
#5, 6, 7 = N
} CHEMICALS IN EXPOSURE RECORD

while the worker was still actively at work. Causes of death would be found from the death certificates which could be located because the residences of these workers were known, either because they were still working (No. 7, 10 and 25) or because the address of the retired worker receiving a pension was known (No. 17).

The third figure shows those conditions which were relevant (i.e., bladder tumor) to exposure to Chemical B, based upon the animal toxicology studies.

3. What is the risk of those with exposure to each of the chemicals? What about increased risk with more years of exposure?

4. Comment on the latent period.

It was essential to produce Chemical B, so safety measures were introduced. (These included change of clothing, including underwear, for working with the chemicals, adequate ventilation, special respirators, a closed system for making and transporting the dangerous chemicals within the plant, and regular physical examinations, including cystoscopy of the workers.) Therefore, it can be assumed for all practical purposes that the exposure to this chemical stopped in 1958 for all of these workers.

Data in the table on the following page are the detailed information on each worker.

FINDINGS OF ALL CHEMICAL B WORKERS COMBINED

Case No.	Year of Birth	Race	Years of Exposure: Time Span	Years of Exposure: Total	Cystoscopies: First Year	Cystoscopies: Total	Bladder or Other Tumor (Year)	Other Health Problems (Year)
1	1913	W	1949-1958	8	1958	15	CA (1958)	...
2	1906	W	1929-1958	16	1957	24	CA (1957) CA of kidney (1964)	Adenoma of colon and colectomy (1959)
3	1922	W	1946-1958	12	1957	60	CA (1957) Tumor of kidney (1960)	...
4	1916	W	1941-1958	16	1957	18	CA (1957)	...
5	1913	W	1945-1958	12	1958	14	Tumor (1958)	Tumor of nose removed (1959), severe lumbago (1967)
6	1901	W	1944-1958	14	1956	30	Tumor (1958)	Bilateral hydrocele, chronic, repaired (1969)
7	1914	W	1945-1951	6	1958	1	...	Died Oct. 8, 1960, from CHD (no autopsy)
8	1924	W	1946-1956	9	1958	15	CA (1965)	Larynx tumor removed (1954)
9	1918	W	1947-1958	11	1958	15	CA (1958)	...
10	1910	W	1939-1952	6	1958	1	...	Died from oat cell CA of lung Oct. 11, 1967 (autopsy negative for GU tumor)
11	1921	W	1946-1958	10	1958	3	CA (1967)	...
12	1918	W	1946-1958	11	1958	1	...	...
13	1915	W	1947-1956	5	1958	1	...	Severe TB (1951, 1964, 1969) Diabetes, receiving insulin injection
14	1928	W	1952-1958	6	1958	39	CA (1962)	...
15	1920	N	1941-1958	13	1958	1	...	...
16	1902	N	1946-1958	12	1958	1	...	...
17	1902	W	1947-1957	10	1958	1	...	Died Nov. 8, 1969, from pneumonia (no autopsy)
18	1911	W	1942-1958	16	1958	35	CA (1958) CA left kidney (1964) CA right kidney (1969)	...
19	1927	W	1952-1958	6	1958	1	...	...
20	1925	W	1948-1958	7	1958	1	...	...
21	1911	W	1946-1958	12	1958	1	...	...
22	1906	N	1930-1958	28	1958	32	CA (1959) Metastasis to neck (1967)	...
23	1910	N	1945-1958	13	1958	1	...	...
24	1921	W	1954-1957	3	1958	1	...	CHD since 1965
25	1905	N	1939-1958	19	1958	24	CA (1958) Metastasis to abdomen (1962)	Died Feb. 10, 1963, from abdominal metastasis

A.B.C. Chemical Company 1950-1990

Teaching Problem

The A.B.C. Chemical Company began operations in 1950. Beginning in 1970 new regulations required that employees working in such operations be under medical surveillance. The plant operations over the preceding two decades were not considered hazardous and only limited information was gathered about employee health. A.B.C. has the most experience with this type of process and the largest work force in such an operation in the U.S.; and, therefore, government researchers are anxious to learn about the health of this large plant work force in order to see if the process is as safe as the management of A.B.C. says it is. A.B.C. really hasn't studied the question but has asked you to provide them guidance on what would be good medical surveillance and to assess whether its employees have higher rates of certain diseases because of chemical exposures related to their specific process.

1. What type of information would you want to find to assess the past health risks from employment in this A.B.C. plant?

2. What type of medical surveillance should be considered assuming you felt a health hazard might be present?

FIGURE 1.

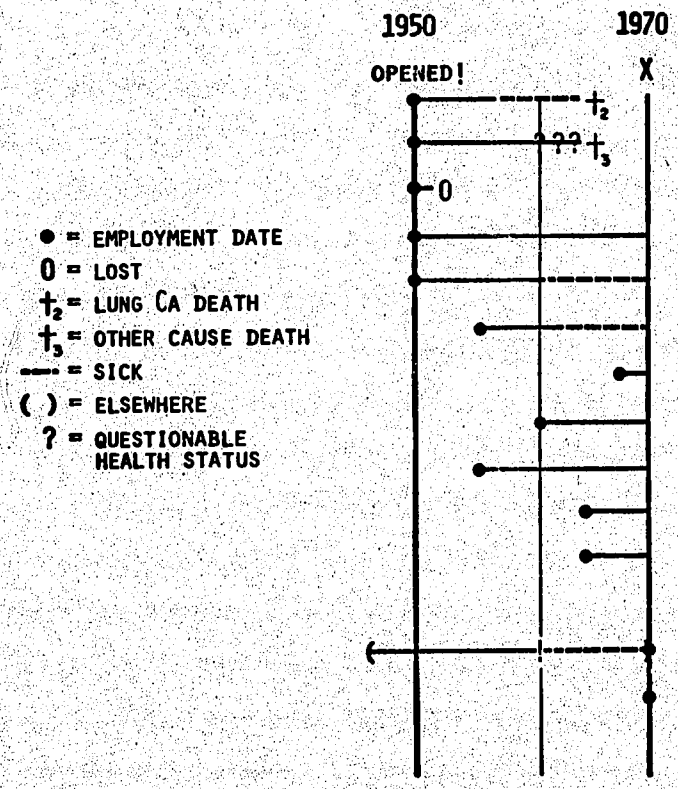
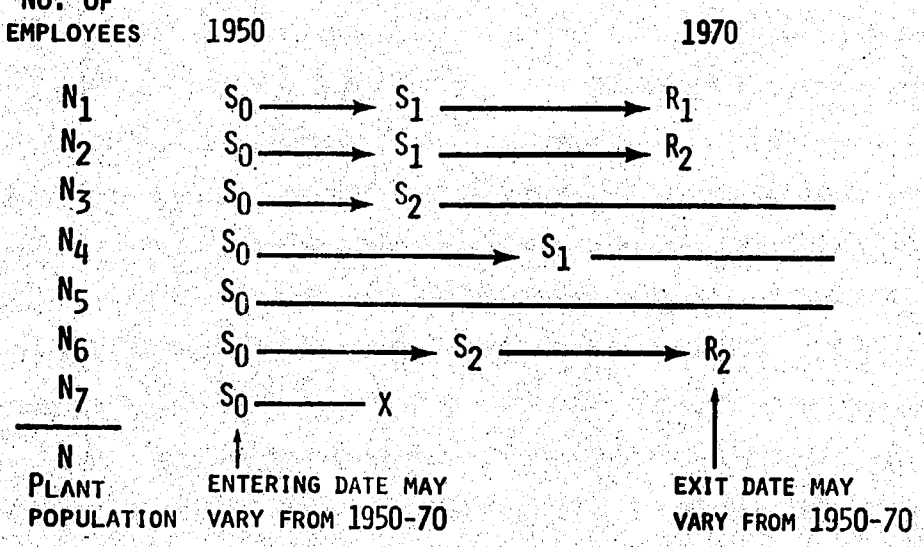


Figure 1 is a time chart for a very small, but representative, fraction of the work force at the time of examining the question in 1970. You notice some workers became sick, some left and were lost to follow-up, some died, and some apparently are healthy. One worker was employed elsewhere in similar work since 1948 and came to work for A.B.C. in 1970.

3. How can you examine morbidity and mortality in such a work force? How can one determine what would be expected for such events, and how can you determine whether an excess in morbidity or mortality has occurred?

FIGURE 2.*



S_0 = HEALTHY STATE

S_1 = DIAGNOSED LUNG CA

S_2 = DIAGNOSED "OTHER ILLNESS"

R_1 = DEATH FROM LUNG CA

R_2 = DEATH FROM "OTHER CAUSES"

X = LOST TO FOLLOW UP

*SIMPLIFYING ASSUMPTIONS:
1) ONLY ONE S PER PERSON.
2) CANNOT DIE WITHOUT THE APPROPRIATE PRECEDING DIAGNOSIS.
3) OPENING OF THE PLANT IS THE BEGINNING OF EXPOSURE.

4. How would you handle the data for those "lost-to-follow-up?"

Figure 2 is a general model for such a plant population which designates some persons as having diseases that are perhaps pertinent (because of animal toxicology studies). N_1-N_7 are the various combinations of health states occurring in this plant population from 1950-1970. More specifically, N_1 represents those persons diagnosed as having lung cancer and dying of lung cancer; N_2 represents those persons diagnosed as having lung cancer but dying of another illness. It is assumed that:

1) all persons' exposures began at the same time;
2) each person develops only one S state (S_1, lung cancer, or S_2, other illness); cases of multiple S states are not considered;
3) the cause of death has been diagnosed in all designated death cases.

Each person in this model is representative of events that could occur in many workers.

5. Explain how the model operates and how specific disease rates can be calculated.

FIGURE 3.

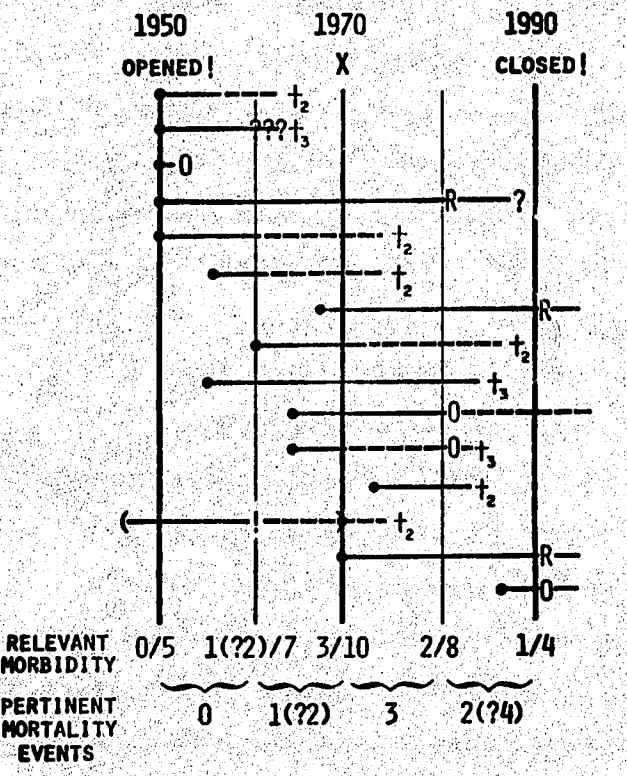


Figure 3 is a representation of the events over the next 2 decades.

6. Discuss measurements of morbidity and mortality indicated as relevant morbidity and pertinent mortality events for each decade. Comment on the overall mortality from lung cancer and whether you feel it is excessive.

The materials for Lecture 5 include two epidemiologic teaching problems: Hematuria in a Factory Work Force, and A.B.C. Chemical Company 1950-1990. The following are the Instructor's Guides to these exercises.

Hematuria in a Factory Work Force

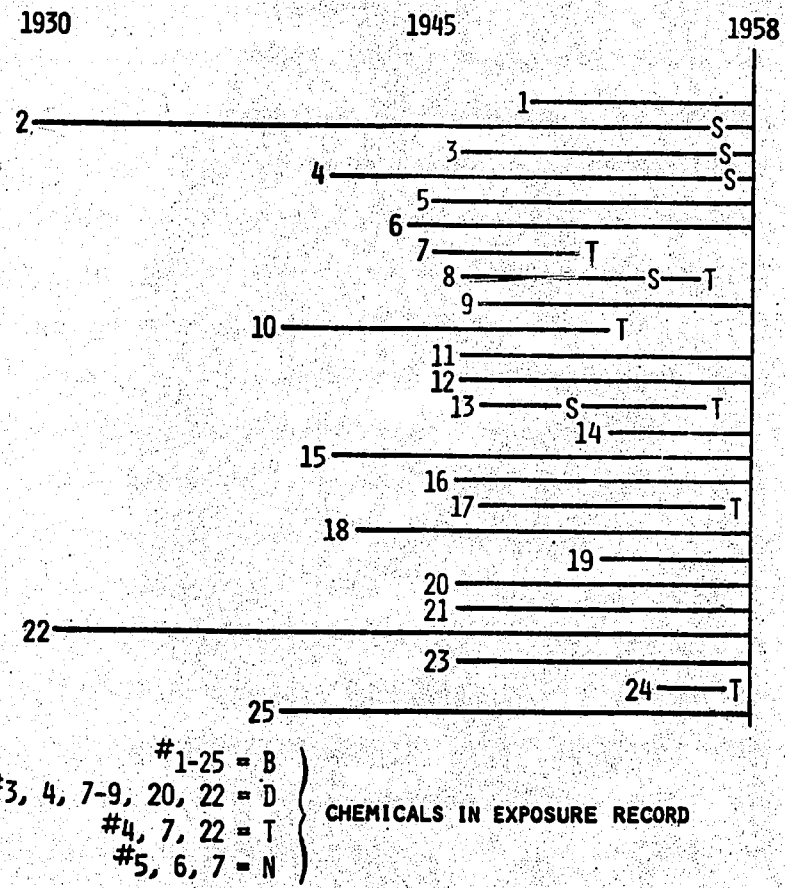
Teaching Problem

INSTRUCTOR'S GUIDE

This exercise is based on a real epidemiologic study and concerns a chemical plant manufacturing Chemical B. The factory began as a small plant with the first worker (No. 2 in Figure 1) joining in 1929 and another worker (No. 22) joining a year later. It began to expand about 1940 and again after World War II. In 1950, the factory was acquired by a larger company with a corporate medical director. A few of the workers (No. 7, 8, 10, 13, 17 and 24) were transferred (T) elsewhere within the larger company. Hematuria in one of the workers alerted the medical director that something serious was going on.

The first figure shows the situation as of 1958. Hematuria in workers 2, 3 and 4 is the key finding. Nothing after the transfer is known about the six transferred workers. However, it was known that five of the workers, including two that were later transferred, had been ill (S) with the illness unspecified. Worker 13 had his first bout of tuberculosis in 1951, and was transferred in 1957. Worker 8, who was transferred in 1956, had a benign tumor of the larnyx removed in 1954. The plant records in a plant this size would not be expected to give any information other than, perhaps, that these had been ill at that time and had lost considerable work time as a result of these illnesses. Hence, it is not surprising that that information on the exposure had to be obtained from interviewing the workers. This would be expected to be fairly reliable. From this, it can be seen that all 25 were exposed to Chemical B (Benzidine). In addition,

FIG. 1

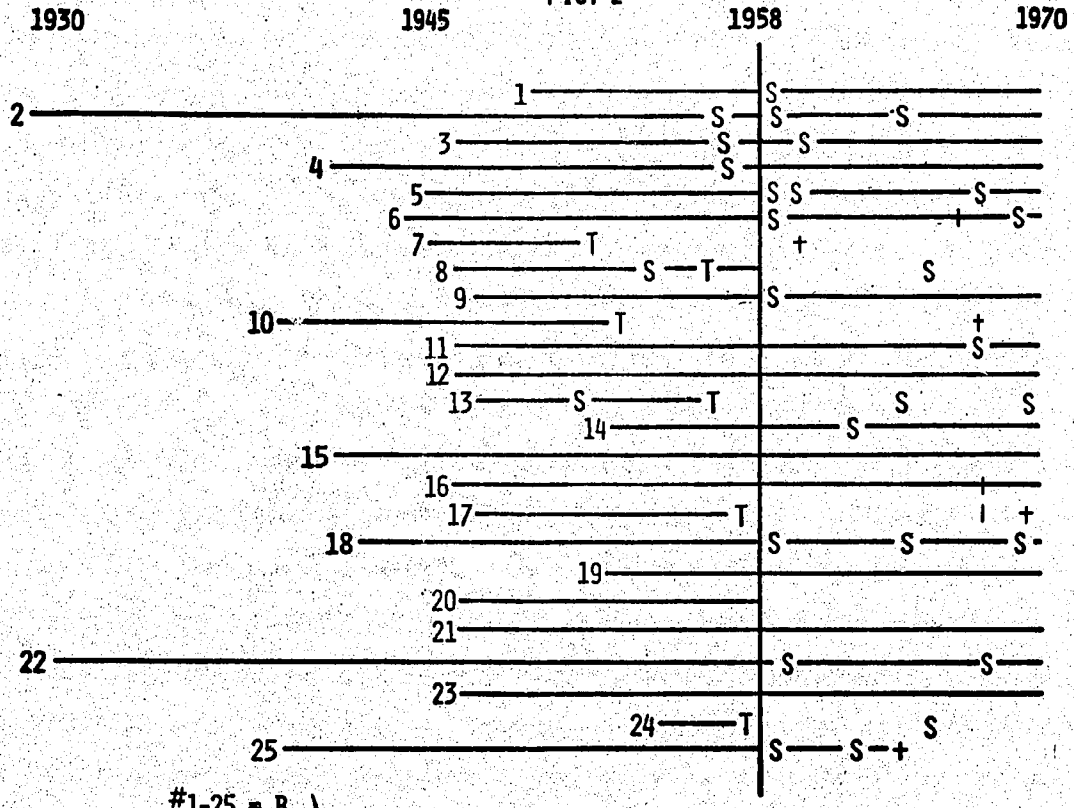


#1-25 = B
#3, 4, 7-9, 20, 22 = D
#4, 7, 22 = T
#5, 6, 7 = N

CHEMICALS IN EXPOSURE RECORD

seven of the workers were exposed to Chemical D (Dichlorobenzidine). Similarly, three of the workers can be shown to have been exposed to Chemical T (Orthotoluidine), and three others were exposed to Chemical N (β-naphthylamine). For those workers who had transferred to other plants of the same company, the company records should show where they had been transferred so that they could be tracked down for interviews. This is a logical point to discuss toxicologic studies, particularly animal test protocols for suspected carcinogens such as benzidine.

FIG. 2



At the same time the consultants were called in, all of these 25 workers were cystoscoped. If the nature of the illness has not yet come up in the class, it can be said instead that all 25 of the workers were examined and 6 of them (No. 1, 5, 6, 9, 18 and 25) were found to be ill. Of course, if they already know of bladder cancer, it can be stated that four had cancer of the bladder and two had papilloma of the bladder. The second figure shows the workers cystoscoped and followed until 1970 (as in the original paper). This was done through company records. Three of these

workers (No. 6, 16, and 17) had their 65th birthdays before 1970, and are listed as retiring (|) at that point. The large company had very good pension, death and health benefits for retired people, so that the company was notified of the illness of worker No. 6 occurring after retirement (although this was a bilateral hydrocele). For the same reason the company was also notified of the death (in Figure 2) of worker No. 17 which occurred after retirement. The deaths of workers No. 7, 10 and 25 occurred before age 65, so these were ascertained while the workers were still actively at work. [Only one of the deaths was from the disease of interest (worker No. 25), so that from deaths alone there would have been no suspicion of anything unusual. The causes of death would be found from the death certificates which could be located because the residences of these workers were known, either because they were still working (No. 7, 10 and 25) or because the address of the retired worker receiving a pension was known (No. 17).]

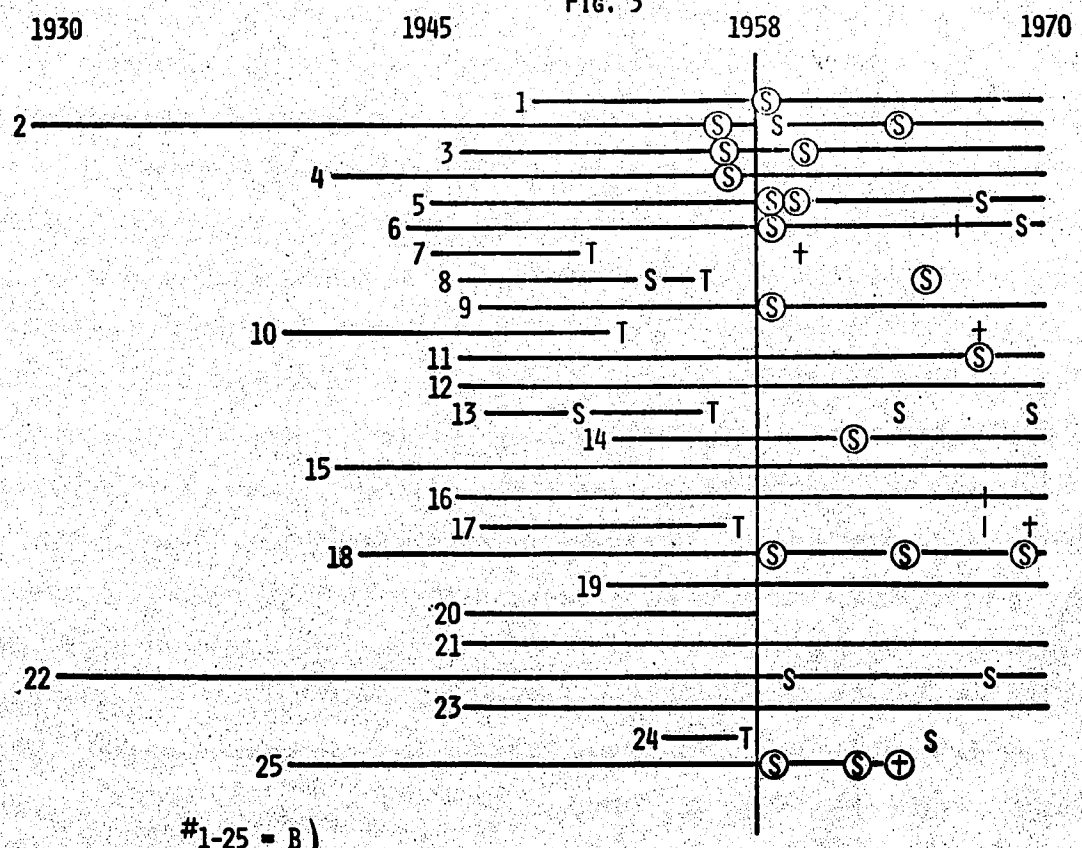
The third figure shows those conditions which were relevant to exposure to Chemical B. (The students can also look at the risk of those with exposure to each of the chemicals and, therefore, may get the idea that benzidine is the exposure of interest although the other three chemicals are also suspicious. The students can also get information on risk of tumor by number of years exposed. From this, the student can see readily that those who develop the tumor had longer exposures than those who did not.)

Chemical B was considered to be essential, so safety measures were introduced. (These included change of clothing, including underwear, for working with chemicals, adequate ventilation, special respirators, a closed system for making and transporting the dangerous chemicals within the plant, and regular physical examinations, including cystoscopy of the workers.) Therefore, it can be assumed for all practical purposes that the exposure to this chemical stopped in 1958 for all of these workers. This is an opportunity to discuss the concept of "zero threshold" for chemical carcinogens.

Reading of the Zavon et al. study could be recommended to the students, or the instructor could present the specific findings, pointing out the way this exercise was changed to simplify the concepts.

Data in the table on the following page are the detailed information on each worker.

FIG. 3



FINDINGS OF ALL CHEMICAL B WORKERS COMBINED

Case No.	Year of Birth	Race	Years of Exposure		Cystoscopies		Bladder or Other Tumor (Year)	Other Health Problems (Year)
			Time Span	Total	First Year	Total		
1	1913	W	1949-1958	8	1958	15	CA (1958)	...
2	1906	W	1929-1958	16	1957	24	CA (1957) CA of kidney (1964)	Adenoma of colon and colectomy (1959)
3	1922	W	1946-1958	12	1957	60	CA (1957) Tumor of kidney (1960)	...
4	1916	W	1941-1958	16	1957	18	CA (1957)	...
5	1913	W	1945-1958	12	1958	14	Tumor (1958)	Tumor of nose removed (1959), severe lumbago (1967)
6	1901	W	1944-1958	14	1956	30	Tumor (1958)	Bilateral hydrocole, chronic, repaired (1969)
7	1914	W	1945-1951	6	1958	1	...	Died Oct. 8, 1960, from CHD (no autopsy)
8	1924	W	1946-1956	9	1958	15	CA (1965)	Larynx tumor removed (1954)
9	1918	W	1947-1958	11	1958	15	CA (1958)	...
10	1910	W	1939-1952	6	1958	1	...	Died from oat cell CA of lung Oct. 11, 1967 (autopsy negative for GU tumor)
11	1921	W	1946-1958	10	1958	3	CA (1967)	...
12	1918	W	1946-1958	11	1958	1	...	...
13	1915	W	1947-1956	5	1958	1	...	Severe TB (1951, 1964, 1969) Diabetes, receiving insulin injection
14	1928	W	1952-1958	6	1958	39	CA (1962)	...
15	1920	N	1941-1958	13	1958	1	...	...
16	1902	N	1946-1958	12	1958	1	...	...
17	1902	W	1947-1957	10	1958	1	...	Died Nov. 8, 1969, from pneumonia (no autopsy)
18	1911	W	1942-1958	16	1958	35	CA (1958) CA left kidney (1964) CA right kidney (1969)	...
19	1927	W	1952-1958	6	1958	1	...	...
20	1925	W	1948-1958	7	1958	1	...	...
21	1911	W	1946-1958	12	1958	1	...	...
22	1906	N	1930-1958	28	1958	32	CA (1959) Metastasis to neck (1967)	...
23	1910	N	1945-1958	13	1958	1	...	...
24	1921	W	1954-1957	3	1958	1	...	CHD since 1965
25	1905	N	1939-1958	19	1958	24	CA (1958) Metastasis to abdomen (1962)	Died Feb. 10, 1963, from abdominal metastasis

A.B.C. Chemical Company 1950-1990
Teaching Problem

INSTRUCTOR'S GUIDE

I. Instructor:

"It is July 1970; you have been engaged as a consultant epidemiologist in a large manufacturing plant. The plant opened in 1950 and has expanded somewhat in the past twenty years. Recent government regulations have required increased reporting of employee health information, and the company has asked you to plan a program for meeting these regulations. Although the company has a certain amount of medical information on all of its employees, it has never analyzed this data and has no idea if its employees are at unusually high risk to specific diseases. Another assignment you have been asked to provide guidance on is whether there are any high risks because of work exposure.

"What type of information would you hope to have available to you to begin assessing employee health in this plant?"

II. Students' questions in response:

What does the plant manufacture? Answer: Zinc and copper.

What are the exposures and the adequacy of controls over the past two decades? Answer: Exposure to arsenic trioxide, sulfur dioxide, etc.; adequacy of controls sporadic, but generally inadequate if a serious effect is demonstrated.

What type of medical information is available on each employee?

Pre-employment physical examination? (+2)

Annual physical examination? (Voluntary, +1)

Medical visits to the industrial clinic for illness or injury? (+2)

Sickness absence reports? (+2)

Hospital illness or injury reports? (+3)

Death certificates? (+4)

What information is available on employees who retire or leave for other reasons?

Name of beneficiary? Address?	
Date of death?	(Complete follow-up if employed for
Place of death?	5 years or more, +2)
Death certificates?	
Hospital reports?	(Not obtainable directly, +1)
Autopsy information?	

III. After these questions have been answered, the instructor and students should then refer to Figures 1 and 2. In Figure 1 the "?" indicates equivocal evidence of symptoms. The symbol "( )" means that the employee was doing similar work in another plant with comparable exposures. Instructor should explain that Figure 1 is a very small plant and that the data are presented to represent a portion of the total plant population. Figure 2 should be explained as a model. Sickness is assumed to be diagnosed. Then Instructor asks the students, using the information available from Figure 1, to answer the following question: "Do you, as the company's consultant epidemiologist, believe that there is any excess risk to death or disease at the plant? For the purposes of this exercise, examine mortality and morbidity separately." Answer: 20-year mortality = 1 lung cancer/10 workers; morbidity = 3 sick/10 workers.

IV. Instructor:

"For the mortality analysis, what (co-) variables would you take into account?"

EXAMPLE RESPONSES: age
sex
race
smoking history

FIGURE 1.

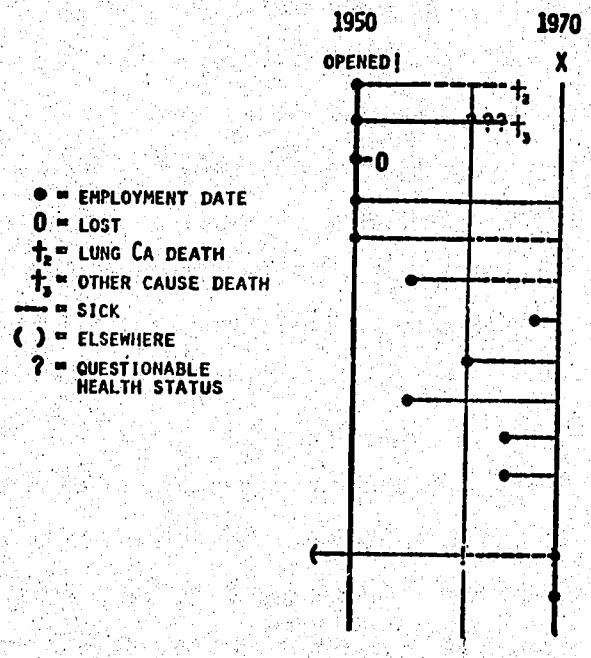
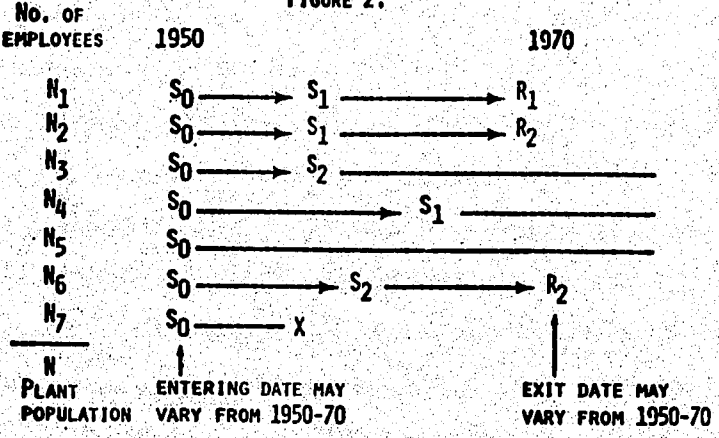


FIGURE 2.*



S_0 = HEALTHY STATE
S_1 = DIAGNOSED LUNG CA
S_2 = DIAGNOSED "OTHER ILLNESS"
R_1 = DEATH FROM LUNG CA
R_2 = DEATH FROM "OTHER CAUSES"
X = LOST TO FOLLOW UP

*SIMPLIFYING ASSUMPTIONS:
1) ONLY ONE S PER PERSON.
2) CANNOT DIE WITHOUT THE APPROPRIATE PRECEDING DIAGNOSIS.
3) OPENING OF THE PLANT IS THE BEGINNING OF EXPOSURE.

V. Instructor:

"What statistical method would you use to determine whether something is going on?" Answer: Given that the students respond (eventually) that they would examine observed deaths versus expected deaths, the instructor asks the following questions:

"How do you get your 'expected' number of deaths? What are the advantages or disadvantages of various standard population bases? Standardized Mortality Ratio (SMR) is often used in such situations. How is it calculated? What does it mean?"

"How do you handle those persons 'lost-to-follow-up'? How can use of the 'person-years at risk' concept aid in this? What disadvantages does it have?"

"A mortality study involves the use of the death certificate as the prime source of information. What are some of the problems associated with its use? What supplemental information could be gathered?"

VI. It is obvious that analysis of morbidity data can proceed in much the same way as the mortality analysis. However, the prime data source is different. The instructor asks: "What would the data source be, and what are some of its advantages and disadvantages? Where could you go for supplementary information?"

VII. Instructor:

"Up until now (1970), the results of the morbidity and mortality analyses are equivocal as to whether there is an unusually high rate of the study disease (in this case, lung cancer) in the plant employees.

Suppose exposure information is available on each employee at least to the degree that he/she can be placed in one of five exposure categories (low to high). How would you use this information in the proceding analyses?

"The concept of relative risk is an important one. What is relative risk? How is it calculated in a retrospective cohort analysis such as this? What does it mean? How can you test its significance?"

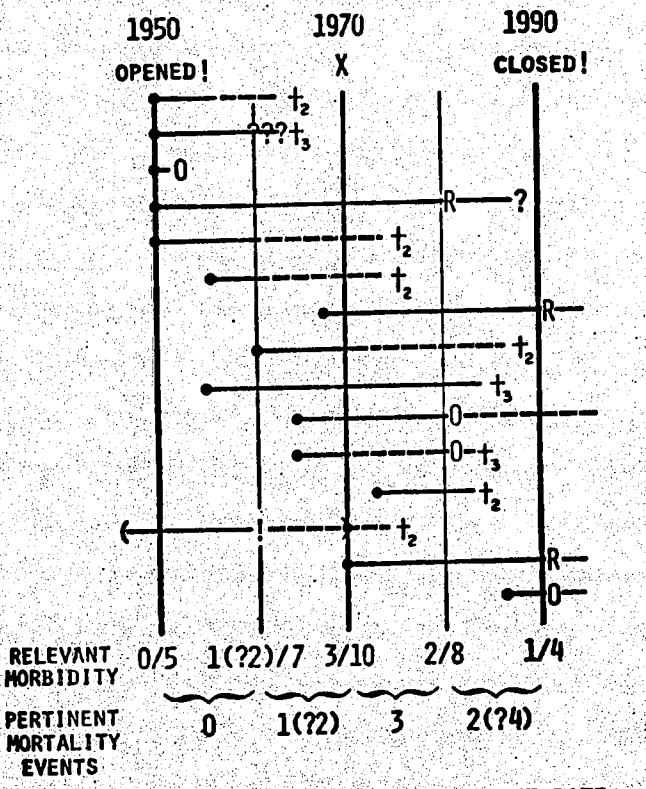
VIII. Instructor:

"By the end of 1970, you have begun to feel that 'something' may be going on in the plant, though you do not feel that the evidence is definitive as yet. You wish to continue your observation of company employees and re-examine the cohort data at 5-year intervals. What type of increased surveillance might you institute? What types of problems are common in follow-up studies (which this has now become)? Figure 3 indicates the results of a 20-year prospective study of this plant population. Analyze the data and report the conclusions that would be drawn regarding the occupational health of this population."

IX. Instructor:

"Suppose you wish to compare the employees in your plant with some other 'special' cohort. What type of comparison cohort might you want, and why?"

FIGURE 3.


1950
OPENED!
1970
X
1990
CLOSED!
RELEVANT MORBIDITY
0/5
1(?2)/7
3/10
2/8
1/4
PERTINENT MORTALITY EVENTS
0
1(?2)
3
2(?4)
• = EMPLOYMENT DATE
0 = LOST
†2 = LUNG Ca DEATH
†3 = OTHER CAUSE DEATH
—— = SICK
( ) = ELSEWHERE
R = RETIRED
? = QUESTIONABLE HEALTH STATUS

Lecture 6

OCCUPATIONAL AND ENVIRONMENTAL HEALTH STANDARDS

OBJECTIVES

1. To present two cases of environmental disease and discuss the control implications.

2. To discuss a model occupational health program using slides so as to indicate the various elements as they relate to occupational safety and health standards.

Lecture 6: Occupational and Environmental Health Standards

Materials Description

Student Materials	Handout - Two Case Studies
Teaching Materials	Appendix C: Slide 8 (xylene) Slides 151-164 (occupational health program) Other slide material that could also be used: Slides 168-180 (byssinosis) Slides 135-136 (carbon monoxide) Slides 165-167 (accidents)
Instructor's Guide and Reference Materials	Lecture Outline (not included) Appendix B: Slide text and Suggested Readings for slides listed in Teaching Materials (Note: Slides contained in Appendix C). Appendix A: Supplementary Pamphlets and Quizzes

Additonal lecture materials will be submitted at a later date to complete Lecture 6: Occupational and Environmental Health Standards. The information will consist of the Instructor's Guide and Reference Materials, including Suggested Readings for:

Slides 168-180 (byssinosis)

Slides 135-136 (carbon monoxide)

Slides 165-167 (accidents)

STUDENT HANDOUT

Case #1

A young paint-spray booth operator was observed to be swaying and somewhat uncoordinated in climbing down from a truck bed where he had been spraying. When questioned regarding how he felt, he not only indicated that he now felt dizzy, but on the previous afternoon he had been ticketed for driving under the influence of alcohol following having performed a similar spraying task all afternoon. He was observed wearing a respirator mask, and the manager stated that the paint solvent had been recommended by the manufacturer as safe for his spray operation.

Comments

Metabolism of Inhaled Chemical Solvents

Human Effects and the Basis of Standards

Types of Work Standards: Environmental, Medical, Worker Education

Clinical problems: What is the health risk of Brand X?
What was the amount of exposure and the prognosis?
Do drugs and environmental chemicals interact?

Community problems: Hazardous waste -- storage and disposal
Transportation
Addiction

Case #2

Two of 70 persons involved in a railroad collision derailment, which resulted in a ruptured railroad car of anhydrous ammonia, were brought into an emergency room. They had been caught between two damaged seats and were rescued after 60 minutes of an undefined exposure concentration. They had acute conjunctivitis, keratitis, rhinitis, pharyngitis, cough and dyspnea -- the latter two persisting for two years. Radiographic evidence of bronchiestosis, a biopsy showing emphysema, and small airway obstruction were all demonstrated in both cases. Bilateral corneal opacities and early cataract changes were observed after two years.

Comments

Irritation of gases and vapors: Clinical findings and mechanisms
Criteria document on ammonia

Clinical problems: Chronic effects from acute or chronic exposure
Criteria for disqualifying job applicants
Criteria for disability evaluation
Emergencies: Trachiostomy and intensive inhalation therapy

Community problems: Firefighters -- Prevention and therapy of smoke inhalation, etc.
Agricultural workers
Early effects of cigarette smoking