

**CONFERENCE**  
**ON**  
**AGRICULTURAL HEALTH AND SAFETY**

**Proceedings of Symposium**  
**Iowa City, Iowa**  
**September 4-5, 1974**

**Society for Occupational and Environmental Health**  
**Environmental Sciences Laboratory**  
**100th Street and 5th Avenue**  
**New York, New York 10020**



C O N F E R E N C E  
O N  
A G R I C U L T U R A L H E A L T H A N D S A F E T Y

Proceedings of Symposium

Iowa City, Iowa

September 4-5, 1974

Clyde M. Berry, Ph.D., Chairman  
Rodney Beard, M.D.  
John Finklea, M.D.  
William Lloyd, Ph.D.

Society for Occupational and Environmental Health  
Environmental Sciences Laboratory  
100th Street and 5th Avenue  
New York, New York 10020

This Symposium was funded in part by the National Institute for Occupational Safety and Health, Contract No. CDC-99-74-98.

July 1975

## CONTENTS

PREFACE .....	vii
FOREWORD .....	viii
INTRODUCTION .....	1
Dr. Clyde M. Berry, Councilor, SOEH	
WELCOME .....	2
Dr. John Eckstein, Dean, College of Medicine The University of Iowa	
Dr. Norbert Roberts, Director, Medical Department, Exxon Corporation	

### OVERVIEW OF AGRICULTURAL HEALTH AND SAFETY PROBLEMS

THE IOWA VIEW .....	7
L.W. Knapp, Jr., Institute of Agricultural Medicine, The University of Iowa	
THE COLORADO VIEW .....	15
Dr. Eldon Savage, Chief, Chemical Epidemiology Section, Colorado Institute of Rural Environmental Health	
THE FEDERAL ENVIRONMENTAL VIEW .....	20
Dr. John Finklea, Environmental Protection Agency, Research Triangle Park, N.C.	
DISCUSSION .....	29

TOXICOLOGY--EPIDEMIOLOGY--SPECIAL PROBLEMS

CHEMICALS IN AGRICULTURAL USE .....	33
Dr. David Mick, Iowa Department of Environmental Quality	
THE MIGRANT WORKER .....	38
Sister Irene Munoz, Muscatine Migrant Health Program, Muscatine, Iowa	
RESPIRATORY PROBLEMS .....	45
Dr. John Kammermeyer, Department of Internal Medicine, The University of Iowa, College of Medicine	
COMMON CUTANEOUS PROBLEMS IN AGRICULTURAL WORKERS .....	54
Dr. Richard L. Zuehlke, Department of Dermatology, The University of Iowa, College of Medicine	
DISCUSSION .....	68
Dr. Robert Wallace, Moderator	

TOXICOLOGY--EPIDEMIOLOGY--HEALTH EFFECTS OF PESTICIDES

THE CALIFORNIA EXPERIENCE .....	70
Dr. Thomas H. Milby, The Hine Laboratory San Francisco, California	
UPDATING TREATMENT OF PESTICIDE POISONINGS .....	81
Dr. Griffith E. Quinby, Consultant, Wenatchee, Washington	
ANIMALS AS MONITORS OF ENVIRONMENTAL QUALITY .....	90
Dr. William Buck, Department of Veterinary Pathology, Iowa State University, Ames, Iowa	
SOME EPIDEMIOLOGIC EXPERIENCES IN THE HEALTH EFFECTS OF PESTICIDES .....	98
Dr. Jack Griffith, Health Effects Division, OPP, EPA, Washington, D.C.	
DISCUSSION .....	102
Dr. Keith Long, Moderator	

TOXICOLOGY--EPIDEMIOLOGY--CHEMICAL AGENTS OTHER THAN PESTICIDES

OVERVIEW OF THE PROBLEM .....	105
Dr. Donald Morgan, Institute of Agricultural Medicine, The University of Iowa	
VETERINARY PHARMACEUTICALS .....	107
Dr. Ann B. Holt, Bureau of Veterinary Medicine, FDA, Rockville, Maryland	
STATISTICS ON ACUTE EXPOSURE FROM AGRICULTURAL CHEMICALS .....	112
Dr. Henry Verhulst, Poison Information Center Washington, D.C.	
DISCUSSION .....	115
Dr. Donald Morgan, Moderator	

COMPARATIVE MEDICINE

COMPARATIVE MEDICINE: AN OVERVIEW .....	119
Dr. Lloyd Selby, Veterinary School and Medical School, University of Missouri, Columbia, Missouri	
POTENTIAL OCCUPATIONAL HEALTH HAZARDS OF LIVESTOCK PRODUCERS WORKING IN ANIMAL CONFINEMENT UNITS .....	141
Dr. Stanley Diesch, School of Public Health, University of Minnesota, Minneapolis, Minnesota	
OCCUPATIONALLY-RELATED DISEASES OF ILLINOIS VETERINARIANS .....	154
Dr. R.J. Martin, Illinois Health Department Springfield, Illinois	
INFECTIOUS DISEASES COMMON TO ANIMAL AND MAN OF OCCUPATIONAL SIGNIFICANCE TO AGRICULTURAL WORKERS .....	160
Dr. Kelley Donham, Institute of Agricultural Medicine, The University of Iowa	
DISCUSSION .....	176
Dr. Kelley Donham, Moderator	

## INJURY PREVENTION

OVERVIEW OF THE PROBLEM .....	178
L.W. Knapp, Jr., Institute of Agricultural Medicine The University of Iowa	
AGRICULTURAL ACCIDENT STATISTICS .....	186
Leon Urben, Director, Farm Department National Safety Council	
BIOSTATISTICS IN AGRICULTURE .....	192
Dr. Leon Burmeister, Biostatistics Section, Department of Preventive Medicine and Environmental Health, The University of Iowa, College of Medicine	
FEDERAL ACTIVITIES .....	208
Dr. Robert Gilden, Agricultural Research Service, USDA	
EMERGENCY MEDICAL SERVICES IN A RURAL STATE .....	213
Dr. C. Earl Gettinger, Director, Emergency Medical Services, Vermont State Health Department, Burlington	
NIOSH's EXPANDING ROLE IN AGRICULTURAL SAFETY AND HEALTH .....	225
Robert L. Peterson, Director, Western Area Laboratory for Occupational Safety and Health Salt Lake City	
DISCUSSION .....	231
Alfred Blackman, Moderator	

## INJURY PREVENTION AND MEDICAL CARE

HEALTH AND SAFETY STANDARDS FOR AGRICULTURE .....	233
Dr. Rollin Schnieder, Chairman, Special Task Force, USDA	
AN EXPERIMENT IN RURAL MEDICAL CARE .....	242
Miss L.M. McGann, Assistant Professor, Department of Family, Community and Preventive Medicine, Stanford University, School of Medicine	
DISCUSSION .....	254
Dr. Peter Isacson, Moderator	

CLOSING ..... 257

Dr. Harry Heiman, Executive Secretary  
SOEH

Dr. Keith Long, Institute of Agricultural Medicine  
The University of Iowa

## Preface

The planning of the conference continually involved making hard choices. On content it was decided to consider toxicology, epidemiology, chemical agents, comparative medicine, injury prevention and medical care. Specific items of unusual interest of concern would be handled within the foregoing general categories.

All participants were requested to provide a fifteen minute presentation. Discussion was held until the end of the session because some of the papers were closely related. All verbal presentations and the discussions were taped and transcribed. The transcriptions and any written texts were submitted to the authors for editing. Some added material. Some deleted material.

The material presented in these Proceedings is that chosen by the program participants to be included. Of course the usual "asides" and administrators announcements have not been included.

Sincere appreciation is expressed to William Durham of EPA who helped the program committee in many ways. Also, the patient assistance of Janet Piercy and Deborah McMann is acknowledged. They have spent many frustrating hours in tape transcribing and have been of invaluable help in the final compilation of the document.

*Clyde M. Berry*  
Clyde M. Berry, Chairman

## Foreword

The Society for Occupational and Environmental Health decided at its December 4, 1973, annual meeting in Washington, D.C., that modern agriculture presented unique problems that should be explored in a national conference.

The Institute of Agricultural Medicine of the University of Iowa was invited to assist in the planning of such a conference. This research group in the College of Medicine at the University of Iowa had been working on mid-west agricultural health and safety problems since 1955.

The experience of the Institute was parochial to a degree so a broader planning base was achieved through representation from the National Institute for Occupational Safety and Health (NIOSH), the Environmental Protection Agency (EPA), and California where considerable data had been accumulated on agricultural health, safety and environmental problems.

Other groups joined in sponsorship. These were the Iowa Department of Public Health, the Iowa Department of Environmental Quality, the State Hygienic Laboratories, the American Public Health Association and the U.S. Department of Agriculture.

The planning committee was specifically charged with identifying the variety of concerns that were associated with agriculture. Specific areas such as the use of pesticides, would be explored in greater depth at subsequent conferences.

The information contained in these symposium proceedings should be of interest to a broad spectrum of government and the scientific community as an overview of the variety and scope of health, safety and environmental problems in agriculture.

## Introduction

Clyde M. Berry, Ph.D.

The Program Committee was composed of Bill Lloyd from NIOSH, John Finklea from EPA, Rodney Beard from Stanford and myself. We wanted to cover the kinds of problems which are encountered in what is now the agricultural industry. The proceedings here are being taped. The way in which they will appear has not yet been decided but they will be available. Dr. John Eckstein, Dean of the College of Medicine, has some words for you.

John Eckstein, M.D.

On behalf of the University of Iowa College of Medicine, it is my pleasure to welcome you to our campus.

In reviewing your program of presentations and discussions, I was impressed by the breadth of topics to be covered by this distinguished assemblage of experts, representing a cross section of public and private organizations throughout the nation. It is clear that a considerable effort has been made to develop a relevant, scientifically-oriented program, pursuing issues of vital human concern. The extensive list of agencies identified as sponsors of your program serves as further evidence of the breadth of interest in the matters to be considered.

For nearly two decades, our Institute of Agricultural Medicine has provided a resource for the investigation of issues and problems specific to the agricultural industry. The creativity and energy of the Institute's professional staff have contributed significantly to the betterment of the lives of those engaged in agriculture, both in the State of Iowa and throughout the nation and the world. The success of the efforts of these individuals is directly attributable to the confidence and support demonstrated by diverse agencies - including the State of Iowa, foundations, private industry, federal agencies, together with the cooperation and understanding of countless farmers, agricultural workers and organizations producing products used in agriculture.

The University of Iowa College of Medicine is pleased to serve as your host for this conference, and we are confident that you will find your time and effort in attending to have been well spent.

Thank you.

## Introduction

Clyde M. Berry, Ph.D.

Thank you, Dean Eckstein. Dr. Selikoff has indicated that he would not be able to appear at this meeting. The Vice-President of the Society for Occupational and Environmental Health is here. Dr. Norbert Roberts, Director of the Medical Department of Exxon Corporation will replace Dr. Selikoff on the program.

Norbert Roberts, M.D.

Thank you, Dr. Berry. Dr. Eckstein, ladies and gentlemen. This timing apparatus is intimidating, so I'm grateful to you for the courtesy of your having lifted it away. I should say that Clyde was exactly right - I did learn only a few minutes ago that I was to extend the Society's greetings to you.

The Society for Occupational and Environmental Health was organized in 1972 because it was felt that there wasn't a medical or professional association that brought together the many disciplines that had an interest in the subject of the health effects of environmental exposures at work or away from work. It attempted to bring together, and did succeed in bringing together, individuals from academia and research activities, from organized labor, from industry and from government. In its relatively short life of just two years it has sponsored, either alone or in conjunction with other respected organizations, a succession of meetings that have varied from relatively modest seminars to ones that were truly international meetings. There was a brief meeting held at Duke on the subject of cotton dust disease. A more extensive review of the health hazards related to beryllium was held in Cleveland at Case Western Reserve. A major international meeting was held on the west coast on the subject of the health hazards of ship building. There was a very successful international meeting in New York reviewing the currently much noted hazards of vinyl chloride. Additionally, there have been some smaller sessions such as a workshop in New York on the significance and implementation of the Robens Report, and a meeting in Washington on the problems of standard setting with respect to occupational and environmental health matters.

It seems to me - and I can say this without being accused of immodesty because I was not responsible for any of these meetings - that they've been of consistently high caliber. I am sure that in the hands of Dr. Berry and his committee, this meeting is going to maintain that high standard. Clyde was with us at Exxon for a number of years. I don't know how we lost him, but we are as proud of his record as any other alma mater would be.

The subject of our attention at this meeting needs no emphasis from me with respect to the matter of its importance. The fact that you have traveled as far as you have and have done this at a time that is not convenient for most of us, and the fact that you are all here for the very beginning of the meeting (nobody has walked in since we've started) testifies to our appreciation of the importance of these discussions.

Thank you.

Introduction

Clyde M. Berry, Ph.D.

The next group of papers are going to deal with the subject of agricultural injuries, occupational trauma. The first speaker will be Pete Knapp from our Institute of Agricultural Medicine. He is going to give us an overview of the agricultural injury problem.

## The Iowa View

L.W. Knapp, Jr.

Thank you, Clyde. Good morning one and all. My topic with respect to the Iowa view on agricultural safety and health is not necessarily a view of Iowa alone but potentially how we look at it, philosophically and otherwise here from Iowa.

In American today there are many misconceptions about agriculture and the farmer, most of which are founded upon a lack of comprehension and understanding by the public in general. The image of today's farming, which in reality is highly mechanized and based upon the science of genetics, chemistry and physics, is colored by the nostalgia which most of us have preserved as a heritage of the frontiers of farming. We recalled through the preservation of memorabilia those things on your walls at home and the farms we can take and see throughout the country called the "living farms", etc. Thus, when most drive through the countryside and notice the orange laden trees or the cows on the hillside or the endless miles of corn of Iowa and Illinois, the wheat fields in the Midwest and the baby pigs running and jumping about, or the sheep and cattle on the range, or the manicured rows of the vegetable crops in truck gardening areas, one cannot truly realize the time, work, expenditure and management needed to produce such an indelible panorama.

Unfortunately, our fleeting glimpses of agriculture from the roadside or through the mass media do not tell us the true story. It does not indicate the quality of life or lack thereof or give us translatable information upon which programs may be based to reduce the pain and trauma inherent in farming operations. Impressions so gained work to the detriment of all for they give the false impression that all is serene and healthy.

If one looks closely at farming he will quickly recognize the transitions that have already taken place from the picture priorly drawn. Lauren Soth, a Pulitzer Prize winner from the Des Moines, Iowa "Register and Tribune", put it aptly in his book, Embarrassment of Plenty, when he said, "Today a farmer must be more a mechanic than a weather prophet, more a scientist than a good judge of growing things. To be sure, modern agriculture is not all science. It is also an art of old." And, "When one talks about farming or farmers in the vast continental sweep of the United States, he must define what areas and what kind of farming he is talking about." These few words of Mr. Soth describe well the dilemma one faces in trying to prepare a general description of the health and safety problems in agriculture. Its diversity and its personal orientation provide mind boggling combinations with which to deal.

U.S. agriculture is geographically diverse, it's independently motivated, it's a loosely knit grouping of operations and people for the production of food and fiber under a variety of environmental conditions. Particular agricultural industries may be the result of the environment, as, for example, are cattle and sheep ranching in the western high plains and the mountains, sugar cane and rice in the south, citrus in Florida and California, pineapple in Hawaii, and the grain and cattle-feeding operations of the midwest. However, the likelihood of finding identical operations that are similar combinations of enterprises, even in the same area, side by side, except in the most specialized operations, is unique. Yet one can find many similar components on different farms, which when evaluated individually, can be equated. Typically there does not appear to be an "average" farm or ranch operation, which may essentially stem from the fact that American farming seems to be in a constant state of evolution.

The applications of machines to agricultural production has been one of the major factors in the development of agriculture as we know it today. Concurrent with mechanization, many of the increases in food production have been made feasible by the biological scientists who have produced varieties better suited to mechanical harvesting. In some instances cultural practices have been changed for mechanization purposes as well.

According to the U.S. Department of Agriculture, for 1972 there were approximately 2,876,000 farms totaling some 1.1 billion acres of land. Of the total land in farms, preliminary estimates for 59 crops indicated that there were 317 million acres planted, 301 million harvested, not including some 3.2 million acres of fruits and nuts and other crops and small acreages so they were grouped together. Of the total agricultural population of 9.4 million people, less than half made up the employment force, of which some 3.2 million were family and some 1.1 million hired. These same farms reported having over  $4\frac{1}{2}$  million tractors, another 820,000 garden tractors, some  $3\frac{1}{4}$  million combines, over  $1\frac{1}{2}$  million corn pickers and picker/shellers, just to mention a few of the machines of the farms.

Now such statistics if used and combined with general operational descriptions of agricultural enterprise must be made if a true perspective of the size and complexities of agricultural work is to be understood and adequately dealt with. For example, dairies will vary from a few cow subsistence operation to 1,000 cow plus milk factories, and beef feed lots from as few as 50 animals or less to multi-thousands. It is not uncommon for one man to handle a 50,000 broiler operation at a time or multi-thousands of laying chickens or turkeys for meat production. However, each and every operation on the smaller side of the comparison may be in addition to one or more other enterprises or combined with off-the-farm employment. The fact that a man is a dairyman does not preclude his being a producer of grain crops for cash, or operating a poultry enterprise on the side, or having a fruit and nut orchard, if the area in which the farm is located is conducive to such operations. Yet today there is an ever-increasing specialization taking place with more farmers turning to one-commodity enterprises where economics of operation force an ever-increasing size for solvency.

Interestingly, off farm work which provides an added cash flow for farmers may also be a complicating factor in his health picture. His off-the-farm exposures and potential fatigue factors of working at two jobs may have a synergistic effect. In fact, by adding those who worked

100 days or more off the farm (according to USDA figures) better than one-third of the work year, that is, better than 20% of the total farm work force reported such activity and it's been reported through personal communication from my friends in the safety field and in the labor force throughout the U.S. that in many areas next to urban centers as high as 50% of the people will work off the farm.

Historically, agricultural accident statistics have been based upon the analysis of information gathered from states records of vital statistics, newspaper clipping sources, voluntary farm organizations, accident surveys, extension service activities, and from interested researchers, such as ourselves. Obviously, such data gives only a fragmented picture of the accident problem at best, though it does provide the foundation for further research and educational programs, on a worst-first basis.

However, during the 1960's, a rapid change in the overall methodology of securing this data for the solution of agricultural accident problems took place. The advent of epidemiological techniques for the study of specific accidents, the statistically sophisticated accident studies in Ohio and Michigan caused the entire picture to be re-thought and brought about a new emphasis on that which could be accomplished as well as the merit of developing standards and regulations to assist in the movement towards safer farm operations.

From preliminary data released by the Farm Department of the National Safety Council in February 1973 for ten states (Ohio, Michigan, New York, Wisconsin, Nebraska, Louisiana, Indiana, Minnesota, Illinois, and Oregon) obtained from using this new form, based on 3,800 accidents reported by the 19,650 sample reporting farms, representing more than 3/4 million farms, indicated among other things, that two-thirds of all work accidents related to the farm 87% occurred to farm family members. Further, that farm tractor overturns have the highest fatality rate for tractor associated accidents. Specifically they accounted for 53% of all on-the-farm tractor fatalities, runover for another 26% of them, power take-off 4%, and others 17%.

The present standardized study which is being used and promoted throughout the country tells us who, to what extent, and how many are involved in farm accidents. However, unless we increase the use of second level or in-depth investigation of these accidents, we are not going to gain the kind of information that will tell us how to resolve those particular problems. I'm very pleased to see that this is being emphasized throughout the country. I'm sure you'll hear more about this when Leon Urben, who is manager of the Farm Department of the National Safety Council, tells you about some of the things they are doing.

Turning to the farm machinery picture, specifically, a description of the machinery which is employed in agricultural operations is nearly endless and this is due to the many tasks a particular machine might be expected to perform. A combine can do many things besides combine grain, for example, that is a variety of grains. A tractor does many things besides plow or harrow. It even chases cows. It provides transportation for people to parties when you can't get out in the wintertime from the highways. It's replaced the old horse. Now you can laugh about these things, but this is a on the farm reality.

The essence of the work that many of these agricultural machines perform is to squeeze, cut, pound, grind, pull, shake, separate or otherwise manipulate agricultural commodities in such a manner or combination of ways to make them useable for farm or market use.

Unfortunately, the longevity of farm machinery is a problem when modifications are made, for in paraphrasing from General McArthur, old machines don't die, they just fade away. Even rusting away takes 50 to 100 years and then major components have not disappeared. Consequently, any standards which are to be promulgated will meet with a certain amount of resistance because it may mean a modification of a whole series of items or the discard of something which is economically useable to the farmer. Specifically, we run into a philosophical problem which the economists have talked about as to where does the money come from in agricultural operations when they talk about the "inflexible market" and the "inelastic demand". Now I'm no economist, but what they're trying to say is the

pricing of agricultural commodities to the farmer is very complex. The farmer doesn't look at his cost production directly and then add a small margin for profit. He has to put his product on the market and sell it as is at the going price. Thus, a simple analogy and maybe not too good a one, if you are in a restaurant and you buy yourself the biggest steak you can buy and pay \$7.00 for it, if you're offered another steak right then and there you probably wouldn't give very much for it. And this is what happens when you fill up the market with food. Just because it becomes cheaper through increased production doesn't mean more people will buy, consequently the farmer has economic shackles limiting the available income to be used for among other things many safety advantages others feel he needs.

The seriousness of farm machinery accidents, which in so many instances result in amputations and permanent disability, has placed them high on the priority list of agricultural safety problems. Such priority is further evidenced by activity throughout the nation such as the promulgation of trying to resolve standards, redesign of equipment and shielding, and the development of new kinds of hardware among others to resolve same.

Farm buildings are an integral part of most farms and vary in design and use from traditionally constructed structures for the housing of poultry and dairy animals to pole barns for storage, to the highly mechanized contemporary confinement structures in which high concentrations of birds or animals are housed. Such confinement structures producing a new variety of environmental problems for the farmer and his employee who works therein.

The use of chemicals, medicants and pesticides has been an integral part of American agriculture from its early beginning. As the demands for greater agricultural production have increased, so have the use of these substances. The farmer has literally grown up using such agents. Today he has and uses a vast array of these chemicals and the potential for worker exposure is much larger due not only to the increased use but because many are now skin absorptive as well.

Pesticides, in general, of course, appear to have received the most concern by the public, press and regulatory agencies.

Presently here in Iowa, as elsewhere in the U.S., the acute problems are much more obvious than those of a chronic nature, a la death under a tractor, the loss of an arm or leg in a power takeoff, or the broken back from a fall off a corn bin, or the drowning in a grain storage to name a few when compared to the chronic, or long-range problems. This does not mean though that these chronic problems are not highly important. It may be more likely that they are inadequately or improperly diagnosed and defined and thus less obvious.

A number of priority needs are obviously apparent if solutions to existing problems in agricultural health and safety are to be found. First, through the efforts of the Farm Department of the National Safety Council, and several land grant institutions, it has been demonstrated that data describing the safety problems of agriculture can be determined. Similar data are needed for other areas of the U.S. and its discovery should be of a continuing nature. Secondly, health data for agriculture needs to be developed as we do not have a health norm for agriculture and consequently are unable to scientifically describe an adverse health effect. Third, educational efforts need to be expanded for there are very few individuals on a local, state or national level who have a responsibility concerning agricultural safety and fewer still who work with agricultural health.

Fourth, little research is underway anywhere of a comprehensive nature on agricultural safety and health problems. However, there are a number of centers where specific interest projects have been undertaken and some of which could be expanded into centers of excellence for a broad attack on existing and developing problems. Task force representative of the nation's safety and health problems to establish priorities and plans are needed.

Fifth, limited practice and performance standards are needed to assure general compliance with known, good safety and health practices. Such standards as promulgated should be of a vertical nature (that is for agriculture alone) and so regionalized as to allow for the various types of climate, terrain and practices which will be directly related to the effectiveness and/or acceptance of said standards. Unenforceable and generally unacceptable standards will do little to improve the general safety and health of farmers and his family and will only further increase the cost of food to the consumer.

Finally, whether these aforementioned points can be accomplished and how soon depends upon the priorities which we individually and as a nation set for ourselves and for agriculture. It is time we lifted the safety and health needs of agriculture out of the cellar and put them squarely in front of us where they belong, for agriculture is not food per se, rather agriculture is people who produce food. And I remind you that that which is said and accomplished here during this conference places before one and all our public concern for and about the safety and health of the agriculturally employed.

Thank you for this opportunity.

## The Colorado View

Eldon P. Savage, Ph.D.

Mr. Chairman - Ladies and Gentlemen:

It is indeed a privilege to be here and to participate in the conference on safety and health. In the time allotted, I will attempt to tell you some of the activities of the Institute of Rural Environmental Health (IREH) at Colorado State University (C.S.U.). As perhaps many of you know, the IREH was established at C.S.U. under a founding grant by the Kellogg Foundation in late 1969 as a sister organization of the Institute of Agricultural Medicine at the University of Iowa. This morning I want to discuss some of the current applied research underway or anticipated. These include studies on nitrates, carbon monoxide, pesticides, pleasure-home accidents, and a proposed demonstration project to provide industrial hygiene services for small businesses.

To refresh your memory, Colorado is a state of some two million residents, and its agriculture is diversified ranging from wheat and sugar-beet production on the plains to cattle and sheep in the high mountains, to a one-hundred-thousand plus cattle feed-lot. The state is divided into six crop reporting districts. Along with the state agriculture, many small businesses have developed along both the front range on the eastern slope and on the western slope of the Rockies. Colorado State University has enjoyed a long history of providing services to rural people through its extension services and has an enviable record in research, being second in the nation only to MIT in the number of research dollars from contracts and grants among land grant institutions.

One of our most interesting research activities has been to attempt to determine the relationship, if any, between high nitrate levels in water and human and animal health. The site of this study has been in a rich agricultural country in northeastern Colorado. Cattle feedlots, sugar beet

production, alfalfa, and corn are the principle crops grown in the county. There are several communities in the county that obtain their domestic water from municipal wells and several other communities that obtain their water from the Poudre River above Fort Collins. For purposes of this study, the communities were divided into control low or no nitrate to high nitrate useage. Initially, hospital records were scanned to determine patients treated for hypertension from both the control and study communities, but when the data were adjusted for age, it was found that those living in communities with high nitrate levels in water supplies experienced hypertension ten years younger in life. This study has been extended to unhospitalized residents of the two study groups. Blood pressure readings have been taken on approximately 200 individuals. People living in the communities with high nitrate levels in the water supplies consistently experienced a significantly higher blood pressure at an earlier age than those people residing in communities with low nitrate levels in their domestic water supplies.

Another study underway at the Institute is a study of hospitalized cases of accidental carbon monoxide poisonings. This study was conducted to determine the epidemiological pattern of carbon monoxide poisonings in Colorado and Wyoming. Hospitals were contacted and pertinent epidemiological data related to time, place, and person relationships were noted. Over two-hundred and thirty case hospital records were reviewed. Of these cases, approximately 57 percent were due to faulty furnace-flue or hot water heater installations in the home. Approximately 29 percent were due to vehicular emmissions, 8 percent were unknown and only 6 percent occurred in job related activities.

The age and sex of carbon monoxide poisoning victims were also noted. Females were the most frequent victims under the age of fifteen. The number of males increased between the ages of sixteen to fifty-five with a precipitous increase in males between the ages of twenty-five to fifty-five. After age fifty-five, the number of cases between males and females were practically the same and no significant differences occurred.

On a monthly basis, the number of cases of carbon monoxide poisoning increased during October to March with the largest number of cases occurring in December and January. The number of cases declined during April, increased during the summer months of May, June, and July, and then dropped off during August and September. Analyses of these data reveal the summer peak to be due primarily to vehicles and the winter peak due to carbon monoxide emissions connected to home heating - faulty flues, poor venting, etc. Since man is less capable of handling CO at high altitudes due to reduced oxygen and since many vehicles give off more CO due to poor motor function at high altitudes, the CO rate per 100,000 population at altitudes greater than 6000 feet and at altitudes less than 6000 feet were determined. The rates were 102 per 100,000 above 6000 feet and 23 per 100,000 below 6000 feet.

Although the Institute at Colorado State University has conducted research on pesticides since 1970, its activities in this area were greatly increased in January of this year when it became one of three Epidemiological Studies Centers in the U.S. under contract with the Environmental Protection Agency. The other two centers are located at the University of Iowa and at South Carolina Medical School. Several research projects are ongoing under terms of this contract that are related to safety and health. Epidemiological investigation of acute pesticide poisonings, analytical development, field re-entry studies, pesticide useage trends, residue levels in the general population, investigations of renal dysfunctions in pesticide-exposed individuals, and related studies. Probably one of the best examples of multiple exposure to pesticides occurred in Colorado about two months ago when an aerial applicator plane crashed while applying parathion. Two truck drivers were the first to the scene of the accident. The pilot suffered a broken leg and was drenched with parathion, but was fully conscious. He advised the two truck drivers who were the first at the scene of the accident to wash him off immediately in a nearby irrigation ditch. They responded and one became fully exposed to parathion while doing so. By this time, others arriving at the scene of the accident called a nearby local fire department and an emergency ambulance crew. The emergency ambulance crew took the patient to a regional hospital and in doing so, two of their people became exposed to parathion. The Denver Poison Control Center immediately

came into the act, and through the media, advised people exposed to wash thoroughly and if they had any symptoms, to see a physician. In the next twenty-four hours, they gave detailed information to forty-six callers. In all, four people were hospitalized. Probably one of the most severely exposed was a nurse in the ambulance crew. One of the original truck drivers who arrived first at the scene worked all day in his contaminated blue jeans. He met his sister that evening at a store in Denver where he bought new shoes and jeans - wearing and changing the contaminated clothing in the store dressing room. One the way home from the store, both his sister and he became ill, displaying most of the symptoms of OP poisoning and both were hospitalized. In the meantime, the pilot recovered fully and was back to work in a few days.

We have recently completed a sample study of current pesticide useage in one Colorado county. This study revealed that of 230 households interviewed, only 23 percent used protective clothing and 29 percent of the users kept pesticides stored under lock and key. On the encouraging side, over 90 percent of the users left pesticides stored in the original containers.

Another on-going study is one designed to determine morbidity among field workers. Migrant families were matched with non-migrant families. All families used a health clinic in Weld County, Colorado. The objective of this study was to determine and compare the types of disease experienced by pesticide-exposed field workers and matched families who are not occupationally exposed to pesticides. There were a total of 429 participants in the field workers group and 185 in the control group. All of the participants work and live in Weld County during the work season between May and October. Work is primarily in the beet, onion and cucumber fields for thinning and hoeing operations. Upper respiratory illnesses were significantly higher in the field workers than in the control groups; although the incidence was rather high in both groups. This high incidence may be due to several factors including poor housing, poor personal hygiene, poor nutrition, and failure to seek immediate medical care.

Another area of investigation in health and safety includes a study of pleasure horse accidents. There are many pleasure horses in Colorado, and I was amazed when I first went to Colorado State University four years ago to find detailed information on costs to board pleasure horses in the C.S.U. General Catalogue. A total of 776 horse-related injuries were gleaned from hospital records by Dr. Williams. Permission was then obtained by physicians to send a mail questionnaire to those suffering injury. Time and place relationship, breed of horse, years riding experience, type and age of tack and related data have been included in the study. Results of the study have revealed injuries ranging from contusions, fractures, torn ligaments, concussions, sprains, etc. The injuries occur by riders falling from horses, riders being stepped on, kicked, or scraped against a solid object, or the horse falling on the rider -- one horse even suffered a fatal heart attack while being ridden. Probably the most interesting case in those studied occurred to a horseman in his late 70's, who injured several ribs when he attempted to jump on his horse from a ten foot high rock ledge only to have the horse move when he was in mid-air. In spite of the injury, he noted that he was a tough, old coot and that he participated in a fifty-mile trail ride the next weekend. Conclusions of this study indicate that if you ride horses long enough, regardless of experience, type of equipment or age of horse, you are apt to suffer an injury.

A demonstration project on Industrial Hygiene Services for Small Businesses is proposed as a pilot project for the provision of occupational safety and health services to small businesses (less than 100 employees) and agriculture. The objective is to demonstrate the capabilities of a land grant university to provide these services through the cooperative extension service, a central occupational safety and health consultation service and the expertise of individuals within the university.

The Extension Service will provide initial contacts with businesses followed the services of consultation service and consultants for special problems encountered. The project will be evaluated in terms of acceptance, cost effective analysis, health hazards discovered and remedies to these hazards. If successful, this project could be used as a model for delivery of these services in other states on a small industrial cooperative basis.

Overview of Agricultural Health and Safety Problems:  
The Federal Environmental View

John F. Finklea, M.D., William F. Durham, Ph.D., and Douglas I Hammer, M.D.

Many Americans, particularly those in our larger cities who are a generation or more removed from an agricultural existence, have forgotten their past and imagine that the farmer lives an idyllic pollution-free existence. However, one has only to glance over some of the topics in this conference to realize that the concept of agriculture as an industry free of environmental hazards is a myth.

The Environmental Protection Agency and other Federal agencies are well aware of some of the health problems associated with agriculture and are working along with State and local government, universities, and industry in an attempt to solve these problems. However, to my knowledge these agencies have not integrated their concerns into a logical program addressing environmental health in agriculture.

RESPONSIBILITIES OF FEDERAL AGENCIES

I would like to briefly review with you some of the Federal activities in the area of agricultural health and safety. I will doubtless talk more about EPA than about the other agencies involved, since that is the program with which I am most familiar.

The most significant impact of EPA on agricultural health and safety is in registration and regulation of pesticides. As a prerequisite to effective discharge of this responsibility, our agency also carries on a

---

From the National Environmental Research Center, Environmental Protection Agency, Research Triangle Park, North Carolina 27711.

research program on the human health effects of pesticides. You will be hearing later in this conference from Dr. William Murray about the epidemiological studies on the health effects of pesticides being carried out by EPA under the Community Pesticide Studies Program. Our agency is also working with the states to assure that pesticide applicators are properly qualified. One should not forget that EPA also has legal responsibilities to assure reasonably clean air and water supplies in an environment free from excessive noise for the farm family as well as the urban resident.

The U.S. Department of Agriculture, in its multifaceted effort to improve the lot of the farmer and the consumer, has a number of programs which have health aspects. Foremost among these USDA programs are studies to develop safer and more effective means of pest control, including various types of biological control. The Agricultural Extension Service also serves an important role in informing the farmer about necessary safety precautions for using pesticides.

The Department of Health, Education and Welfare is concerned with the health and safety of agricultural products and farm workers. For example, a major program of the Food and Drug Administration monitors pesticide residues in food crops and assures wholesome food supplies for the consumer. The National Center for Toxicological Research, a joint effort of FDA and EPA, is assessing the safety of long term, low level exposures to a variety of agricultural chemicals. Units of the National Institutes of Health such as the National Cancer Institute and the National Institutes of Environmental Health Sciences are conducting research to determine whether or not certain agricultural chemicals add to our health risks. The Center for Disease Control also plays an important role through its links to state health departments and through the research and scientific efforts of the National Institutes of Occupational Safety and Health.

The Department of Labor, under OSHA (The Occupational Safety and Health Act), has responsibility for issuing guidelines to protect agricultural workers. Among Federal agencies, the Department of Labor has taken the lead

in protecting migrant workers, for example, by setting standards for farm housing used by migrants.

The Department of Transportation issues guidelines for safe transportation of pesticides and sets safety standards for certain farm vehicles, such as trucks and tractors.

#### EXPOSURE AND/OR HEALTH DIFFERENCES BETWEEN RURAL AND URBAN POPULATIONS

Rural and urban populations have been shown to differ with regard to exposure to a number of potentially toxic chemicals. These and other environmental differences may be at least partly responsible for some of the observed variations in morbidity and mortality statistics which distinguish city dweller from farm populations. However, the links between exposure and human disease, especially chronic disease, have not usually been established.

1. Urban-rural studies of exposure or residues - A number of studies have shown that levels of DDT, its metabolite DDE and a number of other chlorinated hydrocarbon residues in both blood and adipose tissue are correlated with exposure.<sup>1</sup> Agricultural workers using pesticides have significantly higher DDT and DDE concentrations in both blood and adipose tissue than does the general population. The actual level for an individual worker depends on the degree of his work exposure to the pesticide. Applicators and other agricultural workers using organic phosphorus pesticides may have lower blood cholinesterase activity levels than the general population.<sup>2</sup> Whether or not this effect occurs depends on the amount of contact with the chemical and also on the protective measures observed. While most of these compounds affect both plasma and erythrocyte enzyme levels, some others, such as fenthion and Dursban, seem to have a disproportionate effect on the plasma cholinesterase.

In a study carried out in Charleston County, South Carolina, polychlorinated biphenyl (PCB) levels in plasma were more frequent and higher in urban than in rural residents.<sup>3</sup> Suspected urban exposure sources of PCB included polluted air and contaminated water.

2. Urban-rural differences in morbidity and mortality - A number of studies have demonstrated striking urban-rural differences in several specific categories of morbidity and mortality in the United States. In general, death rates for all causes and many individual causes are higher in urban than in rural areas.<sup>4</sup> Deaths due to arteriosclerotic heart disease, cancer (all sites), tuberculosis, and cirrhosis of the liver are all more common in urban areas. Although attention is often focused on the negative correlation between heart disease death rates and water hardness, most studies reporting this observation ignored population density which is in fact, a much stronger predictor.<sup>5</sup> Cancer of the lung occurs much more frequently among urban dwellers of this country and Great Britain.<sup>6</sup> Deaths due to accidents are more frequent in rural areas whereas those for homicide tend to be higher in urban areas.<sup>7</sup> Urban death rates for suicide almost universally exceeded rural rates during the 19th and early 20th century although today there is no difference or a slight rural excess.<sup>8</sup>

A recent monograph on "Infectious Diseases" summarizes incidence and mortality data for several specific disorders.<sup>9</sup> The incidence and death rates for amebic dysentery, diphtheria, whooping cough, tetanus, poliomyelitis, influenza and diarrhea of the newborn all were higher in non-metropolitan areas. The incidence of bacillary dysentery and measles was higher in metropolitan areas, but the death rates were higher in non-metropolitan areas. Pneumonia and meningococcal infections did not vary by urban-rural locations, but death rates due to puerperal sepsis, bronchitis, and emphysema all were more frequent in metropolitan areas.

Urban-rural differences in both disease incidence and prevalence have been documented by the U.S. National Health Survey. Age-sex adjusted rates

of acute conditions, days of restricted activity, and bed disability all were lowest in the non-SMSA farm areas. Likewise, the incidence of infective and parasitic disease, upper respiratory conditions, and "all other acute conditions," was lowest in farm areas.<sup>10</sup> With regard to the prevalence of selected chronic respiratory conditions, chronic bronchitis, asthma, and hay fever were lowest in rural areas whereas chronic sinusitis was reported most frequently in farm areas.<sup>11</sup>

Of course the reasons for these observed differences are both multiple and complex. Certainly differences in diagnostic custom, in availability of medical care, and in patterns of selective migration are involved. Nevertheless, after these aspects are accounted for, it is clear that part of the difference in morbidity and mortality patterns can be attributed to differences in the urban-rural environment. Furthermore, the environmental differences encompass both the non-occupational as well as the occupational factors.

#### UNSOLVED PROBLEMS

From my viewpoint in a Federal regulatory and research agency, there appear to be a number of unsolved or continuing problems in agricultural health and safety, including:

1. Availability of health care - The urban-rural differences in morbidity and mortality recounted earlier point out the problems of the availability and utilization of health care in rural areas as well as hazards peculiar to agricultural occupations. Medical care availability is generally better in urban areas. Several speakers in this Conference will address the specific problems of rural emergency medical care, rural general medical care and the delivery of health care in rural areas. Suffice it to say that although these problems still exist, efforts toward innovative solutions have begun.

2. Health of migrant workers - The special health problems of migrant workers were long neglected but are now beginning to receive consideration in various public health programs. I am pleased to see that the health of migrant workers is one of the topics to be discussed here.

3. Hazard of new and substitute pesticides - The recent limitations placed on the use of persistent chlorinated hydrocarbon pesticides have resulted in an increased usage of non-persistent, but acutely toxic organic phosphorus and carbamate-type pesticides. That is, we have exchanged an environmentally toxic group of compounds for chemicals which are less persistent and safer for the environment but on the average present a greater health hazard to the farmer-applicator and others directly exposed. The fact that acute occupational pesticide poisonings have not noticeably increased with this change in usage pattern may be credited, at least partly, to the joint USDA-EPA program "Operation Safeguard", which was designed to warn farmers of this hazard. It seems reasonable to continue this warning program until farmers generally are aware of the hazard of these newer pesticides.

4. Need for improved indices of exposure - The increased usage of organic phosphorus and carbamate pesticides referred to earlier has pointed up the need for improved methods of providing an early warning of possible over-exposure. Chemists at our Center have developed a urine test for exposure to organic phosphorus pesticides, based on excretion of the alkyl phosphate or thiophosphate moiety of the molecule. This procedure is more sensitive than blood cholinesterase as a measure of exposure. The method needs further testing to determine its correlation with poisoning.

5. Reentry problem - The reentry question will be discussed in detail by Mr. Harold Alford, Office of Pesticide Programs, EPA, later in this meeting and I will not go into it further here except to say that this is a matter on which we need more research to clarify the cause of these delayed poisoning incidents. The etiology of these poisoning outbreaks, which may occur 30 days or longer after spraying has puzzled our scientists for a number of years.

6. Disposal of unused pesticides - Farmers and others who use pesticides are often faced with the question of how to dispose of unused pesticides. In desert areas these materials may be safely buried with no threat of contamination to ground water. The only truly safe method of disposal is by burning. However, incineration must be accomplished in special high temperature ovens to assure complete combustion of the pesticide. Simpler disposal methods are needed which are more accessible to the individual farmer.

7. Changes in methods of pesticide application - One factor which may affect the hazard of pesticide usage for the farmer is change in the method of application. For example, the recent introduction of ultra-low volume (ULV) spraying techniques with the attendant smaller size of the spray droplets has brought about an increased suspendability of these particles in air. Studies carried out by our Center have shown an increased respiratory as well as dermal exposure for applicators using ULV applications in comparison with conventional dilute spray procedures.

8. Accidental injury - The greater hazard of accidental injury, both chemical and traumatic, for the rural as compared to the urban resident was considered above. Accident prevention is certainly a complex problem but equipment safety standards should prove helpful. Furthermore, improvements in the availability of emergency rural health care will surely reduce the associated morbidity and mortality.

#### SUMMARY

In summary, the environmental health and safety problems of agricultural workers and the rural family tend to be different in many respects from those of urban residents, even though many of their overall health problems are very similar. The rural environmental problems are no less real than the urban. These pollution problems need and deserve continued and increasing scrutiny by research workers to more clearly

define the important problem areas and to suggest feasible solutions. The Federal government is pursuing a number of research and regulatory activities to help solve agricultural health and safety problems. Among agencies involved in these activities are EPA, USDA, DHEW, Transportation and Labor. The conference here assembled provides a good mechanism for integrating our health and safety concerns; for highlighting continuing problem areas that require additional research, and for discussing progress toward solutions of other health questions relating to the most basic of American industries.

## REFERENCES

1. William F. Durham, Body Burden of Pesticides in Man, *Annals of the New York Academy of Sciences*, 160(1):183-195, June 23, 1969.
2. W. Taylor Sumerford, et al, Cholinesterase Response and Symptomatology from Exposure to Organic Phosphorus Insecticides, *A.M.A. Archives of Industrial Hygiene and Occupational Medicine*, 7(5):383-398, May 1953.
3. John F. Finklea, et al, Polychlorinated Biphenyl Residues in Human Plasma Expose a Major Urban Pollution Problem, *American Journal of Public Health*, 62(5):645-651, 1972.
4. B. MacMahon and T.F. Pugh, Chapter 4. Classification of Disease in Epidemiology, Principles and Methods. Little, Brown and Company, Boston, 1970, pp 376+ff.ix.
5. C. Pinkerton, et al, Cadmium Content of Milk and Cardiovascular Disease Mortality, *Trace Substances in Environmental Health V. A Symposium*, D.C. Hemphill, Ed., University of Missouri, Columbia, 1972, pp. 285-292.
6. B.W. Carnow and P. Meier, Air Pollution and Pulmonary Cancer, *Archives of Environmental Health*, 27(3):207-218, Sept. 1973.
7. M. Wolfgang, ed., Status and the Relational System in Studies in Homicide. Harper and Row, New York, 1967, pp. 323+ff.viii.
8. J.P. Gibbs, ed., Variation in Suicide Rates in Suicide, Harper and Row, New York, 1968, pp. 338+ff.x.
9. C.C. Dauer, et al, Infectious Diseases. Harvard University Press, 1968, pp. 262+ff.xviii.
10. Acute Conditions, Incidence and Associated Disability, United States, July 1964-June 1965. National Health Survey, National Center for Health Statistics, PHS Publication No. 1000, Series 10, No. 26, 1965.
11. Prevalence of Selected Chronic Respiratory Conditions, United States - 1970. National Health Survey, National Center for Health Statistics, Vital and Health Statistics, Series 10, No. 84. DHEW Publication No. (HRS) 74-1511, Rockville, 1973.

## Discussion

L.W. Knapp, Moderator

Before we turn the program for the next portion over to Dr. Wallace, we do have a brief discussion period to provide you an opportunity to ask a few questions. To start this off I have been asked if I might reiterate the priority list. I'll try to be very brief on that. First of all, what I said is that we need to have better statistics. I talked about the efforts of the National Safety Council as a pilot study program with their standardized form in getting us this kind of information. Secondly, I pointed out that we need to develop some kind of a health norm so we will be able to describe adverse health effects, whether they are of a chronic nature or whether they are of a traumatic nature. Third, we need to expand our educational effort. This isn't all a matter of regulation or of engineering design - there's a lot of education that has to take place in this. Fourth, we are doing practically nothing research wise yet though I would have to say that NIOSH does have a number of programs funded now. Things are beginning to get underway but in general we have no broad approach. And fifth, I think we also need to have some task forces established in this area which are made up of people knowledgeable which will be representative of the total country. For example, we can have a pretty good idea of what the situation in the midwest is, but I am not familiar with Colorado except through Dr. Savage and Dr. Bagby. They know the problems they face. And sixth, I think we need a number of regulations, particularly some performance standards which can apply to the agricultural problems which the farmer will accept and use. He should not feel that they are imposed on him. Because of the diversity of agriculture enforcement is nigh impossible. Those are my six points. Now, do we have any further questions you'd like to address to any of the previous speakers?

Dr. Rodney Beard

Dr. Savage, what are nitrate levels you find associated with increased blood pressure?

Dr. Eldon Savage

Several exceed the 10 mg/liter of nitrogen in water and the highest community is above 30 ppm. The control communities are near the zero nitrate level. The communities that have high nitrate levels usually use well supplies and are located in rural areas where you have rich agricultural land and cattle feed lots. The highest nitrate level is in a small town called Nunn, Colorado. Nunn is in a dry-land farming area. There are no feedlots nearby. We have attempted to trace down the source of nitrate and we really have not been successful. A recent suspect is the old Cheyenne Air Force Artillery Range that is located above the watershed. This range was used extensively during World War II, as a training site.

Unidentified Speaker

How do the carbon monoxide poisonings occur?

Dr. Eldon Savage

Vacationers enroute to Colorado travel by auto across the plains into Colorado and may have been subjected to temperatures of 90-100°. As they drive into the mountain areas they get cold and roll the windows up and many of them will pull off to the side of the road to view the mountain scenery. We found that some vehicles hit rocks and damage the exhaust system. We have checked some cars and campers at high altitudes for CO levels. In these cars - new or old - we were getting CO levels that were approaching what you would find in downtown urban areas. During these studies, we talked to a rural physician who is also a county coroner. He discussed several

incidences of CO poisoning that he has treated or has seen as coroner. He has incomplete records of those cases he has treated in his office. In his opinion, cases occur more frequently during temperature inversions. As county coroner, he had looked at and has been called in on several light airplane accidents. He is also of the opinion that carbon monoxide may be involved in some of these accidents.

Mr. L.W. Knapp

We have time for one more question.

Unidentified Speaker

In your definition of carbon monoxide poisoning what were you using as a clinical diagnosis?

Dr. Eldon Savage

Those were all hospitalized cases.

Unidentified Speaker

And how were the hospitals defining them?

Dr. Eldon Savage

They varied from hospital to hospital. A few cases had blood work done on the, but most were on symptomatology. In general, hospital records leave something to be desired in studying the epidemiology of carbon monoxide poisonings. All of the cases that I have reported on CO in this group were accidental poisonings.

## Introduction

Robert Wallace, M.D.

I am going to adhere to the time schedule with vigor. This particular section is about epidemiology of agriculturally-related illness but in fact a good portion of it will be really some of the clinical aspects of agricultural exposures. The first speaker is Dr. David Mick from the Iowa State Department of Environmental Quality in Des Moines. He was with us in the Department of Preventive Medicine for several years and was very productive in the Community Pesticide Program. He will speak about chemicals in agricultural use.

## Chemicals in Agricultural Use

David L. Mick, Ph.D.

Who determines what chemicals are used in agriculture? Conversely, who determines what chemicals are not used in agriculture? Who is the guiding light? Who exerts the greatest influence?

The above questions are partially answered in a conclusion found in the Report of the Secretary's Commission on Pesticides and Their Relationship to Environmental Health (1). The conclusion was that the final decision regarding the usage of pesticides must be made by those governmental agencies with the statutory responsibility for public health and for pesticide registration. Do you agree with this conclusion?

Who within the governmental agencies should be entrusted to make decisions concerning the use of agricultural chemicals? What technical information should they consider in arriving at a decision? How do these officials make a decision when no technical solution is evident?

Some insight might be gained from an article that appeared in the Scientific American (2) and relates to nuclear war. The information may not be directly applicable to the agricultural chemical business, but the general theme should make us think. The authors state that:

"both sides in the arms race are confronted by the dilemma of steadily increasing military power and steadily decreasing national security. If the great powers continue to look for solutions in the area of science and technology only, the result will be to worsen the situation. It is our considered professional judgement that this dilemma has no technical solution."

One example that parallels the preceding philosophy is the spraying of roadsides with herbicides. Some agencies and individuals say that we no longer have to blanket spray the roadsides in the state. They advocate spot spraying for noxious weeds only because they feel that the weeds have been suppressed to the point that continued blanket spraying is more detrimental to desirable vegetation than it is to the weeds. Some complain that blanket spraying of roadsides is causing the disappearance of the wild rose and other wild flowers. This decision is coming mostly from an aesthetic viewpoint, not from any scientific research. Perhaps there is no technical solution. It is difficult to scientifically measure aesthetics.

An article by Laski<sup>3</sup> was published in the thirties, but it contains some information that is applicable today. It mentions that the day of the plain man has passed -- common man is being pushed into antiquity. He isn't able to judge the adequacy of the decisions today because the world has become so complex. Laski wrote that:

"no one could seriously deny that in fact none of our social problems is capable of wise resolution without formulation of its content by an expert. But it is one thing to urge the need for expert consultation; it is another and very different thing to insist that the expert's judgment must be final. For special knowledge and the highly trained mind produce their own limitations. Expertise too often fails to see round its subject. It sees its results out of perspective by making them the center of relevance to which all others must be related. Too often, also, it lacks humility; and this breeds in its possessors a failure in proportion which makes them fail to see what is before their very noses. It has, also, a certain caste-spirit, so that experts tend to neglect all evidence which does not come from those who belong to their own ranks. Above all, the expert fails to

see that every judgment he makes not purely factual in nature brings with it a scheme of values which has no special validity. He tends to confuse the importance of facts with the importance of what he proposes to do about them.

The expert, in fact, simply by reason of his immersion in a routine, tends to lack flexibility of mind once he approaches the margins of his special theme. He is incapable of rapid adaptation to novel situations. He unduly discounts experience which does not tally with his own. The expert rarely understands the plain man. What he knows, he knows so thoroughly that he is impatient with men to whom it has to be explained. The danger which confronts us is the quite fatal one, that, by the increased complexity in civilization, we may come to forget the humanity of men. A mental climate so perverted as this would demonstrate at a stroke the fragility of our social institutions. For it would reveal an abyss between rulers and subjects which no amount of technical ingenuity could bridge. The material power that our experts multiply brings with it no system of values. It can only be given a system related to the lives of ordinary people to the degree that they are associated with its use. To exclude them from a share in its direction is quite certainly to exclude them also from a share in its benefits. We must ceaselessly remember that no body of experts is wise enough to be charged with the destiny of mankind."

An example where the experts listened to others involved publication of the Occupational Safety and Health Standards for Farm Workers Dealing

with Pesticides in the Federal Register of March 11, 1974. Included was the statement:

"no pesticide shall be applied while any person not involved in the application is in the fields being treated."

If Iowa farmers adhered to this, they would have to break the law to get their crop planted on time.

The EPA said that the response to the proposal was unusually heavy with approximately 1,000 written statements submitted and several conferences were held with interested parties. Written statements were received from growers, grower-organizations, farm-labor organizations, pesticide manufacturers, representatives of federal, state, and local governments, the academic community and the general public. This input resulted in a more acceptable revision of the proposal which now reads that there is a prohibition against applying pesticides when unprotected workers are in the area being treated.

The authorities in the federal government listened to the people directly involved in the situation. And that is the basic theme of this presentation. It's about the limitations of experts, particularly concerning agricultural chemicals. Just because somebody has a good technical background and considerable knowledge at hand doesn't mean that the person shouldn't listen to others. Furthermore, it is important to remember that in some situations there is no technical solution to the problem.

## References

1. Report of the Secretary's Commission on Pesticides and Their Relationship to Environmental Health, U.S. Department of Health, Education, and Welfare, 1969.
2. Wiesner, J.B. and York, H.F., Scientific American 211:27, 1964.
3. Laski, H.J., Harpers 162:101, 1930.

The Migrant Worker  
His Health and Safety

Sister Irene Munoz C.H.M.

Health, hygiene and occupational safety are not mere academic themes or topics to discuss before concerned and interested people like yourselves.

A mere thirty miles away from here, and in thousands of other similar places in the country, these are painful realities and everyday concerns for a group of people who we call migrants. These are the marginal citizens who migrate throughout the United States to harvest our crops. The migrant citizens have been grossly neglected by society, despite their vital role in modern agriculture. Each year more than a million leave their homes for work that is so vital to our economy; yet, - receive so little recognition. They travel because of economic necessity to survive. By working the longest hours, by living in deplorable housing, by earning the lowest wages and facing the worst health conditions, namely; unsafe water, nitrates, inadequate toilet facilities, pesticide poisoning, sun, stoop labor. Migrants are reduced to subhuman entities and indeed it is a harvest of shame.

If you were a migrant farm worker you would be paid around \$1,500 a year. If everybody in your family worked, you might make \$2,700. Many days you would not work. None would be available. Your life expectancy would be 49. Your children would be more than twice as likely to die at birth; and your wife in giving birth. Your families chance of catching influenza, pneumonia, tuberculosis or some other infectious diseases would be three times the national average. You would probably never reach the eighth grade. You would be lucky to have two rooms in which to lodge your family. You might have some electricity, but probably no toilet, sink, bathtub or shower.

I am not talking about the 1920's, the 1930's, the 1940's, years of depression and dust bowls. I am speaking about migrants today in 1974 throughout the United States. I am speaking about people who come into

migrant clinics with T.B., pesticide poisoning, slipped disc, and hernias.

I am speaking of United States citizens who live in 12 x 7 huts, who walk hundreds of feet in a poorly lighted camp to use the toilet facilities, who live ten to thirteen in a single room, who have no drinking or toilet facilities in the field, and who hide behind the corn stalks to ease nature's call, people who are forced by economic necessity to use their children in stoop labor and who after a work day of fourteen hours still qualify for food stamps, people who because of language, culture, and economic indigence are not adequately treated by the various health and social agencies in our communities.

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 benefits enacted by Federal and State law - such as unemployment insurance, general welfare assistance, minimum wage standards, child labor protections, and coverage under the National Labor Relations Act.

The bulk of the domestic migratory workers travel in three major routes northward from States along the southern border of the country. 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 in 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. Blacks 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 Chicano's work along this route.

Because of the nature of migrancy, which includes temporary housing that is crowded and inadequate, families are housed thirteen to a room. Due to these deplorable conditions, communicable diseases such as T.B., Impetigo, and parasitic diseases are prevalent.

Lack of refuse cans, proper extinguishers, self-closing lids on privy risers, mattresses unclean and full of holes are further causes of acute health problems of the migrant worker.

As many of these houses are in camp settings, existing housing laws are poorly enforced and non-existent. Often when migrants complain of poor housing and work conditions to public health officials, they do this in fear because of ejection by the grower.

This happened quite recently in the state of Illinois. This has happened repeatedly in that the migrant remains silent and continues his existence in the sub-human condition for fear of loss of wages and/or job.

Inadequate water purification systems present many problems of Shigellosis and other parasitic conditions. High nitrates in water is often not communicated or posted for families to be informed. Diarrhea is always prevalent whenever there are migrant children in poor housing and sanitation facilities. Drinking facilities are not provided in the fields. Often water is carried in large containers in fifty gallon barrels or canteens.

Toilet facilities are not provided in the fields which is against OSHA laws and human concerns.

Inadequate warning signs and type of pesticide used is lacking. Re-entry warnings are not posted. If a migrant contracts a pesticide in his system, adequate treatment is not feasible as the type of pesticide is unknown to him or grower. Only the large companies are aware of this information and then this is difficult to obtain from them.

Daycare programs continue to be in need for migrant children. Newborns and toddlers are taken to the fields while the families are at work, thereby subjecting them to pesticides, hazards, infections, etc.

Child labor has not been eliminated with migrant worker children. Migratory children, who comprise a significant segment of the children employed in agriculture, are the most seriously affected by the absence of a meaningful child labor law. The most common reason for their employment is the low wages paid to the family breadwinner, which are not sufficient to meet minimum family expenses. Child labor interferes with the normal processes of growth and development in the child, as they (the children) are subject to chronic fatigue which lowers a child's resistance to disease and which interferes with the natural growth processes.

### Proposed Solutions

The solutions which I offer are neither new or unique, nor panaceas. But they are realistic, feasible, possible and very urgent if we are to face up to the sad realities of migrancy and work for a viable solution or alleviation of this black mark in our economic system which is migrancy. I offer the following:

- 1) Re-define the term migrancy and migrant to include all people who travel from state to state or intrastate in search of seasonal farm labor including all forms of farm-related industries. A migrant camp, site - should be any place where one or more people come to do seasonal farm or farm-related work. This is so that adequate laws can be enacted

- or enforced by public health officials to ensure the health and safety of all workers.
- 2) The elimination of child labor nationally from agricultural work. All efforts should be made to safeguard our youth from employment which is injurious to their welfare, hazardous to their health and obstructs their education.
  - 3) All migrants should be covered under the minimum wage law in all states. The extension of minimum wage coverage to farmworkers is the first step to bringing these people economic assurances which have been the right of our nation's industrial work force for the past three decades.
  - 4) The National Labor Relations Act should be extended to migrants employed in agriculture. The migrant must be given the chance of organizing and demanding a fair wage and better working conditions.
  - 5) More legislation is needed to ease the flow of foreign labor coming into this country and destroying whatever organizing efforts farm workers undertake.
  - 6) Compulsory workmen's compensation laws should be extended as to provide coverage for all agricultural workers in all states.
  - 7) A national compulsory housing code that will cover all migrant housing.

I would hope that what I have said today will not go by the wayside.

Migrancy has been cussed and discussed for many years and the struggle still continues and will continue until economic justice is assured the migrant worker. You here present today are very vital in helping us achieve this goal.

References

1. The Migratory Farm Labor Problems in the U.S., 1968 Report.
2. Christofer News Notes.
3. Muscatine Migrant Staff, 1974.  
Chairman of the Board, 1974.  
Muscatine, Iowa.
4. Personal experiences working with migrant workers as a project nurse for seven years.
5. Migrant Workers.

## Introduction

Robert Wallace, M.D.

Our next speaker is Dr. John Kammermeyer from the Division of Allergy and Immunology of Iowa's Department of Medicine. He'll discuss some of the respiratory problems in agriculture.

## Respiratory Problems

John Kammermeyer, M.D.

### Some Special Aspects of Pulmonary Disease in a Farm Setting

There are many respiratory illnesses that are equally prevalent on the farm and in urban settings; but there are several pulmonary diseases that are either more common or pose special problems in a farm setting. Three of these pulmonary problems, extrinsic asthma, farmer's lung, and silo-filler's disease, will be discussed briefly.

The first of these, asthma, may be defined as paroxysmal or episodic, non-exertional, wheezing dyspnea. These episodes are the result of a hyper-reactive bronchial tree which readily goes into spasm, thus narrowing the bronchial passageways and diminishing airflow in and out of the lungs. Many different things may act as an insult to the bronchial tree causing bronchospasm. Thus not all asthma is allergic in nature. Some patients present a picture of intrinsic asthma where non-specific irritants (such as smoke, fumes, and cold air) as well as respiratory infections are the major triggers for the asthmatic attacks.

Other patients present with a picture of extrinsic or allergic bronchial asthma, where, based on history and skin tests, one is able to document an allergic sensitivity to one or more inhaled allergens as being responsible for the asthmatic attacks. Those inhalants most commonly incriminated as triggers in allergic asthma include pollen grains, mold spores, animal danders, and dusts of various sorts. Indeed, any material that is protein in nature and can be dispersed into a fine powder that is capable of being inhaled is potentially capable of inducing an asthmatic sensitivity in an allergic individual.

In a farm setting there usually is a much heavier local exposure to various pollens, especially grass and ragweed pollen, than in an urban setting. Thus, frequently a patient's asthma may be more difficult to manage during a given pollen season if they live in a farm setting, than if they live in town.

In general, certain farm environmental settings allow for a greater mold spore exposure than if the patient lived in town. These settings include the barn, especially if old hay or straw is present, and the fields, especially during harvesting when dead and decaying plant material is prevalent and readily serves as an excellent medium for mold to grow on. However, based on mold spore sampling, both in urban and rural settings, which has been carried out in the Iowa City area this year, there does not appear to be as large a differential in mold spore exposure between rural and urban settings as previously assumed. Indeed, throughout much of the summer, the average urban dweller seems to get as much mold spore exposure when working in his yard or mowing his lawn as he would if he were on a farm. But during the fall harvest period there is little doubt that there are much higher levels of mold spore exposure on the farm than in the urban setting.

Obviously there may be a greater and more varied exposure to various animal danders in a farm setting than in town. Not infrequently an asthmatic sensitivity to horse, cattle or hog danders is seen in a patient from a rural setting. However, there appears to be something about hog dust and danders which are quite irritating to the human when inhaled, and which may nonspecifically aggravate asthma or cause symptoms suggestive of bronchitis even though skin testing is totally negative.

Dusts, especially house dust, are known to induce asthmatic attacks in a sensitized individual. There is no greater exposure to house dust on the farm than in town, but there is a greater exposure to grain dusts, in which the grain protein is present in a highly pulverized form, and which are capable of sensitizing an allergic individual so as to induce an asthmatic attack on subsequent exposure. Cornmeal, wheat flour, and oatmeal are all capable of inducing an asthmatic response in a sensitized individual when inhaled.

Here in Iowa, the major grain dust exposure is to cornmeal or corn dust, present either in animal feeds or around corn bins or storage areas. Not infrequently a patient may relate that his asthma flares when opening and emptying a sack of animal feed or when he is working around corn storage areas.

As can be seen, there is likely to be a heavier exposure in the farm setting than in town to various inhalant allergens. Thus, significant avoidance of the allergen may be difficult if not impossible to achieve; and broncho-dilator medications, hyposensitization, and cromolyn sodium become the major categories of therapy for extrinsic asthma in the patient living in a rural setting.

Hypersensitivity pneumonitis, or farmer's lung, is a second type of allergic respiratory disease which may be seen more commonly in a farm population. Almost any inhaled organic dust, whose particles are smaller than 5 micra and thus able to penetrate to the periphery of the lung, appears to be capable of inducing the development of a hypersensitivity pneumonitis (Table I). Although this type of pulmonary disease can develop in an urban setting where an air conditioner or humidifier is contaminated with mold, in general the most common cause of hypersensitivity pneumonitis, especially in Iowa, appears to be the inhalation of spores of thermophilic actinomycetes. These actinomycetes readily grow in decaying vegetation, such as decomposing hay or silage where temperatures in the range of 40-60°C may occur. The most common exposure setting is working with old moldy hay or silage in a barn or silo.

In addition, a number of other types of fungal spores, including *Cryptostroma*, *Graphium*, *Penicillium*, *Aspergillus*, *Mucor*, and *Pullularia*, encountered in specific occupational exposures have been incriminated as being capable of causing a hypersensitivity pneumonitis (Table I). Moreover, pulverized debris of *Sitophilus granarius*, the wheat weevil, has been shown to be capable of causing a hypersensitivity pneumonitis when inhaled where contaminated wheat flour is being milled or processed. Therefore it is not unreasonable

to suspect that other types of mold spores or insect debris not yet recognized might also be capable of inducing a hypersensitivity pneumonitis upon repeated exposure.

Clinically, several forms of hypersensitivity pneumonitis have been recognized. The most common pattern is the acute form which develops 4-6 hours after a moderate to heavy exposure to the offending agent. The patient develops cough, dyspnea, fever, chills, and malaise. On physical examination basilar rales usually are noted; and the chest x-ray may show a picture of peripheral, finely nodular, interstitial infiltrates. A leukocytosis may occur; and pulmonary functions tend to show reduced volumes, decreased compliance, and impaired diffusing capacity.

Frequently, however, when the exposure is to smaller amounts of the offending material, chronically over a long period of time, a more insidious form of hypersensitivity pneumonitis is seen which presents in a subacute or chronic form. The subacute pattern may resemble a chronic progressive bronchitis, with gradual onset of dyspnea, chronic cough, anorexia, and fatigue. Again pulmonary functions reveal progressive restrictive and diffusion defects. Chest films usually show a fine interstitial infiltrate and sometimes may show early pulmonary fibrosis. The chronic form may present as longstanding progressive pulmonary fibrosis leading to pulmonary insufficiency.

Histologically the more acute picture is that of a granulomatous interstitial pneumonitis which may go on in the chronic form to extensive pulmonary fibrosis. Commonly, precipitating humoral antibodies against the offending agent can be demonstrated in the patient's serum. Treatment includes the use of corticosteroids in the acute phase and avoidance of future exposure to the offending agent.

A third type of lung disease, silo-filler's disease, is usually seen in a farm setting and is due to chemical toxicity. Silo-filler's disease is the result of exposure to toxic levels of nitrogen dioxide which is formed from fermenting silage during the first several weeks of storage. The nitrogen

dioxide collects in the silo as a slightly brownish gas and is most commonly associated with corn or alfalfa silage. The course of clinical illness depends upon duration of exposure and concentration of nitrogen dioxide present, but generally there are three phases noted.

Immediately upon exposure the patient develops cough, dyspnea and weakness. If the exposure is to a high enough concentration of nitrogen dioxide, the picture of an acute bronchopneumonia develops, which may go on to massive pulmonary edema and a fatal outcome. Usually, however, following this initial phase, a second phase consisting of a period of minimal symptoms or total remission of symptoms occurs, lasting from two to six weeks.

Finally, several weeks after the initial exposure, a third phase develops consisting of progressive pulmonary insufficiency which is marked by cough, dyspnea, fever, and chills. On physical examination moist rales are present, and the chest film shows a diffuse, nodular infiltrate. Pathologically the picture is that of a bronchiolitis obliterans, with the terminal bronchioles obstructed by an organizing fibrous exudate. This second acute phase may also result in fatality if the initial exposure was severe enough; however, more often the patient recovers in several weeks with little if any residual pulmonary impairment. Treatment is primarily supportive including the use of oxygen and assisted ventilation if necessary. Steroids appear to be of some benefit in reducing the amount of inflammatory reaction at the bronchiolar level.

#### Summary

In summary, there are three pulmonary diseases, extrinsic asthma, farmer's lung, and silo-filler's disease, which are either more common or harder to manage in the farm setting. Two of these, extrinsic asthma and farmer's lung, are allergic in nature, the former caused by inhalant allergens which penetrate only the proximal part of the pulmonary tree, and the latter caused by inhalant allergens which are able to penetrate much more distally.

Silo-filler's disease, on the other hand, is a response to a toxic chemical exposure. Extrinsic asthma may be triggered by many inhalant allergens including pollens, mold spores, animal danders, and dusts. Both farmer's lung and silo-filler's disease may develop following exposure to silage; however, the former is due to inhalation of actinomycete spores in old decaying silage, whereas the latter is due to the inhalation of nitrogen dioxide fumes generated in fresh silage during the first few days or weeks of storage. Therapy of extrinsic asthma includes avoidance of the allergen if possible, the use of bronchodilator medications, and hypo-sensitization. Avoidance of exposure to the offending agent is the most important aspect in the management of farmer's lung and silo-filler's disease. If exposure has occurred, then supportive management and corticosteroid therapy are indicated.

TABLE I

## ETIOLOGY OF HYPERSENSITIVITY PNEUMONITIS

	Disease Name	Source of Antigenic Material Inhaled	Antigen
Induced by Microorganisms	1) Farmer's lung	Moldy hay	Thermoactino- myces vulgaris or
	2) Bagassosis	Moldy sugar cane	
	3) Mushroom worker's lung	Mushroom compost	
	4) Hypersensitivity pneumonitis	Contaminated air conditioner or furnace humidifier	Micropolyspora faeni
	5) Maple bark pneumonitis	Infected maple bark	Cryptostroma corticale
	6) Malt worker's lung	Moldy barley, malt dust	Aspergillus fumigatus Aspergillus clavatus
	7) Sequoiosis	Moldy redwood sawdust	Graphium sp. Pullularia pullulans
	8) Cheese washer's lung	Moldy cheese particles	Penicillium casei
	9) Paprika splitter's lung	Paprika dust	Mucor stolonifer
Induced by Animal Proteins	1) Bird fancier's lung	Parakeet, Budgerigar droppings	Avian protein in serum and droppings
	2) Pigeon breeder's lung	Pigeon droppings	
	3) Hen worker's lung	Hen droppings	Bovine or Porcine proteins
	4) Pituitary snuff taker's lung	Pituitary snuff	
Miscellaneous	1) Wheat weevil disease	Infested wheat flour	Sitophilus granarius
	2) Suberosis	Moldy cork dust	--
	3) "New Guinea" lung	Moldy roof-thatch	--
	4) Fishmeal worker's lung	Fishmeal	--
	5) Coffee worker's lung	Coffee bean dust	--
	6) Detergent enzyme worker's lung	Enzyme dust	Bacillus subtilis enzyme

## Selected References

Asthma

Patterson (ed.), Allergic Diseases, Diagnosis and Management. Philadelphia: J. B. Lippincott, 1972, pp. 87-123.

Sheldon, Lovell, Mathews, A Manual of Clinical Allergy. Philadelphia: W.B. Saunders, 1967, pp. 88-175, 326-455.

Hypersensitivity Pneumonitis

Patterson (ed.), Allergic Diseases, Diagnosis and Management. Philadelphia: J. B. Lippincott, 1972, pp. 532-542.

Reed, C.E., "Hypersensitivity Pneumonitis," Postgraduate Medicine, 51:120-127, 1972.

Hargreave, F.E., "Extrinsic Allergic Alveolitis," C.M.A. Journal, 108:1150-1154, 1973.

Silo-Filler's Disease

Ramirez, R.J. and Dowell, A.R., "Silo-Filler's Disease: Nitrogen Dioxide-Induced Lung Injury," Ann. Int. Med., 74:569, 1971.

Scott, E.G. and Hunt, W.B., "Silo-Filler's Disease," Chest, 63:701, 1973.

Donoghue, F.E. and Schmidt, H.W., "Farmer's Lung and Silo-Filler's Disease," Med. Clin. N. Amer., 48:903, 1964.

Moskowitz, R.L., Lyons, H.A., and Cottle, H.R., "Silo-Filler's Disease," Am. J. Med., 36:457, 1964.

Lowry, T. and Schuman, L.M., "Silo-Filler's Disease--A Syndrome Caused by Nitrogen Dioxide," JAMA, 162:153, 1956.

Grayson, R.R., "Silage Gas Poisoning: Nitrogen Dioxide Pneumonia, A New Disease in Agricultural Workers," Ann. Int. Med., 45:393, 1956.

## Introduction

Robert Wallace, M.D.

Our next speaker is Dr. Richard Zuehlke from the University of Iowa College of Medicine, Department of Dermatology, who is going to discuss skin conditions in agriculture.

## Common Cutaneous Problems in Agricultural Workers

Richard L. Zuehlke, M.D.

### Introduction

Farmers experience the same skin diseases as others, but there are some conditions which are seen more often in agricultural workers than the general population.

This paper will discuss several types of problems seen with a greater incidence in those engaged in agriculture. These have been grouped as follows: (1) contact dermatitis, (2) infections, (3) damage from sun and heat induced changes and (4) arthropod induced problems.

### Contact Dermatitis

The majority of cases of contact dermatitis are due to the irritant effect of chemicals. If anyone's skin has enough exposure to an irritant, a dermatitis will develop. Most other instances of contact dermatitis are due to a specific allergy. Only certain persons who become sensitized, following exposure to a particular antigen, and are subsequently re-exposed will develop this form of dermatitis. Rarely, a contact dermatitis develops only if there is exposure to sunlight in the presence of the contactant. This is called photocontact dermatitis. Photocontact dermatitis may be either a phototoxic (nonallergic) phenomenon or photoallergic.

Farmers are exposed to many agents capable of eliciting a contact dermatitis. In fact most insecticides, herbicides, etc., are capable of producing an irritant contact dermatitis if there is significant exposure. The following discussion will just mention the agents which are more potent irritants, allergens or photosensitizers.

Of the insecticides, pyrethrum is one of the more potent allergic sensitizers. There are sometimes cross reactions between pyrethrum, chrysanthemum, shasta, daisy, and ragweed oleoresin. This means that someone who has been sensitized with pyrethrum might develop an allergic contact dermatitis if exposed to chrysanthemums. The synthetic chlorinated hydrocarbons such as aldrin, lindane, chlordane, and dieldrin rarely sensitize and usually do not cause irritant contact dermatitis if used properly. Chlordane and lindane have been reported to cause necrotizing vasculitis and the accidental ingestion of lindane has resulted in porphyria cutanea tarda, but such complications of insecticide use are rare. Phenothiazine is sometimes used as an insecticide. It can act both as a sensitizer and a photosensitizer. Furthermore, some persons who have become sensitized by cutaneous exposure to phenothiazine will develop dermatitis if they take a phenothiazine, by mouth, as a tranquilizer in the future. Tetramethylthiuram, which has been used to eradicate Japanese beetles is a moderately potent sensitizer. Its importance in this regard is increased by the fact that there are many other potential sources of contact with tetramethylthiuram. These include rubber, adhesives, soaps, shampoos, paints, preservatives, putty, rat repellent, rocket fuel, fungicides, and herbicides.

Fungicides may include mercury, a sensitizer; formaldehyde, an irritant and sensitizer; quaternary ammonium compounds which can rarely sensitize and tetramethylthiuram, which is discussed above.

Herbicides sometimes contain tetramethylthiuram; maleic hydrazide, which may sensitize; and trichloroacetic acid, a potent irritant. The commonly used herbicide 2,4-dichlorophenoxyacetic acid (2,4-D) is not a potent sensitizer. It may, however, produce an irritant contact dermatitis if it is not used properly.

Most fumigants do not cause cutaneous changes if properly used. Sulfur dioxide, however, has been reported to cause urticaria in susceptible persons.

Animal feeds have additives which may include antibiotics and phenothiazines. Hence these may cause an allergic contact dermatitis or a photo-contact dermatitis.

Of the plants causing contact dermatitis the most important ones are in the rhus group. This includes poison ivy, poison oak, oak leaf poison ivy, and poison sumac. The term poison is actually misleading. The rash produced by these plants is due to an allergen: an oleoresin called urushiol. It is not a toxin or poison. These plants have several features in common. They have waxy, white fruit which is segmented like a peeled orange. They also have clusters of white flowers. With the exception of poison sumac, which has 7-13 leaflets, they have three leaflets with a common point of origin. They generally grow as vines or small shrubs, although occasionally these are large enough to resemble trees. Poison sumac is again the exception. It grows as a woodish shrub or small tree and never as a vine. Poison ivy grows in all sections of the United States except the Southwest and Pacific Coast. Poison oak is found along the Pacific Coast. Oak leaf poison ivy is found along the East Coast from New Jersey to eastern Texas. Poison sumac is usually found east of the Mississippi.

The sensitizing oleoresin is not present on the surface of intact rhus plants. There must be some injury to the plant to allow it to escape. It then quickly dries on whatever it contacts and may maintain its antigenicity for many months. Although it is best removed from clothing by a cleaning solvent, ordinary laundering is usually sufficient. The oleoresin does not vaporize, but may be carried by windborne particles in smoke. The urushiol may therefore get on one's skin by direct contact with the plant, from contaminated objects which touch the plant (e.g. clothes, pets, tools, etc.), or by small airborne particles arising from the burning of the plants. The rash begins six hours to seven days following contact with the oleoresin. Usually the interval is about two days.

The initial cutaneous changes are erythema and edema. Vesicles quickly form in many of the involved areas. The vesicles usually rupture producing

a serous drainage. This does not spread the rash. The increasing extent of the dermatitis is due to some areas having gotten less oleoresin, to subsequent acquisition of oleoresin from contaminated objects, or to resistance of areas of skin with a thicker stratum corneum. Careful observation will frequently reveal one or more areas of linearity. This is helpful in diagnosing rhus dermatitis. The rash is very pruritic.

The severity of rhus dermatitis depends on the quantity of antigen which contacts the skin and the sensitivity of the person. The most frequently involved persons are children and workmen who do their jobs in fields and woods. It is less common in old persons, probably because of decreased exposure and the reduced immune competence associated with old age. It is also less common in blacks.

Other plants are also capable of eliciting allergic contact dermatitis. A group of the Compositae family including chrysanthemums, pyrethrum, and daisies may act as sensitizers. There are hundreds of species of primula most of which are nonsensitizing. *Primula obconica* and *Primula malacoides* contain allergens.

The common ragweed (*Ambrosia artemisiifolia*) is best known because of its protein antigen which causes allergic rhinitis in the late summer and fall. This plant also has an antigenic oleoresin which is carried on the pollen and may cause an airborne allergic contact dermatitis. This results in dermatitis of exposed areas without any sparing of shaded areas (e.g. under the chin, behind the ear lobule) as is seen in photosensitive dermatoses. Sometimes there is an accentuation in flexural creases and at the edges of clothing. The first sign is usually redness and swelling of the eyelids. This problem is most prevalent in August and September. For the individual patient there is a tendency for the annual recurrences to be more persistent and after several years the patient may become affected throughout the year. A vicious itch scratch cycle probably serves to perpetuate the rash during the months when the pollen is not in the air. Ragweed oleoresin cross reacts with

chrysanthemums, pyrethrum, marsh elder and linseed oil. It may also produce a photoallergic contact dermatitis.

Bulb fingers is a condition found in those who sort and pack dried tulip, hyacinth, onion and garlic bulbs. Patients with this problem present with redness, tenderness, and tingling of their finger tips. Continued exposure results in scaling and fissuring. It is thought that this may be produced by the bulbs directly or by chemicals on the bulbs such as fungicides.

Many vegetables can produce dermatitis. The most notorious are carrots, but artichokes, asparagus, celery, chicory, cucumbers, horse radish, kidney beans, lettuce, mustard greens, parsnips, potatoes, spinach and tomatoes are also capable of producing a contact dermatitis.

Wood can cause dermatitis. The usual mechanism is primary irritation due to mechanical trauma, e.g., wet sawdust. Domestic woods known to cause an irritant contact dermatitis include pine, oak, poplar, acacia, birch, cedar, and spruce. Some imported woods may produce an allergic contact dermatitis, e.g., satinwood and teak. Lichens may also elicit an allergic contact dermatitis.

The term phytophotodermatitis refers to the nonallergic response on the skin produced by juices from certain plants in combination with sunlight. It presents as irregularly shaped bullae with a bizzare arrangement. The lesions heal leaving hyperpigmentation which usually persists for months. Phytophotodermatitis is produced by chemicals called furocoumarins. Most of the plants with furocoumarins are in the Umbelliferae family or the Rutaceae family. Plants in the Umbelliferae family with furocoumarins include parsley, celery, parsnip, dill and fennel. Limes and lemons are furocoumarin producing members of the Rutaceae family.

Farmers may also be exposed to creosote which is used as a wood preservative. It is a powerful irritant and photosensitizer.

### Treatment of Contact Dermatitis

The management of rhus dermatitis will be discussed first since it is the most frequent and severe form of contact dermatitis which affects farmers. Furthermore, some of the principles involved in treating rhus dermatitis are applicable to the treatment of contact dermatitis from other agents.

Washing with soap and water immediately following contact with the oleoresin will reduce the extent and severity. If this is not accomplished within about 20 minutes of exposure, it is of little value, but probably still worth trying.

If rhus dermatitis is mild, symptomatic treatment with compresses and 1% phenol in calamine lotion will usually suffice. Systemically administered antihistamines are of some value. Corticosteroid creams are frequently used, but are not very effective for this type of dermatitis.

Severe rhus dermatitis is usually best managed with systemic corticosteroids. Forty milligrams of prednisone daily in divided dosage is often an appropriate starting dose. When new vesicles are no longer forming the dosage may be reduced by 5 milligrams every day. Occasionally it is necessary to continue the systemic steroids for up to three weeks. Compresses, colloidal baths, and calamine lotion are helpful adjuncts, even when steroids are administered.

There are many over-the-counter topical preparations intended for the treatment of rhus dermatitis. The ones containing anesthetics and antihistamines should be avoided since they sometimes sensitize.

There is lack of agreement on the efficiency of attempts to hyposensitize persons sensitive to urushiol. The procedure provides only partial protection at best and may produce side effects such as pruritus ani. Nevertheless, it is probably worth a try in those who cannot avoid exposure and

are quite sensitive. The hyposensitization process involves the ingestion of gradually increasing amounts of urushiol. It must be started two to three months before the expected exposure. Best results are obtained with continued ingestion of small amounts of the oleoresin after the routine course has been completed.<sup>1</sup>

Eradication of rhus plants is best accomplished with herbicides or by grubbing.<sup>2</sup> Herbicides are best used in the spring after maximum foliage development. However, it can be done less effectively up to three weeks prior to the first frost. Retreatment of the plants with herbicides is almost always necessary. Grubbing is useful if there are not too many plants. It is best done in the early spring when the ground is wet. Methods such as mowing, sickling, etc., which leave the roots, are ineffective. Plants which are removed should be buried or burned with care to avoid the smoke which may contain debris-carrying oleoresin.

The management of other forms of contact dermatitis is usually centered around topical corticosteroids. The occlusion of topical corticosteroids with a thin plastic seal such as Saran Wrap (R) markedly increases their cutaneous absorption. Principles of treating dermatitis in general should always be remembered such as soaks and compresses for weeping lesions and lubrication for dry scaling lesions.

Steps to reduce the incidence of contact dermatitis developing on farms should include the following:

1. Label directions should be followed when using insecticides, herbicides, etc.
2. Washing exposed areas before lunch and at the end of the work day.
3. Wearing clean uniforms and gloves when appropriate.
4. Protective clothing should be worn when working with known sensitizers or potent irritants.
5. Airplane spraying should be done when workers are not in the field.

Most of the preceding information is contained in "Occupational Contact Dermatitis".<sup>3</sup> This excellent book may be consulted for a more detailed discussion of many of the problems discussed.

### Infection

A few types of infection are much more common in farmers. These include "animal ringworm", orf, and milker's nodules.

"Animal ringworm" refers to a fungal infection acquired from animals.<sup>4</sup> This can of course be caused in urban dwellers by Microsporum canis acquired from cats and dogs. The farm acquired "animal ringworm" is usually due to Trichophyton verrucosum, Trichophyton mentagrophytes or Microsporum gypseum. These sometimes infect livestock and horses as well as cats and dog. Furthermore, Microsporum gypseum is frequently acquired from the soil. In areas of dense terminal hair such as the scalp and beard, it presents as fluctuant, purulent lesions. On less hairy skin it may be manifested by less inflamed, red, scaling lesions with a tendency for central clearing or by more inflammatory lesions which present as patches of spreading erythema with the formation of multiple small pustules. The diagnosis of the dermatophyte infection can be diagnosed by potassium hydroxide mounts and/or cultures. Hair is used when the lesions are in the hairy areas and the scales or pus are examined when the lesions are on less hairy skin.

Treatment is best carried out with griseofulvin (microsize) 500 mg. daily. When hairy areas are involved, measures to reduce inflammation such as the epilation of loose hair, compresses, systemic antibiotics (for secondary bacterial infection), and even a short course of systemic corticosteroids are helpful. These measures reduce the chances of scarring hair loss. Small areas of less inflamed animal ringworm occurring on less hairy skin can simply be treated with a topical antifungal agent.

Orf<sup>5,6</sup> is caused by a virus which is usually acquired from newborn lambs with "scabby mouth". It most commonly presents as a solitary lesion on the hands, which passes through many stages: a red papule, a hemorrhagic pustule or blister, a red weeping surface, a dry crust with black dots, small papillomas, and finally a thick crust with decreasing size of the papillomas and flattening of the lesion. Orf heals spontaneously in above five weeks. When the lesion is moist, compresses are helpful and systemic antibiotics are indicated if secondary bacterial infection develops. The healing time can be reduced by about 50% if the lesion is treated early with curettage and electrodesiccation.

Milkers nodules<sup>5,6</sup> are also of viral cause. The infection is acquired through contact with the udders of infected cows. The incubation period is about one week. The presence of two to five nodules on the hands is most characteristic. The lesions are inflammatory papules initially. They progress to reddish-brown or violaceous nodules. These nodules may become crusted, verrucoid, or granulomatous, but they do not vesiculate or ooze. Regional lymphadenopathy and secondary bacterial infection often occur. Milkers nodules disappear spontaneously in one to two months. Systemic antibiotics are sometimes helpful in treating superimposed bacterial infection.

#### Sun and Heat Induced Changes

The sun is a significant factor in inducing cutaneous changes. Aside from ordinary sunburn, the majority of these are due to the chronic cumulative effects of ultraviolet light from the sun. The photobiology of skin is a very complicated subject, but in simple terms, the rays which produce sun burning are the same ones which cause chronic cutaneous changes. The most common of the chronic sun induced cutaneous changes are actinic keratoses and skin cancers. These both have a higher incidence in lightly complexioned individuals. Actinic keratoses present as red lesions with a gritty scale. These are found primarily on the face, neck, ears, backs

of the hands, and the extensor aspect of the forearms. If untreated, some will eventually progress to skin cancers. They are usually treated by curettage and electrodesiccation or liquid nitrogen freezing when few in number. Multiple actinic keratoses are most commonly treated with topical 5-flourouracil solution.

The two most common types of skin cancer are basal cell carcinomas and squamous cell carcinomas. Basal cell carcinomas occur with greatest frequency on the face, neck, and ears. They may present in several different ways but the most common is the nodular form. This begins as a pearly nodule which enlarges while the center becomes eroded. The margin in a classic basal cell carcinoma is rolled, translucent, and telangiectatic. Many modes of therapy are effective in treating this type of lesion. The most commonly used form is curettage and electrodesiccation. Basal cell carcinomas almost never metastasize, but they can be quite locally destructive, if untreated.

Squamous cell carcinomas are less common than basal cell carcinomas. They occur with the same sites of predilection as actinic keratoses. They usually begin as crusted firm lesions with a red base. More advanced lesions may be nodular and ulcerated. The treatment is similar to that for basal cell carcinomas. About 2% of squamous cell carcinomas do not remain localized.

The use of a wide-brimmed hat and a good sunscreen, such as 5% p-amino-benzoic acid in alcohol, will help to reduce the incidence of sunburn, actinic keratoses, and skin cancers.

Miliaria rubra (prickly heat) develops in hot, moist environments. It presents as uniform, minute erythematous papules or vesicopapules. Because they are regularly spaced, the lesion may appear to be located in the hair follicles. Closer observation, however, will reveal that the lesions lie between hair follicles. It has a predilection for body folds areas, sites of pressure, and areas of friction. The process is caused by obstruction of sweat ducts. Although it is disputed, some believe that pathogenic

bacteria play an etiologic role.<sup>7</sup> Removal from the hot humid environment is the most important factor in the management of miliaria. Topical steroid cream, particularly in combination with neomycin, are also helpful.

### Arthropod Problems

Agricultural workers are also exposed to hordes of arthropods some of which may bite, sting, or infest the skin. The cutaneous response to most types of bites, stings and infestations varies considerably with the degree of sensitization. Generally the initial exposure results in little or no reaction. Then as the person develops sensitivity, red macules, papules, purpuric lesions, or blisters may develop. Finally the sensitivity may wane. A complete discussion of all forms of medical problems in farmers caused by bugs is beyond the scope of this paper. Some of the more common, characteristic, or serious ones are discussed below.

In rare instances fatal anaphylactic responses have followed stings by Hymenoptera. This group includes bees, wasps, hornets, and yellow jackets. Usually a sting by one of these insects produces only a local or mild systemic response. Hyposensitization is very effective in preventing serious reactions and is recommended in those who have had any degree of systemic involvement following a sting by Hymenoptera. This would include those who have developed generalized hives, wheezing, fainting or shock. Hypo-sensitization is usually not advised for those who simply develop local pain and swelling at the site of the sting.<sup>8</sup> Persons with a history of significant allergic reactions following Hymenoptera stings can also be given advice on how to reduce their chances of being stung and what to do if they are stung. They should wear light, nonflowery clothing, stop using scented preparations, avoid places and activities where these insects are likely to be encountered, keep an insecticide aerosol handy, and if they are stung they should take diphenhydramine 50 mg and ephedrine 25 mg immediately and go to the nearest medical facility.

The puss caterpillar has fine hollow tubes interspersed among its body hairs. Irritants are secreted through the tubules as the caterpillar crawls across the skin. This secretion produces an urticarial reaction with a grid-like pattern. Although this eruption is itchy and painful, it is of no great significance.

Chiggers are mites which frequently infest farm people. The larval form is only about 0.25 mm. long. For the most part, they feed on low vegetation, but require a source of animal protein for further development. One such source is man. The larvae injects saliva into the skin of man which digests the skin enzymatically. The larvae simply lie in this defect and feed for one to four days before falling off. The clinical appearance varies with the type of clothing worn and the degree of sensitivity. The most characteristic appearance is the presence of erythematous papules around the belt line or in other areas where clothing is tightly opposed to the skin. Chigger "bites" disappear spontaneously. It is claimed that clear nail polish provides rapid relief from the itching.

Farmers performing jobs in which they handle grain, straw, or hay may be infested with the grain mite. These mites burrow into the epidermis of man and produce lesions which vary according to the degree of sensitization. The lesions may present as red macules, petechiae, papules, small blisters, or pustules. It results in a very annoying, burning pruritus which may be accompanied by fever. This condition can be treated by applying a 1% lotion of gamma benzene hexachloride following a shower and leaving it on the skin for 24 hours. This should be applied just one time.

Diethyltoluamide is probably the best all purpose repellent for insects and mites. Most insect bites require no treatment, but occasionally because of their number, over-reaction on the part of patients, secondary infections, etc., it is sometimes appropriate to treat insect bites. The use of a topical steroid aerosol often provides good symptomatic relief. Another simple form of therapy is to wet the involved skin and sprinkle a papain

containing meat tenderizer over the lesion.<sup>9,10</sup> This is effective if used early and works by enzymatically destroying protein and polypeptide secretions which can act as allergens or irritants. Systemic antihistamines are of some value in reducing the pruritus associated with multiple bites. If secondary infection supervenes antibiotics, usually systemic, are indicated.

## Bibliography

1. Epstein W.L., et al: Poison Oak Hyposensitization. Arch Dermatol Syphylol 109:356-360, 1974.
2. Farmer's Bulletin No. 1972, U.S. Department of Agriculture, U.S. Government Printing Office.
3. Adams R.M.: Occupational Contact Dermatitis. Philadelphia, J.B. Lippincott, 1969, pp. 171-192.
4. Carney R.G. Sr.: Dermatology for the Student and Physician. Iowa City, University of Iowa, 1970.
5. Fitzpatrick T.B., et al: Dermatology in General Medicine. New York, McGraw-Hill, 1971.
6. Rook A, Wilkinson D.S., Ebling F.J.G.: Textbook of Dermatology. Philadelphia, F.A. Davis, 1972.
7. O'Brien J.P.: The Etiology of Poral Closure. J Invest Dermatol 15:102-127, 1950.
8. Sheldon J.M., Lovell R.G., Mathews K.P.: A Manual of Clinical Allergy. Philadelphia, W.B. Saunders, 1967, 321.
9. Arnold Jr. H.L.: Immediate Treatment of Insect Stings. JAMA 220:585-586, 1972.
10. Loder J.S.: Treatment of Jellyfish Stings. JAMA 226:1228, 1973.

## Discussion

Robert Wallace, M.D. - Moderator

I would like to leave some time open for discussion before we break. Would anyone like to query any of the speakers?

Unidentified Speaker

What are the number and prevalence of various respiratory diseases? Also, what general control measures can be taken?

Dr. John Kammermeyer

First of all let's consider bronchial asthma. Allergic asthma is a fairly common problem since about 20% of the population is atopic or has an inherited tendency to allergic problems such as hay fever and/or asthma. In different epidemiological studies anywhere from 1% to 4% of the adult population has had significant asthmatic problems, and this would be the same in both agricultural and urban populations.

As far as hypersensitivity pneumonitis is concerned, it is considered an uncommon problem. There are no good hard and fast statistics except a few studies in Wisconsin dairy farmers where it seems to be more prevalent than elsewhere in the U.S. But, it is our feeling, based on our own clinical experience as well as the feeling of other allergists around the country, that it is probably much more prevalent than realized. For instance, one group of internists in the Milwaukee area during one year of their practice, identified six new cases of hypersensitivity pneumonitis when they were being very careful and looking hard for this entity. It probably frequently is passed off as some type of viral pneumonia by many physicians, so we really don't know the true incidence.

As far as silo filler's disease is concerned, it is a relatively uncommon problem; because, fortunately, many farmers realize today that

it is not a good idea to go into the silo during the first two to three weeks after filling it with fresh silage. The best treatment is prevention and they usually do just that.

What was the other question?

Dr. Robert Wallace

Can anything be done to reduce the incidence of these respiratory diseases?

Dr. John Kammermeyer

As far as reducing the incidence of asthma there is really not very much that can be done except trying to avoid the allergen when a person is aware of what sensitivities he has. In our Allergy Clinic we approach the management of asthma in three ways: (1) We instruct the patient to try to avoid exposure to the allergen(s) if at all possible including the use of air conditioning, masks, etc. (2) We manage symptomatic difficulty medically with bronchodilators, and (3) We place the patient on immunotherapy with extracts of the various allergens.

As far as hypersensitivity pneumonitis, the best treatment is avoidance, when the offending agent is recognized. If exposure to the offending agent is unavoidable, then coverage with steroid therapy may prevent clinical disease. However, we don't encourage this as a frequent maneuver.

## The California Experience

Thomas H. Milby, M.D., MPH

Large scale use of the synthetic organic pesticides began in the early 1950's. Since that time, California has been a major user of pesticides, and has been said by some to lead all other states in the nation as a consumer of these toxic chemicals. (Accurate figures confirming this are not available) During this period, California has also been numbered among those states reporting the largest number of pesticide related occupational illnesses and deaths per annum. This is probably due to a combination of factors including heavy pesticide usage, a large agricultural work force and an official, statewide occupational injury and disease reporting system which is generally accepted as the most effective in the nation. Because this reporting system is unique to California and the "California Experience" is the subject of this discussion, a brief explanation of the reporting system as it now exists is in order.

The California occupational injury and disease reporting system was created by state law and is administered by the California Department of Industrial Relations.<sup>1</sup> This law requires any physician who attends a case of illness or injury believed by the physician or by the patient to arise out of, or in the course of the patient's employment, to complete a special form supplied by the Department of Industrial Relations and submit that form to the Division of Labor Statistics and Research of that department. Many other states have occupational disease reporting laws which generate little usable data. One reason for the relative success of the California reporting system is that for insurance purposes, the physician must fill out the reporting form and submit it along with his statement of fees for services to the appropriate Workman's Compensation insurance carrier. It is a simple matter to fulfill the requirements of the law by merely preparing an extra copy of this form and forwarding it to the Department of

Industrial Relations. This is the major reason for the success of the reporting system.

The California reporting system receives over one million reports annually. Of these, some 30,000 are classified as occupational diseases, the remainder being classified as various conditions, largely attributed to physical trauma. The occupational disease reports are forwarded by interagency agreement to the California Department of Health, where they are used in systems of public health surveillance, among which surveillance of pesticide injuries is an important component.

Table 1 is a summary of reports of occupational diseases attributed to pesticides and other agricultural chemicals during the 18 year period 1954-1971. At this point, it must be emphasized that the numbers included in this slide are raw numbers and not rates. That is to say they do not take into consideration the number of individuals employed in pesticide related occupations in the state in general or specifically in agriculture. Unfortunately, employment figures are not available in a form sufficiently refined in terms of occupation to be meaningful as denominator data upon which to develop incidence rates. The table does suggest that since about 1959, there has been little change in the actual number of reports of occupational diseases attributed to pesticides in California, with the exception of two years, 1959 and 1963. During the year 1959, a large outbreak of organophosphorous pesticide poisoning among citrus pickers in the southern part of the state occurred. Unfortunately, no official investigation of this outbreak was made. In 1963, an episode of parathion poisoning among peach pickers took place in California's central valley. At that time, state health officials investigated the outbreak intensively and found that more than 100 workers engaged in the picking of peaches suffered parathion poisoning due to exposure to residues dislodged from parathion treated foliage. Pre-harvest spraying was particularly heavy that year because of an unusually large infestation of insect pests.<sup>2</sup>

On Table 2, cases of pesticide poisoning reported between the years 1959 to 1971 (with the exception of 1962 for which no data are available) are divided into three major groups according to causal agent: organophosphorous compounds, halogenated hydrocarbon compounds, and all other pesticides. The group entitled "all other" consists mainly of reports in which the reporting physician did not include the name of the pesticide thought to have produced the illness. Scattered throughout this category are compounds such as fertilizers, herbicides, sulfur and other miscellaneous pesticides. It is apparent that among reports in which a pesticide is named, the organophosphorous compounds are by far the most common offenders. To examine this point further, Table 3 summarizes data from 1971 only, and illustrates several important points. First, the organophosphorous compounds are much more likely to produce systemic poisonings than are the halogenated hydrocarbons, and secondly, the "all other" category is made up largely of cases classified as "skin conditions". Review of data not presented here indicates that it is the herbicides which make the largest single identifiable contribution to pesticide related illnesses classified as "skin conditions".<sup>3</sup>

Any discussion of occupational health problems in California attributed to pesticides should comment on a specific occupational health problem involving exposure to pesticides which, although by no means limited to the state of California, is recognized as a serious problem in California and has been the subject of much regulatory activity within the state. The problem is exposure, among agricultural field workers, to residues of organophosphorous pesticide compounds remaining on treated plant foliage. Exposure to the worker occurs when, in the course of his employment, he is required to come into substantial contact with foliage containing high levels of organophosphorous pesticide residues.<sup>4</sup>

The clinical picture of illness resulting from exposure of this kind is somewhat different than the classical picture of organophosphorous pesticide poisoning, seen in workers who manufacture, formulate or apply these toxic agents. In contradistinction to the dramatic picture of intense

parasympathetic stimulation, characteristic of excessive exposure to concentrated materials or sprays, the signs and symptoms exhibited in patients with residue poisoning are insidious in onset and only mild to moderate in severity. The dynamics of exposure are those of daily absorption of small doses of organophosphorous compounds, dislodged in the course of thinning or harvesting crops during which procedures, close and prolonged contact with heavy foliage is required. If these dislodgable residues contain high concentrations of organophosphorous pesticides, which is occasionally the case, those exposed on a daily basis may undergo progressive inhibition of cholinesterase at a rate which exceeds the body's capacity to regenerate this enzyme. When blood cholinesterase levels drop below about 75% of normal, generalized symptoms such as anorexia, insomnia, lassitude and fatigue may occur. As cholinesterase levels continue to drop, the worker may develop nausea, headaches, abdominal cramping, diarrhea and excessive sweating. It is usually these manifestations which cause the worker to seek medical attention.

A diagnosis of organophosphorous pesticide intoxication may be made based on history of exposure and laboratory determination of red blood cell and plasma cholinesterase levels. Removal from exposure for several days in order to permit normal regeneration of cholinesterase in conjunction with symptomatic treatment is generally all the therapy that is required.

Bailey, et al,<sup>5</sup> summarized 562 cases of organophosphorous pesticide residue poisoning reported in California between the years 1949 to 1970. Crops involved were mainly citrus, however, peaches, pears and grapes were also implicated. Prior to 1970, except for the two notable years 1959 and 1963, during which 2/3 of the 562 reported cases occurred, episodes of residue poisoning were relatively rare and little official attention was focused upon organophosphorous pesticide residues on foliage as an important occupational health problem.

In 1970, four separate episodes of organophosphorous residue poisoning were reported between the months of May and October in California. These

were summarized by Ray and Pependorf.<sup>6</sup> All episodes occurred in citrus crops. In all, 55 farm workers were made sufficiently ill to seek medical attention. State and County health officials, in cooperation with local physicians and state and county agricultural officials were able to study these episodes in considerable detail. During the course of these investigations, it became abundantly clear that although pesticide application rates were well within legally approved limits, all workers examined were suffering from marked cholinesterase depression.

At that time, it was decided by California health and agriculture officials that the annual threat of episodic outbreaks of residue poisoning among farm workers constituted an unacceptable situation. However, because organophosphorous pesticide residue poisoning among farm workers had not been previously considered a serious occupational health problem, little thought had been given to methods of prevention. Several alternatives to the solution of the problem were considered. The first and most obvious alternative was to prohibit or severely curtail the use of organophosphorous pesticides. This alternative was rejected. A second alternative was to require the use of personal protective devices such as respirators, impervious clothing and the like. This alternative was considered unrealistic in view of the high ambient temperatures encountered in California's central valley during the summer months. A third alternative considered was to require periodic cholinesterase testing of all potentially exposed farm workers. This alternative, in turn, was rejected as being impractical in view of the very large numbers of farm workers involved in California agriculture. A fourth alternative embodying the traditional industrial hygiene principle of "make the work place safe" was chosen as the most practicable of all alternatives considered. This alternative was thought to be feasible because of the evanescent nature of members of the organophosphorous family of compounds following their application to the agricultural environment.

Accordingly, through cooperation with public agencies and private groups, a schedule was devised which stipulated required waiting times between application of certain organophosphorous pesticide compounds to certain crops and

entry by workers into the treated fields, orchards or vineyards. These waiting times were called "reentry intervals" and in 1971, were applied through administrative regulation to all organophosphorous compounds legally registered for use on citrus, grapes, peaches and nectarines in the state of California.<sup>7</sup>

Although the agricultural community in California expressed concern that reentry intervals might prove to be a serious economic burden on their operations, to date, such does not seem to have been the case.

During the year 1971, the first year in which the reentry regulations were in force, only one case of residue poisoning was reported. This involved a single individual who had been picking peaches which had been sprayed with parathion 31 days prior to his entrance into the orchard. This reentry interval was in full compliance with state regulations. Other workers in the same orchard suffered no ill effects. It is not known where the afflicted worker had worked during the period prior to his entering the parathion treated field.

In 1972, two verified episodes of organophosphorous pesticide residue poisoning were reported.<sup>6</sup> In one episode, 3 workers were reported hospitalized with organophosphorous pesticide poisoning after picking oranges for one day in a parathion treated grove. Reentry interval regulations had been observed. In a second episode in 1972, nine workers out of a crew of 22 became ill while picking oranges. They were treated with atropine by a local physician, but no cholinesterase determinations were done at the time. Investigation of this event showed that the reentry time for parathion had not been observed and workers had been permitted to enter the fields in violation of regulations. As a consequence, the grower's spraying application permit was revoked. No other episodes of residue poisoning were reported in 1972.

In 1973,<sup>8</sup> there was but a single episode of organophosphorous pesticide residue poisoning. The pesticide involved was a new compound being used on an experimental basis and therefore was not subject to reentry period

restrictions. Twelve pickers were hospitalized in this incident, and several others treated on an outpatient basis. Analysis of the causal factors surrounding this episode was beclouded by the fact that the workers had picked oranges in the orchard which had been treated by the experimental compound for only a few hours before they became ill. For three days prior to that time, they had worked in another field which had been heavily treated with a variety of other organophosphorous pesticides. In the case of this latter field, the official reentry interval times had been observed. It is unclear, therefore, what contribution, if any, work in this field contributed to the subsequently reported episodes of illness.

At this writing, no episodes of organophosphorous pesticide residue poisoning have come to the attention of official sources in California during the year 1974.<sup>8</sup>

The concept of reentry intervals as a means of protecting agricultural workers from hazardous exposure to organophosphorous pesticide residues dislodges from treated plant foliage has occasionally been challenged by various individuals or groups. However, the most compelling argument in favor of the reentry concept is found upon inspection of the California experience over the last 3 1/2 years. During this period, where reentry interval regulations were observed, only two verified episodes of organophosphorous pesticide residue poisoning were reported, and, in all, only four individuals were involved. This is strong evidence that the reentry concept, when properly applied, can be very effective in protecting the agricultural worker. Until a strategy is devised which is at least equally protective, it seems likely that the reentry interval strategy will continue to enjoy favor in California and should be adopted as the strategy of choice for protection of agricultural workers wherever exposure to organophosphorous residues is identified as a significant occupational health problem.

Table 1  
 REPORTS OF OCCUPATIONAL DISEASE ATTRIBUTED TO  
 PESTICIDES AND OTHER AGRICULTURAL CHEMICALS  
 CALIFORNIA, 1954-1971

YEAR	ALL INDUSTRIES	AGRICULTURE	OTHER
EXCLUDING EYE CONDITIONS AND CHEMICAL BURNS			
1954	391	248	143
1955	531	326	205
1956	789	464	325
1957	749	434	315
1958	910	599	311
1959	1,093	782	311
1960	975	668	307
1961	911	578	333
1962	827	545	282
1963	1,013	746	267
1964	844	539	305
1965	779	520	259
1966	869	565	304
1967	921	571	350
1968	324	499	335
1969	727	454	273
1970	957	634	323
1971	922	611	311

Source: State of California, Department of Public Health, Occupational Disease in California Attributed to Pesticides and Other Agricultural Chemicals, Annual Reports.

Table 2

OCCUPATIONAL DISEASES ATTRIBUTED TO PESTICIDES  
CALIFORNIA, 1959-1971\*

	1959	1960	1961	1963	1964	1965	1966	1967	1968	1969	1970	1971
Organophosphorous Compounds	455	325	254	324	177	160	238	296	287	312	253	253
Halogenated Hydrocarbon Compounds	70	80	77	74	65	38	68	67	63	68	51	51
All Others	568	570	580	615	602	581	563	558	484	347	653	618
Total	1093	957	911	1013	844	779	869	921	834	727	957	922

Source: State of California, Division of Labor Statistics and Research,  
Doctor's First Report of Work Injury. Statistics compiled by  
State of California, Department of Public Health.

\*Data for 1962 not available

Table 3

REPORTS OF OCCUPATIONAL DISEASE ATTRIBUTED  
TO PESTICIDES BY CLINICAL CLASSIFICATION  
OF DISEASE, CALIFORNIA, 1971

	Total	Systemic Poisoning	Respiratory Condition	Skin Condition	Other
Organophosphorous Compounds	253	174	2	14	63
Halogenated Hydrocarbon Compounds	51	17	5	22	7
All Others	618	58	85	388	87
Total	922	249	92	424	157

Source: State of California, Department of Public Health,  
Occupational Disease in California Attributed to Pesticides  
and Other Agricultural Chemicals, 1971

## References

1. Section 6407, State of California Labor Code, 1967.
2. Milby, T.H., et al: Parathion residue poisoning among orchard workers. *J. Am. Med. Assoc.* 189: 351, 1964.
3. Source: State of California, Department of Industrial Relations, Division of Labor Statistics and Research, Doctor's First Report of Work Injury. Various years.
4. Milby, T.H.: Effects of pesticides in occupational exposure. In *Agricultural Chemicals-Harmony or Discord for Food, People, and the Environment*. J.E. Swift (ed.). University of California, Division of Agricultural Sciences, 1971.
5. Bailey, J.B., et al: Pesticide residues on grape leaves evaluated for adverse effects on grape pickers. *Arch. Environ. Health*. (In press).
6. Ray, R. and Pependorf, W.: Review of illness reports from organophosphate pesticide residues in California. School of Public Health, Department of Environmental Health Sciences, University of California, Berkeley, 1973.
7. California Administrative Code, Title 3. Article 23, Farm Worker Safety, section 2475. Adopted June 15, 1971.
8. Personal communication from Ephraim Kahn, M.D., Chief, Environmental Studies Laboratory, California Department of Health, September, 1974.

## Updating Treatment of Pesticide Poisoning

Griffith E. Quinby, M.D., M.P.H.

Except in life-threatening emergencies, it is advisable if not essential to obtain a reasonably complete history and perform a physical examination before making a final diagnosis, much less treating any illness. It sounds perhaps silly to start talking this way, but few medical practitioners require or obtain a sufficiently thorough and accurate history of exposure and clinical course of pesticide poisoning before instituting treatment. They accept the diagnosis of the patient's family or other informers. Even before it became popular amongst ecologists, environmentalists and other exaggerationists (including a few physicians) to blame poliomyelitis, neuropathies, blood dyscrasias, cancer, psychiatric and other diseases upon pesticides, there was and there still exists a tendency to accept pesticides as a cause of illness without sufficient confirmatory medical evidence. Faced with history of exposure to pesticides, they ignore the incidence of the same diseases expected in non-exposed population. Moreover there exists no good all-inclusive definition of pesticide poisoning.

The majority of original reports of illness suspected to be caused by pesticides in my twenty-five years of pesticide practice have not been confirmed as pesticide poisoning when carefully scrutinized by thorough history, physical examination, adequate laboratory work, good differential diagnosis and - if need be - therapeutic trial. Too often the primary physician accepts half-way or reasonable plausible association of time sequence of sometimes insignificant pesticide exposure with onset of illness not otherwise explained. Diagnosis by default or making pesticides a scapegoat in half-complete differential diagnoses has resulted too often.<sup>1, 2</sup> There has even been the tendency to attribute symptoms and signs of illness totally unrelated to the known modes of action of pesticides without any effort being made to explain why this aberrant phenomenon should be attributed to pesticides. This is especially frequent in cases covered by occupational insurance. Some

clinicians feel no obligation to make their diagnoses fit what is known about illnesses caused by pesticide formulations. They have acted as if the M.D. degree or some other doctorate confers some halo giving them a right to make any diagnosis they choose irrespective of its clinical or epidemiological merits and defensibility - and perhaps in the past they have had this right legally. Moreover, some careless editors of otherwise reputable journals published these bizarre case reports of disease attributed to pesticides without clinical toxicological editing. Some have been totally inconsistent with known or even reasonably speculated pharmacologic or toxicologic modes of action. Most such articles have failed the test of time. It is interesting to speculate on whether peer review by the Professional Standard Review Organizations will partially rectify this malpractice.

In the theme of this occupational conference, it is sad to report that my own Washington State Industrial Insurance Program has adopted the financially sound management policy of trying to refute all proven or strongly presumptive pesticide poisonings and attribute findings to some non-occupational syndrome. What is worse morally, the state insurance will not pay for differential diagnoses that rule out pesticide poisoning even after significant exposure. This has of course caused many physicians to diagnose poisoning following exposure whether they really believe it was causative or not. Otherwise, their services may not be compensated. Such poor practice must go on in other states that have the same policy.

The foregoing negativistic statements should not be construed as failure to recognize that there has to be a first time for every prior unknown mode of action to be diagnosed and/or published. However, in most of these new findings, the author was usually constrained to offer reasonable new proof or plausible presumption to explain his findings and interpretations.

The foregoing must also not be construed as failure to recognize that it is also necessary to institute treatment in emergencies or with inadequate history until the additional data can be collected either by the diagnostician, his staff, or other helpers.

The history-taker must listen carefully to the patient or other informant expecting this history to be incomplete or wrong in the majority of cases but tragically or classically correct and complete in a significant minority percentage of instances. Possibly in the industrial setting, the majority of illnesses blamed originally on pesticides can be substantiated diagnostically.

The most courageous - and yet legally dangerous - tactic that a physician can practice is to withhold or delay treatment in mild to moderate illnesses that follow significant or uncertain exposures. Whenever he does this, he should of course be as thorough as practical in seeking to establish all other differential diagnoses. Too many handbooks or textbooks on diagnosis in toxicology fail to emphasize the need for exercising conservative judgment in attributing illness to pesticides.<sup>3</sup>

An additional problem, often overlooked in correctly diagnosing diseases caused by pesticides is that many formulations of pesticides cause diseases by chemicals other than the primary intended ingredients such as solvents, carriers, adjuvants, precursors, side reactants, interactants, decomposition products and even reconjugation of molecular moieties of the pesticide.<sup>3</sup> Dr. Thomas Milby published a classical illustration in the instance of furfural, the precursor of malathion, causing dermatitis in various malathion formulations.<sup>4</sup> One of the most recently recognized potential hazards of poisoning by other than the active agent is that of carcinogenic asbestos up to 3% in many dusts, pellets and pills of pesticides and drugs.

Undertreatment by physicians inexperienced in poisoning has long been a problem of the consulting toxicologists especially in those cases requiring atropinization of severe anticholinergic crises. There seems simply no arbitrary limit to the single or total dosage of atropine required to titrate any given severe organic phosphorus poisoning especially after ingestion or massive occupational exposure. Neither has there been established any such arbitrary limit for the cholinesterase-reactivating antidote pralidoxime (2-PAM).

Overtreatment with atropine even to death has occurred where the therapist has used a single therapeutic response such as heart rate or miosis without recognition that the entire patient's vital signs and response must be followed, especially pupillary dilatation, heart rate, lung wetness, tearing and sweating to decide when atropinization is sufficient to taper off or discontinue.

There has also been overtreatment with pralidoxime after the drug has reactivated all the cholinesterase necessary to re-establish nerve conduction merely because all the signs and symptoms had not been relieved. Also in cases of ingested organic phosphorus pesticides dissolved in Xylene, continued use of higher doses of pralidoxime does no known good after cholinesterase has been reactivated to maximal levels during increasingly permanent phosphorylation by some of the organic phosphorus compounds.

In certain cases of massive ingestion of such things as parathion, malathion and paraquat, no one in this country has had the courage to surgically evacuate the gastro-intestinal system, but I am convinced this is the only way to save some lives.

One of the most inexcusable forms of overtreatment has been the use of atropine or pralidoxime in regionally anatomically restricted topical anticholinergic poisoning such as unilateral or bilateral miosis, brief bronchogenic constriction from breathing vapors or dilute dusts for short times. The only treatment these cases need is diagnosis of topical organic phosphorus poisoning, discontinuation of exposure, reassurance, and perhaps intelligent observation for the hours necessary to assure spontaneous recovery during judicious medical neglect.<sup>5</sup>

Failure to recognize psychogenic nausea and vomiting has caused many over-treated illnesses and much undue public, political, and economic concern. Washington and Texas have seen at least three outbreaks of psychogenic nausea, vomiting and even public hysteria in corn pickers, school

children, and others exposed to the nauseating odors of the mercaptan-producing formulations of disulfoton (Di-Syston) and Thimet (phorate).<sup>6</sup>

Some of the older pesticides like sulphur, the polysulphides, and nicotine have received so little attention in the literature that it was difficult to find appropriate references for the 1969 Report of the Secretary's (HEW) Commission on Pesticides.<sup>7</sup> Yet every older physician in areas of formulation and agricultural use of these pesticides has seen frequent chronic dermatitis from sulphur and polysulphides as well as classic nicotinic signs from over-exposure to nicotine.

Increasing reliance upon organic phosphorus compounds, carbamates, and carbamoyl oximes as substitutes has followed the limitations of usage of the chlorinated hydrocarbons with attendant greater occupational hazards from production, shipment, storage, and dispersal. This means physicians must expect greater frequency of anticholinergic poisoning even though it may be of briefer, self-limited duration if due to carbamates and more dramatic if caused by the carbamoyl oximes.

Propoxypur (Baygon or isopropoxy phenyl carbamate) has caused up to 100% attack rates of mild anticholinergic poisoning among the household sprayers of the World Health Organization and in about 1% of household residents. Their signs and symptoms disappear rapidly without treatment after exposure is terminated even when they can not decontaminate their skin and clothing as thoroughly as they should.<sup>8</sup> Usages of Baygon approved in the United States have not caused the expected occupational poisoning to my knowledge even though there has been growing reliance upon it.

DDVP formulated in one of the plastics has produced a chronic dermatitis beneath flea collars in dogs and reportedly in veterinarians or other dog handlers but details have not been published.<sup>9</sup> Neither has the skin irritant been even suggested. Some DDVP solid formulations were suspected to be suspended in polychlorinated biphenyl or polychlorinated terphenyl solids that may contain polychlorinated dibenzofurans.<sup>10</sup>

Parathion and certain carbamate applications have continued to cause since 1948 epidemics of mild or moderate and rarely severe poisoning in workers who enter treated crops either the same day or before the residues had sufficient hours to decay. In California this problem is somehow inexplicably clinically more frequent and more serious with valid reports of parathion poisoning in peach pickers extending out to 40-odd days or more after last application.<sup>11</sup> Also authorities in California and a few other states with similar climates, together with some national authorities, believe that some other organic phosphorus compounds alone or in combinations cause poisoning in those who enter crops too early after application. This so-called "Early Entry Poisoning" has been a great debatable issue in recently proposed legislation to eliminate this form of occupational poisoning. It is regrettable that this issue has been contended mostly in the political, legal, and judicial arena instead of in scientific circles where it should be settled. As far as I know, no one has published a diagnostic review of crop workers or early entry poisoning with great care given to critical confirmations of etiology. How can we expect our politicians and legislators to draft correct practical laws or regulations when there is no reasonable agreement among the physicians diagnosing, treating, and trying to prevent recurrence of early-entry poisoning?

Sometime prior to October, 1973, Dr. Joseph Holmes and his co-workers of the University of Colorado treated two cases of mevinphos (Phosdrin) poisoning<sup>12</sup> adding to those treated during the preceding decade or more.<sup>13,14,15</sup> One of these agricultural workers showed marked improvement following intravenous atropine as well as greater improvement following intravenous pralidoxime (2-PAM), the second not given 2-PAM. The younger worker had microscopic hematuria, but the clinical description indicates catheterization as the early cause of red blood cells. However, hematuria persisted for eight days following withdrawal of the catheter as was found in seven other cases of organic phosphorus poisoning previously reported by the senior author. This young greenhouse sprayman also complained in his Mexican Spanish of "burning of the eyes" that may be a newly observed symptom or an interpreter's

error. Hypercoagulibility was temporarily increased in one of these cases as reported by the senior author 13 years previously in other organophosphorus poisonings. Increased fibrinolysis was observed in the second case. Neither of these laboratory findings was directly related to the clinical picture. A satisfactory mode of action for the hematuria has not been proposed.

In preparation for this publication, your author has discussed with several other clinical toxicologists the future impact that peer review of all hospitalized illnesses by the Professional Standards Review Organizations (PSROs) is having or will have on the diagnosis and treatment of occupational pesticide poisoning. No significant suggestions were made except that there are insufficient physicians trained in clinical toxicology to treat or consult in diagnosis and treatment occurring in pesticide poisonings. In such a controversial field, it remains to be seen whether PSROs will require physicians not specialized in toxicology to judge the indication, adequacy, duration and therefore the cost of treatment procedures. I would appreciate referrals of records of all such paradoxical administrative procedures.

In August, 1974 after eight years of formative planning, the American Academy of Clinical Toxicology has just announced its first examination for Board Certification in Clinical Toxicology to take place in Denver, Colorado in February, 1975. Anyone interested this year may apply before a November date. Board Certification hopefully is to be recognized and sponsored by the American Medical Association. It should lend to diplomates a formal recognition of their training, experience, and qualifications in treatment of poisoning. This is expected to be one basis to warrant fee schedules and salary levels parallel to certain other Board Certifications above that of non-certified physicians. This should also clarify eligibility for peer review by PSROs of clinical toxicological management in all private hospitals and government-controlled diagnostic and treatment facilities.

## References

1. Biskind, M.S., DDT poisoning, a serious public health hazard, *Am. J. Digestive Diseases* 16, (2) 73, Feb 1949.
2. Goldstein, N.P.; Jones, P.H.; Brown, J.R., Peripheral neuropathy after exposure to an ester of dichlorophenoxyacetic acid, *JAMA* 171:1306-9, Nov. 1959.
3. Quinby, G.E., Physico-chemical changes in pesticides after formulation causing health hazards, presented Mar. 24, 1967 at Society of Toxicology, Atlanta, Ga.
4. Milby, T.H. & Epstein, W.L., Allergic contact sensitivity to malathion, *Arch Environ Health* 2:434-7, Oct. 1964.
5. Quinby, G.E. & Doornink, G.M., Tetraethyl pyrophosphate poisoning following airplane dusting, *JAMA* 191:1-6, Jan. 1965.
6. Quinby, G.E., Management of intoxication from organophosphorus pesticides in aerial applications, presented at AMA Council on Occupational Health, Grand Teton National Park, Wyoming, 1971.
7. Mrak, E.M., Report of the Secretary's Commission on Pesticides and their Relationship to Environmental Health, U.S. Dept. of Health, Education, & Welfare, Dec. 1969.
8. Quinby, G.E.; Babione, R.W.; Hernandez-Moreira, C.F., Toxicological observations on the use of (Baygon) 2-isopropoxyphenyl-N-methylcarbamate as a malaria control insecticide in El Salvador, *Industr Med Surg* 1967.
9. Oehme, F.W., Minisymposium on veterinary toxicology presented at First French, American and Canadian International Congress of Clinical and Analytical Toxicology in Montreal, Canada, Aug. 1974.
10. Finklea, J. et al, Polychlorinated biphenyl residues in human plasma expose a major urban pollution problem, *Am J Pub Health* 62:645-51, May 1972.
11. Milby, T.H.; Ottoboni, F.; Mitchell, H.W., Parathion residue poisoning among orchard pickers, *JAMA* 189:351, 1964.
12. Holmes, J.H. et al, Short-term toxicity of mevinphos in man, *Arch Environ Health* 29:84-89, Aug 1974.

13. Quinby, G.E., Further therapeutic experience with pralidoximes in organic phosphorus poisoning, JAMA 187:202-206, Jan 1964.
14. Lehman, R.A., Protopam Chloride, pralidoxime chloride (enclosure brochure) Campbell Pharmaceuticals, Inc. 1964.
15. Gonzalez-Leprat JA, et al, Intoxication with organophosphate inhibitors of cholinesterase, Ann Faculty Med Montev 50:255-268, 1966.

## Animals as Monitors of Environmental Quality

William B. Buck, D.V.M., M.S.

Thomas L. Carson, D.V.M., M.S.

A herd of feedlot cattle being fattened for slaughter suddenly sicken and many die. Many exhibit convulsive seizures and other signs of illness. Investigation reveals that their feed has accidentally been contaminated with an insecticide.

A herd of swine becomes ill, and many die with a high fever. Investigation reveals that they are infected with the virus of hog cholera.

A small urban community experiences the death of many dogs and cats in a localized neighborhood. Investigation reveals that someone has been placing strychnine in wieners and hamburger, then deliberately feeding it to neighborhood animals in order to reduce their population.

A Midwestern farm family experiences continuous poor health in their children manifested by tiredness, frequent respiratory infections, and poor eyesight. Their animals do not reproduce well, and the young animals that are born fail to grow efficiently. Investigation reveals a water system contaminated with coliform bacteria and nitrates.

Horses and cattle grazing near a smelter sicken and die because of the contamination of the forages with lead emitted into the air from the smelter. Several dairy farmers in the vicinity of a phosphate mineral producing plant observe extreme lameness and emaciation in their cows. Closer examination reveals that the cows' teeth are mottled, soft and worn into the gums so that they cannot chew their food, thus, drastically reducing their milk production. Further investigation reveals that high levels of fluoride are being emitted into the air from the phosphate plant which contaminate the forages consumed by the cows.

A swine producer experiences an outbreak of abortion in sows about to farrow. Discouraged with his problem he send them to market for slaughter. In the slaughtering operating the packing house worker unknowingly exposes himself to the bacterial agent which causes undulant fever.

In each of these reports a health problem exists which reflects a breakdown in environmental quality. Although potentially hazardous to man, either directly or indirectly, these disorders are first manifested in animals. The member of the medical team who first confronts these problems is the practicing veterinarian. By nature of his training and experience, he is best able to recognize the importance of these problems as they relate to man, his food supply, and his environment. Although the practicing veterinarian has the first contact with these problems, he has a host of specialists to assist him in laboratory diagnosis and interpretation of the findings. These include state and federal regulatory veterinarians and other public health officials; epidemiologists, toxicologists, pathologists, and microbiologists in veterinary diagnostic laboratories; and finally the backing of animal researchers in federal and state laboratories.

These events recall the coal miner's canary. Caged canaries were taken into coal mines. More vulnerable than man, their death by unseen and unsmelled gases drifting into the mine shaft gave miners time to race to the surface. Today's food-producing animals, pets, and wildlife are man's moder-day "canaries." The atmosphere around the earth is analogous to the coal mine. It is limited in space and has a finite tolerance for pollutants in order for life to continue. Our animals breathe the same air as man, drink the same water, are exposed to the same chemicals in our environment, are subject to many of the same infectious disease organisms, and experience similar difficulties as man from crowding. Thus, our animals became sentinels or indicators of the quality of our environment.<sup>1</sup>

The veterinary profession has a major role in monitoring the effects of environmental quality on animals and, in cooperation with medical and other allied professions, assessing the potential hazards to man. Being trained in

comparative animal medicine, the veterinarian is charged with the primary responsibility of caring for and preserving the health of our animal populations. Whether it be man's companion animals, wildlife in their natural habitat or in confinement, or the production of animals for food, the veterinarian, along with animal scientists, nutritionists, geneticists, economists, agronomists, and biologists, is dedicated to the task of improving their well-being and, indirectly, that of man.

### Animals as Sentinels

The following are some specific examples of how our knowledge of animal health serves to preserve the well-being of man and warn him of potential environmental hazards.

a) Chemical Pollutants -- Many species of animals are equally or more susceptible than man to the toxic effects of chemical pollutants. Lead poisoning is frequently diagnosed toxicosis in cattle. Lead poisoning is also frequently seen in dogs living in the urban environment. Lead poisoning is one of the most frequently diagnosed toxicosis in children that results in permanent damage or death.<sup>2</sup> Therefore, by comparing the epidemiological findings pertaining to lead poisoning in cattle, dogs and other animals with that in humans, we are able to determine that lead is an important contaminant of our environment. Armed with these facts, it then becomes a matter of convincing our society that the emission of lead through automobile exhausts and industrial smokestacks must be curtailed and that the use of lead in paints and other materials in close association with man and animals must be curtailed.

Another example may best be given with the following case history: A poultryman had 20,000 laying hens for egg production. He purchased a feed mixture from a local feed company. The company, in mixing the feed, accidentally contaminated the mixture with granules of insecticide which had been stored in a warehouse in the vicinity of other feed ingredients. After feeding the insecticide-contaminated feed for several days, the poultryman noticed his birds were more excitable than usual but, because no other signs of illness were apparent, did not recognize that a problem

existed. The eggs produced from these birds contained several parts per million insecticide but went undetected into consumer use. Subsequently, the poultryman decided to replace his hens with a new flock of younger birds. He sold 10,000 of them to a soup manufacturer. During the processing of the meat for soup, the birds were found to be contaminated with several parts per million of the insecticide. This finding resulted in the alerting of the poultryman, the local veterinary practitioner, the feed company, the state and federal regulatory officials, the Federal Food and Drug Administration, and other public health officials. With the aid of a chemist in a veterinary diagnostic laboratory, the source of insecticide in the feed was chemically confirmed; and subsequent investigations revealed how the insecticide had been accidentally incorporated into the poultry feed. All 20,000 birds were destroyed instead of being made into chicken soup.

The documentation of problems in animals resulting from exposure to chemicals in the environment occurs daily. In this manner we are able to prevent the contamination of meat, milk, and eggs produced for human consumption. In addition, we are able to identify the chemical contaminants in our environment and, thus, provide a warning of possible hazards to man.

b) Zoonoses -- The term zoonosis refers to a disease naturally transmissible between man and animals. Some of the better known diseases in animals that are transmissible to man include rabies, equine encephalomyelitis, tuberculosis, brucellosis, salmonellosis, leptospirosis, psittacosis, toxoplasmosis, and histoplasmosis. Cooperative endeavors among members of the public health team and microbiologists in veterinary diagnostic laboratories enables us to identify and bring under control such disease outbreaks, thus preventing their spread to humans.

c) Food Hygiene -- A major proportion of the average American's diet consists of meat, milk, and eggs or other food of animal origin. Animals may harbor subclinical infections or may contain chemical residues in their tissues which are undetectable by the producer. For this reason we have inspection of animals in stockyards, sales barns, and packing plants prior to slaughter. Routinely, tissue specimens are obtained and analyzed for

pesticides, hormones, and chemical residues; examined for parasites such as tapeworm cysts and trichina; and in some instances cultured for infectious agents. Again, these findings reflect the environmental quality in which these animals were raised.

#### Animals as Models

a) Effects of Chemical Pollutants -- The acute and chronic effects of environmental pollutants on man must be predicted if acceptable criteria standards are to be established. Since it is very difficult to study these effects in humans, we turn to animals as our experimental models. It is readily understood that pathological processes can best be intensively studied in animals by controlling the environment and exposing experimental animals to specific toxicants or disease organisms. Their effects at various dosages and periods of exposure can be ascertained. Assessment of changes in physiology, cellular morphology, and behavior can be correlated with the level of exposure and resulting levels in the body tissues. By studying the effects of environmental pollutants on several species of animals, one can then predict the potential effects on man under specific conditions of exposure and duration. This information can then serve as a basis for setting criteria standards for the various pollutants in our environment.

In developing the criteria on which to base environmental quality standards, we find that the greatest paucity of data is in the area of environmental toxicology. A significant proportion of government funds allocated to health effects research has gone into specific studies in environmental toxicology. Examples of such studies include the effects of nitrogen dioxide and lead exposure on immune responses; carcinogenicity of hydrocarbons; effects of ozone on the respiratory tract; effects of long-term exposure to cadmium, lead, arsenic, and mercury; and behavioral and electrophysiological effects of insecticides and other neurotoxicants. Meaningful environmental research requires input from the integration of three approaches: (1) laboratory animal toxicologic studies, (2) clinical investigations with human subjects, and (3) epidemiologic studies under naturally occurring conditions.

b) Medical Developments -- Teamwork is the best approach, and it is here that the allied health professionals use the animal as a proving ground for untried therapeutics, the execution of surgical techniques, and the development of prosthetic aids for use in human medicine. Surgical techniques developed in animals are now being applied in the field of human medicine. The transfer of healthy organs from one individual to another is an example of this progress. The action of sweet clover poisoning in cattle was first observed by a veterinarian which resulted in the development of dicoumarol for use in treating disease of the heart and circulatory system in man.

The prevention of many communicable diseases in humans depends upon the production of biologics by official agencies and industries. This involves the use of varieties of large and small animals. It must be remembered that horses are needed to manufacture diphtheria antitoxins, tetanus antitoxin, and tetanus toxoid. Sheep are used in the preparation of whooping cough vaccine and calves in the production of smallpox vaccine. Small animals are bred for diagnostic and experimental purposes to insure the rapid development of new methods for administering the immunizing biologics. The development of chemotherapy for man and animal use has taken place largely through the advice and guidance of the veterinary profession in research laboratories throughout the world. Studies on the transfer of resistance phenomenon by bacteria in animals have far-reaching influence on public health.

Aging among animals is a much shorter process than it is in man. Man's interest in studying the aging process has led him to make observations in the animal kingdom, hoping to find important clues toward solving some of our problems associated with aging and chronic diseases. The relationship of nutrition to the degenerative processes should be an exact science in animals due to the fact that almost every facet of animal life can be controlled by the investigator.

#### Summary

Animals, including farm animals, pets, and wildlife, can serve as monitors of environmental quality. Just as the coal miner's canary warned

of unseen and unsmelled toxic gases, today's animals are our modern day "canaries." If we carefully observe those animals sharing man's environment, we may be able to detect when environmental deterioration becomes potentially hazardous to humans.

## References

1. Buck, W.B. and Herrick, J.B.: Quality of Life: the Veterinarian's Contribution. Iowa State University Veterinarian. 32:129-133. 1970.
2. Perlstein, M.A. and Attale, R.A.: Neurological Sequellae of Plumbism in Children. Clin. Ped. 5:292-298. 1966.

## Some Epidemiologic Experiences in the Health Effects of Pesticides

Jack Griffith , Ph.D.

The Epidemiologic Studies Program (ESP) is a 4-element program of field investigations with a scope of national capability. It is essentially a newly designed program, however, the ESP utilizes much of the scientific expertise and field experience derived from the former Community Studies Program which originated in DHEW in the mid 60's. The objective of this new program is to determine the effects of pesticides on human health. This is to be accomplished by the detection of acute and chronic effects through field investigations of those occupationally and environmentally exposed to pesticides.

The Epidemiologic Studies Program is an operational arm of the Office of Pesticide Programs, and it is directly responsible to the particular needs of OPP in terms of applied scientific information for regulatory decision-making. The program has been designed to be directly responsive to a new strategy developed by the Agency's Office of Pesticide Programs (OPP). A primary consideration in the OPP strategy is the protection of human health by a "Hazard Evaluation System". Health effects data supplied by our program is the keystone of that system.

Program activities are supported under contract to universities or State Health Departments in 12 states. At 3 locations, Centers of Excellence have been established. The availability and accessibility of professional schools, in-depth staffing and "co-opting" arrangements with scientists and medical personnel enhance the capability of the Centers of Excellence to provide a strong leadership and support role in behalf of the remaining nine project communities, i.e., the centers provide the other projects in-depth expertise and coordination for team investigations in any U.S. location.

Three HEMB scientists (Field Studies Coordinators) are based at the centers to ensure day-to-day responsiveness to OPP's scientific and regulatory information needs. The Field Studies Coordinators (FSC's) are responsible for coordinating program activities between a given Center of Excellence and respective state projects, maintaining frequent liaison activities among the various projects, and identifying problem areas before they become of serious consequence.

### Epidemiologic Experiences

I. In 1974 the Texas ESP undertook a study of Hexachlorobenzene (HCB) contamination and its effects on a Louisiana population exposed through the transportation and disposal of chemical wastes from a chemical plant and a solvent plant (HEX wastes - a mixture of hexachlorobenzene, hexachlorobutadiene, water and other chlorinated hydrocarbons). The contaminated area was defined by previous cattle, air, and soil surveys. All inhabited households were located, and a systematic sample drawn, with the sampling procedures designed to yield about 100 exposed individuals (controls were drawn from similar housing in an area not adjacent to the suspect area). Each house was visited by an ESP scientist and several procedures were carried out:

1. A cutaneous porphyria oriented history was obtained;
2. A 10 ml heparinized venous blood sample in an evacuated glass container was obtained and immediately cooled;
3. An examination of exposed skin surface was performed;
4. Food samples were taken;
5. Urine samples were taken;
6. Dust samples were taken.

Plasma hexachlorobenzene (HCB) residues ranged from 345 ppb in waste disposal facility workers to 23 ppb in the general population (within the sample population's - exposed had 3.57 ppb vs .5 ppb in the controls - significant at the .001 level). There was no evidence of cutaneous porphyria by history or skin examination. Males had significantly higher residues than females, 4.71 ppb vs 2.79 ppb, age was not a factor in residues levels. A possible

association between HCB residues and coproporphyrin was found (the correlation coefficient for HCB and coproporphyrin was .19 on 120 blood-urine pairs - significant at the .05 level.) Only 2 of 48 meals sampled were positive for HCB. There was a correlation between HCB levels in household dust and blood levels (correlation coefficient of .29 - significant at the .025 level). Essentially, the ESP field team was able to plot the transportation path to disposal of the HEX waste, monitor the residue and establish that the population along the route did indeed have a greater burden of hexachlorobenzene residue than the community population in general. Both the solvent and chemical plants have undertaken to improve upon their disposal system as of this date.

II. In 1969 the California Project undertook a study of chlorinated hydrocarbon residues in blood of children from the children of 12 Tulare County Mexican-American families. The range of blood residue values were p,p'-DDE 10-53 ppb, p,p'-DDT 2-32 ppb, both of which were higher values than reported for white and non-white male adults from Florida who are generally attributed to be highly exposed. Seventy-five percent of the children examined showed higher levels than the highest level recorded in the blood of the Florida adult males. In a later study conducted during 1970-1972 the California Project undertook a study of chlorinated hydrocarbon insecticide residues in the blood of children of farm worker families. The children sampled were members of families of persons enrolled in the California study of persons occupationally exposed to pesticides. Significantly lower levels of DDT and DDE were found among non-exposed farm worker children. These results indicate that blood chlorinated hydrocarbon insecticide residues may be some indication of the habits of individual families.

III. A study was undertaken by the South Carolina Project in 1972 to confirm differences in occurrence of DDT and DDE residue levels among children of whites and Negroes. The Project examined 192 apparently healthy children between the ages of 6 and 9 from public and private schools in South Carolina. These children were stratified by race, sex, place of residence and by one year age spans. Venous blood samples collected and

analyzed for pesticide residues revealed that Negro children between the ages of 6 and 9 had residue levels 2-3 times greater than white children. The DDT levels averaged 18.4 ppb in Negroes and 6.7 ppb in whites, while the DDE levels were 55.6 and 24.8, respectively. As previously observed in other projects among adult subjects, white male children had significantly higher levels than white female children.

IV. The Hawaii Project studies morbidity in the general population among a sample of households in Oahu where pesticides were used either daily or not at all. Observations were controlled for age and sex of the persons within the households. There was no significant difference between the two groups in mean annual income, educational level, or occupational pesticide exposed but these two groups were not necessarily reflective of the general population in these variables. The daily user group contained more persons of part-Hawaiian or Filipino ancestry than the non-use group. On analysis the daily-use group had a significantly higher prevalence of asthma and chronic bronchitis confirmed than the non-use group. There was also more chronic sinusitis among the daily users.

A revisit to the study households revealed no difference in the prevalence of environmental allergens such as vegetation, animals, mold, etc. Examination of the non-smokers in both households for spirometric measures of respiratory function revealed further physiologic evidence of respiratory impairment in the daily-use group.

This is one of the more rigorously done epidemiological studies in the 14 projects and the findings merit further investigation and verification, though other interpretations besides a direct cause-effect relationship of pesticides on chronic respiratory disease are possible.

## Discussion

Keith Long, Ph.D., Moderator

Dr. Tom Carson

Are there any investigations of or any danger from polyvinyl chloride piping materials used in domestic water systems? Dr. Kay, do you want to come over here by the mike?

Dr. Kingsley Kay

It is my understanding that there are tremendous numbers of questions being raised about polyvinyl chloride. There are many, many questions being raised about vinyl chloride coming out of polyvinyl chloride. We know it is in there. It is secluded and we know that it diffuses. I'm going to do a paper at the American Chemical Society next week which is on the diffusion of vinyl chloride through polyvinyl chloride and so on and so forth. I know that people are working on the water pipe thing but there are no results. For instance, there still aren't any results on vinyl chloride coming out of polyvinyl chloride food wrap films. But as suspected, it is coming out in considerable quantity. But as far as I know, nothing concrete on any of these yet.

Dr. Griffith Quinby

For those of you who are not aware or have not seen the article in the Journal of the American Medical Association, something is coming out of polyvinyl plastics that caused meat wrappers to have asthma. The substance has not been identified, but the attack rates are very high and the assessment of the problem is very incomplete. I would suspect when the figures are gathered that there would be a much greater problem than is appreciated. Some time this last March I brought this problem up before the Washington Lung Association and immediately hands began to go up all over the audience of internal medicine specialists who had seen asthma in meat wrappers and didn't know what it was caused by.

Dr. Kingsley Kay

In Chemical and Engineering News that came out September 3, 1974, there is quite a long item on meat wrappers asthma, so called. I believe it isn't accepted medically yet. But, in any event, it was stated in this article that they have found that there is a pesticide or a systabesatol compound like the one I mentioned today and that comes out and hydrogen chloride is formed when the plastic is cut on a hot wire because it combusts and that there are assorted hydrocarbons.

Dr. Kaye Kilburn

I would like to add two more facts. First, Phosgene is produced when polyvinyl chloride is burned. Phosgene was used as war gas in the First World War. Second, Phosgene is  $\text{COCl}_2$  and when it is hydrated with  $\text{H}_2\text{O}$  hydrogen chloride is produced. Combustion of polyvinyl chloride in a closed space during meat wrapping has produced several instances of meat wrapper's asthma. This is a toxic effect from the combustion of a new chemical but the topic is an old familiar agent. Whether there is sensitization, as Dr. Kay has suggested, is unknown. Meat wrappers recover from their asthma totally and very completely if they are taken out of exposure and it recurs with re-exposure. Whether this really has any relation to polyvinyl chloride problems or whether it is just an accident that combustion of it produces Phosgene, I think is still up for grabs.

Dr. Rodney Beard

I have recently reviewed information on meat wrapper's asthma. I think a very striking point is that it has occurred regularly, but it is associated with particular batches of the wrapping material. It seems not to be so much a matter of the vinyl chloride per se, but something else that appears to get into it. Whether by design or by chance, I think is still uncertain.

Dr. Kingsley Kay

I don't want to leave the impression of having said that there was a sensitizer in polyvinyl chloride film or in the combustion products.

Dr. Ernest Dixon

I would like to comment on the second part - and that is that the heat sealing of the various films that are used - and many are not polyvinyl chloride. That many are polyethylene and other materials has not been well established at all. The probability of there being any Phosgene liberated is awfully small or, if so, it is in the very rapid transition through the hydrogen chloride phase to hydrochloric acid. As a matter of fact, aerobic heat degradation of polyvinyl chloride does not liberate vinyl chloride in perceptible amounts from the studies that have been done thus far. It can be liberated under anerobic conditions. Now, I didn't hear the first question, Dr. Kingsley, on the pipe but I heard part of the answer and I am not certain. What was the question on the plastic pipe?

Unidentified Speaker

Has it been established that vinyl chloride is vinyl chloride coming out of the pipe?

Dr. Ernest Dixon

After the pipe has been fabricated, formed and in use -- well, I think that I can say in general, based on studies that are not yet fully completed, that it can come out under some circumstance, probably in very trivial amounts, and an awful lot depends upon the residual monomer that was in the resin used to formulate the pipe. The change of any significant residual monomer being extractable after fabrication of the hard plastic pipe is essentially negligible. Certainly a state of equilibrium of unavailability of monomer for migration is reached in a very short period of time. Also, there is a very hard "skin" or seal on the surface that precludes migration. We've done studies, for example, by regrinding pipe made a week ago, dug up from the ground six years ago, or ten years ago; etc., and we have found very little monomer liberated from at least the ones made from low monomer resin.

## Overview of the Problem

Donald P. Morgan, M.D., Ph.D.

Pesticides are the most conspicuous and the most publicized hazards in the agricultural environment. Their real and potential impact on health has been the subject of the previous session. But as we all know, pesticides are only part of the overall chemical hazard picture. Many toxic threats to the health of farmers date back to the dawn of agriculture and animal husbandry. Some of the most obvious are the pollens, grain dusts, animal danders and fungal toxins which long antedate the industrial era. Even so, relatively limited research has thus far been done to reduce these threats to the health of agricultural workers. And, as agriculture has become more massive and technologically sophisticated, a host of new chemicals has been added to an already complex chemical environment. Many farms are now ad hoc arrangements of the old style fields and barns alongside the structural elements of modern industrial plants: chemical warehouses and machinery for chemical application, machinery storage and maintenance garages, disposal systems for animal wastes, and primary food storage and primary processing plants. None of the tasks involved in any of these activities is done without some risk of toxic injury. Recently, an author examining the fuel requirements of modern food production commented that modern agriculture has become a series of mechanical strategies for converting petroleum into food. And any visitor who visits a modern farm must be impressed with the array of huge machines for tilling, planting, cultivating and harvesting. Less apparent is the burden of mechanical maintenance and operation involving exposure to fuels, fuel additives, degreasing agents, anti-rust paints, paint solvents, paint removers, and exhaust gases from internal combustion power sources. Certainly, one of the most serious chemical hazards of the modern farm environment is anhydrous ammonia. Accidental exposures of the eyes to anhydrous ammonia are causing additional cases of blindness, among farmers every year. Education of farmers to the seriousness of this matter has been a major objective of the Institute of Agricultural Medicine in recent years.

The film produced for this purpose is a creditable contribution to the educational effort.

Nitrogen oxides are particular hazards on farms and they come from at least two sources. First, they evolve from fresh silage. Silo-fillers disease was discussed by Dr. Kammermeyer. It accounts for a continuing small, but steady, percentage of toxic farm accidents. In addition, wells are often contaminated with nitrate fertilizer, exposing entire farm families to excessive intake of nitrates.

Finally, feed additives and veterinary medicinals present new and uncertain risks to handlers as new agents regularly become available. These risks need to be evaluated. These continuing chemical inventions promise significant improvements in food production and I suspect they will remain a permanent part of the agricultural scheme. If you doubt the earnestness with which chemical innovations are urged on today's farmer, I hope you can enjoy Iowa's evening tv commercials, where we learn how to keep our silage from rotting and our sows from getting constipated.

We have with us two speakers this afternoon who have long experience in matters of drug and chemical safety. First, it is my pleasure to introduce Dr. Ann Holt, Deputy Director of the Division of New Animal Drugs with the Bureau of Veterinary Medicine of the Food and Drug Administration, Rockville, Maryland. For 10 years she has had responsibility for the efficacy and safety of new drugs used in veterinary medicine. She will speak on the subject of veterinary pharmaceuticals. Dr. Holt --

## Veterinary Pharmaceuticals

Ann Brooke Holt, D.V.M.

The Bureau of Veterinary Medicine is one of the six Bureaus of the Food and Drug Administration. We in the Bureau of Veterinary Medicine are responsible for regulating the use of animal drugs and feed additives by livestock producers to ensure their safe and effective use in treating, preventing and controlling disease in food producing animals, pet animals, and birds. Our responsibility is not only to ensure the safety of drugs for the animal but also for the user and the consumer who buys food derived from treated animals. This latter responsibility is currently our number one priority because it is safe to say that sometime during their lifetime, food producing animals receive one or more drugs before they reach market size or weight. The majority of confined animals, swine, beef cattle, lambs or poultry are fed one or more drugs continuously in their rations for disease prevention or to improve their pound of feed to pound of gain conversion rates in order for them to be raised and marketed more efficiently. In 1973 more than 400 million dollars worth of drugs were sold for use in feed alone. And if these same animals get sick, they are administered a variety of drugs by parenteral injection and by mouth. Unlike drugs used in human medicine, 68 percent of therapeutic drugs used in animals are labeled for over the counter use as opposed to prescription use. That is, the livestock producer can buy most of the drugs he needs to treat his own animals without seeking the aid of a veterinarian.

The intent of Congress when considering the prescription section of the Food and Drug Law has always been to enable a livestock owner to treat his own animals. Therefore if adequate directions for use of a drug by a livestock producer can be written, the Bureau of Veterinary Medicine must permit its sale directly to the user. However, these adequate directions for use must include not only directions for administration of the drug to the animal

but also adequate instructions to enable the farm worker to use the drug safely. Directions for use include, where applicable, cautions to wear gloves, to avoid inhalation, how to dispose of empty containers, emergency antidotes and how to handle and clean equipment. They are based upon information concerning the pharmacology of the chemical, the dosage form of the product, the conditions under which the drug is expected to be used and the results of studies conducted under field conditions which have been designed to demonstrate, among other things, the directions for use can reasonably be expected to be followed in practice.

In addition, today, the label of all drugs given to food producing animals must include a Warning statement telling the user how long after the administration of the last dose of a drug the animal must be withheld from slaughter or its milk or eggs discarded following treatment if metabolism studies have demonstrated that residues of the drug are likely to be found in food following its use.

Although we are not aware of any documented evidence that harm has resulted to man from eating meat containing drug residues, the potential does exist and the literature contains one reported incident from England in which a woman, hypersensitive to penicillin, developed an allergic dermatitis from milk containing as little as 0.018 ppm of penicillin.

Therefore the possibility of harm is present and a major concern of the Food and Drug Administration is not only to educate and prevent the livestock producer from marketing animals and their products too soon after a drug has been withdrawn but also that he doesn't slaughter an injured animal for his own and his family's use without observing drug label warning statements. From the results of an FDA contract recently completed in Missouri, we know there is a positive correlation between the numbers of antibiotic resistant fecal organisms found in farm families and their animals. The same study also demonstrated a positive correlation between the fecal flora of non-farm families that consumed meat from the farms in the study. The

study did not tell us the significance of these data, however. We do not know, and there is no indication that these families have a higher incidence of gastro-intestinal disease than the normal urban family or when ill that these families respond differently to treatment.

Our drug experience reporting system which requires the manufacturer of a drug to report adverse reactions and complaints to us at least once a year or within 10 days if a report is serious, contains only two reports of adverse effect to a drug user. One concerned a veterinarian who swallowed horse worm medicine while stomach tubing horses and had symptoms of nausea and incoordination for 10 days. The other concerned an employee of a small animal hospital who developed a sensitivity to a flea dip for dogs. This does not imply that because we have received so few reports of drug accidents that none occur. On the contrary, it seems strange that we do not have more. We have no reports, for example, of hypersensitivities developing among agricultural workers handling medicated feeds either at feed mills or on farms. Both environments can be extremely dusty and one would think some feed handlers exposed to dust, which in all likelihood contains antibiotics and other medicaments, would show some adverse effects. We know that allergic reactions have occurred among workers exposed to dust in drug manufacturing plants. Perhaps, like a lot of other things, such incidents have not been looked for and therefore not reported rather than not occurring.

At the present time the Bureau of Veterinary Medicine is initiating an audio-visual educational program for use by farm radio and television stations of which there are about 7000, which is designed to tell producers where they can obtain information about proper usage and repeating over and over again the importance of observing the label direction, warning, and caution statements.

We hope by this means, in conjunction with our scientific review of field use data before new animal drugs are approved, to prevent accidental misuse and injuries from occurring during or following the use of animal

drugs. When we do receive reports of adverse effects that either result in harm to an animal, drug user or to people consuming food derived from animals, however we are prepared to take regulatory action to re-label, restrict distribution or if necessary, remove a drug from the market.

## Introduction

Donald P. Morgan, M.D., Ph.D.

We will go on to the next speaker and then have time for questions and discussion. It is my pleasure now to introduce a gentleman whose name has been associated with poison control for as long as I can remember and perhaps he will tell you how long before that. As long as I have heard of the Poison Control Clearinghouse, I have heard the name of Dr. Henry Verhulst, and it my pleasure to introduce him now to discuss problems of drug and chemical safety.

## Statistics on Acute Exposure from Agricultural Chemicals

Henry L. Verhulst

Data -- one of the most important words -- one of the most important commodities in our lives. There is a constant request for every type of data. Then it must be expanded into a national projection frequently with little scientific basis and last, if it involves any hazard, someone will suggest a cost/benefit analysis. Few of the people requesting such information are familiar with the difficulty in collecting data, verifying its authenticity, and developing a base for a national projection. It appears certain, however, that the demand for information will continue and it is our responsibility to obtain all data that is available. It is my opinion that all such data should be presented with full recognition of its strengths and weaknesses. I am grateful, therefore, to have this opportunity to discuss the information collected by the Poison Control Program.

The primary function of the poison control center is to collect and maintain information on the toxicity of commercial products and give this information, along with treatment recommendations, to the physician when needed to treat a patient. The Clearinghouse is receiving information from industry on an increasing number of national products. The data on toxicity still varies greatly in degree of completeness although most information on pesticides is good. Following receipt of company data, the Clearinghouse personnel, after review of literature and their own case reports on similar products, finalizes the information which it supplies to the centers on 5 x 8 cards for use when needed. Most centers now accept calls from the lay public and while treatment information, other than first aid instructions are not supplied, information on the seriousness of the ingestion is discussed with the parent. If a potential poisoning does not exist the parent is so notified, however, if any hazard exists, the case is referred to medical sources.

The case is reported to the National Clearinghouse for Poison Control Centers on a standard form which is usually filled out by the center when the call is received or in the emergency room if the patient presents.

The symptoms are reported at that time. Also treatment, particularly emesis or lavage, is initiated and when evacuation of the stomach is completed the patient is frequently released. Removal of the product may result in symptoms not occurring which might have occurred if left in the stomach or minor symptoms could occur at home but go unrecognized since the parent is not observing the child in the belief he is completely cured. We receive additional information on some cases when hospitalized but in many reports the symptoms reported are those present when information is sought. We received approximately 164,000 reports of ingestion from 517 poison control centers in 46 states in 1973. Children under 5 years of age were involved in 102,000 cases. Pesticides have decreased slightly from 5.5 percent to 4.8 percent of the total cases reported from 1970 through 1973. Approximately 90 percent of the cases in pesticide categories reported for children under 5 years of age involve insecticides and rodenticides. Fungicides, herbicides, and animal repellants represent a very small percentage of the cases reported.

What type of data is available? Data is tabulated by category of product, i.e., Insecticide, Rodenticide, Trade Name of Product, Age of Patient, Number of Cases with Symptoms, Hospitalization, and Fatalities. Tables list comprehensive breakdown by age, types and number of each symptom, persons making calls and type of report, and types of poisoning, i.e., accidental, inhalation, suicide intent. The latter tables are produced only on a category basis not individual products. The basic document is retained for a period of 5 years and can be quickly obtained for review for any other comments it might contain if needed. These report forms have been a source of much review in the past year by companies considering action in the area of child-resistant packaging. Also when new formulations are marketed, reports of ingestion alert us to symptoms occurring. This supports basic toxicity data obtained from animals.

The tabulations prepared by the Clearinghouse are of no value in comparing the pesticide problem from one state to another. If a state has no reporting centers, such as Vermont, there will be no reports of pesticide ingestions. An active center which is reporting, on the other hand, will supply data which can be used as an indicator of a problem. Harlingen, Texas,

has for years reported a number of parathion poisonings each year which indicated need for continuing efforts at education.

This area reports to us a large proportion of the parathion poisoning reported by centers in Texas. Comments on the form also give some idea of circumstance of exposure. For 8 cases reported from Harlingen in 1973, 4 stated it was sprayed around the house, 2 worked with parathion, 1 was a pilot, and the last states exposure to parathion. It is very obvious that information on the cause of poisoning, age of individuals involved, and to some extent the degree of illness occurring in a geographic area, can be determined. The data will be available only if cases are reported by individual poison control centers. I mentioned the large percentage of rodenticide ingestions involving children. The tabulations show over 800 of 1400 children ingested products of one company in the rodenticide category. It is our belief that the data we tabulate highlights some areas of concern and at times specific educational programs for prevention. If we can assist you with specific information, we will be glad to do so if it is available.

## Discussion

Donald Morgan, M.D., Ph.D., Moderator

I ask now for questions and discussion. As we are taping these comments, I request that you either come up and state your question into the microphone, or please tell me your name and the question and I will repeat it.

Dr. Kelly Donham

What is the present position of the FDA in the light of the Swann Report?

Dr. Ann Holt

The Swann Report was a report from England which led to stricter regulation of antibiotics used in animal feeds for growth promotion and feed efficiency in England. In essence, if an antibiotic is used in human medicine, they are controlled as prescription drugs for animal use.

Following receipt of the Swann Report in this country, the Food and Drug Administration convened an expert committee to make recommendations as to the Report's applicability to the United States. We are taking their advice. The drug manufacturers are currently doing studies to develop data to show whether resistant bacteria do develop under field conditions which are resistant to antibiotics and might comprise therapy in either sick animals or humans. Also some studies are being done on the development of salmonellosis in animals. These studies will not be completed until, I believe January of 1975, when we expect the data to start coming in. After that it will have to be analyzed and I can't tell you what is going to happen.

Dr. Donald Morgan

Dr. Holt, while you are here, could I ask what mechanism you use for getting reports of adverse reactions among handlers of veterinary pharmaceuticals?

Dr. Ann Holt

We really don't have a mechanism for getting reports for user adverse effects to be very honest with you. The two reports that I mentioned were submitted by the people that were involved. The drug firms send us reports as required by the Regulations. The report includes any adverse report in animals they receive during a year so theoretically they would be submitted to us. That is really all I can say about it.

Dr. Griffith Quinby

Dr. Verhulst, we clinical toxicologists are already being asked about the value of a new commercial source of toxicology data. I refer to a system for storing and retrieving toxicologic data on commercial products. It is known as the Micro-poison index or something to this effect. Are you familiar with it, and would you care to comment on the adequacy of this \$300 per unit data storage tool, as compared with pre-existing data storage devices? Are you familiar with the one I am talking about?

Dr. Henry Verhulst

I am aware that it is being marketed in Denver, but I am not completely familiar with it, so I would rather not talk about it.

Dr. Donald Morgan

Dr. Verhulst, one problem we have encountered with the Poison Control card file is the difficulty of finding the generic name from the proprietary names that are commonly available from the poisoned individual or from relatives. Are there any plans being made to establish a card file on the basis of proprietary

names as well as generic names? This is perhaps peculiar to the pesticide area, but it has been a difficulty that has arisen in the past.

Dr. Henry Verhulst

Well, we have tried to do this particularly with the drug area. We were under the impression that it was not as big a problem in the pesticide area as we are discovering. One of the things I did not mention is that we do have a computer data base and this is going to simplify tremendously the matter of putting all of the trade names, into a base and linking them to their generic names. We are well on our way on drugs and pesticides will be following. There are five outlets now and there should be four more going after a few weeks. Right now they are at Seattle, Kansas City, Detroit, Boston, New Orleans and they will be going into Salt Lake City, Atlanta, Baltimore and Albuquerque and that is going to simplify that whole process.

Dr. Ernest Dixon

Do not most of the poisoning problems center around locally produced and marketed products?

Dr. Henry Verhulst

I guess you can interpret that question two ways, Dr. Dixon. When the problem does occur it most frequently is with the local product, that is true. If it is a national product we will have a much higher probability of obtaining information.

Dr. Donald Morgan

If there are no more questions, we shall consider this session adjourned.

## Introduction

Kelley Donham, D.V.M.

It is the time of day to get started. The first section this morning is Comparative Medicine. Comparative medicine is an area that has no easy straight forward definition. Generally speaking when we consider comparative medicine we are talking about the studies of relationships of the health and diseases of animals and their relationships to the health and diseases of man. It is a study that overlooks animal species boundaries to solve health problems of man. We heard a couple of examples yesterday where this was applied. Dr. Carson's talk on using animals as a model of environmental health and then Dr. Kammermeyer mentioned some of the allergic problems to animal dander and so on. These are only a few of the areas that are in the realm of comparative medicine. Our first speaker this morning is Dr. Lloyd Selby who will present an overview of comparative medicine as it applies to the health problems of the agricultural worker as well as the environment in general. Dr. Selby is from the University of Missouri where he holds a joint appointment in the Medical School, Department of Community Health and Family Practice, and also is in the Veterinary School where he is in the Department of Microbiology, specializing in Public Health. I am very pleased to introduce Dr. Selby who will present an overview of comparative medicine as it pertains to the health of agricultural workers and general environmental health.

## Comparative Medicine: An Overview

Lloyd A. Selby, D.V.M., Dr. PH.

### Introduction

Comparative medicine brings together the various disciplines to study a particular disease or group of diseases in both human beings and animals. Thus, by its very nature, comparative medicine requires a team effort. This may include field studies among the human and animal populations within a geographic region, as well as definitive laboratory studies in man or animal models. Also, the comparison may involve the whole disease process or it may only include one aspect such as comparative pathology. (Leader, 1967a, b)

Comparative medicine as it relates to agricultural health and safety is concerned with the conditions or diseases that affect the health and safety of individuals engaged in agriculture as a profession e.g. farmer, dairyman, as well as those individuals in allied fields who directly or indirectly support agriculture. In general, the individual engaged in agriculture or an allied profession must be exposed to or come in contact with the agricultural environment. Thus, an individual residing and working in a large, urban area who works as a commodity broker would not be considered from a comparative medical standpoint as it relates to agricultural health and safety.

It is the purpose of this paper, therefore, to present an overview of comparative medicine primarily as it relates to agriculture, proceeding from the general to the specific. The items presented will include the philosophical bases, problems and possible solutions as well as the future aspects of comparative medicine.

### Philosophy

Neither man nor animals live in a vacuum. They are exposed to multiple environmental factors, individuals of the same or different species (Parrish, 1973),

disease agents (Top, 1964), as well as their own genetic mosaic (Childs, 1973), and the interactions between these variables (Freeman, 1973). All these variables both directly or indirectly influence their state of health. We have discovered that the physical environment is only one facet of the disease-health continuum. The social and psychological aspects are also important aspects of health. This is as true with domesticated animals as it is with man. These latter areas are important and need to be developed in the future in comparative medicine. The role of the companion animal as it relates to the mental health of man requires further study and evaluation (Fox, 1972; McCulloch, 1973).

Sometimes our reasoning in comparative medicine is by analogy (Beveridge, 1972). For example, if the clinical disease and pathological manifestations of a disease are similar e.g. congenital malformations, then the more we learn about congenital malformations in animals, results in more information that can be applied to human congenital malformations (Marienfeld, 1967; Selby, et al., 1971). Findings in comparative medicine have resulted from studies designed with this objective in mind, as well as, chance observation of medical discoveries where one or more aspects of a disease in a species are applied to the same disease in another species. However, comparative medicine requires more than just extrapolation from one species to another. It must also be supported by other scientific data (Brodie, 1962; Oehme, 1970).

Animals may also help clarify our understanding of the disease process in man by indicating areas which need investigation and methods which might be used (Beveridge, WIB, 1972). For example, it was Jenner's observations that milkmaids, when immunized with exudate from cow pox lesions, were immune to smallpox. His studies instituted the present day immunization practices for smallpox. Today, with more sophisticated smallpox vaccine, with man as the only natural host and an extensive active eradication program by the World Health Organization, smallpox is no longer a major worldwide infectious disease.

Some of the ways in which comparative research on domestic and wildlife diseases aid in improving human health include (Pritchard, W.R., 1962; Beveridge, 1968):

1. Contributions to basic knowledge about the disease. Frequently in man, only the terminal stages of the disease have been studied in detail while in animal studies, it may be possible to observe the complete disease spectrum.
2. Indicates methods of controlling the transmission of the disease.
3. Techniques developed in animal species e.g. surgical techniques that can be applied to man.
4. Provides animal systems as a model for disease research.

Although more research is conducted in the area of human medicine, studies of like conditions or disease agents in animals sometimes have been more productive in a shorter period of time because:

1. The animals' environment could be more clearly defined.
2. Due to the population numbers, more instances of the disease were observed and studied. The shorter life cycle of animals is an enhancing factor and a total generation can be observed in a shorter period of time. In genetic studies, this phenomena is an extremely important variable in the research design.
3. Variations and changes can be made in the animals' ecology, e.g. changes in environment or husbandry and management practices.
4. Animal models may be housed and utilized more economically from an ethical and time-cost standpoint.

### Problem Areas of Comparative Medicine

In agriculture family members are usually part of the work force. As a result, health problems of the individual as well as their family must be considered. Age is an important variable in considering which diseases have the greatest impact. In the very young, prenatal and postnatal, infectious diseases are important. In the teenager and young adult, accidents are a problem while in the older age groups, chronic and degenerative diseases are a problem. Overall, however, occupational diseases are a major health concern and the primary focus of this conference. Therefore, in this session we will concentrate a major portion of our efforts on the occupational diseases significant to agriculture workers and allied professionals in the same environment.

A number of the infectious diseases are common problems of man and his domestic animals. Many are zoonotic diseases, that is, a disease transmitted from animals to man or one that has a common source of exposure for both animals and man (Schwabe, 1964; Steele, 1973a, 1973b). Zoonotic diseases are considered an occupational hazard for individuals in the agricultural field (Anom, 1964; Diesch, 1974; Donham, 1974). A discussion of this aspect of health and disease was included, a decade ago, in a joint International Labor Organization/World Health Organization Committee report in 1962 (Joint ILO/WHO Committee Report, 1962). Because the zoonoses will be discussed in detail later in this session, (Diesch, 1974; Donham, 1974; Martin, 1974) I will mention the zoonotic diseases only from a comparative medicine standpoint. Specific studies of those zoonoses associated with existing agricultural practices may lead to a more complete understanding of the disease process, more practical and economical methods of control and/or eradication in both man and his domesticated animals.

For example, with leptospirosis, it has been stated that complete control in man depends upon the elimination of the carrier (Menges, 1959). Both domestic and wild animals may have inapparent infections and the organism tends to localize in the kidneys and may be chronically shed in the urine. It is essential that when human leptospirosis cases are

diagnosed, carriers, usually animals, must be identified before preventive medicine measures can be taken. Domestic pets, food producing animals and various wildlife species, especially the rat, may act as reservoirs of leptospirosis. Thus, each instance of human leptospirosis may differ because of the disease's complex transmission cycle which includes an environmental phase. Frequently water is contaminated with leptospirosis and has an important role as a source of infection (Diesch and McCulloch, 1966). The readily visible domestic animal is ecologically a common source of infections, but is probably not the primary reservoir. Therefore, control measures must not be confined strictly to the domestic animal population.

However, the zoonoses are not the only important diseases of individuals or their families in the agricultural field. Diseases with one or more environmental components are, in fact, some of the common, as well as some of the most important health problems in the agricultural population. One may not initially consider environmental factors as having an important role in accidental injury and death, but environmental factors, including location, time of day and general weather factors, are important. Traumatic accidents, discussed later in this conference, are one of the acute non-infectious conditions that cause increased morbidity and mortality in agricultural workers (Cooper, 1971). Comparable problems occur among veterinarians where the farm or ranch was the location for most injuries to practicing veterinarians (Thigpen and Dorn, 1973). In addition to traumatic injuries, other occupational problems may affect veterinarians and they will be presented shortly in this session (Martin, 1974).

Another area of occupational hazards which has been discussed earlier in this conference is the accidental exposure to toxic trace substances e.g. pesticides (Long, K., et al., 1969; Hourrigan, 1970). Recently we investigated a number of acute outbreaks of arsenic poisoning in cattle where residues of the pesticide had been improperly dumped on the ground in pastures where animals were allowed to graze. The potential public health problem from intoxicated cattle entering man's food chain was

evaluated (Selby, et al., 1974). In this particular instance, the animals were not a model of human disease in the strict sense, but rather a model to help evaluate the potential food source, i.e. meat, as a potential public health problem. Thus by understanding the dynamics of arsenic in the ruminant, we were able to assess the potential public health problem to man.

In addition to the zoonoses, traumatic injuries and intoxications, the chronic or degenerative diseases are important in health problems in predominantly rural agricultural populations (Whipple, 1965). Again, age is an important factor for these populations have a tendency to be skewed toward the older age groups.

Cardiovascular diseases (Clarkson, et al., 1970; Lufinbuhl and Detweiler, 1970), cancer (Willham, Jr., 1971; Dorn, 1972a, 1972b), and arthritis (Van Pelt, 1965; Sokoloff, 1973) are some of the more important chronic diseases that have been studied from a comparative medicine standpoint, the first two having received the most attention. There is also a group of diseases that we do not mention frequently and when we do, it is often with the attitude that it is someone else's problem. This group of diseases are mental disorders, including illness, retardation, alcoholism and addiction disorders (Hilleboe, H.E., 1968).

But what about possible solutions, in the comparative medicine sense, for the major health problems of those individuals living and working in agriculture? Defining the problems involved is only one aspect of comparative medicine. Providing a solution is a more complex issue.

### Possible Solutions

Solutions to the agricultural health problems just reviewed require the combined efforts of many individuals and disciplines. No one profession or discipline can solve the complete problem.

Therefore, team effort is the only practical method that can be used in studying those diseases that are important in comparative medicine (Busse, 1965; Hamilton, 1967; Argyris, C., 1968). For example, Table 1 presents the disciplines which were involved in a comparative study of congenital malformations in man and swine (Marienfeld, et al., 1967; Selby, et al., 1971).

Table 2 shows the link between the medical research team and those individuals in agriculturally related fields who are involved in various ways with the production of pork. Interdisciplinary research in comparative medicine was discussed at the First Institute on Veterinary Public Health Practice (1960) as well as the congressional hearings on Human and Animal Health that were held in 1961 (Veterinary Medical Science, 1961). More recently, a bill was before Congress, primarily for animal disease research (Animal Health Research, 1973). The direct intent of this latter bill was not to emphasize the public health aspects of medicine. Yet, there is no doubt that research on animal diseases, many of them zoonotic diseases, will lead to a better understanding of the disease process in both animals and man, including newer methods of prevention, treatment and control.

To illustrate how possible solutions to disease problems can be solved by comparative studies, two situations will be presented: one on histoplasmosis and the other on an instance of pesticide intoxication.

Histoplasmosis was once thought to be a rare and highly fatal disease. During World War II numerous inductees into the Armed Forces of the United States had calcified pulmonary lesions suggestive of tuberculosis. However, their tuberculin skin test reactions were negative. A number of investigators hypothesized that the high incidence of pulmonary calcification associated with negative tuberculin skin tests might be due to another fungus disease (Rogers, 1966).

However, the reservoir for the causative organism Histoplasma Capsulatum, was unknown. At one point, it was suggested that animals, probably the rat,

was the reservoir of infection for man (Emmons, 1950). Subsequent studies by Emmons and others indicated environmental factors are important, that soil is the reservoir (Furcolow, 1965), and that old bird roosts and abandoned chicken houses are a foci of infection with aged guano acting as a growth stimulant for the fungus. Further studies with domestic animals including epidemiologic skin tests and culture studies, indicates histoplasmosis occurs among most species of domestic animals and many species of wildlife (Selby, 1974). As field studies indicate, it is suggested that even within the endemic area foci of infection for histoplasmosis may tend to be localized (Menges, et al., 1967). Coincidental studies of wildlife, primarily rodents, support this hypothesis. However, H. Capsulatum was isolated from some farms with negative histoplasmin skin test reactors and not isolated from some farms with positive histoplasmin skin test reactors in the domestic animals. In addition, soil isolation studies sometimes appear to be contrary to domestic animal or human sensitivity studies, yet the wildlife animal isolations studies correlate fairly well with domestic animal sensitivity studies. This suggests that although H. Capsulatum may tend to have a local foci, the fungus may be more widespread than presently realized and that not all these foci are related to infection in man or animals (Menges, et al., 1967).

The second situation that illustrates the documentation of human health problems by comparative medical studies, in the environment and domestic animals, is the epidemiologic investigation related to an instance of an apparent pesticide intoxication. During the early phase of the Community Study of Pesticides (Louisiana), (Selby, et al., 1969), a request was received to investigate an instance where a spray plane operator had "accidentally" released pesticide while flying over the yard, cistern, chicken house and house of a family living adjacent to a sugar cane field. Further history indicated that occupant's wife was hospitalized with neurological symptoms. She had been admitted to the hospital unable to stand or walk without aid. Initially, organic pesticide intoxication was not considered because she had a history of being treated for neurological problems, possibly psychological, the previous year. When

interviewed, she stated, however, that she remembered that a similar spraying accident had also occurred the year before at the same time as her original hospitalization. In both instances, approximately 300 laying hens began to molt and laid "Hard-boiled eggs" and died.

We were unable to detect pesticide residues in the patient's blood. We were, however, able to detect levels of Carbaryl (1-naphthyl-N-methylcarbamate) residues in vegetation from her front yard. By adapting the existing analytical methods, we also were able to detect similar residues in the blood from a surviving chicken. Thus, comparative medical studies in the environment and in the animals aided in the documentation of an instance of human intoxication. At this point our investigation ceased at the request of the patient and her husband. Their request, in turn, had been initiated by the spray plane operator who objected strenuously to our studies.

The two situations, the first on the general problem of histoplasmosis and the second, on the specific problem of an instance of apparent pesticide intoxication, are presented to illustrate how comparative medicine studies can further our understanding of diseases related to agriculture health and safety. In an overview of comparative medicine, it is impossible to completely review all the various aspects of comparative medicine. There is, however, I feel, a responsibility, although not clearly stated, to explore from philosophical viewpoints, the future of comparative medicine.

#### Future Considerations

Because of the diverse nature and urgency of some of society's problems, comparative medicine is beginning to expand into "new frontiers" (Beveridge, 1972). True, many animal models in biomedical research have been discovered (Cornelius, 1969; Doyle, *et al.*, 1969; Valtin, 1974) but there is a need for additional models (Prichard, 1970). Comparative medicine is also expanding into the area of environmental quality (Carson, 1974). Man in his rapidly changing world has become more concerned about his environment and himself

as an individual as well as a member of society as it relates to man's survival (Knutson, 1965; McCulloch, 1970). With this increased interest and concern of society, a number of issues have come to the forefront which are important considerations in comparative medicine. Newer dimensions of the legal and ethical concepts associated with human research are being explored (Ladimer, 1970). Research only on animals as an alternative is one option, but the same legal and ethical concepts need to be considered. Another option is to use data collected on animal populations, sharing the same environment with man or exposed to the same environmental factors. Although this type of study may have limitations (Parrish, *et al.*, 1968; Hugh-Jones, 1973), newer, more sophisticated methods can be developed to minimize these limitations and be used in comparative studies of diseases common to animals and man. The feasibility of these studies is enhanced by the team-approach to disease research. For well-organized, planned team research is the key to our understanding those environmental quality variables that are related to agricultural health and safety. This conference depicts this philosophy. We must, however, be selective in using the appropriate biological model in studying the environment of man and his domestic animals (Leader, 1967a, b; LeMunyan, 1969). Many of the direct effects of environmental variables have been studied in man or animals, but we can learn even more from comparative studies (Hyslop, 1971). This is especially true in the study of environmental trace substances where biological variations between species and within species (Al-Shahristani and Shihab, 1974) can create difficulties in interpretation. But society with its newer technology and use of modern drugs has created new problems e.g. the problems of drug-resistant pathogenic bacteria and its transfer from one species to another (Dulanegand and Laskin, 1971; Smith, 1974; Burton and Blenden, 1974). This drug transfer mechanism, because of the close environmental relationship between agricultural workers and their domestic food producing problem is one of the more important areas of comparative medicine research today and it will be even more so in the future.

Another area of concern related to societal pressures is that of alcoholism. Comparative medicine studies hold the key to developing more sophisticated methods of prevention and eventual control of the problem accentuated by the ecosystem in which we live (Mello, 1973; Lester and Freed, 1973). Because man and his domestic animals are living longer, the chronic and degenerative diseases associated with aging will continue to be studied extensively (Breslow and Catcott, 1960; Steels, 1960). These studies by their very nature are complex studies with multiple variables.

Another particular area of health that relates directly to individuals in agriculture and their families as well as the aging phenomena is that of mental health. Laboratory animals have been used extensively in the study of behavior, but what of animal behavior as it relates directly to man's physical and mental well being? Dog bites are a problem (Graham-Jones, 1972), as well as traumatic injuries from the large food producing animals e.g. the dairy bull. This physical interaction of man and domestic animal can, besides physical injury, also cause mental injury to the individual and his family. These problems require further study, especially general population studies. For example when, because of disease problems, a producer, i.e., farmer or dairyman is forced to sell animals or his complete herd, this not only has an economic impact, but also a mental impact, e.g. mental depression (Leinbach, 1958). Another aspect of the mental health will be the study of the companion animal as related to mental health in man (Antyeles, 1967; Fox, 1972; McCulloch, 1973). A recent study of interest in this area was the evaluation of "affection for people as a function of affection for dogs" (Brown, et al., 1972). Yet, comparative ethology and psychology in general populations is in its infancy (Tobach et al., 1973). It will continue to grow and develop in the years ahead, through multidiscipline research. These efforts in comparative medicine can best be summarized by a statement made by Sir William Osler when he stated, "There is but one medicine."

Table 1. Professional Disciplines Involved in the Multi-species Study of Congenital Malformations in Man and Animals Primarily Swine (Marienfeld et al., 1967; Selby et al., 1971)

Professional Discipline	Activities
<u>Program Staff</u>	
Physician Pediatrician	Design and evaluation of overall program; classification of human malformations from hospital and vital statistics records.
Veterinarian Epidemiologist	Design and evaluation of field studies in domestic animal population; classification of animal malformations from pathology reports and data collected from field surveys.
Pathologist	Autopsy of malformed domestic animals and preparation of pathology reports.
Demographer	Evaluation of vital statistic records for natality, morbidity, and mortality related to malformations.
Statistician	Design and evaluation of field studies and data collected from existing reporting systems or special surveys.
Systems Analysis	Design and direction of computer staff and programs to support data collected from vital statistics and field studies.

Table 1. (Continued)

Professional Discipline	Activities
Computer Programmer	Develop computer programs for analysis and evaluation of data collected during the study.
Cartographer	Design methods to be used to evaluate spatial relationships between malformed offsprings and environmental variables.
<u>Field Staff</u>	
Veterinarian Epidemiologist	Collect and evaluate data on malformed offsprings in domestic animal populations primarily swine.
Practitioner	Examine and report occurrences of malformations in domestic animal populations.
Toxicologist	Collaborate and consult on outbreaks of fetal wastage and malformations related to environmental toxicants.
Extension Specialist Livestock Agent	Act as liaison between livestock producers and program staff in reporting information on animal population numbers and occurrences of malformations.

Table 1. (Continued)

Professional Discipline	Activities
Livestock Producer	Report animal population numbers and numbers of malformed offspring.
<u>Consultants and Support Disciplines</u>	
Mammologist	Collection and evaluation of natality and mortality data on wildlife populations as related to fetal wastage.
Embryologist	Consultant on the embryogenesis in domestic animals.
Geneticist	Consultant on genetics as related to outbreaks of malformations in animals.
Geologist	Collaborator and consultant on environmental trace elements patterns in the geochemical environment.

Table 2. Sectors of the Swine Industry and their Main Concern with Swine Diseases

Sector	Diseases
Producers	Abortions, stillbirths, neonatal deaths, anemia.
Feeder	Pneumonia, arthritis parasites.
Buyer	Shipping loss, excessive shrinkage.
Packer	Loss of meat or body organs due to parasitism and disease.
Veterinarian	Disease outbreaks; sporadic instances of swine disease, primarily in sub-adult or adult animals.
Farm Advisor (e.g., Extension Specialist)	Reproductive performance, nutritional deficiencies.
Researcher	Genetic infectious or noninfectious diseases, e.g., anomalies

## References

1. Al-Shahristan, H. and Shihab, M.K. (1974). Variation of biological half-life of methylmercury in man. *Archiv. Environ. Hlth.* 28:324-344, (June).
2. (1973) Animal Health Research Committee of Agriculture and Forestry. U.S. Government Print Office, Washington, D.C.
3. Anom. (1964). Occupational Diseases: Acquired From Animals. Continued Education Series, No. 124. University of Michigan, School of Public Health, Ann Arbor.
4. Antyeles, J. (1969). Human emotions and veterinary practice. *J. Am. Med. Assoc.* 155:2018-2025.
5. Argyris, C. (1968). On the effectiveness of research and development organizations. *Am. Sci.* 56:344-355.
6. Beveridge, W.I.B. (1972) *Frontiers in Comparative Medicine. Vol. 1, The Wesley W. Spink Lectures on Comparative Medicine.* University Minnesota Press, Minneapolis.
7. Beveridge, W.I.B. (1968). The Future of Comparative Medicine. *Mo. Med.* 65:98-103.
8. Breslow, L. and Catcott, E.J. (1960). Present and future utilization of veterinarians in public health with particular attention to chronic diseases and aging. In "Comparative Medicine in Transition," pp. 317-323. Ann Arbor, Michigan. School of Public Health, University of Michigan.
9. Brodie, B.B. (1962). Difficulties in extrapolating data on metabolism of drugs from animal to man. *Clin. Pharmacol. Ther.* 3:374-380.
10. Brown, L.T., Shaw, T.G., and Kirkland, K.D. (1972). Affection for people as a function of affection for dogs. *Psychol. Rep.* 31:957-958.
11. Burton, G.C. and Blenden, D.C. (1974). The effect of antimicrobials in animal feeds on the fecal flora of animals. In "Antibiotics in Animal Feeds and in Food for Man" (L.D. Sabath, Ed.), C.C. Thomas, Springfield, Ill. (In press).
12. Busse, E.W. (1965). Administration of the interdisciplinary research team. *J. Med. Educ.* 40:832-839.
13. Carson, T. (1974). Animals as Monitors of Environmental Quality. Proceedings Agriculture Health and Safety Conference, Iowa City, Iowa, (September 4-5). In press.

14. Childs, B. (1973). Garrod, Galton, and clinical medicine. *Yale J. Biol. Med.* 46:297-313.
15. Clarkson, T.B., Prichard, R.W., Bullock, B.C., Lehner, N.D.M., Lofland, H.B., and St. Clair, R.W. (1970). Animal Models of Arteriosclerosis. In "Animal Models for Biomedical Research III," pp. 22-41. National Academy of Sciences, Washington, D.C.
16. Cooper, K.K.C. (1971) Accidents in agriculture. *Injury* 3:1-8.
17. Cornelius, C.E. (1969) Animal models - a neglected medical resource. *N. Engl. J. Med.* 281:934-944.
18. Diesch, S.L. and McCulloch, W.F. (1969). Isolation of pathogenic leptospire from waters used for recreation. *Public Health Reports* 81:299-304.
19. Diesch, S.L. (1974). Potential Occupational Health Hazards of Livestock Producers Working in Animal Confinement Units. *Proceedings Agriculture Health and Safety Conference, Iowa City, Iowa (September 4-5)*. In press.
20. Donham, K. (1974). Infectious Diseases Common to Animal and Man of Occupational Significance to Agriculture Workers. *Proceedings Agriculture Health and Safety Conference, Iowa City, Iowa (September 4-5)*. In press.
21. Dorn, C.R. (1972). Comparative oncology: dogs, cats, and man. *Perspect. Biol. Med.* 15:509-519.
22. Dorn, C.R. and Schneider, R. (1972). Public health aspects of cancer in pet dogs and cats. *Am. J. Public Health* 62:1460-1462.
23. Doyle, R.E., Garb, S., Davis, L.E., Meyer, D.K., and Clayton, F.W. (1968). Domesticated farm animals in medical research. *Ann. N.Y. Acad. Sci.* 147:129-204.
24. Dulaney, E.L., and Laskin, A.I., Eds. (1971). The problems of drug-resistant pathogenic bacteria. *Ann. N.Y. Acad. Sci.* 182:1-415.
25. Emmons, C.W. (1950). Histoplasmosis: animal reservoirs and other sources in nature of the pathogenic fungus. *Histoplasma. Am. J. Public Health* 40:436-440.
26. Fox, M.W. (1965). *Canine Behavior*. C.C. Thomas, Springfield, Ill.
27. Freeman, G.H. (1973). Statistical methods for the analysis of genotype-environment interactions. *Heredity (Lond)* 31:339-354.

28. Furcolow, M.L. (1965). Environmental aspects of histoplasmosis. *Arch. Environ. Health* 10:4-10.
29. Graham-Jones, O. (1972). Man bites dog. *Vet. Rec.* 91(5):115-117.
30. Hamilton, M. (1967). Planning of team research. *Br. Vet. J.* 123:375-382.
31. Hilleboe, H.E. (1968). Public health in the United States in the 1970's. *Am. J. Public Health* 58:1588-1610.
32. Hourrigan, J.L. (1970). Safe use of pesticides on livestock. *J. Am. Vet. Med. Assoc.* 157:1818-1827.
33. Hugh-Jones, M.E. (1973). The uses and limitations of animal disease surveillance. *Vet. Rec.* 92(1), 11-15.
34. Hyslop, N. St. G. (1971). Factors influencing the epidemiology and epizootiology of airborne diseases. *J. Am. Vet. Med. Assoc.* 159:1500-1507.
35. Joint ILO/WHO Committee on Occupational Health, 4th Report (1962). Occupational Health Problems in Agriculture. WHO Tech. Rep. Ser. No. 246.
36. Knutson, A.L. (1965). *The Individual, Society and Health Behavior.* Russell Sage Foundation. New York.
37. Ladimer, I., Ed. (1970). New dimensions in legal and ethical concepts for human research. *Ann. N.Y. Acad.Sci.* 169:293-593 (Jan. 21).
38. Leader, R.W. (1967a). The concept of utility in mechanisms of disease. *The Rockefeller University Rev.* :9-13 (Jan-Feb).
39. Leader, R.W. (1967b). The kinship of animal and human diseases. *Sci. Am.* 216:110-116.
40. Leinbach, S.P. (1958). A general practitioner's work with depressed patients. *J. Iowa Med. Soc.* 48, 660 (Dec.).
41. Lemunyan, C.D. (1969). Selection of the Appropriate Biological Model for Research in Environmental Health. In "Animal Models for Biomedical Research II," pp.26-31. National Academy of Sciences, Washington, D.C.
42. Lester, D. and Freed, E.X. (1973). Criteria for an animal model of alcoholism. *Pharmacol. Biochem. Behav.* 1:103-107.
43. Long, K.R., Beat, V.B., Gombart, A.K., Sheets, R.F., Hamilton, H.E., Falaballa, F., Bonderman, D.P., and Choi, Un. Y. (1969). The epidemiology of pesticides in a rural area. *Am. Ind. Hyg. Assoc. J.* 30:298-304.

44. Luginbuhl, H., and Detweiler, D.K. Animal Models for the Study of Cerebrovascular Disease (1970). In "Animal Models for Biomedical Research III," pp. 35-41, National Academy of Science, Washington, D.C.
45. Marienfeld, C.J., Silberg, S.L., Menges, R.W., Crawford, W.T., and Wright, H.T. (1967). Multi-species study of congenital malformations in Missouri. *Mo. Med.* 64:230-233.
46. Martin, R.J. Occupationally Related Diseases of Illinois Veterinarians. Proceedings of Agriculture Health and Safety Conference, Iowa City, Iowa (September 4-5). In press.
47. McCulloch, M.J. (1973). Companion animals and mental health: a video-cassette program.
48. McCulloch, W.F. (1970). Environmental health and ecology: old concepts with new meaning for man's survival. *J. Am. Vet. Med. Assoc.* 157:1432-1438.
49. Mello, N.K. (1973). A review of methods to induce alcohol addiction in animals. *Pharmacol. Biochem. Behav.* 1:89-101.
50. Menges, R.W. (1959). Control of leptospirosis in man and animals. *Publ. Health Rep.* 74:149-152.
51. Menges, R.W., Furcolow, M.L., Selby, L.A., Haberman, R.T., and Smith, C.D. (1967). Ecologic studies of histoplasmosis. *Am. J. Epidemiol.* 85:108-119.
52. Wilham, S., Jr. (1971). Leukemia and multiple myeloma in farmers. *Am. J. Epidemiol.* 94:307-310.
53. Oehme, F.W. (1970). Species differences: the basis for and importance of comparative toxicity. *Clin. Toxicol.* 3:5-10.
54. Parrish, H.M. (1973). Animal-man relationships in today's environment. *Am. J. Public Health* 63:199-200.
55. Parrish, H.M., Blenden, D.C., and Weil, T.P. (1968). Some missing measurements in comparative medicine. *Canad. J. Comp. Med.* 32:483-485
56. Prichard, R.W. (1970). Some Human Diseases for Which Animal Models are Needed. In "Animal Models for Biomedical Reserach III," pp. 157-167, National Academy of Sciences, Washington, D.C.
57. Pritchard, W.R. (1962). Creating new knowlecge for human health. *Vet. Econ.* 3(8):43-46, 48.
58. Rogers, D.E. (1966). The spectrum of histoplasmosis in man. *Med. Times* 94:664-682.

59. Schwabe, C.W. (1969). *Veterinary Medicine and Human Health*. 2nd ed., Williams and Wilkins, Baltimore, Maryland.
60. Selby, L.A., Case, A.A., Dorn, C.R., and Wagstaff, D.J. (1974). Public health hazards associated with arsenic poisoning in cattle. *J. Am. Vet. Med. Assoc.* (In press)
61. Selby, L.A. (1974). Histoplasmosis in "Diseases Transmitted from Animals to Man," (Hubbert, *et al.*, editors), 6th Ed., C.C. Thomas, Springfield, Ill. (In press).
62. Selby, L.A., Hopps, H.C., and Edmonds, L.D. (1971). Comparative aspects of congenital malformations in man and swine. *J. Am. Vet. Med. Assoc.* 159:1485-1490.
63. Selby, L.A., Newel, K.W., Waggenspack, C., Hauser, G.A., and Junker, G. (1969). Estimating pesticide exposure in man as related to measurable intake; environmental versus chemical index. *Am. J. Epidemiol.* 89:241-253.
64. Smith, H.W. (1974). Clinical problems of preventive medicine: antibiotic-resistant bacteria in animals; the danger to human health. *Brit. Vet. J.* 130:110-119.
65. Sokoloff, L. (1973). Animal model: arthritis due to mycoplasma in rats and swine. *Am. J. Pathol.* 73:261-264.
66. Steele, J.H. (1973). A bookshelf on veterinary public health. *Am. J. Public Health* 63:291-311.
67. Steele, J.H. (1960). Comparative Medical Research and Chronic Diseases of Animals. In "Comparative Medicine in Transition," pp. 324-330.
68. Steele, J.H. (1973a). The zoonoses: an epidemiologist's viewpoint. *Prog. Clin. Pathol.* 5:239-286.
69. Thigpen, C.K. and Dorn, C.R. (1973). Nonfatal accidents involving insured veterinarians in the United States, 1967-1969. *J. Am. Vet. Med. Assoc.* 163:369-374.
70. Tobach, E., Adler, H.E., and Adler, L.L., Eds. (1973). Comparative psychology at issue. *Ann. N.Y. Acad. Sci.* 223:1-192.
71. Top, F.H. (1964). Environment in relation to infectious diseases. *Arch. Environ. Health.* 9:699-723.
72. Valtin, H. (1974). Genetic models in biomedical investigation. *N. Engl. J. Med.* 290:670-675.

73. Van Pelt, R.W. (1965). Comparative arthrology in man and domestic animals. J. Am. Vet. Med. Assoc. 147:958-967.
74. Veterinary Medical Science and Human Health, Committee on Government Operations. U.S. Senate, 85th Congress. U.S. Government Print Office, 1961.
75. Whipple, H.E., Ed. (1965). Comparative cardiology. Ann. N.Y. Acad. Sci. 127:1-875.

## Introduction

Kelley Donham, D.V.M.

Thank you, Lloyd. I think your presentation was an excellent perspective of the concepts and application of comparative medicine to the health of agricultural workers and the quality of the environment.

Moving to the more specific examples of the application of comparative medicine to the agri-environment, Secretary of Agriculture Lounsberry mentioned last night that the agricultural production in this country has increased many fold over the past 3-4 decades. One of the primary reasons for this increase in productivity has been the increase in technology. This new technology has also brought some health problems that were always not necessarily anticipated. One area that has become of concern lately has been in the area of confinement feeding. This is a type of management where animals are housed together in very close quarters. The advantages of this system are greater efficiency in land use, ease of handling livestock, and just general economic reasons. There are some health problems associated with confinement feeding that we have been aware of here at the Institute of Agricultural Medicine and that Dr. Stanley Diesch of the University of Minnesota has been looking at. Dr. Diesch is an alumnus of this Institute and is now on the faculty at the University of Minnesota in the College of Veterinary Medicine and he also holds a joint appointment in the School of Public Health there. Dr. Stanley Diesch will talk about Potential Hazards of Livestock Producers in Confinement Livestock Units.

Potential Occupational Health Hazards of Livestock  
Producers Working in Animal Confinement Units

Stanley L. Diesch, D.V.M., M.P.H.

Introduction

In the past, mixed species and a rather small number of food producing animals were kept per farm unit. With today's increase in specialized farming, a large number of a single species is often housed in concentrated livestock production units. Therefore, people directly associated with animals may be exposed to the common environment of a single species for longer periods of time.

Many present day housing facilities are confined or semi-confined units where animals are reared on slotted floors over manure pits or on an accumulation of manure. No bedding is used on slotted floors. This results in concentrated manure slurry. Because of these newer farm management systems, animal excreta often remains in confinement units for weeks to months instead of a day or two.

The concentration of animals and manure results, in potentially excessive direct human contact with pathogenic microorganisms and the release of harmful gases from the slurry within the confinement unit. Ventilation systems are utilized to reduce moisture, remove odors and to generally circulate air. However, movement of air and lower humidity keeps dust particles and microorganisms floating in the environment.

Review of the Literature and Research

In an effort to document the cause and effect relationship of livestock confinement units and human health hazards, an effort was made to determine

if human health hazards were a problem or if cases of illness have been reported or documented.

To determine if illness of livestock producers had occurred, I consulted the Minnesota State Department of Health. Dr. Fleming indicated that he has not received reports of illness of occupationally involved persons in livestock confinement units: no direct association had been reported.<sup>1</sup>

In 1974 a review published entitled "Livestock and the Environment", contained 1264 abstracts of which 55 pertained to health. Of the 55, none appeared to directly document the occupational health effects associated with the livestock confinement unit.<sup>2</sup>

Preuschen<sup>3</sup>, of West Germany, reports observations made on healthy workers exposed over a long period to livestock confinement units without bedding, where excreta remains for several days or weeks, where anaerobic decomposition takes place, and where ventilators have reduced moisture of air so more dust is generated. The results were that:

1. Bad smell from animal houses is not only unpleasant, but health damaging. Irritation of the bronchias (coughing) and dizziness (similar to being sea sick) are the result.
2. Subjects with a sensitive respiratory system tend to have shortness of breath and will become easily tired.
3. Existing bronchial allergies may be intensified so that persons smelling emissions from animal houses become unable to work because of asthma.

In initial experiments, Preuschen of the Max-Planck Institute, studied the influence of respiration of human subjects on normal air and odor intensive air. Subjects with normal respiration and handicapped respiration were used. Their findings were that normal working capacity, even of healthy persons, will be reduced by inhaling air from animal houses without bedding. Persons with a previous respiratory system handicap have

to face serious health damages after they worked in such houses for one to three years.

As a practicing Iowa veterinarian working in livestock confinement units, especially swine, I have personally experienced some of the above mentioned health effects. Other practicing veterinarians have indicated similar experiences.

Research has been conducted on the constituents of the atmosphere of livestock units. Day<sup>4</sup> et. al. have identified  $\text{NH}_3$ ,  $\text{CO}_2$ , and  $\text{H}_2\text{S}$  in the atmosphere of confined swine units. Additional constituents have been identified. Investigators have implicated  $\text{H}_2\text{S}$  in swine deaths.  $\text{H}_2\text{S}$  as high as 800 ppm has been measured during anaerobic pit agitation.<sup>5</sup> Lawson and McAllister<sup>6</sup> found that  $\text{H}_2\text{S}$  exceeded 1000 ppm above agitated manure slurry. Both levels are high enough to be considered dangerous.

Elliott<sup>7</sup> et. al. have compiled the following threshold limit values: Threshold limit values (TLV) for  $\text{CO}_2$ ,  $\text{NH}_3$ , and  $\text{H}_2\text{S}$  considered dangerous for man and animals.

Gas	Level	
	TLV	Dangerous
	ppm	
$\text{CO}_2$	5,000	250,000
$\text{NH}_3$	50	5,000
$\text{H}_2\text{S}$	10	500-800

In trials Curtis<sup>8</sup> et. al. have studied the affects of aerial  $\text{NH}_3$ ,  $\text{H}_2\text{S}$ , and swine house dust, alone or combined, on swine health and performance.

Ammonia alone at 50 or 75 ppm had little effect on growth performance, at levels more commonly encountered in practice ( $10 \text{ mg/m}^3$ ), it had no effect. Hydrogen sulfide alone at 8.5 ppm, or 2 ppm in combination with  $\text{NH}_3$  at 50 ppm had little effect on rate of gain or feed efficiency.

Another potentially hazardous gas is methane ( $\text{CH}_4$ ) which is produced in anaerobic decomposition of animal manure. It is of danger in the starting up of oxidation ditches in which manure has been collected prior to beginning of aeration. Methane which is produced in anaerobic systems is only slightly soluble in waste water or water and will escape. Methane should be vented to the atmosphere or collected and burned as a heat source. Care must be exercised to prevent occurrence of a methane-air mixture in the range of 5 to 15% by volume. Such mixtures are highly explosive.<sup>9</sup>

Researchers in Sweden and Europe have conducted studies concerning liquid manure gas poisoning in cattle. Chronic manure gas poisoning was first described there in the 1960's by Bengtsson, Ekesho and Jacobsson.<sup>10</sup> The effects were described as a general deterioration in condition and production, tendency to hemorrhage, softening of hooves followed by lameness, dyspnea, and tachycardia. Further data regarding chronic gas poisoning in cattle have been presented by Hogsved<sup>11</sup>, and Hogsved and Holtenius.<sup>12</sup>

Examination of the air in cowsheds with liquid manure handling showed that  $\text{H}_2\text{S}$  contamination of the air was characteristic and that high concentrations of this poisonous gas may occur when liquid is agitated in some way. The presence of  $\text{H}_2\text{S}$  can rarely be identified in cowsheds where solid manure is handled.<sup>12</sup>

Hogsvedt<sup>13</sup> further indicates that a large number of acute poisonings have occurred in both cattle and pigs in Sweden. These have occurred in connection with heavy agitation of liquid manure which has been stored for a long time. Acute cases of poisoning have occurred even when agitation has taken place out of doors, if there has been an open connection between cowshed and manure tank. The development of the acute or peracute poisoning

is very rapid. Convulsions and dyspnea can occur, some animals surviving can suffer from nervous disease and laminitis afterwards.

The chronic poisoning as described by Hogsvedt can sometimes take a long time for visible signs to develop. Dairy cows lose flesh and yield and tend to develop lameness because of extreme changes in hooves in such as softening of the horn and deep infections. There is also a general tendency for cattle to develop subcutaneous hemorrhage, with some described larger than a man's head. It is believed that  $H_2S$  is an important etiologic factor. They feel that the combination of  $H_2S$  and  $NH_3$  may play an important role in poisoning.

#### Minnesota Research - Survival of Pathogens in Animal Manure Disposal\*

The occupational hazards of the more than 150 zoonotic diseases (those naturally transmitted between vertebrate animals and man) has been documented. In the United States some of the occupational health hazards have been caused by brucellosis, Q fever, leptospirosis, salmonellosis, the source of which usually is animals; and often livestock. In the U.S. approximately 100 human cases of leptospirosis and 20,000 human cases of salmonellosis are reported each year.

During the past 5 years I have been engaged in a research project supported by the Environmental Protection Agency and formerly the U.S. Public Health Service. This research was designed to determine the survival of pathogens in beef cattle manure disposal by the oxidation ditch. Leptospire shed from the urine and salmonella shed in the feces of infected cattle were used as study models. Both diseases cause major health and economic problems. Bacterial counts of 100 million leptospire per ml of urine, and 10 million salmonella per gram of feces have been reported being shed by infected cattle. Shedding may occur from weeks to months duration. Studies

\*This investigation was supported by Environmental Protection Agency Grant No. R.802205.

were conducted in simulated laboratory models and a field oxidation ditch unit over which beef cattle were housed.

During this research project four feeder cattle (1100 pounds weight) were found dead on slotted floors over the field oxidation ditch, which contained manure slurry. On autopsy a diagnosis of idiopathic toxicosis was made. Cause of death was the likely emission of toxic gases.

During the past two years research objectives were to measure the viability and infectivity of leptospires and salmonella in aerosols caused by a potential mechanical dissemination of a laboratory model oxidation ditch and the field model being used to treat beef cattle waste under a confinement housing unit.

Leptospires seeded for five days in the manure slurry of a laboratory model oxidation ditch were measured as surviving 18 days at winter temperatures ( $2^{\circ} - 5^{\circ}\text{C}$ ) and for 138 days at summer ( $20^{\circ}\text{C}$ ) temperature.<sup>14,15,16</sup>

In an attempt to transmit leptospires by aerosol created by the rotor of the model ditch, weanling hamsters were housed on wire mesh over the rotor of the leptospiral seeded ditch. Hamsters exposed to these aerosols did not develop evidence of infection as measured by detectable serum agglutinating antibodies of kidney infection. In other experiments, hamsters were exposed to microbioaerosols of leptospires in an isolation chamber for five minutes at concentrations of  $2 \times 10^3$  to  $2 \times 10^8$ . These failed to develop infection.<sup>17</sup>

Results indicated that leptospires which had been recovered from the manure slurry 17 days post seeding had lost measureable virulence when studied in hamsters.

Salmonella survived for 17 days post seeding in the model oxidation ditch at ( $20^{\circ}\text{C}$ ) temperatures. Survival was measured for 47 days at winter temperatures.<sup>18</sup>

Aerosol transmission of salmonella was attempted by placing week old turkey poults in cages over the seeded slurry and rotor of the model oxidation ditch. Salmonella was transmitted to poults housed above the aerated manure slurry. In further experiments turkey poults exposed in an separate isolator unit became infected when exposed to S. typhimurium at  $10^4$  to  $10^5$  bacteria per liter of air.<sup>17</sup>

To evaluate human and animal health hazards in a field beef housing unit, a aerosol sampling program was developed above the operating oxidation ditch. The air of the housing unit was found to harbor a rich bioaerosol. Counts approximating 100 to 200 total colony forming units per liter of air sampled were measured during the one year sampling period. Findings indicate that high levels of bacteria were associated with the housed animal population and not the oxidation ditch treatment system. Indicator fecal bacterial aerosols also were higher when animals were present.<sup>19</sup>

### Discussion

The expansion of the concentrated livestock units which has developed in recent years has resulted in new concern for the occupational health of those who came in contact with the environment of these facilities. From a review of the literature, it is apparent that very little effort has been made in the United States to document human cases of infections or toxic diseases of those occupationally challenged in livestock confinement units.

In a closed or semi-closed environment livestock confinement unit the potential for transmission of zoonotic diseases exists directly from infected shedding livestock or indirectly by aerosols from the manures below the animals. Both disease agents leptospores and salmonella may be transmitted by airborne methods. Infected animals may shed the pathogens for weeks to months. Our research has shown that leptospores may survive for 138 days at summer temperatures in aerated beef cattle manure slurry and salmonella for 47 days at winter temperatures.

Both acute and chronic health hazards exist due to possible release of high levels of gases such as  $H_2S$  and  $NH_3$ . Although these high levels may be the exception rather than the rule, they can occur when manure is mixed in an anaerobic pit or when a aerobic system which has failed for a period of time becomes anaerobic and then mixed again.

In reviewing the literature, I was unable to document human fatalities associated with the above conditions, but the danger and health hazard have been documented by both the acute deaths and chronic conditions resulting in cattle and swine. The hazards to both animal and human health have been documented in the literature cited from Sweden and Germany.

From July - November, 1973, I studied Environmental Health Effects of Animal Wastes Systems in several European countries and Great Britain. In Sweden, there was great concern for and documented results of the development of toxic levels of gas of livestock housed above liquid manure pits. They indicated that control or eradication of salmonellosis is nearly impossible from farms with liquid manure systems. One Swedish researcher indicated that this fact will likely result in discontinuance of the use of liquid systems on salmonella contaminated farms.

In Europe there appeared to be an increase in the flushing of animal wastes with water from a holding space beneath confined animals to a holding tank outdoors. In a number of locations the slurry was being aerated outdoors.

Work on the chronic health effect of humans of confined livestock units has been conducted in Germany. The health effects of people with previous respiratory problems has been shown.

Although the concentration of a single species on one farm, may result in greater exposure potential to people, the subsequent automation and improvement in structural facilities and design in areas such as ventilation

in some situations results in a relatively "safe" environment. But the "break-down situation, the improperly designed livestock unit or overcrowding of livestock within a unit can result in a definite health hazard being created. In the United States, we need closer cooperation between those responsible for development of systems and those concerned with the health of animals and man.

Since July 1, 1973 Swedish farmers who build new facilities for 10 cows, 50 pigs or 500 hens must have all new buildings approved and controlled by the county veterinarian. This law developed after the 1960's during which time many buildings were constructed which were unsatisfactory to animal health.

The illness and death of animals from pathogenic microorganisms and toxic gases can be utilized as an excellent example of comparative medicine. Here animals become monitors of the environment and can alert those concerned with health that a potential health problem exists for those occupationally involved. This information should be better utilized by those responsible for maintaining health.

## References

1. Personal Communication. Dr. Dean Fleming, Director, Disease Prevention and Control, Minnesota Department of Health, Minneapolis, Minnesota, August, 1974.
2. Ramsey, R.H.: Livestock and the Environment, A Bibliography with Abstracts. EPA-6 60/2-74-024. Environmental Protection Technology Series, Office of Research and Development U.S. Environmental Protection Agency. Washington, D.C. 20460 (April, 1974): 1-357.
3. Preuschen, G.: Air Pollution and Human Work Capacity. In Proceedings of the International Livestock Environment Symposium. April 17, 18, 19, 1974, University of Nebraska, Lincoln, Nebraska. Published by American Society of Agricultural Engineers, St. Joseph, Michigan: 195-198.
4. Day, D.L., Hansen, E.L., and Anderson, S.: Gases and Odors in Confinement Swine Buildings Trans. ASAE 8: (1965): 118-121.
5. McAllister, J.S.V., and McQuitty, J.B.: Releases of Gases from Slurry. Res. Agr. Res. (Min. of Agr., N. Ireland) 14 (2) (1965): 73-78.
6. Lawson, G.H.K., and McAllister, J.V.S.: Toxic Gases from Manure Slurry. Vet. Rec. 79(9), (1966): 274.
7. Elliott, L.F., DeShazer, J.A., Peo, E.R., Jr., Travis, T.A., and McCalla, T.M.: Some Constituents in the Atmosphere of a Housed Swine Unit. In Proceedings of the International Livestock Environment Symposium. April 17, 18, 19, 1974, University of Nebraska, Lincoln, Nebraska. Published by the American Society of Agricultural Engineers, St. Joseph, Michigan: 189-194.
8. Curtis, S.E., Jensen, A.H., Simon, J., and Day, D.L.: Effects of Aerial Ammonia, Hydrogen Sulfide and Swine Housing Dust Alone and Combined on Swine Health and Performance. In Proceedings of the International Livestock Environment Symposium. April 17, 18, 19, 1974, University of Nebraska, Lincoln, Nebraska. Published by American Society of Agricultural Engineers, St. Joseph, Michigan: 209-210.
9. Lawrence, A.W.: Anaerobic Biological Waste Treatment Systems. In Agricultural Wastes: Principles and Guidelines for Practical Solutions, 1971 Cornell University Conference on Agricultural Waste Management (1971): 79-92.

10. Bengtsson, G., Ekesho, I., and Jacobsson, S.O.: Ett Presumtivt Fall av Kronisk Godschgaforgiftning. Sv. Vet. Tidning, Vol. 17, nr 8, (1965): 248.
11. Hogsved, D.: Forbisedda Sjubom srisker vid Hantering Avegodsel i Flytande form. Stenciltryck 1001, Statens, lantbruksbyggnadsforsok. 1966.
12. Hogsved, O., and Holtenius, P.: Ett Kroniskt Sjukdomssyndrom hos Notkreatur i Vissa Stallar med Flytgodshelhantering. XI Nordiska Vet. Kongressen. Stockholm (1966): 954.
13. Hogsved, O.: Liquid Manure Gas Poisoning in Cattle. Report presented at the 5th International Meeting on Disease of Cattle, Opatija, Yugoslavia, (1968): 1-7.
14. Diesch, S.L., Pomeroy, B.S., and Allred, E.R.: Survival and Detection of Leptospire in Aerated Beef Cattle Manure in Livestock Waste Management and Pollution Abatement. Proc. of the International Symposium on Livestock Wastes. Am. Soc. of Agric. Eng. (1971): 263-266.
15. Diesch, S.L.: Survival of Leptospire in Cattle Manure. JAVMA, 159 (11) (1971): 1513-1517.
16. Will, L.A., and Diesch, S.L.: Leptospire in Animal Waste Treatment -- Animal Health Hazard? Proc. of the 75th Annual Meeting of the U.S. Animal Health Assoc. Mtg. (1972): 138-149.
17. Will, L.A., and Diesch, S.L., Pomeroy, B.S., Spier, S.L., and Goodrich, P.R.: Aerosol Dispersion of Pathogens from a Model Oxidation Ditch. In proceedings of the International Livestock Environment Symposium. April 17, 18, 19, 1974, University of Nebraska, Lincoln, Nebraska. Published by the American Society of Agricultural Engineers, St. Joseph, Michigan: 176-181.
18. Will, L.A., Diesch, S.L., and Pomeroy, B.S.: Survival of Salmonella typhimurium in Animal Manure Disposal in a Model Oxidation Ditch, AJPH, 63(4), (1972): 322-326.
19. Goodrich, P.R., Spier, S.L., Diesch, S.L., and Will, L.A.: Microbial Aerosol Monitoring of A Beef Housing Oxidation Ditch. In proceedings of the International Livestock Environment Symposium. April 17, 18, 19, 1974,

University of Nebraska, Lincoln, Nebraska. Published by American Society of Agricultural Engineers, St. Joseph, Michigan: 182-188.

Kelley Donham, D.V.M.

Thank you, Dr. Diesch, for your very interesting and enthusiastic presentation.

Continuing on in this comparative medicine section of the program, it was mentioned that there are animals that serve as models of the environmental quality. The local rural environment and the workplace for agricultural workers is usually the same. Thus, the local environment is related to occupational health problems of agricultural workers. One animal model to consider that we might overlook is man. Dr. Jim Martin from the Illinois Department of Health is going to talk to us today on the occupational health problems of veterinarians in Illinois. Veterinarians are a well defined group and relatively easy to obtain data from, as compared to agricultural workers. Because the veterinarian in many cases (at least the food animal practitioner) shares the same work environment with the agricultural worker, and thus is exposed to many of the same kinds of occupational hazards. Thus, the comparative approach may be utilized to learn something about the health status of a data deficient population (agricultural workers) by looking at the occupational health of veterinarians.

## Occupationally-Related Diseases of Illinois Veterinarians

R.J. Martin, D.V.M.

I would like to share some information with you this morning that we collected on health matters that relate to veterinarians within the State of Illinois. The data was collected through a concentrated effort to complete a questionnaire for every non-military veterinarian in Illinois in 1967, 1968, and 1969. The questionnaires were designed to first delineate the characteristics of veterinarians in Illinois, and later to specifically outline some of the health problems that affect veterinarians within the State. A composite roster of the veterinarians in Illinois was compiled using names supplied by the American Veterinary Medical Association, the Illinois State Veterinary Medical Association, the Illinois Department of Registration and Education (the licensing agency within Illinois), and the University of Illinois College of Veterinary Medicine. Of 1,195 veterinarians on the final composite list, interviews were obtained on 1,186 -- only nine short of 100%. Interviews were performed by the Auxiliary to the Illinois State Veterinary Medical Association as well as staff members of the Illinois Department of Public Health. An article that relates to the basic characteristics of the Illinois veterinary population was published in the June 1972, Vol. 160, No. 11, issue of the Journal of the American Veterinary Medical Association.

We observed a decreasing prevalence of brucellosis in Illinois veterinarians. We also found that Brucella infection was associated with practice type, large animal practitioners and general practitioners having higher infection rates. Comparing when veterinarians became ill with brucellosis to their time of graduation from veterinary college, Illinois findings support earlier suggestions based on Ohio data that most of the brucellosis infections in veterinarians have occurred by the fifth year following graduation. A large number of cases the year of graduation could conceivably include some infections during the senior year in

veterinary college. Regardless, it certainly seems that educational changes are in order so that veterinary students are taught not only technique, but safe technique.

When reviewing the number of brucellosis infections according to decade of onset, the annual incidence peaked in the 1950's, perhaps reflecting an increasing number of veterinarians in practice from 1910 through 1960. With all other things being equal, and an increase in the basic population, we perhaps would expect an increase in infections. The increase could also be due to an improved understanding of the clinical spectrum of brucellosis. Also, perhaps this peaking in the 1950's is due to increased exposure to infected cattle and strain 19 Brucella vaccine during the early years of the bovine brucellosis control programs. The reduction in incidence in the 1960's perhaps reflects a reduction of infection in the reservoir.

The evidence here suggests that strain 19 Brucella vaccine is rapidly becoming a problem in terms of Brucella infections in veterinarians. In the 1950's there were 69 cases; 14% were due to strain 19 vaccine. In the 1960's, of 22 total cases, 18% were due to strain 19. Despite the very splendid record of strain 19 vaccine, perhaps as in the case of hog cholera, and as in the case of smallpox vaccine, there is now a greater hazard from using strain 19 Brucella vaccine than from withholding it.

There were 11 chronic health conditions included in the 1967 Health Study Questionnaire. Eight of these chronic health conditions occurred at higher rates in Brucella-infected veterinarians than among the other veterinarians who were not infected with the brucellosis. In six of these eight conditions, the mean year of birth was later for veterinarians who had been infected than for those who were not infected. Within the Brucella-infected group, 4% of the veterinarians reported they had murmurs as compared to 2.4% in the non-infected group. The mean year of birth for the infected was 1923 which is three years later than that of the non-infected veterinarians. Considering veterinarians who reported they

had diabetes, 5.8% of the Brucella-infected veterinarians had the disease compared with only 1.6% in the non-infected veterinarians. The mean year of birth for the Brucella-infected individuals with diabetes was 1920, which is 15 years later than that of the non-infected veterinarians with the condition. Age adjustment techniques have not been applied to these data to date; therefore, the data at this time can only suggest that an association does exist between Brucella infection and certain chronic health conditions. Certainly such associations have been suggested previously for brucellosis and heart disease.

Exposure to rabies is also historically associated with veterinarians. The prevalence and type of exposure among Illinois veterinarians was investigated in 1964 by means of a mail questionnaire by Drs. E. Cavins and G. Woods, both members of the staff of the University of Illinois. Over 13% of the 580 veterinarians who responded to the questionnaire mailed by Cavins and Woods had received rabies vaccine as a result of exposure to rabid animals during the preceding five years. Investigation of cases of animal rabies by the Illinois Department of Public Health between 1963 and 1967 indicated that Illinois veterinarians were vaccinated as a result of exposure to rabies-infected animals at a rate 312 times that of the general population. Of the veterinarians who completed health interviews, 251 (22%) had been inoculated against rabies as a result of exposure to the disease. There were 365 exposure incidents among the 251 veterinarians. Vaccine was administered as a result of exposure while examining a patient in 64% of the 365 exposure incidents, because of a bite in 20%, necropsy 5%, other causes 3%, and unknown reasons 7%. There seemed to be an association between exposing species and type of exposure. Dogs and skunks commonly exposed by biting, while cattle and horse exposure usually occurred while examining the patient. When relating exposure to rabies to year of graduation from veterinary school, it appears that rabies exposures are very frequent the first five years after graduation. Perhaps this reflects, as in the case of Brucella infections, there is a need for some of our veterinary colleges to stress the self-protection portion of preventive medicine.

Another item of concern in the health interview with Illinois veterinarians was accidents that occurred in this population. Realizing the word "accidents" has a very broad definition, an attempt was made to narrow the responses received by using the following selected questions:

1. How many work days have you lost in the last 12 months due to accidents?
2. Have you ever had an accident to your eyes which was occupationally related, and if "yes", what was its nature?
3. How many times have you experienced a fractured bone and how many of these were occupationally related?

There were 66, about 6%, of the veterinarians who had lost at least one work day the preceding 12 months due to an accident, with a total of 986 work days lost. A total of 93 veterinarians, about 9%, had suffered 99 occupationally-related eye accidents, 51 were physical in nature, 22 chemical, 9 infectious, 9 ultra-violet, and 8 not stated. There appeared to be some protection from wearing glasses as illustrated by the following eye accident rates. Those individuals who routinely wore glasses had a rate of 6%, and those who occasionally wore glasses 9%, while non-wearers had a rate of 13%.

A total of 470 veterinarians (44%) had experienced fractured bones. These 470 veterinarians had experienced 776 fractures. When only occupationally-related fractures were tabulated, the number of involved veterinarians fell to 140 (13%). These 140 veterinarians experienced 208 occupationally-related fractures. When the distribution of the 140 veterinarians with occupationally-related fractures is related to practice type, most occupationally-related fractures occurred among government employees (21%), large animal practitioners (17%), and retirees (19%). The general practitioners and commercial veterinarians accounted for 13% each. Of the ten retired veterinarians who reported occupationally-related fractures, five have been in large animal practice, two in government, two in general practice, and one had been in small animal practice.

Certainly the data presented deals with statistical associations only. It is hoped these associations will point to areas where more definitive studies can be conducted in order to truly delineate those health situations that involve the veterinary profession.

Kelley Donham, D.V.M.

Thank you, Jim. We have seen several areas where health of man and health of animals are related. Still probably the most common thought of area would be those infectious diseases that man and animals have in common. In the following paper, I will consider those infectious diseases common to animal and man of occupational significance to agricultural workers.

Infectious Diseases Common to Animal and Man of  
Occupational Significance to Agricultural Workers

Kelley Donham, D.V.M.

The health of man is intimately associated with the health of animals with which he is in close direct or indirect contact. One very important association is the infectious diseases that man and animals have in common. There are four types of relationships that exists in terms of disease transmission between animals and man:

1. disease of vertebrate animals transmissible to man and other animals, (zoonoses);
2. diseases of man transmissible to other animals, (anthropozoonoses);
3. diseases of vertebrate animals chiefly transmissible to man, (zooanthroponoses); and
4. diseases transmissible to man from the environment (animals being the source of environmental contamination).

In common usage, a distinction is often not made between these four types of relationships and the term zoonoses may be used for any of the diseases common to animal and man. The 1967 Food and Agriculture Organization/World Health Organization, Expert Committee on Zoonoses,<sup>8</sup> listed over 150 diseases that man and animal have in common. Domestic livestock may be affected by a number of these diseases, thus the reason for concern for health of those who work involves direct contact with livestock, or indirect contact through contamination of the work place. Many feral animals and domestic non-livestock species also share diseases with man and offer a potential occupational hazard when the agricultural work place encroaches on the ecological niche of these species.

## Review of Literature

Many reports and articles have been published which indicate that there are several diseases common to animal and man for which agricultural workers represent a population-at-risk, due to the occupational-environmental relationships.<sup>9,16,19,23,27,28</sup> Top, et. al. 1962,<sup>27</sup> described twelve occupational zoonotic diseases thought to be significant to the health of agricultural workers. This article discussed the mode of transmission and some of the basic health effects on the individual. West, 1964,<sup>28</sup> indicated that farming has the second highest occupational disease rate compared to other occupational groups in California. One case of tetanus and two cases of brucellosis were cited as examples in this report. Steele, 1968,<sup>19</sup> has reported on the relationship of animal-borne diseases to occupational health in agriculture. History, worldwide perspective, and trends were considered for 32 zoonotic diseases. However, little documentation was noted to differentiate the agricultural occupational group from the general rural population. Disease rates were not presented. Saltzman, 1970,<sup>17</sup> has reported on rural occupational health from a practitioner's point of view. He indicated that "... farmer's illnesses were peculiar to farmers alone." Tularemia and undulant fever were listed as examples of diseases for which agricultural workers were a special risk group. The rural environment was indicated as the source, but again there existed no documentation to differentiate the agricultural workers as a high risk population, as compared to the general rural and general urban populations.

A 1964,<sup>9</sup> report from the Canadian Department of National Health and Welfare on industrial hygiene problems in agriculture cited problems in diagnosing and reporting as responsible for lack of information on incidence of occupational disease acquired from animals. The report further states that research and evaluation will be necessary to establish the true importance of zoonoses as hazards of agricultural workers. A joint International Labor Organization/World Health Organization Committee considered the occupational health problems in agriculture.<sup>16</sup> The 1962 report indicated that the agricultural worker as compared to the urban dweller is more likely to encounter

disease agents and have more frequent and longer lasting illnesses. The report also described the difficulty in determining the occupational relationship of zoonotic diseases. A total of 45 diseases (several of which do not occur in the U.S.) were categorized arbitrarily into 3 groups as follows:

1. diseases principally contracted through an agricultural occupation;
2. diseases occasionally contracted through an agricultural occupation;  
and
3. diseases questionably contracted through an agricultural occupation.

No documentation in the form of incidence rates, prevalence rates, case reports, etc., was given to support the categorization.

A summary of previously published reports and articles on the occupational nature of zoonotic diseases includes the following points:

1. several diseases have been indicated as occupational diseases;
2. very little data are given to document these statements;
3. of the total number of zoonotic diseases, relatively few are mentioned as occupational diseases. Only one report attempted to rule out those zoonotic diseases which are not occupationally acquired;
4. lack of data causes difficulty in determining the occupational nature of zoonotic diseases.

### Objectives

The Occupational Health and Safety Act of 1970 has created the need for a critical analysis of the health hazards of zoonotic diseases to agricultural workers. There has not been a comprehensive study that has attempted to bring all relevant available data to focus on this subject. Previous reports have not considered the full spectrum of diseases common to animals and man, and most have relied heavily on subjective expert opinion rather than documentation. Thus, a critical review of pertinent data (state-of-

the-art), was undertaken so that objective action could be taken to deal with diseases common to animals and man in perspective with other health problems of agricultural workers.\*

The objectives of this study were as follows:

1. To compile a list of diseases common to animal and man in the United States that may have some potential as an occupational health hazard of agricultural workers.
2. To review the data relevant to the relationships of these diseases to the occupational health of agricultural workers.
3. Analyze the data and, if possible, to accept or reject for each disease the hypothesis that it is an occupational health problem for agricultural workers.
4. To place each disease in one of three categories according to the relative risks of agricultural workers as compared to the general rural population and general urban population:
  - a. Diseases for which agricultural workers have a definite risk.
  - b. Diseases for which agricultural workers have a questionable risk.
  - c. Diseases for which agricultural workers have a doubtful risk.

### Procedure

A total of 49 diseases were selected by the author for study from a list compiled by the Center for Disease Control of 170 diseases common to animal and man.<sup>3</sup> The selection was based on the plausibility of the diseases as occupational health problems of agricultural workers, according to the occupational-environmental relationships of the diseases in man and the disease in nature, Table 1. The diseases were then subjectively categorized according to their plausible importance as occupational diseases, based on

---

\*Support for this study came from the National Institute of Occupational Safety and Health, contract number HSM-99-OSH-145(2), entitled State-of-the-Art Report on Occupational Safety and Health in Agriculture.

authors opinion. It is emphasized that the listing was subjective and served only as a study list. Those with highest plausibility as occupational diseases of agricultural workers were placed in the first priority for further study. Those of lower plausibility for occupational disease of agricultural workers were placed in the second and third priorities.

The literature was reviewed for each disease. Pertinent data were collected which would support or refute the statement that agricultural workers have a greater probability of contracting the disease as compared to other populations at risk. The following types of data were considered:

1. exposure potential for the agricultural worker - extent of animal reservoir and mechanisms of transmission from animal to man;
2. case reports;
3. morbidity and mortality reports;
4. isolations of the etiologic agents;
5. serological surveys; and
6. epidemiologic studies.

The pertinent data were then evaluated and the diseases were recategorized according to their importance as occupational diseases of agricultural workers. The following categories were used: 1) definite risk; 2) questionable risk; and 3) doubtful risk. For the purpose of this review, occupational disease was defined as a disease which is contracted as a result of actual work activities or contracted through environmental exposure in the work place.

The data reviewed for the individual diseases were too voluminous to include in this paper, and are reported elsewhere.<sup>2</sup> What will be reported in the paper are:

1. a summary and analysis of the data collected, and
2. a discussion of the problems encountered in obtaining pertinent data.

Table 1

Study List for the Comparative Medicine Section of the  
State-of-the-Art Report on Occupational Safety and Health in Agriculture

First Priority*	Second Priority	Third Priority
1. Brucellosis	1. Salmonellosis	1. Trichinosis
2. Leptospirosis	2. Listeriosis	2. Pasteurellosis
3. Toxoplasmosis	3. Staphylococcal infections	3. Erysipelas
4. Rabies	4. Taeniasis	4. Cutaneous larval migrans
5. Tetanus	5. Echinococcosis	5. Visceral larval migrans
6. Anthrax	6. Collibacillosis	6. Rocky Mt. spotted fever
7. Erysipeloid	7. Tuberculosis	7. Colorado tick fever
8. Pseudotuberculosis	8. Streptococcal Pharyngitis	8. Strongyloidiasis
9. Q. Fever	9. Influenza and parainfluenza	9. Pneumococcal infections
10. Psittacosis/ ornathosis	10. Dermatophilosis	10. Encephalomyocarditis
11. Histoplasmosis	11. Tularemia	11. Dirofilariasis
12. Blastomycosis	12. Plague	12. Sporotrichosis
13. Ringworm	13. Cryptococcosis	13. Babesiosis
14. Equine Encephalitis	14. Acariasis	14. Fascioliasis
15. Newcastle disease		15. Balantidiasis and giardiasis
16. Vibriosis		
17. Cowpox		
18. Pseudocowpox		
19. Vesicular stomatitis		
20. Contagious Ecthyma		

\*Priority refers to the plausibility of the disease as an agricultural occupational health hazard. The pertinent literature was reviewed for these diseases in this order of priority in attempt to substantiate or disprove the occupational hazard to agricultural workers.

## Results

Table 2 represents conclusions and interpretations of the relevant literature, available published and unpublished data regarding diseases common to animal and man, relative to the occupational health of agricultural workers. The diseases are categorized according to the risks of agricultural workers relative to the general rural and general urban populations. The diseases are not necessarily listed in order of importance.

## Discussion

This table represents the best effort to separate out those diseases of occupational significance to agricultural workers from the 170 diseases listed by the WHO which are common to animal and man. According to the author's interpretation, of the available data, those listed in the definite risk category were documented as occupational health hazards. The available data were not adequate to define the occupational significance of several diseases. These were listed in the questionable category. No relationship to agricultural occupations were found for those listed in the doubtful risk category.

Due to the problems in data collection, rates were generally not available. Thus, interpretation was required of less direct types of data (previously listed) to arrive at the final categorization. Also due to problems of data collection, quantitation and ranking of the diseases in order of importance was not feasible.

Problems of Data Collection - One of the problems associated with this study was that direct and pertinent data regarding the subject are limited. As mentioned, previous reports and articles on the subject have dealt in very general terms with very little substantive data. One report specifically states that lack of data is a very real problem in dealing with this subject.<sup>9</sup>

Table 2

The Occupational Significance to Agricultural Workers of Selected Diseases Common to Animal and Man: Risk for Agricultural Workers in Comparison to the General Rural and General Urban Population

Definite Risk	Questionable Risk	Doubtful Risk
1. Brucellosis	1. Pseudotuberculosis	1. Cowpox
2. Leptospirosis	2. Psittacosis/ornithosis	2. Taeniasis
3. Toxoplasmosis	3. Vibriosis	3. Dermatophilosis
4. Rabies	4. Salmonellosis	4. Trichinosis
5. Tetanu	5. Listeriosis	5. Pneumococcal Infections
6. Anthrax	6. Tuberculosis	6. Babesiosis
7. Erysipeloid	7. Streptococcal Infections (pharyngitis, Erysipelas)	7. Fascioliasis
8. Q Fever	8. Influenza and Parainfluenza	8. Giardiasis
9. Histoplasmosis	9. Plague	
10. Blastomycosis	10. Cryptococcus	
11. Ringworm	11. Nematodiasis (cutaneous Larval Migrans, Visceral Larval migrans, and Strongyloidiasis)	
12. Equine Encephalitis	12. Colorado Tick Fever	
13. Newcastle Disease	13. Pneumococcal Infections	
14. Pseudocowpox	14. Encephalomyocarditis	
15. Vesicular Stomatitis	15. Dirofilariasis	
16. Contagious Ecthyma		
17. Staphylococcal Infections		
18. Echinococcosis		
19. Collibacillosis		
20. Tularemia		
21. Acariasis		
22. Pasteurellosis		
23. Rocky Mountain Spotted Fever		
24. Sporotrichosis		
25. Balantidiasis		

An article considering the zoonoses as occupational diseases discussed some of the basic problems in getting accurate and meaningful data.<sup>1</sup> The article mentioned that case reports and general articles in the literature are numerous, and tend to indicate an occupational relationship. However, the article goes on to say, "Readily, it becomes apparent that all too infrequently is suitable information available as to the number or percentage of victims exposed at work. What is most striking of all is the lack of statistical information, regarding occupational zoonoses in reports, in compliance with the occupational disease reporting laws common to nearly all states, and similar data in connection with the Workmen's Compensation Commissions."<sup>11</sup> Five factors are present which negate the possibility of getting incidence information from these sources:<sup>11,27</sup>

1. lack of compliance with occupational disease reporting laws in most states;
2. in those states where occupational disease reporting is practiced, zoonotic diseases often are not differentiated, and grouped under the general heading, infections;
3. mild cases are often not reported;
4. until fairly recent times, most agricultural workers were not required to be covered under jurisdictional compensation coverage.

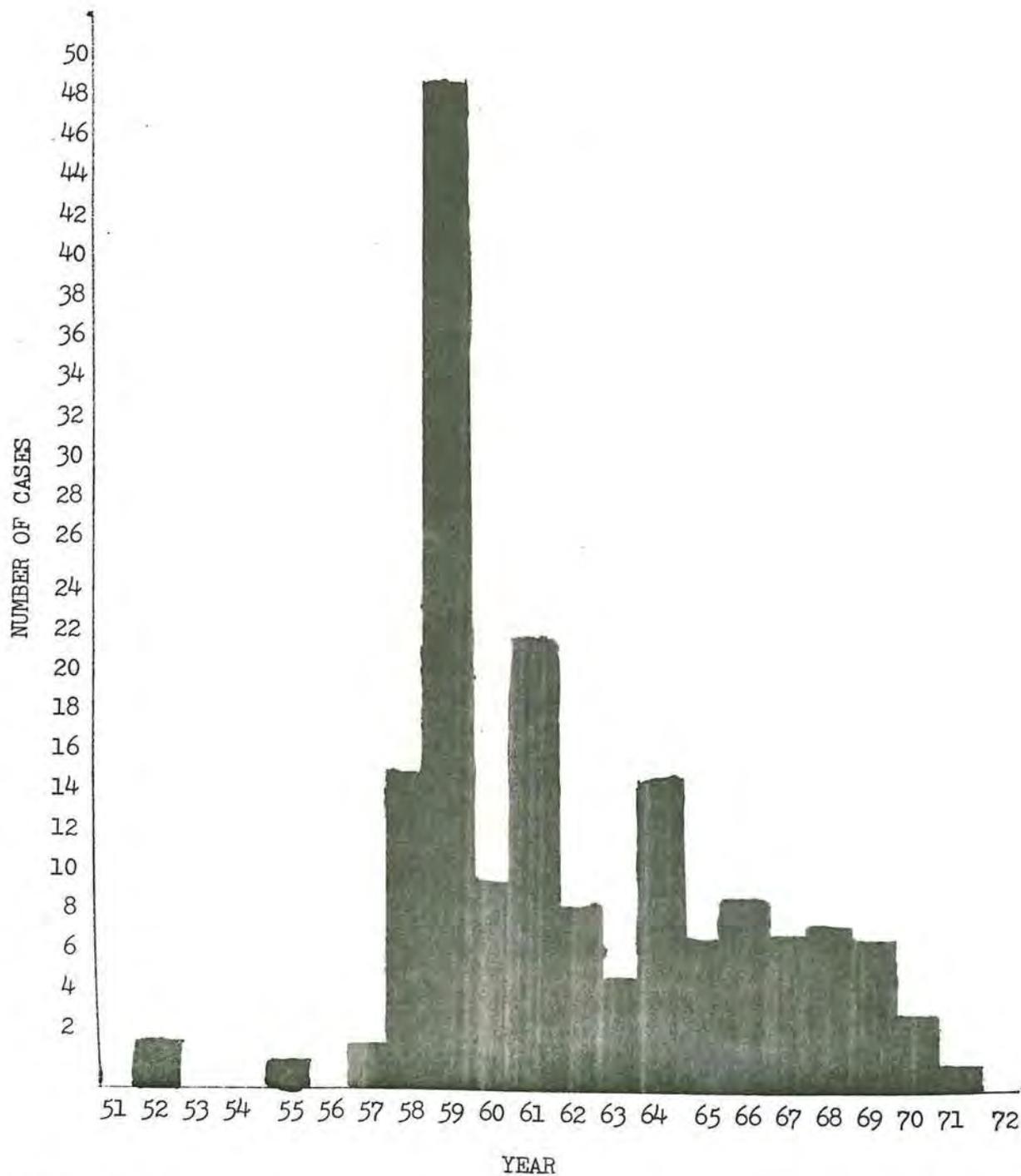
The following statement summarized the state of existing pertinent data, "... there are no official statutes that may be accepted as revealing the true frequency of zoonoses as occupational diseases."<sup>11</sup>

Two insurance companies in the Midwest who insure employers of agricultural workers against claims of occupationally acquired illnesses, were contacted for possible information on risks of agricultural workers acquiring infectious diseases from animals. Both companies indicated they had very little of this kind of information, and although they need the information, they have found such information to be unavailable.<sup>17</sup> The lack of data gives a false picture of the actual problem. Underdiagnoses, lack of reporting, and failure to associate the agricultural occupation with the disease are

specific problem areas which are common, in varying degrees, to all zoonotic diseases. The disease leptospirosis is no exception to this problem. However, for this particular disease, there are data available which will lend evidence to document the reasons for lack of data. The reasons would be similar for many of the zoonotic diseases. The problems of lack of data and thus the difficulty to determine the actual health effects of the disease as an occupational health problem for agricultural workers can be demonstrated by example, using some data collected for leptospirosis.

Problems of Data Collection - Exemplified by Leptospirosis - The Comparative Medicine Section of the Institute of Agricultural Medicine Section of the Institute of Agricultural Medicine at the University of Iowa, was involved in a study on the epidemiology of leptospirosis between the period 1956 to 1970. The results of these studies indicated that leptospirosis is a disease that can be readily found if looked for,<sup>26</sup> thus prevalence and reporting is often a reflection of the expertise and interest in this disease in a specific area.<sup>21</sup> Figure 1 indicates cases of leptospirosis reported in Iowa over the past 23 years. During the latter part of the 1950's, the number of cases appeared to increase. This trend continued until the late 1960's and early 1970's. The increase in reported cases is paralleled by the leptospirosis research activities, which started in 1955 and ended in 1970, carried on by the Comparative Medicine Section of the Institute of Agricultural Medicine, University of Iowa. When the case finding activities, epidemiologic studies, and laboratory diagnostic facilities of the unit were discontinued, the number of reported cases dramatically declined. This relationship of interest in the disease, and cases reported, was also realized by a report on the status of the disease in Massachusetts.<sup>22</sup> Protein clinical signs, lack of adequate laboratory support, lack of awareness of the disease by physicians, and inadequate research facilities are inter-related factors responsible for the lack of recognition and reporting of cases.

Many cases are probably either subclinical or sufficiently mild so that the individual fails to report to a physician. Spontaneous recovery may occur, which apparently was the situation found in the study of a cohort in

Figure 1 - Numbers of Human Cases of Leptospirosis in Iowa 1951-1972.<sup>7,29</sup>

\*These cases were documented by McCulloch et. al.,<sup>12</sup> but not reported in the Iowa Morbidity Report published by the Iowa State Department of Health.

Nebraska;<sup>15</sup> two individuals were found positive in a serological survey, and reported previous symptoms were very suggestive of leptospirosis, but they were never seen by a physician. The occurrence of subclinical cases is indicated by the lack of history of clinical disease in many positive reactors in serological surveys.

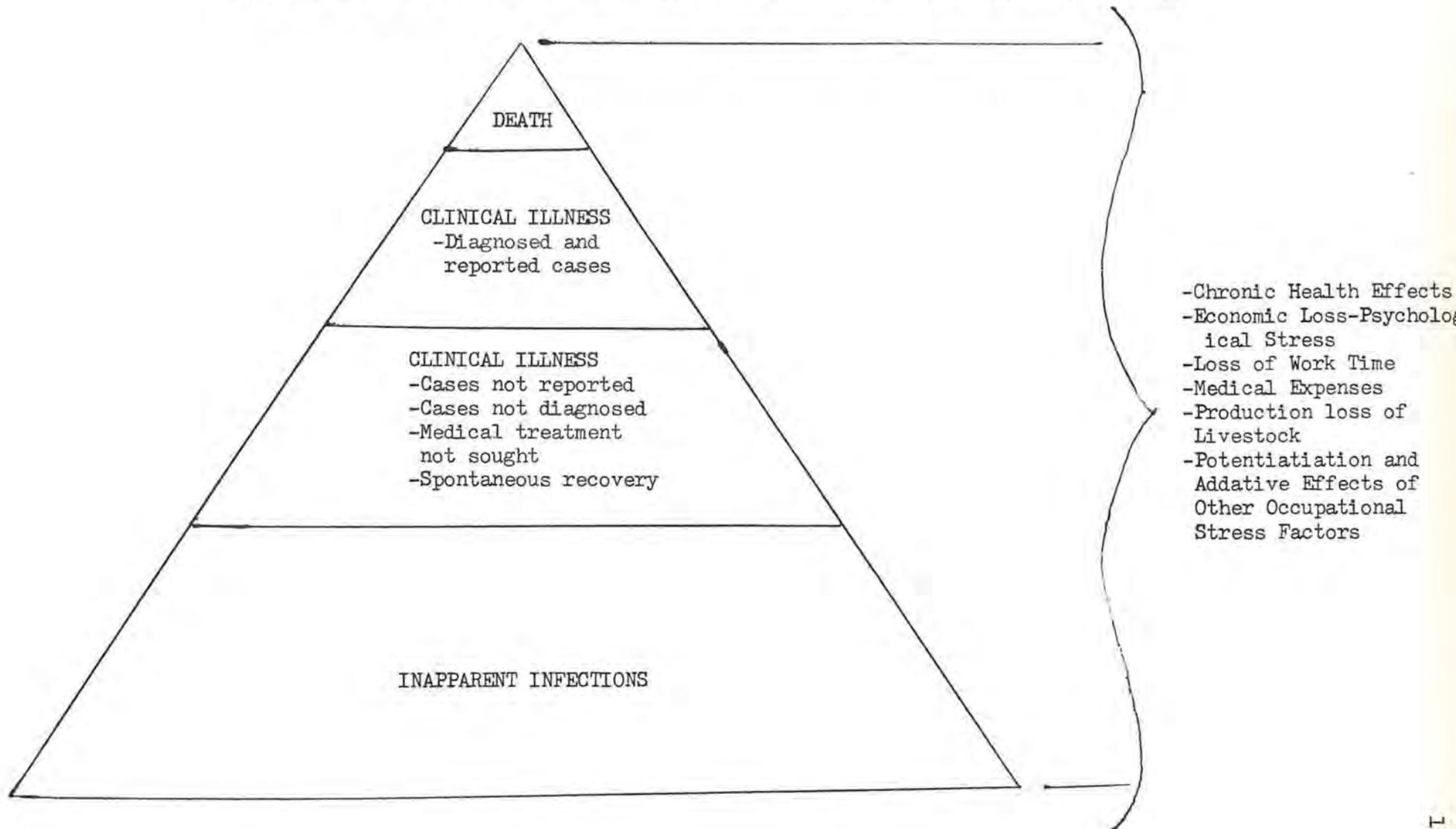
Problems of Data Collection: Health Effects - Exemplified by Leptospirosis - The health effects of a disease transmitted from animal to man must take into consideration the physical, mental and social well being, and not merely the absence of diseases or infirmities, (according to the definition of health by the World Health Organization).<sup>10</sup> The physical effects can be taken from morbidity and mortality reports, and case reports. Figure 1 indicates the reported cases of leptospirosis for the period 1947-1970.<sup>29</sup> During the past decade the average number of reported cases has been 83 per year. Approximately 62% to 74% of the reported cases have required hospitalization and the length of stay has been in the range of 1-3 weeks.<sup>5,20</sup> An average of 14 deaths per year due to leptospirosis has occurred during recent years.<sup>29</sup> The case fatality rate is much higher for the age group above 50-years.<sup>20,25</sup>

The recorded morbidity and mortality are thought to be only a minor portion of the total health effects of this disease, and have been compared to the tip of an iceberg in that the major part of the problem is not obvious.<sup>12</sup> Figure 2 indicates that undiagnosed cases, unreported cases, subclinical illness, chronic physical effects, and mental stress, are factors that are not obvious in the disease picture. In many instances, only those cases with more severe clinical signs are diagnosed.<sup>5,25</sup> Leptospirosis has been referred to as "... one of the least diagnosed diseases in the world."<sup>21</sup>

There are several reasons why the more mild forms of the disease are probably often not diagnosed or reported:

1. Protean clinical signs. The disease may mimic influenza, various central nervous system disturbances, and other febrile origin diseases.<sup>5,13,14</sup>

Figure 2 - Iceburg Model: Disease Spectrum in Man for Certain Zoonotic Diseases



2. Lack of adequate laboratory support.<sup>1,6,18,21,24</sup>
3. Lack of awareness of the complete disease picture among physicians.<sup>4,5,13</sup>

### Conclusions

The stated objective of the OSHA is to insure a safe and healthful work environment. Before effective measures can be taken to prevent occupational diseases, transmitted from animals, the problem must be defined. The paper is only the first step in defining the problem. The next step would be to quantify and identify regional differences in problems. Setting priorities and policy would be a step further, and the final step would be to establish control programs and monitoring of results. The problems in data collection make this progression quite difficult. The most acute deficiencies are the facts that total numbers of reported cases are invalid, and denominator values are not available in most cases.

It is suggested that a task force consisting of 5-10 experts in the field may be able to make progress towards a more complete defining of the problem than any individual. A priority of the task force would be to develop the resources of data gathering. Specific geographic areas could be recommended for in-depth studies. Areas could be designated to determine disease rates so that a true national picture of the occupational nature of these diseases may be obtained.

Certain zoonotic diseases have been suggested as occupational hazards for certain groups of agricultural workers for many years. The Occupational Safety Act of 1970 has forced a more critical evaluation of this problem. Inadequacies in the disease reporting systems and other data sources do not allow a valid analysis of the problem in terms of importance in comparison to other occupational health problems of agricultural workers. To obtain the needed information, a new approach with substantial commitment to the problem is necessary, rather than a revamping of present reporting systems.

## References

1. Crawford, R.P., W.F. McCulloch, F.H. Top, S.L. Diesch. Epidemiologic Studies of Sporadic Human Cases of Leptospirosis in Iowa. 1965-1968. JAVMA. Vol. 155(12):2084-2090. 1969.
2. Donham, K.D. Comparative Medicine Addendum to State-of-the-Art Report on Occupational Safety and Health in Agriculture, The National Institute of Occupational Safety and Health, July, 1974.
3. Epidemiological Aspects of Some of the Zoonoses. USDHEW, PHS, CDC, DHEW Pub. no. (CDC) 74-81.
4. Glosser, 15th ALRC Proceedings Summary. Surveillance of Human Leptospirosis. Spirochaetal News, Bul. Vol. 2(1):13-14. 1973.
5. Health, C.W., A.D. Alexander, M.M. Galton. Leptospirosis in The United States (concluded). Analysis of 483 Cases in Man, 1949-1961. New Eng. J. Medicine. Vol. 273(17):915-922. Oct. 1965.
6. Huhn, R.G. Use of Killed Leptospiral Diagnostic Antigens. Proc. 76th Ann. Mtg. U.S. Animal Hlth. Assn. pp. 658-672. 1972.
7. Iowa Morbidity Report, 1951-1960. Iowa State Department of Hlth, Div. of Preventable Diseases, Lucas State Office Bldg., Des Moines, Iowa 50319.
8. Joint FAO/WHO Expert Committee on Zoonoses, Third Report, WHO Technical Series Report No. 378, WHO, Geneva. 1967.
9. Kay, K. Industrial Hygiene Problems in the Agricultural Industry. Senior Scientific Consultant, Occupational Hlth. Div., Dept. of National Hlth and Welfare, Ottawa, Canada. May 1963.
10. Kilbourne, E.D. and W.G. Smille. Human Ecology & Public Hlth. 4th Edition. MacMillan Co., Toronto, Ontario. 1969.
11. McCord, C.P. Comparative Medicine in Transition. The Zooanthroponoses as Occupational Diseases in the United States. Proceedings of the First Institute on Veterinary Pub. Hlth. Practice, Oct. 6-9, 1958. Univ. of Michigan, School of Pub. Hlth., Ann Arbor, Michigan, pp. 349-365.
12. McCulloch, M.F., J.L. Braun, R.G. Robinson. Leptospiral Meningitis: Report of a Case and Epidemiologic follow-up. J. Iowa Med. Soc. pp. 728-731. Nov. 1962.
14. McCulloch, W.F., J.L. Braun, R.G. Robinson. Leptospiral Meningitis Report of a Case and Epidemiologic follow-up. J. Iowa Med. Soc. Nov. 1962. pp. 728-731.

15. Miller, N.G. A Serologic Investigation of Leptospiral Infections in Dairy Farmers and Cattle Ranches. *Am. J. Hyg.* Vol. 74:203-208. 1961.
16. Occupational Relationship Zoonoses to Agricultural Workers. Joint ILO/WHO Committee on Occupational Health (Occupational/Health in Agriculture). WHO Tech. Rpt. Series 246, WHO, Geneva, 1962.
17. Pendgraft, W.L. Personal Communications. Environmental Health Division Manager, Employers Mutual Companies, P.O. Box 712, Des Moines, Iowa. R. Heston, Director of Eng. Grinnell Mutual Ins. Co. Grinnell, Iowa.
18. Report of the Committee on Leptospirosis. U.S. Livestock Sanitary Assn. Proceedings. pp. 195-196. 1968.
19. Slatzman, B.N. Medical Aspects of Rural Occupational Health. *The J. of Arkansas Med. Soc.* Vol. 66, No. 9, pp. 306-309. Feb. 1970.
20. Schnurrenberger, R.P., R.A. Masterson, J.H. Russell. The Zoonoses in Ohio, 1958-1962. *Ohio State Medical J.* pp. 462-465. April 1968.
21. Seatalowica, F.T., T.P. Griffin, J.A. Stunkard. The International Dimensions of Leptospirosis. *JAVMA.* Vol. 155(12):2122-2132. 1969.
22. Smith, R.E., I.M. Reynolds, G.W. Clark, J.A. Mulbury. Bovine Leptospirosis in Massachusetts. Dept. Veterinary & Animal Sci., Univ. of Mass. at Amherst Research. Bulletin No. 600. Aug. 1972.
23. Steele, J.H. Occupational Health in Agricultural Animal-Borne Diseases. *Arch. Environ. Hlth.* Vol. 17:267-285. Aug. 1968.
24. Sulzer, C.R., J.W. Glosser, C.H. Calsher. A Preliminary Report of a Serosurvey for Leptospiral Antibodies in Patients with Ecnephalitic Symptoms. *Spirochaetal News Bull.* Vol. 2(1):13-14. 1973.
25. Thomson, W., M.D. Leptospirosis - An Occupational Hazard. *Nursing Times.* July 2, 1970.
26. Tjalma, R.A., M.M. Galton, A.J. Trop. Human Leptospirosis in Iowa. *Med. Hyg.* Vol. 43(3):387-396. 1965.
27. Top, F.H. Occupational Health in Agriculture. *Modern Medicine.* pp. 140-184. Feb. 1962.
28. West, I. Occupational Disease of Farm Workers. *Arch. Env. Hlth.* Vol. 9: 92-98. July 1964.
29. Zoonoses Surveillance, Leptospirosis. Annual Summary Leptospirosis 1970, issued November 1971. USDHEW, PHS, CDC, Atlanta, Georgia.

## Discussion

Kelley Donham, D.V.M., Moderator

Dr. Donham

Now, if there are any questions we have a few minutes for a discussion period. If there are any questions for any of our speakers in this section -- yes.

Dr. Quinby

Dr. Diesch, I was pleased to hear you bring this out and I hope you have some references to what you called a hex on humans - animal odors or odors created by decaying offal and excreta, which I designated in my presentation as psychogenic nausea. Now, in addition to the ones I mentioned yesterday, the war-time experience brings out easily that humans get psychogenic nausea from seeing decaying human corpses. They also get it from a number of sources including the traditional skunk odor when a person is sprayed with the skunk excreta.

Dr. Diesch

I would just like to make a brief comment which I didn't refer to in my paper. In Europe, especially in the Netherlands, the public concern was for animal odors. In October of this past year there were 500 piggeries and poultry farmers in courts. Neighbors of these farmers had signed petitions of complaint. In the past ten years the population of Amsterdam, for example, has decreased approximately 200,000 people. These people have moved into the rural communities and into the small villages -- one reason being that their commuting service is tremendous. Here you can depend on their trains and buses to be on time. These very people who have moved into the villages and rural areas are now tending to complain about the odors associated with increased agricultural production. It's very interesting that the Netherlands population density is approximately 1,000 people per square mile, so it's difficult to have agriculture very far away from some of your neighbors. This was also true in the Bremen area of Germany where

about 50 piggeries per week were having petitions signed against them. Farmers were brought into the courts to try to close their operation or decrease odor. It's a very significant problem in Europe. In reference to the human effect of skunk odors, etc., mentioned by Dr. Quinby, as a practicing veterinarian I recall that several farmers in holding pigs for castration did collapse and faint at the sight of blood, or odor, or due to the hot day. These situations do exist and I don't think from an agricultural occupational health approach we have really studied these factors. There's a lot of research and work needed to be done in these specific areas.

Dr. Donham

I think we've noticed one thing in looking at some of these problems. There seems to be a tremendous biological variation in individuals that work in these animal confinement units. Some people seem to be able to work in there with no significant effects at all while other people in the same family will have problems; respiratory, nausea, headache or lightness of head and so on. It was mentioned yesterday by Dr. Kammermeyer that swine dander seems to have as one effect, some kind of non-specific, irritating effect on the upper respiratory tract. Adverse effects associated with other animal danders seem to be entirely allergic manifestations. By observation, it is apparent that the environment in swine houses, particularly the odor, is more more pungent than in cattle housing units and poultry units. Whether this is related to fatty acids and other intermediary metabolic products related to the skin of the swine that are different from other animals, we do not know. This is another area that needs to be studied. Most of the research in the area of confinement housing has been done by engineers. Dr. Diesch's program has been utilizing an interdisciplinary study approach with engineers as well as biologically oriented and medically oriented people. I think it is a good approach to the problem.

Are there any other questions or comments from any of the other speakers?

## Overview of the Problem

L.W. Knapp, Jr.

In the development of any effective injury control program, one must first determine who it is we are trying to protect, what are the injuries we are trying to protect them from and finally, what counter measures are available which will effectively ameliorate the problems so described.

I shall dwell in particular in this presentation upon the acute injury problems demanding immediate attention, however, this does not mean that the chronic or minor traumatic problems are of any less importance. In fact, a discussion of the physiological and psychological problems associated with farming and the self-treatment aspects seen in rural America could well be separate conferences all unto themselves. I would define trauma for this presentation as the result of body as those mechanical, chemical, electrical and thermal insults to the body resulting in injury which occur in agriculture.

Turning first to determine who it is we are attempting to protect from such problems, one can quickly define those at risk from a preventive point of view through simple extrapolation of census data from the U.S. Department of Agriculture and other health sources. For example in the U.S. in 1970 there were 4.8% or  $9\frac{1}{2}$  million people who made up the total farm population. Over less than half of these were decision makers - that is, the farm operators, part operators, or farm tenants who run the farms. Further, of the approximate  $4\frac{1}{2}$  million employed in agriculture, only little over 1.1 million were employees and of those employees 172,000 plus were classified as migratory. But this is not a complete picture, for today's commercial farms (most of which are still managed by the farm family) produce a major portion of the food for general consumption beyond the farm family's own needs, specifically the food which you and I buy in the grocery store. This group in essence represents less than 40% of all the operational farms in

the U.S. In fact, 35% of all farms produce 89% of all sales. It is obvious to me then, that we should not only be concerned for the farmer and his family's health and safety from a humanitarian point of view but I think also be concerned from an entirely selfish point of view, if we wish to preserve our present standard of living and eating habits.

Now which of the aforementioned people (that is of the total farm population, the decision maker, or the hired worker, or society in general) are we trying to protect? The conference by definition says occupational but I personally feel we need to look at all of them and obviously whatever we do for the occupationally employed will certainly have spinoff for the rest of the farming community.

Now while one can rightly and should recognize the total safety picture, we must first face the immediate problems of trauma which is obvious to us all. The mechanical devices which are designed to reduce labor input and aid the farmer in his endeavors are capable of producing serious injury - in fact, they produce nearly 1/3 of all injuries on the farm. This is because they themselves are, or are connected to, some power source of considerable energy. And it is particularly true when a person makes contact with that source of energy that the machine does not differentiate between animal and plant protoplasm.

The farm tractor, which produces the greatest number of fatalities from a machinery point of view, isn't necessarily the most dangerous machine on the farm from an exposure point of view, according to the studies which have been conducted in Michigan and Ohio and which are now being substantiated by further work through the National Safety Council. However, the seriousness of these injuries and fatalities place them high on the safety problem list. Present concerted efforts by industry, educators and government to resolve this problem are bearing fruit. For example, the development of Roll Over Protection Structures to prevent injury in case of overturn and their mandatory use now being prepared under the Occupational Safety and Health Act will hopefully change this picture as will similar efforts affect

the power takeoff injuries and other machinery guarding problems. However, one cannot expect overnight miracles from the promulgation of such standards or regulations. For example, let's look at the tractor overturn situation. First, the existing tractors on today's farms have an average operative life in excess of 11, maybe 12 or 13 years, and as less than 150,000 new units on the average are added annually, the dilution factor for reducing the accident potential will be small for there are over four million tractors already in existence on today's farms. Secondly, the hired force involved in agriculture is only roughly one-third of the total labor force, thus resulting in further dilution. And lastly, new studies indicate that a further dilution is evident, for when comparing tractor accident rates versus age on a per million hours of use basis, operators between the age of 10 and 14 and those over 65 had rates of ten times and seven times higher respectively than the average. This is according to the Michigan and Ohio studies. And as these two groups are largely made up of family members, they will thus not be subject to any mandatory regulations. We in the Institute do hope there is considerable spinoff to also protect the family members.

I'd like now to turn for a few moments to a few slides which will hopefully startle you, but maybe more importantly give you a glimpse of the kinds of injuries associated with farming, as well as portray some of the post-accident problems (rehabilitation) that result from such traumatic encounters. I'm going to avoid any reference to cost, time or pain associated with such injuries and leave any reference to the demands upon our health services in this country in serving agriculture to those who are going to appear after us in this program. Slides, please.

Slide 1. Power take-off injuries. Emasculation is probably one of the most dramatic ones that we have seen. 2) This is a child's arm. I would remind you that all power take-off injuries do not affect just the worker - they affect his family. For after all, the home and the farm are one and the same - they are the work place. This child came to the hospital. You can see the damage to the thumb, to the forearm, to the midarm, to the shoulder. The father said it looked like a limp noodle wrapped around the power

take-off. 3) A leg. The man got himself caught in the power take-off, was thrown to the ground, his pants removed. I didn't put that picture in for you to show you what happens to clothing - and this is a problem with clothing, especially in the winter - power take-off accidents in the winter are a disaster because of the farmer's ability to now buy insulated underwear which do not give (tear) as easily as did his old coveralls - consequently, power take-off injuries in the winter are much more serious than they are in the summer. 4) Rotary-powered lawn mowers. In one of the brief studies we did here in a ten-county area where we have a number of doctors who report, we found that rotary-powered lawn mowers saw considerably more use on the farm as compared to urban use. This should be obvious to all when you recognize how much space is available to be mowed on a typical farmstead. In this instance a wire was thrown into this leg. 5) Hand injuries. A large number of hand injuries are associated with power linkage devices (example - this drive belt on this combine). In this instance the operator was making an adjustment and put his hand into the wrong location - lack of shielding might be one of the problems we could point to in this instance. Similar situations exist with roller-chain drives, flat chain drives, etc. 6) An injured foot. Grain augers are often involved in injuries and work is presently underway to resolve this problem. As an added point of information one must remember that in agricultural operations the hand and foot must be considered as two of the farmer's most useful "tools", thus to say don't put your foot or hand in this or that area is to deny normal and acceptable work patterns on the farm. 7) Tractor overturns. We talked about the Roll Over Protective Structures and so forth earlier and you can see in this slide the young boy's leg protruding from under the tractor. A problem for those here who are interested in emergency rescue is how do two people and an ambulance remove a multi-ton tractor from the victim. 8) Highway accidents. This combine was being driven at dusk from the field to farmstead when it was hit by a truck from behind. The operator was hurled off the combine into the ditch but not hurt. The truck which hit him was a small pickup, it rolled over in the road and killed the driver. 9) Burns. There are many burns on the farm in that burning of trash and unwanted refuse is common and flammable liquids are in abundant quantity (gasoline, kerosene, diesel oil, propane, etc.)

10) Environmental problems are on the increase. Observe the dust cloud about the combine. In addition to the obvious contaminants in the atmosphere dust and odors we must also be aware of the less obvious. There is carbon monoxide around the farm especially in the confinement housing, the sheds and the barns and where gasoline operated equipment runs. We talk about the "great open" air on the farm but maybe it isn't all that "open" after all. 11) The corn picker hand is all too evident on the farm. 12) The anhydrous ammonia eye is a new environmental problem. The use of fertilizer is ever on the increase and the alkali burn to the eye is one of the most serious insults to the eye. 13) Today, one of industry's approaches on new machines is, of course, the complete environmental enclosure, for both the tractor and for the combine. This cab can and is providing a reasonably clean environment in which the operator can perform his work. 14) How does a man get onto his tractor after he's lost his leg in a power take-off accident? 15) How does a man deal with the mechanics of operating a farm when he only has one hand? That one man might say you can take and do farming with one hand but two hands sure makes it a hell of a lot easier. These last two slides demonstrate some of the rehabilitation problems of work on a farm after loss of a leg or hand. I believe it's important that we recognize the many complexities there are in agriculture including those behavioral aspects which do not fit into a typical industrial pattern where in general industrial hygiene techniques may be applied across the board. There are obvious complications in this approach, however it doesn't mean we can't make use of portions thereof in establishing new ways of doing things.

Most accidents on the farm are not the result of a single event but rather a series of events thus the proximate cause is the one we can obviously see, however the ultimate cause is what we actually need to deal with. Thus I bring to your attention the use of epidemiological techniques mentioned earlier in this conference. It has been our experience that such research does cost money - it requires long and diligent search to find the basic problems. We feel in the Institute that this technique is practicable and desirable for we are of the opinion that our long and diligent work on the tractor overturn accident and PTO accident were influential in the devel-

development of the hardware design of the new shielded power take-off drive lines use by the industry and in the fact that today there are anti-roll frames or Roll Over Protective Structures available to keep the tractor off the man's back in case it overturns.

If we're going to effectively deal with acute injury problem, then the following points are germane. First, the farmer must be made cognizant of those safety and health problems that are changing agriculture and to present to him these new things which he has not seen before. He must be a part of seeking a solution. Secondly, he must be provided with adequate training and educational programs to equip him to conduct his work in a safe and healthful manner in this ever-changing occupation. Third, we must provide him with the chemicals, the animal medicants, the machines and supportive personal protective equipment such as to minimize the hazards he faces in his work. And fourth, as I mentioned earlier, we will likely need some minimal legislation, regulations and enforcement to assure society and encourage the farmer and those industries which support him in his endeavors to do their utmost to protect everyone's welfare. Consequently, such acts must be based upon a significant correlation between the problems he faces and the prevention on the injury which he sees.

This very conference will obviously have an impact upon improving the safety and health of the farmer and his family even if we but go away from here better informed. However, we can have a significant impact if we employ the information presented here in this conference by creating a new philosophy, direction and drive to meet the challenge ahead.

As a philosophical afterthought, I believe we must assure ourselves that while we treasure our heritage and are proud of our accomplishments in agriculture, that these same values must not become the shackles of our future. And quoting from Stuart Udall, as he says: "We have mastered the arts of animal husbandry, we know the life laws of crops and insects, we know how to plan our agricultural output. In effect, we have enhanced the future of everything - except for the overall future of the human race. The

time has come for us to evolve an ecology of man in harmony with the constantly unfolding ecologies of other living things. We need a man-centered science which will seek to determine the inter-relationships whose understanding will enhance the condition of man."

## Introduction

Alfred C. Blackman

Thank you, Pete. You did very well with all that you had to say to keep within the time restraints. Now we have a picture of the overall problem with some concrete examples. I think it would be worthwhile to hear from Leon Urben from the National Safety Council who will discuss (he is the Director of the Farm Department, incidentally) their programs and the collection of agricultural accident data. Leon.

## Agricultural Accident Statistics

Leon Urben

For 25 years after farm safety became an organized department of the National Safety Council, the Farm Conference and others expressed the need for a national profile of agricultural accidents if an effective counter attack was to be made on this problem.

In 1968, when Michigan State University conducted an accident study based on the random stratified sampling technique used by Ohio State University in 1967, it was the first time that two states could be compared directly as far as agricultural statistics were concerned.

The National Safety Council Statistics and Farm Department then developed a step-by-step procedure for other states to conduct similar studies. We utilized the experience of these two states, Michigan and Ohio, and added what we call bi-level or supplementary accident forms for specific types of accidents. If you develop one form for all of the potential possibilities in reporting an accident you would have a form that is just impossible to use. So instead we get the basic accident information on the original form and then arbitrarily decide we want more information in specific areas - such as tractors, or elevators and augers or animal accidents and so on and then develop a supplementary form which will be used in the event that such an accident occurs. Now this allows us to obtain not only profile information on the kinds of accidents and the magnitude of the problem, but also we're getting a lot more information about specific kinds of major accident problems.

Eleven \$2,000 grants were authorized by the National Safety Council to be given to states who would conduct this study as developed by NSC. The concept offered standardized techniques and information but allowed a high degree of flexibility to obtain additional information by states who

had unique problems or interests. I might add this \$2,000 in no way covered the out-of-pocket expense of the program, but apparently was enough to interest and motivate these states into conducting it.

Based on continuing experience, the procedure was revised and streamlined in 1972. The survey procedures and reporting forms are in a continuous state of updating to adjust to individual needs as well as to take advantage of lessons we learned from each study.

To date, eleven state surveys are completed, four more will be completed this year or early next year and seven more states are gearing up to start in 1975. These twenty-two state studies will be representative of approximately 70 per cent of the farms and ranches in the United States.

State land grant universities have been spearheading these studies in most states utilizing the extension service as well as other expertise from other departments, such as agricultural economics or rural sociology, to develop the sample for the particular state. Farm organizations, extension homemakers councils and other organizations have furnished the voluntary interviewers at the county level.

With the help of the Extension Service, USDA, the American Farm Bureau and other organizations, the U.S. now has been arbitrarily divided into nine regions of five or six states each. We have combined the smaller states in some areas so we have basically five units within each region. The states will rotate the study within the regions for the next five years so at the end of this time we will, in fact, have a national profile as well as a great body of knowledge describing the accident picture as it is on our farms and ranches.

In anticipation of an increasing and continuing body of farm accident statistics, we are developing ways of establishing a priority list of problems. We have based it on severity as well as frequency and at this time the

weighting by severity seems to be the most acceptable as far as our conference is concerned.

Our Statistics Department has also developed a technique called "tree-search" which is particularly effective when analyzing large numbers of accident cases. The "tree-search" technique is used to determine which type of accidents meeting certain criteria are occurring significantly more often than expected. For example, in a matter of minutes we can determine which day of the week shows up significantly more often than expected for males, aged 15 to 24, who had an accident with hand tools in farm buildings. As many as 20 variables can be used as criteria in a single search. Now this technique will become increasingly effective as the total number of accidents recorded increases. Obviously, with the 3,800 cases we currently have, if you limit a particular kind of accident to all these criteria you may get down to one or two accidents which, of course, is hardly significant. But it's a technique which can be used and by the time we have these four more states we will have doubled the number of accidents so that as we get more accidents we will be able to use this system much more effectively.

Our statisticians tell us that if we have at least one hundred accidents of a particular type and in sufficient depth from a statistical sample, we can probably get 80-90% of the information about the specific kind of accident that we need so that either educational material, design criteria or possibly even regulatory information can be developed. We have done this in the area of farm tractors and elevators and augers. It wasn't too many years ago that the word was that it was impossible to elevate corn with a guard over the intake because you couldn't get the corn in. Well, if you'll notice the design of the elevators and augers on today's market, three or four years after this study came out, you'll see that it is possible and we are progressing steadily in the area of guarding a lot of these machines. We also have done a study on home and work falls. We find that home falls in rural homes is not particularly unique or different than you would find in their urban counterpart. A lot of the states in the study were located in the ice belt from New York to Minnesota, including Oregon and ice was a problem in nearly half of the work falls outdoors. This probably will not be as large a factor when we get other states added to the total.

An accident, as defined in this study, is an event that results in an injury requiring professional medical care or that results in the loss of a half-day or more time from normal activity. Farm and ranch residents, hired help and others working or visiting on farms and ranches had approximately 170,000 accidental injuries in a one-year period. This projected total is from the 10-state summary of May 1973 which recorded an actual 3,810 accident cases with approximately a  $2\frac{1}{2}$  percent sample of the farms in each participating state.

Nearly  $\frac{2}{3}$  of the 170,000 accidents were on the job. Family members accounted for 87 percent of these accidents and hired help 11 percent. Visitors and others accounted for the balance. On the injuries reported, 62 percent were classified as slight, 34 percent severe, 3 percent permanent, and .9 percent were fatal.

Typically, falls accounted for approximately 30 percent of the accidents in the home and 25 percent of the work accidents. It is important that we zero in on the major accident causes while trying to prevent accidents in rural areas.

When injuries by parts of the body were reviewed, we feel we are missing a real bet by not utilizing protective apparel on farms as they have for many years in other businesses, or other industries. Hard hats, safety shoes, eye shields and other apparel are available at a relatively low cost and could make a significant reduction in the number and severity of injuries. I could go on and on but time does not permit and I assure you that we would be most happy to share this information with those of you who would like to follow up on it. In summary, we feel the studies meet the following criteria for acceptable data sources.

You get sufficient information to give you the overall picture - the profiles of the major problems - so that priorities can be set and resources for education and other things allocated.

You get exposure information so that raw accident figures can be evaluated properly.

You get sufficient details of selected individual cases so that countermeasures can be suggested.

Data gathering is relatively inexpensive. This is because of the use of volunteers which we're very strong on and believe that this is one of the keys to getting good accident data.

You can generalize the information gathered in other areas - the data is not simply local statistics.

You can at least begin to estimate the error in your figures to get an idea of the accuracy of available information.

Here is a real important one, I think. The studies can be repeated to verify information previously obtained, to check the effectiveness of countermeasures or programs, and to determine accident trends.

You get results without waiting too long. Somewhere between a year and a half and two years, after you initiate this program, you can get the information and summarize it.

Finally, it works, and is working.

We feel gratified that a long-felt need for better statistics in agricultural accidents is finally coming to fruition thanks to literally thousands of professionals and volunteers throughout the country, and that this information will not only give us the knowledge we need but will also point more precisely to areas that could produce results with additional research persons and adequately funded research projects.

Thank you.

## Introduction

Alfred C. Blackman

Thank you, Leon. I'm sure that you've added significantly to the total information of the group and what is available in the way of injury information. We're going to approach the statistical problem now in a second way. Dr. Leon Burmeister of the Department of Preventive Medicine and Environmental Health here at the University of Iowa will discuss biostatistics in agriculture. Dr. Burmeister.

## Biostatistics in Agriculture

Leon Burmeister, Ph.D.

### I. Introduction

The connotation of "Biostatistics in Agriculture" is distinctly different from that of "Statistics in Agriculture". It is well known that statistics as a current discipline originated in agricultural research. However, the basic concepts were developed from problems concerning crop experiments, animal experiments and genetic concepts. Our definition of "Biostatistics in Agriculture" includes the consideration of the effect of the agricultural environment on the people actually involved in farming. Thus detailed consideration is given to statistics describing the relative health of rural residents and of the farming occupation.

The nature of farming and the conditions under which it is completed are much different from the nature and conditions of most urban occupations. Farming is subject to long hours, dangerous equipment, hazardous materials such as pesticides and to certain harmful environmental conditions, such as various types of dust. Thus, it would seem that the health of farmers may be poorer than that of other occupational groups. However, it is often argued that farmers also enjoy health benefits such as active physical exercise in an environment free from such urban-related problems as air pollution. This side of the argument can be augmented by the fact that farmers as a group are older than people in urban occupations.

It may be concluded that neither side of the question of the relative health of farmers is totally convincing. Thus, detailed consideration is given to available mortality statistics according to various occupations and place of residence to determine if the relative health of farmers can be assessed quantitatively.

### 1.1 The Definition of a Farmer

There exist many difficulties in the quantification of the health of farmers. Perhaps the most basic of these problems is the definition of a farmer. Certainly, the place of residence alone does not suffice. There are many people who live at a rural route address who commute to urban areas and are not engaged in farming to any degree. It is even more difficult to place in the proper occupational group people who live at a rural route address, hold a full-time urban job and farm in the evening and on weekends. The residence and occupation problem is further complicated by the fact that a surprisingly large number of people who reside in towns and cities consider themselves to be farmers.

### 1.2 Further Occupational Difficulties

The principal statistical source of the health status of Iowa residents by occupational classification is the information contained on death certificates. The death certificates have been computerized by the Iowa State Department of Health and include occupational information from 1964 through 1970. It must be assumed that the indicated occupation is accurate and is the primary occupation of the deceased. A further difficulty is that the information coded may have a tendency to classify a person as being employed in an occupation of higher social acceptance than in reality, since the information is given by the family at a time of bereavement. The possibility also exists that the indicated occupation may be the most recent and not the life-time occupation. It would obviously be difficult to obtain, but it would be very helpful to include for those whose primary occupation was farming, the type of farming done and the percentage of working time spent engaged in farming. An occupational history for all occupations would be helpful in mortality studies. The cost of such a system, however, would be prohibitive and the accuracy of the information might be doubtful.

The preceding discussion does not include the special problems in assessing the health of farm women. Most of these farm wives consider themselves housewives; however, many are at least part-time farmers. It is relevant to consider the occupational hazards of farming and their possible effects on farm wives. Thus, the information available on women from death certificates will be included. However, no information will be available on the percentage of time a farm wife may have spent in farm-related labor. Of course, that information is also lacking on all part-time male farmers.

## II. An Analysis of the Causes of Deaths of Iowa Residents

### 2.1 Comparisons of Cause of Death by Place of Residence

The information coded from death certificates in Iowa from 1954 to 1971 distinguishes rural and urban places of residence, according to the census definition, which includes those living in towns of less than 2,500 as rural residents. Although the rural farm and rural non-farm residents are combined onto one class, the comparisons of rural and urban death rates for each of 18 general cause of death categories are included to obtain indications of causes of death that are more common for rural residents. The comparisons are made separately for males and females. The results for each cause of death are summarized in Table I.

To facilitate the interpretation of Table I, it is helpful to consider for example, the first category, infectious and parasitic diseases. In ten of the eighteen years, the difference between the rural and urban residents' death rates is statistically significant. In this case, the number of urban deaths is greater in each of the ten years than the expected number of urban deaths. This expected number results from assuming the death rate for each age category (in five year intervals) is the same for the urban residents as it is for the rural residents.

The following causes of death comprise the most salient features of Table I.

### Neoplasms

With the exception of one year (1957), the male death rates due to neoplasms are significantly different for rural and urban residents in Iowa. In each of the years, the death rates for the urban residents are higher than for the rural residents.

The difference in rates is not so distinct for the female residents. In 1964, 1965 and 1969 through 1971, the rates are significantly different for the urban and rural female residents. However, the differences are not consistent as they are for the males. In 1965 and 1969, the rural rates are higher. In 1964, 1970 and 1971, the urban rates are higher.

### Diseases of the Circulatory System

The differences in death rates due to diseases of the circulatory system are very dramatic. Only in 1959 was there no significant difference in the male rates. The male rural residents have very distinctly lower rates than do the urban residents.

As in the other cause of death categories, the differences in rates for female residents are not as large nor as consistent. Of the four years with statistically significant differences in female rates, the rural rates were higher three times. This is the reverse of the male death rates by residence.

### Diseases of the Respiratory System

The male results are identical to those in the category "Diseases of the Circulatory System". The rural rates are significantly lower in every year except one, in which the difference in death rates was not statistically significant.

The rates for female residents were significant for four different years. In three of these years, the rural rates were significantly higher. Thus the results for the female residents are also identical to those for diseases of the circulatory system.

#### Diseases of the Digestive System

The death rates for the rural men are significantly lower in fifteen of the eighteen years. The other three years the death rates were not significantly different.

The female comparisons are unusually similar to the male comparisons for diseases of the digestive system. Although the rates were significantly different in only eight of the eighteen years, in each instance the rural death rate was lower than the urban rate.

#### Accidents

Note that Table I differentiates accidents at work and away from work in 1968 through 1971. The death rates for the rural men are very significantly higher for all years in both classifications.

The difference in death rates due to accidents in female residents does not exhibit such a constant significant difference. However, the existence of accidents in the rural female residents must not be minimized. In eight of the eighteen years included in the larger accident category in Table I and in two of the four years from 1968 to 1971 in the Accident at work category, the female rural residents have significantly higher death rates due to accidents.

Deliveries and Complications of Pregnancy

In four of the five years from 1954 through 1958, the rural females had a significantly higher death rate than did the urban residents. Although the rural rate was significantly higher only twice since 1958, the conclusion is drawn that the pregnancy care received by the rural residents may be in need of improvement.

TABLE 1 Number of Years from 1954 through 1971 that Rural Death Rates for General Causes of Death Differed Significantly from Urban Death Rates\*

<u>CAUSE OF DEATH</u>	<u>MALES</u>	<u>FEMALES</u>
Infectious and Parasitic Diseases	10	4
Neoplasms	17	3 2
Allergic, Endocrine, Metabolic, Nutritional	4	4
Blood and Blood Forming Organs	1	1 2
Mental, Psychoneurotic and Personality	8	2
Nervous System and Sense Organs	5 1	1 7
Diseases of the Circulatory System	17	1 3
Diseases of Respiratory System	17	1 3
Diseases of Digestive System	15	8
Diseases of Genito-Urinary System	3 1	1 4
Diseases of Skin and Cellular Tissue	1 1	2 1
Diseases of Bone and Organs of Movement	1 1	3
Congenital Malformations	6 1	8
Senility and Ill-Defined Conditions	4	1 3
Accidents (All 1954 - 1967) Not at Work (1968 - 1971)	18	8

Table 1 (Continued)

<u>CAUSE OF DEATH</u>	<u>MALES</u>	<u>FEMALES</u>
Accidents at Work (1968 - 1971)	4	2
Deliveries and Complications of Pregnancy		6
Certain Diseases of Early Infancy	18	17

\* The top entry in each cell is the number of years with death rates significantly lower for the rural residents. The bottom entry is the number of years with significantly higher death rates for rural residents.

## 2.2 Conclusions from the Place of Residence Comparisons

The most striking of the comparisons is the very significant, consistently higher death rate for the rural male residents due to accidents. This result is expected, of course, because of the well-known hazards of the farming occupation. Perhaps more important is the fact that the accident rate is significantly higher for female rural residents in eight of the eighteen years included in the study. Although much needed concern traditionally is given to the improvement of the farmer's safety record, it may be concluded that the emphasis on safety programs should not be directed only at the male farm resident. The farm wife in many cases also operates the dangerous agricultural machinery, and she also must be made aware of the dangers of mechanization.

In most of the other disease categories, the death rates for the female residents are different than for the male residents. For all classes of disease other than accidents, the results and recommendations for females should be handled separately from the males.

## 2.3 Comparisons of Cause of Death by Occupation

The place of residence comparisons give indications of causes of death that may be unusually high for farmers. However, no definite conclusions can be drawn due to the combining of rural farm and rural non-farm residents. To obtain the death rates for the eighteen general causes of deaths for farmers, a similar analysis was completed for each of 11 occupational classifications. The classification farmers and farm managers is used as the standard. Due to changes in the occupational codes, only the years 1964 through 1970 are included in the comparisons of death rates by occupational classification. Also, the number of female farmers and farm managers is so small that comparisons made to that group are of questionable quality and will not be considered here.

The results of comparing the death rates by occupational classification are summarized in Table 2.

In the construction of Table 2, the occupational classification service workers in private households was excluded since there were too few deaths of male Iowans in this category to make comparisons meaningful. Also the cause of death categories "Deliveries and Complications of Pregnancy" and "Certain Diseases of Early Infancy" are not included in the occupational analysis.

#### 2.4 Conclusions from the Occupational Comparisons

Most occupational classifications have lower death rates than do farmers for the causes of death included in Table 2. The very definite exception to this statement is the classification laborers (except farm) who had no yearly death rates for any cause of disease that were significantly lower than the rates for farmers and farm managers. In fact, for eight of the causes of deaths, the death rates for the non-farm laborers were significantly higher for each of the seven years included in the study. The only other occupational group that had generally higher death rates than farmers was the craftsmen, foremen and kindred occupation. Combined over all causes of death, the death rates were significantly higher in 23 years and lower in 8 years. Each of the other seven groups had generally lower death rates than those of farmers and farm managers. Included in these seven groups are the farm laborers and farm foremen. It would seem as if this occupational group would be exposed to the same hazards as are the farmers and farm managers. Indeed, the accidents at work are not significantly different for the two groups. However, the farm laborers are generally younger and often are classified into other occupational groups such as farmers and farm managers before their deaths.

TABLE 2

Number of Years from 1964 Through 1970 that Occupational Death Rates for General Causes of Death Differed from the Death Rates of Farmers and Farm Managers\*

Cause of Death	Occupational Groups								
	Managers & Adminis- trators (except farm)	Sales Workers	Clerical & Kindred	Craftsmen, Foremen & Kindred	Operatives	Laborers (except farm)	Professional Technical & Kindred	Farm Laborers & Farm Foremen	Service Workers
Infectious & Parasitic Diseases				1	1	7			3
Neoplasms	5	7	7	5	7	7	7	7	7
Allergic, Endocrine, Metabolic, Nutritional	1	7	7	1	3	7	4	7	7
Blood and Blood Forming Organs	1	1	1		1				4
Mental, Psychoneurotic and Personality	1					6	2		1
Nervous System and Sense Organs	5	5	4	3	5	5	4	6	6
Diseases of Circulatory System	7	7	7	1 1	7	7	7	7	7
Diseases of Respiratory System	6	7	7	7	1	7	7	6	7
Diseases of Digestive System	1	4	6	3	1	7	3	7	7
Diseases of Genito- Urinary System	4	6	7		4	7	4	5	7
Diseases of Skin and Cellular Tissue	1		1	2		4		1	

TABLE 2 (Continued)

Cause of Death	Occupational Groups								
	Managers & Adminis- trators (except farm)	Sales Workers	Clerical & Kindred	Craftsmen, Foremen & Kindred	Operatives	Laborers (except farm)	Professional Technical & Kindred	Farm Laborers & Farm Foremen	Service Workers
Diseases of Bone & Organs of Movement						3	2		
Congenital Malformations	1			1	1	2	1		
Senility & Ill- Defined Conditions				2	1	3	2 1		1
Accidents (All 64-67) Not at Work (68-70)	6	6	7	2 2	5	7	7	6	7
Accidents at Work (68-70)	2	3	3		1	1	3		3

\* The top entry in each cell is the number of years with death rates higher than those for farmers and farm managers. The bottom entry is the number of years with lower rates.

### III. Conclusions and Recommendations

The inferences that can be drawn from this study are limited because the analyses of cause of death were completed for only one state. However, it does appear as if rural places of residence, as defined by the Bureau of Census, are healthier than urban places of residence. But from an occupational point of view, farmers and farm managers appear to have better health only when compared to laborers (except farm) and craftsmen, foremen and kindred. It is particularly clear that the major problem confronting both farm men and farm women is the significantly higher farm accident rate. It is also important to emphasize that farm women in general have different health problems than do the men. Consequently these problems need to be solved in order to improve the overall rural health.

There are several recommendations that could result in a more thorough understanding of the health of farmers and their families. The concept of health indices has been applied to Iowa counties (1). The conclusion is drawn that 88% of the counties forming the worst quartile based on the indication of health status given by the index are in the southern two tiers of counties, which are relatively poor from an agricultural aspect due to terrain and soil type, and the urban counties. It can also be shown that the health of a county is possibly related to the strength of its agricultural economy as measured by the per cent of rural residents appearing to be employed exclusively on the farm. These results are based on an admittedly simple health index. It is recommended that more elaborate and hopefully more sensitive health indices could be developed to indicate areas in both rural and urban situations that are in need of improved health.

This study is based entirely on mortality data. National studies including morbidity data are available, primarily from the Health Interview Survey and the Health Examination Survey conducted by the National Center for Health Statistics. These national statistics are helpful in the general assessment of rural health, but the morbidity statistics are not generally

applicable at the state levels. Thus sample surveys at the state level are necessary to supply needed state information. Indeed such studies are now being completed, although they are limited to accident statistics (2).

The Iowa death certificate data represent only one state and one general type of farming. National studies (3) indicate some problems exist for farmers that may not be a cause for concern for Iowa farmers. An example is the apparently higher than average rates for infectious and parasitic diseases, which did not appear to be a concern of Iowa farmers, at least as a cause of death. However, it would appear to be informative to complete similar cause of death studies in selected states that represent different geographic areas and different types of farming. The results may be greatly different from those generated by the Iowa study. If so, the consequent recommendations for improved rural health would then be specific for geographic area and type of farming.

References

1. Iowa State Department of Health and the Office of Comprehensive Health Planning, "Measures of Health Status for Counties and Regions in Iowa, 1965 - 1969," December, 1970.
2. Urben, Leon, "Agricultural Accident Statistics", presented at the Conference on Agricultural Health and Safety, The Society for Occupational and Environmental Health, Iowa City, Iowa, September, 1974.
3. The National Center for Health Statistics, Acute Conditions, Incidence and Associated Disability, United States, July 1970 - June 1971, Series 10, Number 82.

## Introduction

Alfred C. Blackman

Thank you, Dr. Burmeister. Our fourth speaker will discuss the activities of the Department of Agriculture of the Federal government to indicate the extent and scope of their program and it gives me pleasure to introduce Dr. Robert Gilden, Agricultural Extension Service of the Department of Agriculture.

## Federal Activities

Robert Gilden

I'd like to talk a little bit about the USDA programs extension service. In our USDA program we had, in the past, an advisory committee to the Secretary of Agriculture who advised him on what the Department of Agriculture should be doing in the field of safety. We are in the process of revising or reestablishing that committee whose two-year limitation has expired. The Undersecretary of Agriculture, Phil Campbell, will serve as chairman, Jon May will sit in, I imagine, as he did in the past, and we'll have someone from OSHA over as well. Their job is to determine where we go, what we're doing now and where we go on from here.

USDA also serves on the OSHA Agricultural Advisory Committee - I happen to be the representative - and we get some USDA input into OSHA. We also have campaign programs with the Department of Agriculture in cooperation with the National Safety Council. Our most famous campaign is National Farm Safety Week and those of you from rural areas have heard about it. We have done this annually since 1944.

We have also established a monthly emphasis campaign program where we choose a specific topic as chore time safety, and encourage the land grant universities and the Department of Agriculture to promote that topic through the mass media. We're also involved with the National Fire Protection Association in Fire Protection Week which is in October. Of course our Forest Service has a continual campaign going on fire protection in the national forests.

We recently developed a memorandum of understanding with OSHA pertaining to, in the case of Extension Service, the education and information delivery programs. The Animal Plant Health Inspection Service also has developed one pertaining to the health-safety conflicts.

The Department of Agriculture also has a food safety task force that is in operation. It's not a specific type program - it's a task force involving a number of agencies.

Now what is Extension Service and what is it doing? I've worked in Extension Service most of my life and Pete Knapp started out in extension at Cornell University a number of years ago. Rollin Schneider is also in extension and you'll hear from him this afternoon. I don't think any one of the three of us would define Extension Service the same way, because it's like the blind man describing the elephant. Extension Service is the educational arm - the informational arm of the Department of Agriculture and also the land grant university system. It stretches out and reaches to the county and community level. Its mission pertains to agriculture and to rural living, which includes the health and the safety aspects of rural America. It is cooperative - it has a Federal arm, it has a state arm, and it has a county arm. Maybe one way to look at it is from the budget aspect - less than 50% of the Extension Service budget comes from Federal funds, less than 50% comes from state funds, less than 50% comes from county funds. It's not quite a third of each - a little more Federal, a little more state than county. But the county commissioners at the county level believe they've got part of the Extension Service program. Our strengths are in our cooperative nature and in our delivery system of reaching down to the local level through the local county agent and the home demonstration agent - being part of that community and of the local people, feeling sure that extension is part of that local rural community.

At the Federal level we have less than 200 employees and that's including secretaries, so we're a very small group. Totally there's about 17,000 employees in Extension Service. I don't know just how it would break out - I suppose in Iowa maybe 100 at the state level, which would be specialists and program leaders, the remainder - you probably average about three per county - about 300 - at the county level.

Last year in safety work in Extension Service we expended 50 man years according to our computerized reporting system. Fifty man years in safety - that isn't very much.

We have in Extension three traditional programs. One pertains to agriculture, one to home economics, which is our rural living portion, and one to youth, which is our 4-H program. Safety is involved in each of the program areas. The 50 man years expended went to all areas, probably more heavily in the home economics or the rural living programs and in the youth program than in the occupational safety program. In the Cooperative Extension Service, we have safety leaders in only about six states or six Land Grant Universities - New York, where Pete started out as a safety leader; Nebraska, Rollin Schneider, safety leader; we have Ohio State University, Michigan State University, the University of Wisconsin, Purdue, and the University of Illinois. Those are our full-time safety leaders. But we're shifting. We're giving greater emphasis to safety. Iowa had a full-time safety leader - now they're out of the business of the full-time safety leader with two half-times. I look for them to be shifting back. The University of California is shifting its emphasis. Kansas State University is shifting into this program. The University of Maryland, Penn State, North Carolina and Alabama - they're all shifting without additional resources. They're reallocating present resources into a safety program.

We also have health specialists and this is part of the Home Ec program. Not every state has these and I'm not quite sure of the breakout - probably about a third of the states. Their role primarily is with the home economics program and the youth program. Their concern is with information on the health delivery system.

In the safety survey that Leon Urben mentioned, we're definitely involved - 100% involved. We've programmed out a five-year repeating survey and as Leon mentioned, nine states, one from each of the nine regions, will be involved in a safety survey. New York, Maryland, Alabama, Tennessee, Kansas, Iowa, Utah and Idaho are presently involved. These surveys will give us a broad spectrum across the United States.

We have at the current time a study going in New York state where we're trying to do an impact safety educational program in three counties - Oswego, Columbia and Steuben. An impact educational program on farm machinery safety and safety on the farm, using all the resources that are available in the state and at the county level. Accidents in these counties will be measured against the rest of the state using workmen's compensation as the basis.

We also have a program on pest management. It's a 2.5 million dollar budgeted program to reduce the use of pesticides by either controlling pests naturally or utilizing a scouting program to reduce the amount of pesticide usage.

We also have, and this is something very dear to my heart, a safety budget this year. We had it until President Nixon - just before his last official act - vetoed the agricultural budget. And so this is under review once again. We hope to obtain \$20,000 per state university to conduct a safety program and put on a full-time safety leader. If we are budgeted, we'll double our input in agricultural safety over what we did last year.

## Introduction

Alfred C. Blackman

The next subject will be on the subject of rural emergency medical care. Mr. Earl Gettinger, who is the Director of Emergency Medical Services at the Vermont State Health Department will discuss their program and how they've implemented it, as well as some of their experiences.

### Emergency Medical Services in a Rural State\*

C. Earl Gettinger, Jr., BS, MT, EMT\*\*  
 Mary Anne Weiner, RN, MS\*\*\*  
 Julian A. Waller, MD, MPH\*\*\*\*  
 David B. Pilcher, MD\*\*\*\*\*  
 Jacqueline R. Goss, EMT\*\*\*\*\*

- \* Presented at the Conference on Agricultural Health and Safety,  
 The University of Iowa, Iowa City. September 5, 1974
- \*\* Director, Emergency Medical Services, Vermont State Health  
 Department, Burlington, Vermont.
- \*\*\* Nurse Coordinator, Emergency Medical Services, Vermont State  
 Health Department, Burlington, Vermont
- \*\*\*\* Professor and Chairman, Department of Epidemiology and Environmental  
 Health, University of Vermont College of Medicine, Burlington,  
 Vermont.
- \*\*\*\*\* Associate Professor, Department of Surgery, University of Vermont  
 College of Medicine; Surgical Director, Emergency Department,  
 Medical Center Hospital of Vermont, Burlington, Vermont.
- \*\*\*\*\* Training Coordinator, University of Vermont - Vermont State Health  
 Department Emergency Medical Services Program, Burlington, Vermont.

Many diverse groups are currently interested in the various problems and solutions involved in establishing and implementing an effective system for the delivery of emergency medical care in rural areas. Because all of us, at one time or another, have been in a rural setting - either for recreational or other purposes - not only should we be quite interested in emergency medical services but more often than we realize, our lives may be dependent upon a rural system, quite far from home, responsible for the delivery of such care.

First, let us examine some techniques that are used in a rural state, such as Vermont, in implementing change in Emergency Medical Services. Our activities are described in two distinct phases. The pre-hospital phase deals with emergency care rendered at the scene and en route to the hospital, while the hospital phase deals with the care provided in the emergency room of the hospital.

Additionally, and perhaps this is a little unique, we would like to note that we view the role of state government in emergency medical services as a provider of assistance and guidance rather than as a governmental agency that often has the reputation for dictatorially setting up standards for enforcement.

Now, an overview of the problem: In 1969 a study of Vermont highway fatalities indicated that 23% of these individuals were dying of survivable injuries.<sup>1</sup> Half of these deaths were due to problems with care at the scene and en route to the hospital. The other half occurred because of problems in the hospital emergency room. Although we do not have specific data for survivability from acute illness and other forms of injuries, the evidence would tend to support that we would find a similar pattern - particularly since the primary cause of the problem can be identified as the inability of both ambulance and hospital emergency room personnel (nurses and physicians) throughout the system to effectively provide the basic skills necessary to deliver basic resuscitation and emergency care.

Additionally, a survey of ambulance services throughout the state<sup>2</sup> identified three top priority problem areas. We would venture to say that these are probably not much different from the problems experienced in many other rural areas of the country. These priority areas of need were identified as:

- 1) Training
- 2) Communications
- 3) Coordination

These served as our basis for implementing change. The initial efforts in solving these problems were four-fold and heavy emphasis was placed in the following areas.

- 1) Creation of Ambulance Districts. These were established by the legislature as political sub-divisions and constituted the patient-shed areas of hospitals throughout the state.
- 2) The establishment of a statewide hospital-ambulance communication system linking each emergency room with all ambulances in its area as well as those from other regions of the state.
- 3) The retention of a Coordinator of Emergency Medical Services.
- 4) And, quite important, the adoption of training for EMTs throughout the state.

All of these occurred simultaneously. In the beginning, primary emphasis was placed on training. The 81-hour EMT program, as developed by the Department of Transportation,<sup>3</sup> was adopted and used throughout the state. At the same time, we were attempting to stimulate ambulance district activities throughout the state to promote planning and activity at the local level for Emergency Medical Services.

#### Preliminary Findings

After approximately one year, we noted that where training programs had been established and the program had been basically a good one, it was easy for us to stimulate district activity. The changes in attitude and concepts of emergency medical services were remarkable and easy to sell when the district was made up of well-trained individuals. Demonstrable progress then became spontaneous.

As time went on, however, we identified more problems - very important ones:

- 1) Poor courses - We found in several areas that the local level had few qualified people who were able to teach practical skills and knowledge in Emergency Medical Care.
- 2) In areas where training did take place, we also started to receive the following complaints from ambulance groups:  
"We try to do a good job and when we get the patient to the hospital, they drop the ball in continuing care."
- 3) We also recognized our inability to respond to and meet local needs. Someone who lives in the capital or home office cannot effectively offer real and knowledgeable assistance at the local level.

Additionally, during this time span, we collected some new essential base line data on hospital emergency departments<sup>4</sup> throughout the state and on existing patterns of emergency communications systems, including ambulances, police and fire agencies.<sup>5</sup>

Accordingly, we re-evaluated our policy for a new and expanded approach to the problem.

#### Expanded Approach

- 1) One of the steps in our expanded approach was the development of training aids and the retention of knowledgeable and articulate personnel of the Emergency Medical Technician caliber to assist in teaching and improving basic practical skills taught at the local level. We are not concerned so much with whether the EMT can do an EKG, but more importantly, we feel he should not only know how to put on a splint, backboard or carry out other basic emergency care procedures, but that he also know when to. Especially important, he must have had some practice and have developed expertise in carrying out such procedures.
- 2) Regional Coordinators were retained to live and work at the local level and provide assistance to the Ambulance Districts, individual

ambulance squads, and hospitals within that area. Much of their activity has been involved in working with the pre-hospital phase of care. This activity includes such things as coordination of courses at the local level, stimulating activity in the Ambulance Districts, improving attendance and representation on the board, setting up communication procedures and protocols, planning for back-up ambulance response and equipment exchanges at the hospital.

Additionally, the establishment of ambulance critiques among the hospital and ambulance personnel is extremely important.<sup>6</sup> In a rural state, one does not get many emergency calls and thus field experience is limited, especially among a cadre of volunteers. Since experience is predicated on field time, many basic skills are likely to become rusty. A technique which can be used to minimize this disadvantage is for all personnel to review and critique each emergency ambulance call. Through such a review, many can benefit from the experiences of a few individuals in handling a particular emergency that they might not otherwise encounter.

All of the activities in which the regional coordinators are involved are directed at assisting in up-grading and maintaining the basic day-to-day activities in emergency medical services as well as at identifying problems at the local level.

In addition, the regional EMS Coordinators have the rather unique capability, utilizing assigned authorized emergency vehicles, to respond to the scene of major accidents and emergencies, in order to evaluate the quality of care both at the scene and in the Emergency Room. This is done with a view to identifying problems and providing guidelines in their solution, as well as assisting groups to be able to provide the most coordinated response and care.

- 3) In addition to the above, performance standards<sup>7,8</sup> were established for hospital emergency rooms by utilizing a statewide workshop and a state EMS Advisory Committee working closely with all interested and concerned parties to develop realistic and workable goals.
- 4) A training program for emergency room nurses was developed and offered. This will be examined momentarily.

### The Results

- 1) We now have basically good EMT courses where individuals are taught and examined in the practical skills necessary in the field.
- 2) People are working together better and setting up a system at the local level as a result of good training and the assistance of the regional coordinators. This activity is most often generated at Ambulance District meetings and subsequently by the regional coordinators, who follow-up on activities discussed.
- 3) There is increased understanding between ambulance and hospital personnel on their respective roles in emergency medical services. This in turn has been reflected in a significant improvement in their working relationships.
- 4) The ambulance personnel and hospital staffs are using the right equipment (i.e. splints, backboards, etc.), and they are working together to do the job rather than undoing each other's efforts. Rather than the nurse or physician slamming the door in the ambulance attendant's face, they are having them in for coffee, they're talking, and they're having a good exchange of ideas and experience. An example is an accident patient who is brought to the hospital by ambulance, immobilized on a backboard and splinted. Now the emergency room staff leave the equipment in place and take evaluation x-rays. In the past, it was noted that they might remove the splint and backboard and later put them back on with the observation, "Yeah, that leg really is broken!"

Change utilizing these techniques is slow; however, it is based on knowledge and acceptance and is more permanent. The key to implementing change is predicated on training, coordination and communications, and by far the most important of these is training.

These foregoing remarks have addressed themselves basically to the problems and solutions generated in the PRE-hospital phase of care.

Now, the four major factors influencing the direction that change took in the HOSPITAL phase of emergency care included:

- 1) The survivable injury study
- 2) The results of upgraded EMT training
- 3) A hospital emergency survey revealing deficits in availability of equipment, staffing patterns and training, and
- 4) The fact that in rural hospitals the nurse is the person most readily available to the emergency room in a life-threatening situation.

These problems were tackled at a workshop<sup>9</sup> attended by physicians, nurses and administrators from all Vermont hospitals and representatives from all professional groups. As a result, performance standards for hospital emergency rooms were set as a basis for classification, and a 30-hour training program for emergency room nurses was developed. The standards for classification as a Basic Hospital state specifically the basic skills that both physicians and nurses must have to resuscitate and stabilize seriously ill or injured emergency patients. The hospital performance standards have been published, and preliminary implementation has begun. Emergency procedure protocols, transfer procedures and emergency department committee functions are also being developed.

The course to teach nurses the required didactic material and practical skills was presented five times last fall to some 100 nurses.<sup>10</sup> Heavy emphasis was placed on the practical skills of patient evaluation, airway

maintenance, resuscitation of pulmonary and cardiac arrest, treatment of chest trauma, hemorrhage and shock, and fracture immobilization. A six-month follow-up evaluation indicates that the objectives have been met to a very high degree.

There has been a significant increase in the number of nurses permitted and willing to carry out basic but crucial emergency procedures. This is occurring both before the physician arrives and, after his arrival, supplementing - and probably in some instances guiding - the delivery of basic and definitive emergency medical care. A number of examples include: initial examination of patients, use of hospital-ambulance radio for definitive patient data, use of oral airway, starting I.V.s, applying both air and traction splints, putting patients on backboards before further workup, applying cervical collars, stabilizing flail chests, sealing chest wounds and interpreting EKGs. Many of these are basic procedures and are part of the day-to-day armamentarium of the EMT. One would expect to find them carried out routinely in any emergency room, but our experiences have indicated the real need to focus on the deficits in these areas and provide the requisite training and skills to carry out the required procedures.

Other changes are also occurring in hospital emergency rooms, and as a results of the training, there is greater unification, understanding, and exchange of information between nurses and ambulance personnel. Training for physicians is also being planned.

Before concluding, some anecdotal but interesting observations should also be noted. In the beginning of our nursing course, a good proportion of the nurses with substantial emergency room responsibility and experience did not know how to properly position or use a bag-mask resuscitator. They themselves were a bit shocked by this realization and consequently were highly motivated to learn in what was a heavily skills oriented course.

Recently, another separate group of nurses, physicians and EMTs were tested for their proficiency in CPR - Cardio Pulmonary Resuscitation.<sup>11</sup>

Ninety-three percent of the EMTs were rated as proficient, while nurses and physicians had a 23 - 25% success rate in carrying out this basic resuscitative skill. Now that we've identified the problem, our work is cut out for us.

### Fiscal Support

Much of our work has been carried out under an EHSDS contract (Experimental Health Services Delivery Systems) with the state of Vermont. The Department of Transportation (DOT) and the Northern New England Regional Medical Program (RMP) have also played significant roles in allowing us to accomplish our goals.

### Summary

In summary, we are utilizing a comprehensive systematic approach in both the pre-hospital and hospital phases of emergency medical care - an approach of planning, organization, ongoing evaluation and most important, training. When good training programs are implemented, change occurs. We're convinced that this approach and concept works because we see change. The study of highway fatalities is being replicated and preliminary evidence indicates that as a result of this approach, we are seeing a decrease in deaths from survivable injuries.

References

1. Perrine, M.W., Waller, J.A. and Harris, L.S. Alcohol and Highway Safety: Behavioral and Medical Aspects. Final Report to the Department of Transportation. (FH-11-6609 and FH-11-6899), Project ABETS, Psychology Department, University of Vermont. Burlington, 1971.
2. Waller, J.A. and Jacobs, L. Ambulance Service in Vermont. Vermont Department of Public Health and Department of Community Medicine, University of Vermont College of Medicine. Burlington. 1971.
3. Basic Training Program for Emergency Medical Technician - Ambulance: Course Guide and Course Coordinator Program. U.S. Government Printing Office, 1969.
4. Kanwit, J.H. and Gettinger, C.E. Hospital Emergency Services in Vermont. Final Report to the Division of Emergency Services, Department of Health, Education and Welfare on Purchase Order #R01-779-71. Vermont Department of Health. Burlington. August, 1971.
5. Goss, J.R., Waller, J.A. and Gettinger, C.E. Emergency Communications and Dispatch Systems in Vermont. Final Report to the Division of Emergency Health Services, Department of Health, Education and Welfare on Purchase Order #PLD 10853-72. Vermont State Health Department. Burlington. June, 1973.
6. Pilcher, D.B. "Ambulance Critique Review." Journal of the American College of Emergency Physicians. November/December, 1974. 383-4.
7. Vermont Guidelines for Hospital Emergency Departments. Volume I: Performance Standards for Hospital Emergency Department Classification. Vermont Department of Health. April, 1974.
8. Waller, J.A., Gettinger, C.E. and Weiner, M.A. "Implementing Rural Emergency Health Service Systems." Journal of the American College of Emergency Physicians. May/June, 1974. 151-5.

9. Waller, J.A., Weiner, M.A., Gettinger, C.E. et al. Proceedings of Workshop on Emergency Health Services in Vermont. Final Report to the Division of Emergency Health Services, Department of Health, Education and Welfare on Purchase Order #PLD 12177-72. Vermont Department of Health. Burlington. January, 1973.
10. Weinder, M.A., Gettinger, C.E., Waller, J.A., Pilcher, D.B. and Goss, J.R. Inservice Training for Rural Nurses in Emergency Care Concepts and Skills. Developed under a grant from the Northern New England Regional Medical Program. 1972-1973. (In press)
11. Morgan, J.G. and Sargent, W. Personal Communication, June, 1974. Medical Center Hospital of Vermont, Burlington. (To be published).

## Introduction

Alfred C. Blackman

Thank you, Earl. The last subject that we will cover before the discussion period and lunch - and we're a little behind schedule but we weren't responsible for that - is to describe and outline for you NIOSH's expanding role in agricultural safety and health and this will be done by Mr. Robert Peterson, the Director of our Western Area Laboratory in Salt Lake City. Bob.

## NIOSH's Expanding Role in Agricultural Safety and Health

Robert L. Peterson

It has long been indicated that the agricultural industries rank high in the rate and severity of occupational injuries and disease. Statistical information is fragmented, however by extrapolating from data collected in some states it has been estimated that the agricultural industry suffers over 2,000 deaths and 200,000 disabling injuries annually, ranking the industry behind only mining and construction in the rate of work related accidents.

It is generally agreed that agricultural safety and health has received much less attention than it should. It is true that several land grant colleges have research programs in the field of safety, especially as it related to machinery and particularly tractors. Also, the American Society of Agricultural Engineers has developed standards which cover many types of farm machinery - some of which relate to safety. OSHA's safety standards on "Rollover Protective Structures for Tractors" are based on these ASAE Standards.

The research going on in the area of occupationally related diseases is scattered and generally has low visibility and much that is done is not directly applicable to standards development.

By and large state occupational safety and health programs have not been addressed to the agricultural problems. The most notable exception is the pesticide problem where some states have very active control programs.

With reference to federal agencies, the Department of Labor has recognized the needs for safety and health standards in agriculture and OSHA is approaching agriculture as a special industry. General or "horizontal" standards are not being applied to agriculture. Thus it is anticipated that agriculture is one of the few industries which will probably have its own

standards ("vertical standards"). At present OSHA has promulgated the following agriculturally related standards:

- (a) Sanitation in temporary labor camps.
- (b) Storage and handling of anhydrous ammonia.
- (c) Pulpwood logging.
- (d) Slow moving vehicles.
- (e) Rollover protection on tractors.

NIOSH activities up to now have been to work with OSHA through membership on the OSHA Standards Advisory Committee on Agriculture, and we support research through the grant mechanism on farmers lung and pesticides. We are completing a criteria document on parathion.

Other federal agencies have responsibilities and interests in agricultural safety and health. The Department of Agriculture has some resources dedicated to health and safety.

EPA has responsibilities relating to, and expends many dollars for research on pesticides. EPA recently promulgated emergency re-entry standards for pesticides.

The Consumer Product Safety Commission has responsibility for controlling safety hazards of small hand tools, etc., which are an important source of injuries to farmers.

The Department of Transportation has been interested in tractor safety, but has deferred further activities in this area to OSHA.

Both DHEW and DOL have grant programs in support of better health care for migrants, but apparently no funds are expended for occupational safety and health per se.

Thus although there is activity and interest in agricultural occupational safety and health research, relative to the total problem it is quite limited. Some of the problem areas involve overlaps of responsibility with some duplication of effort, and we have no federal strategy for dealing with the problems nor do we have a national data collection system to identify problems and establish priorities for research.

Recognizing the need and our responsibility under the Occupational Safety and Health Act, NIOSH has recently initiated an expanded agricultural safety and health research program, with program responsibility assigned to the Western Area Laboratory for Occupational Safety and Health in Salt Lake City, Utah.

As the availability of occupational safety and health professionals with expertise applicable to agricultural problems is limited both within and outside of NIOSH, it was decided to operate the research program by an in-house contract. This would allow the maximum use of existing NIOSH field equipment, computer and other facilities. It would permit readily available consultation from a variety of professionals on the NIOSH staff, and thus make maximum utilization of our limited budget.

There were several elements that influenced the design of the initial NIOSH Agricultural Occupational Safety and Health Program Plan.

Research strategies cannot be properly selected until information is at hand that suggests, or indicates where the problems are and how significant they are.

To ascertain what our efforts should be from the large reservoir of possibilities, we formed a Task Force to conduct an issue analysis of the possible NIOSH strategies in the area of agricultural occupational safety and health and prepare recommendations. The Task Force utilized a State-of-the-Art Report on occupational safety and health in agriculture, prepared under contract with the Institute of Agricultural

Medicine, University of Iowa, as a major reference. Also used were contracts with other federal, state, private agencies and organizations, and individuals active in occupational safety and health.

Based upon the Task force recommendations, our first task is to obtain extant data on farm accidents and occupational diseases for use in developing our initial project plans. In the past we have relied on geographically limited studies and professional intuition and interests to establish research priorities. The validity of priorities determined by these methods and the ability to evaluate the effectiveness of any control measures implemented, is open to question.

Secondly, we believe that NIOSH must assume federal leadership in establishing an agricultural safety and health data collection system. Rather than create a new system we will explore the practicability of a cooperative information system with the National Safety Council and possibly others, broadened in scope to include occupational disease and other desired data. Therefore, concurrently with the collection of extant occupational accident and disease data in the agricultural milieu, NIOSH will involve itself in developing and possibly operating a continuing data collection system with national relevance. We are hopeful that organizations and agencies who are collecting limited data will cooperate by giving what data they have and are collecting, and where appropriate allow us to "piggy back" upon their systems and use their experience and expertise.

As pointed out earlier, several agencies other than NIOSH have authority and responsibility to conduct research in the definition and control of certain agricultural hazards. Accordingly, we will be contacting those agencies with a view to determining what occupational safety and health related research they are doing, and have done. This kind of information is necessary to assure ourselves that we do not unnecessarily duplicate effort or infringe upon the legal responsibilities of other agencies.

Although funds are insufficient to do so at this time, some thought is being given to the feasibility of developing an agricultural occupational safety and health information clearing house at the Western Area Laboratory for Occupational Safety and Health. Our current thinking is that by maintaining a service center on agricultural research activities and reports, anyone contemplating a research project could rather quickly determine whether or not someone else had or was doing similar research and/or could be given the titles and source of any published reports related to the proposed project. If implemented we intend to use our automated technical information storage and retrieval system as a resource in providing this service.

Because of the widespread use of pesticides, their toxicity and the diseases caused by their use in agriculture, high priority should continue to be placed on the control of pesticide hazards. Therefore, NIOSH will concentrate an initial effort on the physiological and behavioral effects of exposure to certain pesticides on humans, leaving to EPA those responsibilities for environmental monitoring and control that is legally theirs.

While we will not unnecessarily duplicate research already underway, we plan to do studies to validate field re-entry safety intervals for certain pesticides and hopefully develop sensitive functional tests to serve as early warning of worker exposure to toxic amounts of pesticides. In addition to studying certain aspects of the pesticide toxicity problem we will initiate as soon as we can hire qualified staff, an epidemiological plan for a study of respiratory impairments among farm workers. Other epidemiological studies will be considered consistently with need and availability of resources.

Future research projects will be identified, developed, and given priority on the basis of the analyses of the agricultural occupational disease and injury data we obtain, and after assuring ourselves that we will not unnecessarily duplicate on-going research by other agencies and organizations.

Although it is too early in the program to be definitive, the obvious purpose of any research we do, will be for use in the development of standards and good work practices for the agricultural industries. Any criteria prepared would take cognizance of the unique characteristics of the agricultural industries and would hopefully eliminate the burden or impracticability that a strictly horizontal standard might have on the industry.

I should like to mention that in recognition of the inadequacy of general health services as well as traditional occupational health services in many rural areas, NIOSH contracted this year to have a survey and analysis made of on-going occupational health programs for agricultural workers in a state or region. Included in this project is the design of an innovative model occupational health program for agricultural workers that may be carried out by some already existing local or state medical care type agency and the testing and evaluating of the model program in an existing local or state medical care type agency. If successful, this effort should ultimately result in improved care for the farm worker.

We feel there is strong justification for undertaking an organized effort to identify causes and develop programs and recommendations to reduce the incidence of farm accidents and occupational disease. We are hopeful that sufficient resources will be available for us to develop and operate on a continuing basis, a viable program responsive to the needs of the agricultural industry and sensitive to the responsibilities of other agencies and organizations involved in agricultural safety and health.

## Discussion

Alfred Blackman, Moderator

Unidentified Speaker

The question that I was going to address to Dr. Burmeister maybe someone in the audience can answer. I was wondering when he presented mortality data if he considered mobility of the work force? It seems to me that there would be a large number of people or a significant number of people anyway, of farm workers who, if they had a chronic health condition, would tend to relocate in an urban area where they would have access to medical treatment. Conversely, there would seem to me some people that would have chronic health conditions who would tend to retire in a rural area. Does anyone have the answer?

Dr. Keith Long

I think that I can help a little bit. I was working with Dr. Burmeister in accumulating these statistics and yes, indeed, mobility was considered. As was pointed out by him, there are some inherent problems like on the death certificate the last place of residence is generally the one that is revealed. And this is why you really don't know whether that individual was a farmer who went to the city or a city dweller who went to the farm or just what was involved. This is an area of inaccuracy with respect to pinning it down to say that this is indeed a farm death or an urban death. Even though you consider it, there isn't a lot you can do about it when you're dealing with death certificates.

Unidentified Speaker

A question of an interesting approach would be to try to relate that to the injury reporting system which currently exists in California and in which the employers all report injuries which require medical attention.

Mr. Ephraim Kahn

I think it was mentioned yesterday that in some ways California's reporting system for occupational injury and disease is unique. But there is one area in which it really fails badly, and that is in relation to the field worker in agriculture. We have done some studies that have not yet been published that indicate to us that the reported cases of occupational disease in agricultural field labor may represent only a very small fraction of the actual incidence.

Dr. Rodney Beard

I'd like to ask Dr. Earl Gettinger about one of the problems in ambulance services in emergency care. It is my understanding that a major difficulty lies in the very rapid turnover of personnel - that a fellow who has been riding an ambulance for four months is an old boy at the game.

Dr. Earl Gettinger

The turnover is related to perhaps the type of ambulance service that is available. When I was with the California State Health Department we surveyed the ambulances. Eighty-seven percent of the emergency coverage by ambulance service in the state of California was provided by municipal operators, and it was like being a migrant worker in many regards. You were on five days a week for 24 hours a day, and I speak from experience because to keep my expertise up I used to do it occasionally to see what the current problems were. They were rather dingy quarters and people did quit and you didn't get the best protoplasm to work for you. Now that we are approaching it as a system to do several things - either have the municipal system, or I think free enterprise can continue to provide good ambulance coverage with decent working hours, decent living conditions, and a decent wage based on their ability to perform with their education. I think we should start to look at ambulance services as public utilities whether they be provided by the public or by private enterprise.

## Health and Safety Standards for Agriculture

Rollin Schnieder, Ph.D.

The program says "Special Task Force to USDA". Although I have been on that committee and Bob referred to it this morning, it is really the Agriculture Advisory Committee to the U.S. Department of Labor that I am reporting on. Two other people in this room serve on that committee -- Dr. Jon May and Bob Gilden whom you heard from this morning. Pete Knapp also served as an advisor.

This committee is a fifteen-person committee made up of four employer representatives, four employee representatives, two from state government - three from universities, and two from the federal government. As it is set up, one of these people has to be from health. This is Dr. Jon May.

Our first meeting was held on July 26, 1972, in Washington, D.C., and since that time there have been ten meetings held all together. There have also been some subcommittee meetings held in the interim. The reason we've had to hold subcommittee meetings is that we have a 270-day period from the time we start on a standard proposal to come up with some kind of report. If we do not come up with a report by that time, the Department of Labor could take that information and write up a proposal starting with and using what the committee had worked on.

The first project that we worked on was on pesticides. I might go back a little bit earlier. On the USDA Special Task Force Committee we had set down to look at some of the major problems. We put these in Category A, Category B and Category C and then put them in the level that we thought they should have. One of the problem areas that came out A-1 time after time was that of tractor overturns. Another one that came out high each time was the one on machine guarding. Another one that came out

high each time was the one on airborne hazards. When we got to the one on pesticides, there was not enough statistics to justify a high rating to pesticides. We did put this high on the advisory committee list since the Department of Labor wanted us to look at the pesticide problem. We stuck primarily to the organic phosphate problem. There were 21 organic phosphates listed, however the subcommittee on a vote of 3 to 1 voted to drop this down to the 12 that they thought were the most persistent organic phosphates. This was what the proposal was written on.

I think you all know what happened after this pesticide standard was proposed. First, rather than it being a temporary standard, it was proposed as an emergency standard. This brought lawsuits from a couple of different sides. I won't go into the detail on this, however we had a problem here that was talked about in the last couple of days -- this of not having good statistics. In some of the reports we could find as many as 800 fatalities per year from pesticide poisonings, 80,000 injuries -- you go back and try to find these and they were just not there. This came from a report that carried a lot of assumptions. The pesticide standard has gone from OSHA over to EPA - you heard a little bit about it yesterday - I'm not going to say anything more about it because it's hard to tell where this is going to end up.

One of the other problems that our committee had to look at was a proposal on one of the vertical standards relating to agriculture. The temporary labor camp standard as related to agriculture had a conflict with the manpower standard. As a result, the standards were being enforced from both the manpower standpoint and the OSHA standpoint. We had a subcommittee work on this to try to wed the two together. This report came out well over a year ago in Denver. It has now been printed in the Federal Register. The proposal that didn't take too much time was on ROPS - the roll over protective structures. We met here in Iowa City in December of 1972 and we came up with a proposal. A subcommittee headed by Dr. Erisman came up with a proposal for ROPS - this was submitted to OSHA. The proposal came out in the Federal Register earlier this year. Hearings

have been held and I would say within a short period of time we're probably going to have a ROPS standard that relates to agriculture. This is one where we had the bodies. It's easy to arrive at a standard like this because you have the bodies, you can make the counts. When you get to a health standard like the pesticide standard and you have such remote statistics to go on it's hard to really build up a case for it.

I am a definite believer in the ROPS standard. I was in on some of the original writing of this through ASAE, as was alluded to earlier this morning. We are now seeing the benefit of the roll over protective structures. I live in a state west of here - as of today we have had three fatalities from tractor overturns. I can remember when we had as many as 40 fatalities per year from tractor overturns. Education, ROPS, all of these things are combined to give us some pretty good statistics this year. Dr. Dodson yesterday made a comment that some of his friends in Michigan couldn't afford not to put it on. When you buy a \$17,000 tractor, the ROPS costs another \$1,400 to \$2,000. If we think of the half-life of the tractor being about 13 years, this runs about \$100 to \$125 per year. We can talk about the roll over protection and the lives saved, however there are other plusses. Yesterday we heard about dust allergies, bee stings and we saw some slides on sunburn. Get this operator into a confinement area and you do away with some of these problems. There was an ad that came out about four or five years ago in one of the trade journals and the context was a letter from a woman. The comment was, "Thanks for letting my husband go back to work." This man had allergies or allergy problems for a number of years. They bought a tractor with an air-conditioner on it. The husband was able to go out and do a full day's work and get away from the dust.

This is the thing that we're seeing.

When I work with our farmers in Nebraska, I point out to them that they are working 500 to 800 hours per year on their tractor. They want to have the best in their car. They want to have air conditioning, radio,

stereo, etc. They want it to be nice when they travel. My gosh, they're spending just as much time on their equipment. In fact, as much time as many people spend in an office.

The office worker demands a good air-conditioning system so why shouldn't the farmer do the same thing? So it's been easy for me to sell.

Some people do not follow this sure thinking. I think this is where we get into problems of some people saying that the farmers will not accept this. They definitely do accept this.

Machinery guarding is another one where we can count the bodies. We can see the torn off arms, we can see the torn off legs. So the machinery guarding standard was not too hard to write. What we did was to lift out parts from the ASAE 318, the 354 and the 361 standards. One of these deals with safety of ag equipment. The other two - one deals with augers, this is the 361, and the other deals with shielding. So we tried to put these all together into a standard. We now have one.

There were four hearings on the standard proposal around the nation. It seems like this might go through. The OSHA people did put a retrofit proposal in which even I did not like because it was too monumental a problem, but this will be a good standard. It will get at a problem that we face. We've killed five people from open power drives this year in Nebraska. Other states have similar or worse problems. The idea here is to get the machine guarded before it is ever put on a line.

Livestock handling is another subcommittee that we had set up. We can look at the statistics and see that there aren't a lot of livestock injuries. We've got three fatalities this year in my state. An 11-year old boy, 10-year old boy and an 8-year old boy. They're all animal injuries - they all fell from a horse - two of them were drug when they were caught in a rope, the other one had the horse fall on him.

It's hard to write a standard for something like this. This was one where we did not come up with a standard proposal. Our proposal was that there was not to be a standard - that this be handled through education.

I had Mrs. Van Wert - a farmer from Hampton, Iowa, - chair the committee on airborne hazards. This was one that it was real hard to get a hold on. All of the things that you've seen in the last couple of days, starting with Dr. Kammermeyer's talk yesterday morning relate to the hazards. You saw Dr. Zuehlke's slides, you heard Dr. Diesch this morning make comments on the things we know as problems. Nevertheless this is one where we could not get a handle on it. We wrote to NIOSH and said, "Okay, what do you have to offer? Can you give us some good statistics?" Dr. Keyes came back and said, "No." So this committee is on hold. This is one area where no one wants to make a commitment. Dr. Quinby said that the medical people had not made a commitment on this. I wish they would because he also made the comment, "How can you expect a 15-person committee to write a standard when we cannot get a whole society to agree." We're running into this problem on airborne hazards. I, in my own mind, think of it as being a real problem, but we don't have the statistics to justify it.

A personal protective equipment proposal has been submitted. This dealt with everything but hearing protection because there is a special noise committee that was working on hearing protection.

We talked about education. There was a special subcommittee set up on education. This is a four-member committee headed by Dr. Erisman from Illinois State University, who is a safety educator. This committee came up with an 11-point proposal, and one of those proposals was that we have a full-time safety specialist in each state. Bob Gilden alluded to this this morning when he said that we have in for \$1,020,000 to get a full-time person in each state and if we do this will fulfill one of the requirements. Another requirement was that we have studies on a five-year basis in the states. We have this going. So we have a lot of things going already - now if OSHA comes and gives us some help this will be real fine.

Walk and working surface is another area that we looked at. This subcommittee just finished its work this last August 20. We we talk about walking and working surfaces this deals with farm equipment or farm buildings. If you look at a combine or a tractor there are some places that are walking and working surfaces. This is what this standard dealt with. If you look at the data coming into NIOSH you will note that machinery guarding and walking and working surfaces rank numbers 1 and 2 on the injuries. This is across the board.

We have another proposal that has been completed, this is on hand and portable power tools. Jim Wiles from Oregon headed the subcommittee and this problem area. A proposal has been submitted to OSHA.

The noise committee will start work sometime soon. There was a fifteen-person noise committee that worked on a standard. The standard was a whole lot rougher than what agriculture could put up with at this time. So agriculture and construction have been left out. This proposal will probably go for industry but for construction and agriculture it looks like we might have a shot at writing our own proposal. We have some data however when we try to go back and research this out it is lacking. Consequently, we have to do a little work of our own. I have a noise bulletin back by the door. This is some of the work that we're doing on tractors over at the Nebraska tractor testing lab. We've tested about 135 tractors over the last four years so we have the information on the noise level of these tractors. We'll have another 25 to add for 1974. We're getting a pretty good hold on some of the newer equipment. We need more information on some of the older equipment.

We have another subcommittee that's working on electrical problems. This is another tough one because through the National Fire Protection Association, ASAE, a number of other agencies, they have never been able to agree. Here we've got a committee with Bob Gilden asking four people to come up with a proposal that might be the rule that a whole nation would follow. And it's a rough one. This committee's really got something to grab onto.

Advancements have been made as a result of work and publicity on safety. We have seen a real interest in safety and I think it shows up at this meeting here. We have seen other things around the nation. The tractor and machinery safety programs are on the increase. We've seen some real good visuals appear just recently. Deere and Company came out with a manual just a few days ago that's a real fine one - a teaching manual. Other companies are doing likewise. We still have a lot of improvement on gathering data on health problems. The Michigan study that was completed recently is one of the good ones but you don't find too many of these.

We have been doing some work in Nebraska on lagoons and some of the gases given off by confinement houses. We did put in for a grant from NIH to do some of the work that Stan was talking about this morning on some of the gases released such as hydrogen sulfide, methane, etc. To my knowledge, we were turned down. The usual answer we get is that we'll have an industrial hygenist attack this problem. My only comment here is that whenever the industrial hygenists come to Nebraska to visit with me they come to find out the answers to these problems - they don't have the answers - they come to find out the answers and what I know about them. Some of this has to go right down to the level of the people that are doing the work. Nothing against the industrial hygenists because I've done a lot of work with them, but again, it's a kind of a different area to them.

I see Dr. Isacson moving over toward the light. I've got some slides that I'd like to show and give you some idea of how I work with the committee by giving them some background on how they would look at the problems. Slide 1 - We have investigated slightly over 200 tractor overturns in the state of Nebraska. This was the one where I say that we have the raw statistics to show that a fatality occurred. We had a 55-year old man killed when he ran this tractor down an incline equal to his years - a 55 foot incline. Slide 2 - Here was one that was hit by a farm truck - see the truck. Pete showed you a slide this morning of the combine that had been hit. Slide 3 - We lost a 42-year old man there. Slide 4 - We lost a 15-year

old boy here. This tractor overturned, caught on fire, pinned the 15-year old boy underneath, and if he wasn't killed from the overturn, the fire did get to him. Slide 5 - Killed a 14-year old here. A backward overturn very similar to the slide that Pete showed you this morning. Slide 6 - Killed a 24-year old man on this one here. Just graduated from ag college and went back home to take over the farm, rolled this tractor down an incline. The tractor never touched him but he did hit his head on a rock and was killed. Tremendous loss. A roll bar in all of these cases would have been the answer to saving the lives. Slide 7 - We run into another problem - here's a cab which we call a soft cab. Killed seven people with this type of overturn. This cab is not sold as a protective cab and we shouldn't think of this as being a protective cab, yet occasionally we'll see that there is an accident that occurred where a person is killed with a cab on the tractor. I go out and check them out and it has yet to be a ROPS cab. We are going 100% where we have the roll over protective structure on. Slide 8 - Here's one where a 29-year old man and his 26-year old wife were killed. Slide 9 - Here we get to the TOPS cab. This is a good one. We had a man come out of this accident with nothing more than a bruised elbow. Slide 10 - Here's one that was hit by a train. Somebody mentioned this morning about the people being in the enclosure and they have the hi-fi and the whole works they wouldn't do without it. Well, this one here turned right in front of a train. Some people wanted to blame the soundproof cab. They said he couldn't hear the train. He didn't look over his shoulder, that's the main cause in this accident. Slide 11 - Here's one where we had a 17-year old boy on a tractor and the boy was belted in and dropped the tractor on its side. He came out with nothing more than a few bruises. Slide 12 - A 20-foot drop, this tractor lit on its top. Man came out alive. Slide 13 - Here was one that ended up 31-foot away from the roadway. It was a 21-foot sheer drop. This man came out with two crushed vertebrae. Slide 14 - Here was one 25-foot down. Protective cab again. No injury. Slide 15 - Here was one 90 degree overturn - no injury. Slide 16 - A pickup hit this tractor head on and killed two boys in the pickup. One got out. The operator of this tractor did go

into shock because of the accident but you can see there is no damage. The tractor did not go over. Slide 17 - This is what happens when a tractor lays on you. This man had driven a tractor for 41 years. A young punk like me probably couldn't have told him a thing about driving a tractor. Some we get to and some we don't.

When we got to the machinery guarding I also try to point out that you cannot guard equipment to the point where you take away the ability of the equipment to do a job. Nevertheless, there are a lot of places you can guard. You can keep the person on the seat so they do not get down to the parts that catch onto clothing. Slide 18 - This is a backward tractor overturn. In medical terms I guess we'd say this is a pneumo-hemothorax. I don't have the x-ray along but this man did survive. Slide 19 - Here we have a baler. You can't protect for this one because this man got off and started kicking hay into the baler. Slide 20 - Here we have another baler accident. An 11-year old boy cut his dad out of the baler. Slide 21 - Here's one you can't protect for. Slide 22 - Here's one you can. This is an open power take-off. Slide 23 - Now that's one you can protect for. Slide 24 - Here's one you cannot protect for. This guy got his foot in an ensilage cutter. Slide 25 - No extra riders on tractors. This little girl fell off a tractor and was hit by a mower. Pete showed you a corn picker hand this morning and I'll show you another one. (Slide 26) Slide 27 - This one you can protect for - open power take-off again. Slide 28 - This one you can protect for - that's an auger. Pete showed you the auger this morning. This is an auger. You can protect for that. Slide 29 - Kicked in the head by a horse. You can't protect for that one. You can't write a standard for one like that.

Okay, if we could have the lights. This is some of the background that we gave the committee and said, "Okay, these are the things that are happening. Now, go at it." And so they went at it. At that point I'll stop.

## An Experiment in Rural Medical Care

Leona M. McGann, MSW, MPH  
Rodney R. Beard, M.D., MPH

Rural America continues to be faced with problems of poverty, communication, transportation, increasing mechanization and fewer jobs, and shortages of medical manpower and facilities. Quality emergency care is almost nonexistent. Chronic illness is prevalent, farm accidents and pesticide accidents numerous. Upper respiratory, gastrointestinal and dermatological symptoms are consistent patient complaints.

Models to meet the needs of the rural health population are frequently described in the literature. The American Medical Association issued pamphlets describing selected models in September 1969, revised in 1972.<sup>1</sup> The models range from descriptions of the Rural Health Associates in Maine, to the University of Florida's College of Medicine project in Mayo, to the Nurse Practitioner in Estancia, New Mexico, and to the Medex, medical corpsmen training and employment program in Washington.

This paper will describe models in California, a state with a wide range of settings. Free clinics and HMO-like developments dot California, but mostly in the urban areas. Other models exist in the mountain areas, such as Mariposa County, where ambulance drivers are trained and an ambulance kept in readiness for the winding trail to the nearest hospital, about 40 miles distant. More and more residents in that area are taking the first aid courses offered by the hospital. In addition, there is a rural health project associated with a medical group, the United Farm Workers Clinics, and a consumer-controlled, fee-for service solo practice in Livingston.

One model described in the AMA pamphlets mentioned above, and in other references, is the Rural Health Project, Inc., of King City in Southern

Monterey County. The Project's former director, Dr. Noel Guillozet<sup>2</sup>, describes it as a

"collaboration of private physicians, a community hospital and the Department of Health, Education and Welfare to provide care for the region's thousand lowest-income families of the community in a 'one door' fashion in the group practice clinic and hospital used by the entire community .... A blend of patients including the low-income, often Spanish-speaking migrant farm laborers who once traveled 25 to 85 miles north to the county hospital, suffering lost wages and enduring long waits, to receive care for themselves and their children, who are fully able to pay. In addition to the medical services provided by the physicians and hospitals, the project provides dental services, transports patients from all sections of the project area when personal transportation is not available, and provides out-reach community health services through community health aide and public health nurses".

Most importantly, families are encouraged to come in for an assessment of their health, which includes physical, and personal or psychological, environmental, socio-economic aspects of their situations.

California is the home of the United Farmworkers' Clinics, located in Calexico, Delano, Salinas and Sanger. All are staffed by a full-time physician; they supplement their physician manpower through volunteer physicians from the community and university centers. Nurses, clinic-trained laboratory, x-ray and outreach, Spanish-speaking family health workers, characterize the staff. All staff, whether fully employed at minimum wages, or volunteers, are very dedicated, working long, hard hours. Clinic hours frequently run past midnight, and span the weekend. The staff are often found fighting restrictive policies of local community hospitals, inadequate housing, and appearing before legislative committees studying the use of pesticides, or farm labor problems. More health care volunteers are always needed to serve the large farmworker population. The farmworkers are served by these clinics at a minimal fee. Farmworkers employed by the United Farm Workers Organization contracts are covered by the Robert F. Kennedy Health Insurance Plan.

Another development is the Livingston Community Health Services (LCHS), distinguished by its grassroots control. The early experiences of LCHS have been reported.<sup>3, 4</sup>

The Central Valley in California is surrounded on the one side by the Sierra Nevada Mountains and the other side by the Coastal Range. During the spring it is dotted with green foliage and colorful blossoms, mostly of almonds and peaches, or the endless stretching of green grape vines. Later the fields are dotted with watermelon and sweet potato plants. Irrigation canals bring water to the originally hot, arid land. Livingston nestles in the center of the Central Valley, and its land area is bisected by Highway 99, an artery of migrant labor, running north and south. In addition to its fruit and vegetable production there is also a large chicken processing plant, now employing about 1,000 people.

Despite mild winters, excellent roads, ready access to the Bay Area, mountain recreational spots, and adequate hospitals, the area has few doctors, 66 per 100,000 in Merced County.

About three thousand people live in Livingston, and another nine thousand within the Livingston High School District area, at that time defined as the LCHS area. The ranks are swelled each summer by the arrival of about three thousand migrants. The predominant ethnic population of the community is Anglos, sixty percent of the resident population; 20 percent is Mexican-American. Other ethnic groups include Japanese-Americans, a Portuguese group, farmers of Filipino and Armenian descent, and a sprinkling of others. In 1970, at the time of a community-wide survey, over one-fourth of the families in the area had incomes under \$4,000 and one-half were less than \$5,000.

In 1969, the Livingston Community Action Council, reflecting concern for the migrants, initiated contact with Stanford medical students. Led by Wells Schumaker, a second year medical student, and with the help of some Stanford faculty, a free clinic for the migrants was developed. Dr. J.J. Wolohan, the town's only practicing physician, offered not only his

enthusiastic cooperation, but space in his building, rent free. The success of the clinic, caring for one thousand patients, brought a good relationship between the community and Stanford University School of Medicine.

However, after 22 years of general practice Dr. Jerry Wolohan, exhausted, unable to recruit a partner or a replacement, announced that in the summer of 1969 he was going to a psychiatric residency, and hoped Stanford's assistance might be enlisted to secure ongoing medical care for the community. His announcement coincided with the arrival of Dr. Count Gibson, Jr., as Chairman of the Department of Community and Preventive Medicine (now Family, Community and Preventive Medicine). Dr. Gibson had developed the first OEO-funded neighborhood health center, Columbia Point, in Boston, and was closely associated with the Mound Bayou Health Center in the Mississippi Delta area. A link with Stanford was supported by Dr. Gibson and an ad hoc committee of the community was formed. This committee set up four basic principles for the health program development:

1. The Center should be community controlled and responsive to the needs of the population. This allows the people of the area to decide what services, programs, it wants and can afford.
2. The Center should be self-supporting. This establishes the intention to avoid dependence on direct government aid, such as OEO centers receive, because of the uncertainty of continued funding and the loss of community responsibility.
3. The Center should serve a geographically defined population. This principle was to avoid overloading the Center and to insure that the people who control the Center will be served by it. The boundary was established as the Livingston High School District, with the addition of an area to the west to encompass the farms of E. & J. Gallo.

4. The Center should be operated to serve the entire community. This reflects the community's desire to avoid the traditional pattern of one quality of care for the rich, another for the poor. Through innovative use of health professionals, administrative techniques and operating efficiencies, it is felt that quality can be brought within the reach of all citizens.

An historic community-wide town hall meeting was held in the fall of 1969. Relationship with Stanford was discussed, particularly the services to be offered by medical students. Concerns of the community members about quality and costs were aired openly. The Merced County Health Department and the Merced County Medical Society reported favorably on the development. The meeting concluded with an overwhelming vote of confidence by the community, urging full speed ahead.

The ad hoc committee was replaced by a Board of Directors, which has responsibility for the operation of Livingston Community Health Services. The original Board comprised a group of residents in the Livingston High School District, appointed or elected by community organizations representing civic, religious, public service, unions, and ethnically-related groups, as well as members-at-large representing the various committees.

Since June 1970, the Board of Directors has met each month. The major task of controlling the operation of the Center and making recommendations to the Board is handled by committees. On the 3rd of August 1970, the Policy Board was legally incorporated. By then the following principles were delineated:

- (a) The Community should be provided with full information about the Center's policies and programs. All aspects of the operation should be continually reviewed and evaluated.
- (b) Comprehensive services should be the goal. This means that social services, dental services, health education, preventive medicine, transportation, etc., should be added to a full complement of the more traditional medical services as quickly as possible.

- (c) The clinic will operate on a fee-for-service basis for an interim period until data can be generated to plan a pre-paid/capitation system.
- (d) All doctors and staff members are to be salaried.
- (e) Care is to be centered around the family unit.

Medical student, intern and resident participation had always been accepted as a major principle of the program.

In July 1970, Stanford medical and nursing students and faculty members began seeing patients in order to help get the Center started.

To help the health services program, Area III, California Regional Medical Program, gave an initial fund of \$25,000. The LCHS Board set out to raise a like sum toward the purchase of Dr. Wolohan's office and equipment. Pancake breakfasts, Christmas tree sales, benefits by service clubs and assistance from the Livingston Chronicle and other business activities raised the necessary money.

Dr. Everett Johnson, an internist in private practice from a nearby town, assumed the position of executive director on September 1, 1970. For three years Dr. Johnson provided care, with considerable help from a National Health Service Corps physician, sundry residents, interns and medical students, plus special consultants in other medical specialties from Stanford and nearby towns.

Other staff in the Center initially included a registered nurse, a licensed vocational nurse, a licensed medical technologist, a business staff of three, and an administrator, paid partially by the research grant; later, aides, business and clerical staff were added to a total of 14.5 members.

From the beginning (June 1970) the service committee has emphasized not only curative aspects of medical care, but the broader aspects of health care promotion and education and assessment, specifying instruction in natural childbirth, nutrition classes, prevention of industrial accidents,

instruction in first aid, education in handling toxic sprays, etc. with a goal of "optimum health for the Community".

Dr. Johnson, the first Clinic director, was succeeded in September 1973 by Dr. James Raveret, a physician who selected Livingston as a place to practice under a two-year National Health Corps contract; the previous National Health Corps physician had left that summer. Dr. Raveret<sup>5</sup> believes that "if we are to have preventive medicine and health maintenance, we have to educate the public along these lines and also develop some sort of national health insurance which includes both these aspects of medicine". While recruiting for a family-practice-oriented physician, he has revamped the medical record system to a problem-oriented approach, has developed a nucleus of staff composed of a registered nurse, (released part-time for a nurse practitioner educational program), business manager, a combined X-ray and lab technician, and receptionist, implemented a simplified billing system, and rearranged the clinic hours to approximately 11:00 a.m. to 5:00 p.m. daily, leaving him time for community health education sessions, regular visits to the nursing homes and an occasional home visit. Emergency calls are referred to the local hospital with emergency room coverage, 8 to 15 miles distant. Patients in need of hospitalization are also referred to other physicians. Administrative tasks, including developing material for the Board, writing grant proposals, etc., continue to occupy a large percentage of the physician's time, but he visualizes this as decreasing, being replaced by community educational endeavors, some perhaps sponsored by the local junior or State colleges.

Thirty hours are spent weekly in practice, seeing approximately 30 to 45 patients daily. When medical students see patients, the patient is also seen by Dr. Raveret. The Center is reimbursed for some of its contribution to teaching by Stanford University School of Medicine through a public health grant.

Five years have elapsed. Have the objectives been achieved or reordered? What is the future of similar models? Is it consumer controlled?

The Board, composed of people from many ethnic backgrounds and economic levels, originally unsophisticated in health and business areas, has become quite knowledgeable through experience, coupled with serious study. No longer will they automatically accept recommendations from outside organizations, including the University, without a full grasp of the situation.

The Board chairmanship has been held by an Anglo insurance executive, a Japanese-American rancher and fruit grower, a Portuguese-American sweet potato farmer, and presently by a Black post office employee. Many of the Board members, active initially, remain as board members, although new members have replaced those who have resigned and others were added as the geographical bounds have been expanded, providing new ideas and dimensions. However, the Board has yet to find the way of shifting membership and power to a broader base. Unlike many of the government sponsored centers with large grants, there has not been an employed organization to design and conduct Board orientation. Presently they have developed confidence in their new National Health Service Corps physician, James Raveret, who has openly presented them with alternatives and information on which to base decisions. They exercise their power when they voted recently not to accept a badly needed physician candidate who was unwilling to accept the position unless he assumed control, not the Board. The authors believe that the future of endeavors rest in consumer control, with a broader base of representation, and knowledge about fiscal matters and health programs. Further economic and other incentives must be shared in a planned way among the entire staff, as well as by the physician and by the consumers.

To secure true consumer representation and its continual involvement in health matters is a problem faced by groups nationwide. Perhaps when LCHS finds out how to develop a broader involvement, including the Chicano community, to orient new members and assume more policy power, it will be an even greater example of consumer control.

Is it self-supporting and serving a defined area?

Perhaps this is the goal that initially was the most difficult to achieve. Only within the past few months has income exceeded expenses. Three administrators and a nearly complete change of staff, except for the business manager, and an expensive external billing system operated by a subcontractor, which were necessary to secure important research data, put heavy strains on the staff organization. In addition, at the outset the recruitment of a well-established private practice physician meant approximately three to four times the present National Health Corps physician's salary. Further, 72% of the patients in the original service area were receiving their medical care elsewhere, so it was imperative that the service area be enlarged. It now includes about 18,000 in contrast to the original 12,000 population. With a smaller staff, increased efficiency, and an enlarged service area, a greater number of patients are being seen. Since July of 1974, the Center has been operating in the black.

Is it serving the entire community?

All are welcome as patients. The free-service-advocates and their efforts to achieve a greater voice are documented in the first-year Board meeting minutes. These community advocates of free care were instrumental in establishing a county-wide government-supported free migrant clinic in Merced, fifteen miles away. Most farm workers seek care there.

The need for an outreach service was recognized early in the Center's beginning. The focus was on minority groups, especially those with language difficulties, and the elderly. Under an Operation Mainstream Progra, aides were hired and trained. Spanish-speaking residents were utilized. Though the importance of this program is recognized by the Board and staff, and its possible dissolution considered most regrettable, it must be considered unavoidable unless the program can obtain a subsidy.

Arrangements are made for different forms of patient payments; reduced payments and long-term arrangements are possible. A subsidy is needed to provide extensive free care.

Is it comprehensive?

Until additional manpower can be secured (physicians and/or physicians assistants and nurse practitioners), a referral mechanism is used to provide a full range of services. Social services which were initially provided by the Welfare Department have now been taken over by a County Mental Health social worker. A school health program is being developed. Examinations are provided for health children between the ages of  $2\frac{1}{2}$  and 18 years of age, as well as to children participating in competitive sports. The medical director serves as a consultant in screening programs, such as the Elementary School Kidney Disease Screening Progra. In industry, a severe tendonitis problem at the chicken processing plant was studied by Stanford physical therapy consultants, resulting in practice changes which are minimizing or preventing a recurrence of this condition. Staff from the plant are being taught first aid.

Is the community provided full information about the Center's policies and programs? Are all aspects of the program reviewed and evaluated continually?

Except for the personnel committee's activities the Board minutes have been distributed to all Board members. It is not known how much reporting back to the representatives' constituency take place. To date suggestions that the committee minutes be translated to Spanish and Portuguese have not been implemented.

Subcommittee work the first year alone included 42 community residents, not including all those involved in fund raising. The Pulse, a bi-lingual newsletter which discussed health care, clinic organization and problems, was distributed monthly to service organizations and patients. While Board meetings are open and announcements are published, there has been little outside local attendance. However, many nationally known health care personnel have had the pleasure of seeing the local board in action and films including information about Livingston have been shown as far away as New Zealand.

A relatively active family planning committee has met regularly with the Center personnel and disseminated relevant multi-lingual literature throughout the community.

Health-related articles have also been occasionally submitted to the local paper.

**Student participation:** A Directory of Community Resources was developed by a second-year Stanford medical student for both staff and patients.

Medical students from Stanford, as well as various eastern medical schools, plus other nursing and undergraduate students from Stanford and the University of Santa Cruz, and pharmacy students from the University of Pacific, have taken clerkships or other experiences at LCHS, not only learning about health care and providing patient services and participating in Board and Committee activities, but sharing in the community life, participating in high school educational programs. One medical student developed a proposal for an industrial medicine program for the local processing plant; other students in medicine and administration have undertaken fiscal projects, such as an analysis of the potentials of the Center's program to support a prepaid plan.

Livingston Community Health Services has demonstrated that consumers can continue to be a viable part of a comprehensive program and that a workable partnership between the consumers and salaried providers can be a reality. Dr. Raveret agreed that he would remain beyond his contract time, and we can expect this partnership relationship to be strengthened. Patients are receiving needed health services and the community is aware that future emphasis will be on health promotion, education, prevention and maintenance. Many students, medical, nursing, pharmacy, and most recently a graduate social work student, have all felt its influence. The program has demonstrated that it can now be self-supporting. However, subsidies or a national health insurance may, again, make possible services available for future community-centered operations.

## References

1. Bible, Bond L., Health Care Delivery in Rural Areas, Department of Rural Health, American Medical Association, September 1969, revised September 1970 and July 1972.
2. Guillozet, Noel, M.D., "Rural Medicine, Making it Now, and the Problems Ahead," California Medicine, 118:4, April 1973, pp. 91-93.
3. A California Town Started a Health Center, Stanford M.D., Stanford Medical Alumni Association, Vol. 10, No. 2, Spring 1971.
4. Wolohan, J.J., M.D., "My Town Replaced Me With An Experiment" Medical Economics, January 7, 1974.

## Discussion

Peter Isacson, M.D., Moderator

Rodney Beard

I judge from what Miss McGann told us and other reports that we have heard that organized medical care programs for rural communities all are dependent on subsidy of some sort. In the case of Livingston, they are in the black now. But this is largely because of the fact that they have a National Health Service Corps doctor who doesn't get paid very much. If they had to meet going rates for physician prices, they would not be in the black. This suggests that there must be something basically wrong about the system if we can't find the money to provide medical care for agricultural workers. As long as this situation persists I think we are going to see limited, inadequate, unsatisfactory medical care programs. I am particularly grateful to Dr. Isacson for having made an extremely important point which is very often overlooked. This is that health care is not merely medical care. Unfortunately most of the people who are influencing the development of national medical care insurance, which is referred to and which should truly be, National Health Insurance seem to be unaware of the fact that medical services are not the whole of health care.

I should like to suggest as a question for some discussion, is whether the development of a national health insurance program may not further weaken rural medical care. My thought is that the available medical manpower will be siphoned off even further from the rural areas to the city areas as more people in the cities have access to funds to pay for medical care. There is no getting away from the fact that most doctors would rather live in cities than live out in the country. I think one of the reasons they have such a hard time getting doctors in Merced County, California, despite all the virtues of that lovely place, is that doctors there have to work too hard. You have to have a certain critical mass of medical manpower in any community, otherwise the new man who comes in immediately finds himself swamped with demands for medical services that will take 60, 70, 80 hours a week of his time. And if he is a conscientious

doctor, he can't fail to respond to that. After a few months of that, or a couple of years, even though he is getting very rich in the process, he will decide that he will go someplace where the traffic isn't quite so heavy.

Miss L.M. McGann

I think that the national health insurance will facilitate more care in the rural area. We spent some time at this conference talking about the migrants. The only feasible program that I have ever heard described that would be a workable one for them was one where they were given a card at their base, their home base, which is frequently southern California, South Texas, or Florida, and they could use that card like we use a health insurance card along the stream. This does mean that there must be units along the stream willing to accept it. I think it may be more feasible if we do have a national health insurance program. I think that we are seeing at Stanford in the last 5 years, more of our graduating students going into the rural areas and to the surprise of our faculty at our medical school, about 20% of our graduating students have expressed interest in family practice and have sought family practice residencies, even though we do not have one at Stanford.

Unidentified Speaker

What is the training of physician's assistants and what are their qualifications?

Dr. Peter Isacson

There are several types of programs and categories of PAs. But, in general, these are often, especially initially, taken from people such as ex-corpsmen from the military who had already had some background in health. Here at Iowa they are given a very compressed medical course, very severe, and difficult. They are given clinical training, they are given some degree of basic science. It is a shorter course without the depth. They are qualified. The arguments on physician's assistants is to what degree they can function

independently. And many states, such as Iowa, have legislation that affects this. There is considerable difference among physicians on whether they can delegate to the PA or whether he must simply be at their shoulder all the time. In general they are qualified to take physicals, do histories, give elementary medication. Many can do minor surgery. The extent of things they can do really depends on the feelings of the physician who is working with them.

Dr. Clyde Berry

Thank you, Dr. Isacson. In closing, Dr. Selikoff has been replaced by Dr. Harry Heiman, Executive Secretary, speaking for SOEH. Keith Long is going to speak for Iowa and the Institute of Agricultural Medicine.

## Closing

Harry Heimann, Ph.D.

I think this has been a good conference. I have enjoyed it. I took lots of notes and I shall now summarize them. But, first, I would like to express the gratitude of the Society for your coming to this conference and helping to make it successful.

The sponsoring agencies for the Conference included the National Institute for Occupational Safety and Health who supplied us with some funds to help defray expenses. In addition to NIOSH, the Institute of Agricultural Medicine of the College of Medicine of the University of Iowa helped us materially by providing all kinds of things to make the conference possible. The Iowa Department of Health, the Iowa Department of Environmental Quality, the State Hygienic Laboratories of Iowa, the American Public Health Association, the Environmental Protection Agency, as well as the U.S. Department of Agriculture all agreed to be sponsors of this meeting.

Now about what happened here, I would like to refer to the material that I wrote on the blackboard:

1. Special health and safety hazards of agriculture
  - A. Those arising from living in rural areas.
  - B. Those arising from agriculture work.
2. Health and safety hazards in agricultural work
  - A. From vegetation per se.
    - I. Toxic products (e.g. rhus toxicodendron).
    - II. Pollen (and other aerosols, as fiber dust).
    - III. Soil dust.
    - IV. Crop storage.
      - a. Production of noxious gases (e.g. nitrogen oxides).
      - b. Growth of microorganisms (e.g. yeasts and molds).
      - c. Toxic products of microorganisms (e.g. aflotoxins).
      - d. Rodent-borne diseases (e.g. leptospirosis).

- B. From animals (such as draft animals, cattle, pigs, sheep, goats, birds and rodents).
  - I. Infectious diseases.
  - II. Parasitic diseases.
  - III. Animal excreta as source.
    - a. Toxic gases (e.g. hydrogen, sulfide, ammonia).
    - b. Infectious microorganisms.
- C. Chemicals
  - I. Pesticides
    - a. Insecticides
    - b. Rodenticides (and other wild animal poisons).
  - II. Other chemicals (such as fertilizers, herbicides and soil sterilants).
- D. Accidents (trauma)
  - I. farm machines and vehicles.
  - II. Uneven terrain.
  - III. Barn hazards.
- 3. Medical care/health care/medical care delivery
  - A. Rural residents (isolation).
  - B. Migrant farm workers (poverty and isolation).

We first talked about rural life and farm work, distinguishing between the two. There apparently is a special hazard in just living in rural areas. Farm work, considered separately, has special hazards. Mr. Knapp told us the size of the problem. It is large, indeed.

The special hazards we discussed can be divided into those caused by vegetation and those caused by animals. Arising from vegetation are the poisons that are produced in the vegetation itself. An example is rhus toxicodendron, capable of producing poison ivy. Pollen, and other aerosols, as well as particulates, which come from vegetation and the storage of vegetation can be harmful. Storage of vegetation can lead to the production of nitrogen oxides, a severe poison when inhaled. Microorganisms often grow in such vegetation kept in storage. Many of these can indeed be troublesome to man.

The second group of hazards are the farm animals. From the animals the farmer is exposed to infectious diseases and the helminths. The excreta from the animals may induce infections and the gases arising from the excreta may make people ill.

The added chemicals that occur in agricultural work were discussed quite extensively. Amongst these are especially the insecticides. Other chemical substances as fertilizer, herbicides and others have to be considered separately.

In the fourth group, we have the accidents which occur to farm workers. This occurs from the special machines that are used by the farmers in field work. Other sources include the unevenness of the terrain, the ditches that abound and danger of driving farm vehicles on and off the highways.

Finally, in a fifth group I would consider the problem of health care and medical care delivery. This includes health needs for the migrant worker and all the others who are on the farm.

## Closing

Keith Long, Ph.D.

I would like to make a couple of comments on behalf of the Section of Environmental Health and the Institute of Agricultural Medicine of the Department of Preventive Medicine and Environmental Health. And I hope that in our role of developing, interpreting and transmitting knowledge for the benefit of mankind that this conference here and your coming to it has enlightened you to this point. There are a couple of comments, Dr. Heimann, that I would like to make relative to this. One is that there has certainly been a broad base of problems identified in this what is one of the first conferences I think nationally on the occupational health problems of agriculture. Secondly, I think it has been very clearly indicated that we know very little about many of these problems. The other point that I would make is that the traditional aspects of solving problems related to health apparently don't really work when it comes to agricultural problems. And it is very clearly indicated that we have got to get the expert to the problem rather than taking the problem to the expert like we have in the traditional sense. I hope when you leave here that you will take some of these to heart. I hope that the Society and Dr. Heimann will see fit to address itself specifically now to some of the issues raised. This has been a very general conference. The papers were held to 15 minutes or so and we just able to touch on the surface of many of these things. Hopefully in the future we'll see fit and perhaps we can have another one here at the University of Iowa. We have certainly been pleased to be your host, we hope you have had a good time here.



