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SESSION I

INDUSTRIAL HYGIENE—STATE AND NATIONAL PROGRAMS

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Chairman

T. L. HAZLETT, M.D.
Professor of Industrial Hygiene
University of Pittsburgh Medical School
Pittsburgh, Pennsylvania

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REMARKS BY THE CHAIRMAN

It is with a great deal of pride that we in Pennsylvania who have been most interested in healthful environment should have had a Division of Industrial Hygiene established in the Health Department of our State.

This division, under the guidance of its Director, Dr. Shilen, has pioneered in the field and its progress had been exceptional over the past years until it ranks second to none in the United States. This not only shows the interest of the several Secretaries of Health but also that of the entire State administration in safeguarding the health of our industrial workers and our communities as well.

No phase of preventive medicine has made such rapid progress in the past 20 years as that of industrial hygiene. In 1932 we became cognizant of the health dangers of breathing free silica and much has been done, as well as much knowledge gained, since that time. Many other substances have been found to have a definite health hazard. We had rested on our knowledge of acute poisonings but had given little thought to a small amount of known toxic material absorbed every day over a period of a year.

With new materials being used in industry and the home there is an ever widening field for research and clinical investigation.

Advances in graduate and undergraduate education have also been rapid in the past decade, and we must continue to give this phase our constant effort in stimulating our medical students. The responsibility rests largely with our physicians who must have the opportunity of having this field of endeavor charted for them.

The Functions of Our Industrial Hygiene Program

By JOSEPH SHILEN, M.D., *Director*
Bureau of Industrial Hygiene
Pennsylvania Department of Health

THE PENNSYLVANIA BUREAU OF INDUSTRIAL HYGIENE recognizes the fact that any health program must have the full cooperation of all concerned if it is to succeed.

A complete program for the improvement of public health must include proper consideration of the health of the industrial worker. This fact is emphasized by statistical evidence which shows that mortality rates for the ten leading causes of death are highest among adult groups.

In addition to conditions which influence the health of the general population, the health of many industrial workers is affected by factors which are closely or directly associated with their work or occupation. These occupational factors, unless controlled or removed, may have serious consequences. They affect the worker personally by resulting in partial or total disability and an impaired resistance to infections which may cause loss of time from work, and consequent loss of earning power.

Remarkable developments have taken place in industry recently, new machinery has been built with unprecedented speed, new processes are being constantly developed, and new substances are being placed on the market as soon as the demand is created. But these very industrial miracles are augmenting the health problems in industry. Perhaps we cannot work miracles for the mental and physical well-being of our workers, but we can and must do everything in our power to reduce or prevent illness and accidents in industry.

With the purpose of assisting industry in the proper control of hazards giving rise to occupational diseases, the Bureau of Industrial Hygiene was established in the Pennsylvania Department of Health in 1936. The administrative organization of the Bureau today consists of a central office and laboratory in Harrisburg, and six branch offices located conveniently to the larger industrial areas of the State, namely: Philadelphia, Pittsburgh, Altoona, Scranton, Erie, and Williamsport. A Division of Air Pollution Control was established within the Bureau in 1949.

With an ever increasing knowledge of methods for proper control of health hazards and with the health of the individual worker constantly in mind, the Bureau of Industrial Hygiene stands ready to aid industry in the control of occupational diseases. These services are provided by your Government, free of charge, to any industry, labor union, physician, nurse, or any resident of the State of Pennsylvania who may have problems in industrial hygiene to solve. In rendering

these services a report is always submitted to the person or agency requesting the services. The results of investigation and remedies recommended are kept confidential. A competent staff is ready at all times to give advice on medical, nursing, dental, engineering and chemical problems, involved with the prevention of illness in industry. Complete plant surveys involving recommendations with respect to such problems are provided by the Bureau.

INDUSTRIAL HYGIENE SERVICES PROVIDED BY THIS BUREAU

A. Medical, Nursing, and Dental Services
   1. Consultation on the diagnosis and prevention of occupational diseases.
   2. Assistance and advice in the organization and administration of adequate medical, nursing, and dental programs in industrial plants.
   3. Studies of occupational diseases and other conditions affecting the health of industrial groups.
   4. Mass X-ray service for industrial employees.

B. Engineering and Chemical services.
   1. Quantitative atmospheric determinations of dust, gases, volatile solvents, toxic metals, etc.
   2. Measurements and advice on air velocities, light, heat, humidity and ventilation.
   3. Advice on mechanical and engineering methods of controlling hazards.

Many of our health agencies are concerned first and foremost with the control of communicable diseases. The results of this emphasis are well borne out by the fact that the communicable diseases today account for only 3 per cent of the mortality in the Nation. However, it is time that health agencies began to shift some of their emphasis toward adult health problems, especially those which account for nearly 80 per cent of all the deaths. These are problems of adult life, such as heart disease, cancer, and others. In studies of absenteeism it has been demonstrated that about 90 per cent of workers' disability is non-occupational in origin. For every day lost due to industrial diseases and accidents, 15 are lost as a result of ordinary adult diseases. It would appear, therefore, that industrial hygiene offers a rare opportunity to do something about our adult health problem. That being the case, it becomes increasingly important to inaugurate a case-finding program in industry.

Industry presents easy access to large groups which simplifies a case-finding program for all conditions either occupational or non-occupational in origin. Here lies a wonderful opportunity for the practice of preventive medicine.

In any health program stress must be made on industrial health. The practice of industrial health or medicine must take into consideration:

(1) Case finding and prevention of occupational diseases and poisons.

(2) Case finding of non-occupational diseases, particularly that group known as degenerative diseases which have the highest death rate, such as diseases of the heart and blood vessels, cancer, respiratory, kidney, etc.

We must remember that more than 90 per cent of the industrial plants in this State employ 500 or less employees. Few of them employ a full-time industrial physician so that the industrial nurse is the only full-time health worker in many plants. She is the key person in the health program. No longer is her chief function that of giving first aid or performing other nursing duties under the direction of the physician. She must not only be the nurse working under the guidance of the industrial physician, but also counselor, health educator, and nutritionist. It is to her the worker is most likely to turn in time of trouble. The success of the entire program may depend on her ability to sell it not only to management but to the worker as well.

The workers who are employed in small plants are exposed to practically the same hazardous material as those in the larger plants and they are also subject to the same non-occupational diseases as the employees in a large plant. Therefore, the medical profession, the nurse, the employer, and the health department must do everything in their power to help inaugurate a health program in the plants which do not have one.

From such a program an industry may expect—

(1) Reduction of absenteeism from sickness and accidents.

(2) Increased production and greater efficiency of workers, from better placement and health.

(3) Reduction in insurance premium.

(4) Improved employee-management relationship.

This plan for small industries has proven sound where tried and it is hoped it will develop in such a manner that management will extend it as it proves its worth.

What is the experience of plants, which now have a medical service, with respect to absenteeism, labor, turn-over, compensation premiums, etc.?

The most practical answer to this question will be found in a pamphlet entitled "Industrial Health Practices" which cites the results of a 1940 survey by the National Association of Manufacturers. It represents the replies from 2,064 industrial establishments regarding their health practices, and it has this to say about the value of the health plant program: "Health programs have proved their worth to companies instituting them."

(1) All but five of a total of 1,625 respondents considered their programs as paying propositions.

(2) Over 90% of those replying, indicated reductions in

	Reduction
Accident frequency	44.9%
Occupational diseases	62.8
Labor turn-over	27.3
Absenteeism	29.7

Conclusion

In conclusion, the medical profession should assume the leadership, together with the Pennsylvania Department of Health through its Bureau of Industrial Hygiene, in giving assistance and advice in the organization of adequate medical programs in industrial plants which will lead to a reduction in lost man-hours.

Industry should cooperate with the medical profession and the Bureau of Industrial Hygiene and avail itself of any advice or assistance the medical profession or the Bureau of Industrial Hygiene may have to offer.

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Functions of an Industrial Hygiene Program at the National Level

By Henry N. Doyle, *Chief*, State Aid Branch
Division of Occupational Health
U. S. Public Health Service
Washington, D. C.

The great changes and progress made by American industry immediately before, during, and after World War II have emphasized the importance of manpower as a national resource and the necessity of protecting and improving the health of the worker. As a result, there is growing recognition among governmental, industrial, labor, and civic groups of the need for programs designed to protect and maintain the health of the Nation's labor force. In the Federal Government, the U. S. Public Health Service is the agency primarily responsible for the development of such programs, and I am happy to have this opportunity to speak to you briefly about its work in the occupational health field.

The concern of the U. S. Public Health Service with the control of occupational disease dates back to the turn of the century. It was not until 1914, however, that this activity became a distinct entity through the establishment of the Office of Industrial Hygiene and Sanitation in the Division of Scientific Research.

In its early years, the Office—which was later to become the Division of Industrial Hygiene and, more recently, the Division of Occupational Health—concentrated its efforts chiefly on a program of intensive research that was to set the pattern for studies the world

over. Between 1914 and 1936, there was undertaken a succession of surveys of the health hazards in the major industries, such as mercury poisoning in the manufacture of felt hats, anthraco-silicosis in the Pennsylvania coal mines, lead poisoning in pottery trades, silicosis and tuberculosis among metal miners.

The findings of many of these studies have been applied not only in the United States but also in various other countries. For example, the pioneer work of the Public Health Service in the field of occupational morbidity and mortality studies, and in the pneumoconioses, has provided the fundamental data which today are being used throughout the world.

In the period from 1936 to World War II, major emphasis was placed by the Service in aiding States to organize industrial hygiene departments, conduct field investigations, perform laboratory studies, and furnish cooperative services when and where required.

As a result of this organizational work, which was implemented by Federal grants under the Social Security Act, State and local industrial health units began to expand their industrial health programs. Today, there is an official occupational health unit in most of the States, in several large cities, and in the Territories of Hawaii and Puerto Rico.

The Nation's program of occupational health activity gained additional momentum during and following World War II. Emphasis on conservation and utilization of all available manpower, introduction of new substances and processes, and the numerous advances and technological changes in industry, all combined to focus attention on the importance of safeguarding the health of workers.

With this increasing awareness has come an expansion of the concept of occupational health. There has been a gradual drift toward considering the total health of the worker, not only diseases of occupational origin.

The broadened scope of industrial hygiene work is exemplified by the progression from early studies of health hazards resulting from exposures to various toxic materials to present and contemplated projects affecting the entire well-being of the worker. Today, the responsibility of the Division of Occupational Health is to deal with all problems affecting the health of workers, not only at their place of employment, but also at home and in the community.

This responsibility is met by studying occupational diseases, making recommendations for the adoption of hazard-free methods in industry, and the fostering of good general health among the labor force through: field investigations and demonstrations; laboratory tests and studies; technical and administrative consultations; information services; and cooperative relationships with other agencies or activities which are also concerned with or interested in occupational health.

Research and laboratory work is conducted at our laboratories in Cincinnati and Salt Lake City. The western station is necessary in order to provide service to the expanding industrial activities of

the West, which now contains approximately a fifth of the Nation's labor force. These two offices comprise the Division's Investigation Branch.

The other major operating branches of the Division are the Program Development Branch and the State Aid Branch, designed to provide greater emphasis to program development activities and Federal-State relations.

Through its technical and consultative work with State and local health agencies, the Division aids in establishing and strengthening State and local occupational health units. At the same time, it carries out its other major objectives—the promotion of the adoption of hazard-free methods in industry and assistance with various local problems involving workers' health.

The consultative work of the Division covers many specialized problems, ranging from surveys of radiological exposures in hospitals to studies of noise in industry. Recently, for example, assistance was provided to the State of Maryland in a study of air pollution in Cumberland, and to the State of Utah in a study of recurring smog conditions in Salt Lake City. In cooperation with appropriate State and local agencies, we also have frequently assisted in surveys leading to the determination of the extent of industrial health problems, as, for example, in Denver, Colorado, and St. Louis, Missouri.

The major investigative work of the Division is centered on problems of industry-wide or national importance. Last year, for example, a study was made of health hazards in the production of chromates, which, as you know, find their way into many defense uses. Suspecting a possible cancer hazard, the industry itself had requested the study. In addition to confirming the existence of an exceptionally high incidence of lung cancer among workers in the industry, the study revealed that a complex chromium compound which had not previously been investigated may be the causative agent.

A report has been prepared, presenting detailed recommendations to safeguard the health of the workers. These recommendations include better control of environmental conditions through application of proper engineering principles in dust control, through better housekeeping methods, and through establishment of routine air sampling by plant personnel. Careful regular medical examination and case follow-up were also recommended. The industry has already taken steps to decrease harmful exposures pointed up by the study.

Of particular significance, I believe, is a study of the uranium industry being carried on in the Colorado plateau by the Division. Under way since 1950, this study has been given impetus by the stepped-up production of uranium, which has accentuated the need to find and control all radiation and other hazards to the health of uranium miners and millers.

Work completed in the past year substantiates that miners are exposed to silica-containing dust, to dusts containing uranium and vanadium, and radiation. In view of the findings to date, industrial hygiene engineers will continue to concentrate on assisting the com-

panies in instituting a dust and radiation control program. To supplement on-the-spot consultation where dangerous hazards were encountered, an interim report, describing the progress of the study and presenting methods for correcting harmful conditions, was issued to the operators in June, 1952.

You may be interested in knowing that one of the most important procedures developed was a relatively simple method for collecting and measuring radon decay products, which present the most significant health hazard in the mines. This procedure enables the mine operators to conduct their own tests and check the effectiveness of control measures for themselves. Several of the larger operators have already obtained the necessary equipment and have been instructed in its use by Division staff members.

An area of study with great public health interest is that of air pollution. Evidences of health effects have taken the problem of air pollution out of the nuisance class and have aroused both the public and health authorities to a new realization of its potential danger. The Meuse Valley, Belgium, the Donora, Pennsylvania, and the Poza Rica, Mexico, episodes have proved conclusively that, under certain meteorological and topographical conditions, unusually heavy pollution of brief duration can cause acute attacks of illness, and death. Attention is now being focused on the chronic, or long-range, continuous exposures to small concentrations of air pollutants to determine their effects upon the health of man.

Some of these answers we hope to obtain from a study under way since 1950 in the Detroit, Michigan-Windsor, Ontario, area. This air pollution study was requested by the International Joint Commission, which considers boundary problems between the United States and its immediate neighbors. Both the Canadian and the United States Governments are participating. The American phase of the study is being conducted by the Division of Occupational Health of the Public Health Service, in cooperation with the local and State governments and other groups.

During the past year, thousands of samples of contaminants emitted from industrial, domestic, and transportation sources were collected by the mobile laboratory and at stationary sampling sites throughout the area. Various analyses were made of these samples to identify the contaminants. Considerable progress was also made in the development of stack sampling programs by industry. Plans were further developed for the biological aspects of the study, which represent the next phase.

Some of the requests that we have received for service have been of an urgent nature—industrial emergencies—as was the case when a radium capsule was ruptured in a Cincinnati plant last year, with resulting exposures of workers and contamination of the plant itself. Other problems, while perhaps not so dramatic, point to the gradual unfoldment of the occupational health program, and the need for service in relatively new areas. The field of mental health and human relations in industry is illustrative of this evolution.

In recent years, management and labor have come to realize that problems of interpersonal relations often result in emotional disturbances and other adjustment difficulties. Today, it is estimated that emotional problems, not all of which are due to difficulties in the plant, are responsible for 30 per cent of the sickness absenteeism in many industries.

At the last two annual meetings of the Advisory Committee to the Public Health Service on Occupational Health, recommendations were made that the Service develop practicable means of studying problems of human relations in industry. Following their Committee's advice, we are now preparing a report that will show the extent of present knowledge of the problem, how it is related to health, absenteeism, turn-over, and other factors, and what steps are being taken to cope with it. This information will serve as a baseline for further indicated studies and activities leading to the development of good practices in human relations in industry.

Impelled by another need, which is daily growing more manifest, the Public Health Service is making greater efforts to encourage the establishment of health services in industry. Our work with the Health Resources Advisory Committee to the Director of Defense Mobilization, has re-affirmed our belief that such services are necessary if industry is to reduce its absenteeism rate.

At present, it is estimated that sickness absenteeism in industry accounts for a loss each year of 500 million man-days, equivalent to two million men out of the labor force every day. It is also known that the establishment of in-plant health services can reduce absenteeism from one-third to as much as one-half. This has staggering implications in terms of our defense program—in the conservation and most effective use of our manpower and in the increase of our productivity.

The development of in-plant health programs poses a special problem to the small plants, in which over 70 per cent of the Nation's workers are employed. Handicapped by lack of personnel and funds, these plants cannot finance the full-time comprehensive health programs found in some of the larger industries. They require guidance in evaluating their needs, together with their plant and community facilities, and in evolving practical plans of operation. We have found that these plans may be different in each case, depending on local variables. For example, the answer may lie in polling the resources of neighboring plants or in collectively employing a physician and nurses to provide part-time services to the individual participating plants. In some situations, a more practical solution might be the establishment of an industrial clinic with qualified specialists to serve local industry. A pattern of feasible operation can be found for almost every situation. Your State industrial health division, and through it, the Public Health Service, can help small plants draw up suitable blueprints for in-plant health programs.

Related to the problem of establishing in-plant health services is the question of the amount of nursing service needed in industry. Since the industrial nurse is a pivotal figure in any industrial health or medical program, such knowledge is essential to effective planning.

Information of this type is particularly important in the light of our accelerated defense program. To obtain the necessary data, our Division undertook a study of the expenditure of nursing time in several selected industries. The report has already been issued.

The activities that I have briefly outlined for you illustrate the scope of the services extended by the Public Health Service. Through your State industrial hygiene agency, our staff—physicians, dermatologists, nurses, engineers, toxicologists, statisticians, and other specialists—are working to help you conquer not only silicosis, lead poisoning, and other traditional occupational health hazards but also the more subtle influences in the working environment. As another example, we are increasingly concerning ourselves with the effects of excessive noise and heat, improper illumination, and other physical factors. We are working toward positive, not negative, ends—that a worker may enjoy a sense of complete well-being, not just freedom from disease. I do not mean to detract, however, from the severity of the hazards that still continue to threaten the health of the worker. So long as a changing technology continues to introduce new substances and processes, that danger will remain with us, and we will have to tackle and control each hazard separately. I do want to say, though, that we now are also moving in the fringe areas, which are also important to the worker's well-being and in order to increase productivity. Finally, through the study of problems of human relations in industry and the promotion of in-plant health services, we are attempting to attack all influences on the health of the worker—nonoccupational as well as occupational. Through this combined approach, we hope to achieve more fully our objective of helping to protect and improve the health of the American Worker.

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Industrial Hygiene Engineering

(Abstract)

By T. F. HATCH, *Professor*
Graduate School of Public Health
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MODERN INDUSTRY operates largely on a system of precise controls and mechanized operations. The shift from individual craftsmanship and other changes to impersonal operation has contributed to the complexity of human problems now confronting industry. The basis for understanding and for dealing with these problems is not as well-grounded in facts and fundamental principles as are the technical aspects of modern industry.

Just as science made present-day industry possible, it must help to solve the human problems that have come in the wake of industrial progress. To do this, it must bring to bear upon these problems the

same kind of approach; by reducing the human problems to the terms of underlying laws and through the development of techniques for dissecting and measuring the separate parts, it can contribute in the same basic way to the needed changes and corrections. The prospects for establishing a scientific approach to the human aspects of industrial management is probably no more discouraging than were those of a half-century ago for finding a substitute in science for the empirical operations of industry then in common use.

Industrial hygiene is a branch of scientific management, concerned with the health and well-being of the worker. It gives primary consideration to etiology of industrial health problems. Progress has been made by subjecting hazards to scientific analysis followed by application of logically suggested corrective measures. Full comprehension of causes has resulted from cooperative efforts of professional specialists from the medical and physical sciences.

It has been concerned chiefly with occupational diseases caused by exposure to specific physical or chemical agents released into the working environment as a direct consequence of industrial operations. The most subtle human problems in industry today, however, arise from psychological rather than physiological stress. For these, the possibilities of identifying the causative stress and establishing underlying relationships are not as evident as the physiological problems arising from clear-cut chemical or physical causes. Nonetheless, the principles of industrial hygiene are applicable and one may look forward to the full development of the field of activity now called human engineering, of which industrial hygiene is really a part. Important to this development is the clear distinction between the contributions of the physical environment to the etiology of problems in the psychological (behavior) field and the sources of stress which have their origin in man-man rather than man-environment relations. Those problems which do have a considerable basis in the physical environment are found to be susceptbile to the scientific approach which has proved effective in the control of occupational diseases. The concept of interdisciplinary teamwork and the demonstrated necessity for such joint study of human problems in industry as a basis for the discovery of useful laws governing man-environment relationships are important contributions of industrial hygiene to industrial science.

SESSION III

INDUSTRIAL HYGIENE IN ACTION

Chairman

JOHN G. CLELAND
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Pennsylvania Department of Health

Initiating the Action

By HAVEN L. WILLIAMS
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Pennsylvania Department of Health

THE SUBJECT ASSIGNED to me is "Initiating the Action." It is often the practice at meetings of this kind to place the less important subjects and speakers at the head of the list and get them out of the way, in order to conserve time for the more profound subjects which are to follow. I am not sure that the program committee had this in mind in my case, but I have my suspicions. However, in ruminating about this title, and casting about for some means of confusing the program committee, the thought came to me that initiating the action is the most important subject of all. In fact, to initiate and to act, compresses into one title the conception of considerable movement. The idea touches upon one of the common frailities of human nature. Men of otherwise outstanding ability have lived mediocre and unrewarded lives because they couldn't get started. Unless we get the action going there will be nothing for the gentlemen who follow me to talk about.

Seriously, lack of initiating the action, justly or unjustly, is the cause of more public castigation of federal, state, and local governmental employees, perhaps, than any other. There are very few days, indeed, in which we do not hear some individual complaint about the lack of action by various government agencies. Of course, we would except the Federal Bureau of Internal Revenue and the Pennsylvania State Police. They seem to encounter no difficulty in getting into action.

In case there are any people present who did not hear Dr. Shilen's discussion of the function of the Bureau of Industrial Hygiene, it may

be well to point out some of our general activities. The Bureau of Industrial Hygiene is charged with the evaulation and control of occupational disease hazards. These hazards consist of the various metallic and chemical substances encountered in industry, and which are of a toxic nature. In furthering the program of occupational disease control, the Bureau of Industrial Hygiene offers a number of services to the people of Pennsylvania. Included among these services is the advice to industry of physicians who are familiar with the problems of industrial medicine, the advice and aid of industrial nurses, the services of a dental consultant, the services of our portable X-ray unit, the Air Pollution Division, and last and I hope not least, the services of our staff of trained industrial hygienists.

It is the work of this last group that we are considering this morning. While it is true that the trained industrial hygienists might, in many instances, be able to decide concerning the seriousness of a health hazard by mere observation, usually an engineering study must be made in order to be certain. Making an engineering study involves the collection of samples of the work atmosphere and the analysis of these samples to determine the amount of the suspected toxic substance which may be present. These anaylses then must be interpreted and evaluated in order to determine the seriousness of the hazard.

Before any of these things can be done, however, the action must be initiated. There are many ways by which the Bureau of Industrial Hygiene is brought into contact with the various plant situations. Many of the studies made by this Bureau are requested. These requests may be grouped under five headings. These headings are: (1) plant management, which includes requests for our service from various plant departments and the plant physician; (2) requests from federal, state, and local government agencies; (3) requests from labor organizations; (4) requests from private physicians; and (5) those received from private individuals. A considerable percentage of all studies are self-initiated. That is, they were recommended by personnel of the Bureau. During the first six months of this year, 44% of the engineering studies made by this Bureau were self-initiated by Bureau personnel, 43% were requested by the plant management, and the remaining 13% were about equally divided among governmental agencies, union, and private citizens.

At this point it may be well to state that we receive many requests for action which do not fall within the province of the Bureau of Industrial Hygiene. At the district offices we receive daily requests to remove dead cats and dogs from alleys, prevent neighbors from making nuisances of themselves, and requests of a similar nature which we are not prepared to handle. Indeed, we receive so many peculiar requests by telephone that after a few years, I thought I had heard everything.

Several years ago, our district office received a telephone call and when I got on the 'phone, a feminine voice in some agitation immediately asked me if I had examined a Miss June Doe. This was not the name mentioned, but it will suffice. At first I thought that someone was kidding me, and I replied that I had not had the pleasure.

The excited feminine voice then seriously stated, "Well, this woman is running around with my husband and I feel that I have a right to know the results of the examination." At this point I realized that I was in something beyond the depth of the Bureau of Industrial Hygiene and I tried to explain to the lady that our work only concerned problems of occupational disease. Unperturbed, the feminine voice replied, "If she has what I think she does, its occupational all right." After explaining that we had neither the equipment, training, nor permission to undertake the type of procedure which she requested, I referred the lady to the office of the District Medical Director, and also to Dr. Everhart's division. As the lady would not divulge her own identity, and I neglected to record Miss June Doe's correct name, I could not determine the outcome of the situation. This is a case where no action was initiated. However, some of my colleagues have criticized me for not handling this situation in what they believed would have been a more satisfactory manner. These have been several negative examples of getting the Bureau of Industrial Hygiene into action and we will now consider the positive ones.

A letter was received by the district office from one of the Nation's leading producers of silica brick. This letter was signed by the Director of Employee Relations. The writer gave the locations of a number of the company's plants in Pennsylvania, and asked our help in reducing dust concentrations in these plants. The plants were visited by personnel of the Bureau and a preliminary examination was made at each location to determine the type of survey needed, the engineering equipment to be used, and the time required to do this work. Arrangements were made with the local plant managers so that the studies could be made during periods of normal plant activity. Surveys were made in these plants at the appropriate time, and the dust hazard was evaluated. In some of the plants, excessive concentrations of dust were encountered and recommendations were made for means of controlling the dust. The company received a detailed report covering this work, and has taken appropriate measures to comply with the recommendations.

Another company engaged in the manufacture of tile and allied products requested an evaluation of the dust condition in their plant. Accordingly, the plant was visited and the study was made in much the same manner as the one just related. It is noteworthy that dust concentrations in excess of 5 billion particles per cubic foot of air were encountered. I believe this is the highest dust concentration ever encountered by this Bureau. As the maximum allowable concentration for the type of dust found in this plant was 5 million particles per cubic foot of air, it can readily be seen that it was a good thing that this action was initiated. Since the time of the first survey in this tile plant, a series of five resurveys have been made. By following our recommendations, together with some major changes for which the plant management was responsible, dust concentrations today in all departments of the plant are less than the maximum allowable limit.

A few years ago, the plant physician of a large foundry wrote to the Department of Health in Harrisburg requesting a study be made of dust conditions in his plant. A copy of his letter was sent to the

district office, the plant was contacted, and the dust study was made. The examples cited above represent typical requests received from plant management.

Many requests have also been received from various governmental agencies. During the Second World War, the War Manpower Commission requested that inspections be made in a number of large foundries. At that time labor was in great demand, and certain types of industries were experiencing difficulty in securing workers. In this instance, men were reluctant to take employment in certain foundries due to the alleged dust hazard. In response to the request from the War Manpower Commission, personnel of this Bureau conducted studies in the plants which were indicated and material aid was given these companies in eliminating the dust hazard and in making the plants more desirable places in which to work.

The Atomic Energy Commission has been advising the Bureau of Industrial Hygiene of purchases of atomic material made by Pennsylvania firms. On one occasion, information was received that a capsule of cobalt 60 had been shipped to a well-known steel company. A routine check was made by personnel of the district in which the steel plant was located. While the capsule was stored in the proper type of lead container, it was being used in a plant location where numerous workmen had to pass in order to enter and leave the building. Accordingly, a study of stray radiation was made. It was found that the workmen were exposed to several times the maximum recommended dosage. As a result of this study, the plant erected the necessary barriers and eliminated this hazard to the workers.

Many requests for our services have been received from national labor organizations. One such request concerned a certain department of a large steel plant. The union contended that crane operators in this department experienced severe nausea, especially during the night shift. An investigation was made immediately and it was found that certain amounts of sulfur dioxide were produced by the furnaces. An engineering study was made which revealed that the concentration of sulfur dioxide was highest during the night shift. While the amount produced by the furnaces was very small, a sufficient concentration was built up during the day to have the undesirable effect on the crane operators which the union had stated. Recommendations were made for the installation of suitable roof ventilators, and the hazard was eliminated.

One of the national labor unions arranged with the U. S. Public Health Service to have an investigation of health hazards made in the Fiberglas industry. The U. S. Public Health Service contacted Dr. Shilen and personnel of this Bureau made inspections of the plants in question, together with physicians from the U. S. Public Health Service. As a result of these inspections, several engineering studies were made in plants involved.

Material cooperation in furthering our work is also received from the Pennsylvania Department of Labor and Industry. On numerous occasions, inspectors from the Department of Labor and Industry have asked us to investigate situations which they have encountered in their

inspection program. Among such instances, a representative of the Labor and Industry Department 'phoned our office and described a new type of welding operation which he had observed in a metal fabricating plant. He asked us to make an investigation to determine whether or not fumes of a toxic nature were being produced at this operation. We then visited the plant and made an engineering study of the questioned operation. Excessive amounts of carbon monoxide were being produced and recommendations were submitted which called for the installation of suitable exhaust ventilation.

Recently the health officer of one of the third class cities in our district was besieged by irate citizens concerning fumes emanating from one of the local factories. The health officer in turn requested our help in determining the validity of the complaints. Personnel of the Bureau of Industrial Hygiene then conducted a study inside the plant to determine the degree of hazard to the workers. Another study was also made by the Division of Air Pollution to evaluate any hazard to which inhabitants of the area might be exposed. While a small amount of toxic materials was found, the amounts were insufficient to be a hazard either to the workers inside the plant or to the residents in the vicinity.

One of the most important means by which the action is initiated is through plant visits made by personnel of the Bureau. During the course of an inspection tour through a plant, an industrial hygienist is often able to detect conditions which are hazardous or which are potentially hazardous. In many cases, the management is not aware of the seriousness of the situation. Many engineering studies are made by the Bureau which were initiated by the industrial hygienists by the manner indicated above.

Several years ago, an industrial hygienist observed a peculiar gadget located on the wall of a public garage. The garage owner stated that it was an ozone machine which discharged ozone through the shop where the mechanics were at work. This ozone was supposed to unite with carbon monoxide produced by the exhaust of gasoline motors. The garageman felt highly elated at finding such a convenient means of eliminating the carbon monoxide. The industrial hygienist was very skeptical of the beneficial results described by the garage owner. Accordingly, studies were made in all the public garages of several counties. It was found that the ozone had no effect on the carbon monoxide. In fact, concentrations of carbon monoxide were found to be as high when the ozone machines were in operation, as when they were turned off. Since ozone is one of the most highly toxic substances known, studies were also made to determine the amount of this substance present in the work atmosphere of the garages. In almost every instance, ozone concentrations were found to be two or three times the maximum allowable limit. Recommendations were made which provided for the installation of suitable exhaust ventilation.

These are some of the ways by which the action is initiated. The manner in which the engineering studies are made will be described by the speakers who follow on the program.

Conducting the Survey

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AT THIS TIME we shall consider as many of the details for the successful conduct of an industrial hygiene survey as time will allow. Naturally, it may be expected that an industrial hygiene survey becomes involved in many details that are peculiar to the industry; the process, the kind of materials handled, and sometimes its location or the community where the plant is situated. Nearly every industrial hygiene survey requires consideration to such involved details as those requiring one to deal with the certain group interests broadly consisting of (a) the industrial management, (b) the industrial employee often including his family also, and (c) the community itself consisting of the specific industrial establishment with all its surrounding homes and neighboring plants. This part of the conduct of the survey is in reality the humanitarian phase, very often overlooked or not considered at all by one inexperienced in survey work. This humanitarian phase of the survey is followed by the more generally understood scientific and engineering phase employing the various testing techniques of the chemist, the physicist, the engineer, the industrial toxicologist and the medical man, as these techniques may bear on the discovery of industrial or occupational disease, or the application and design of preventive health measures. During this scientific phase of the survey it is quite a common occurrence to accumulate a mass of technical data which must be evaluated and prepared in good literary form by the survey team. This preparation of a good, clear, concise, written report by the survey team could be considered as the educational phase of the survey; and credit likewise to the various discussions and conferences which usually are necessary when a survey is finally concluded. A survey cannot be considered finished until such time that the specific health hazard has been proved to have been adequately controlled, or eliminated.

The primary purpose for the conduct of an industrial hygiene survey is to evaluate correctly, and at large, the nature and degree of a health hazard which may be caused by the dispersion of a noxious solid, liquid, or gaseous substance into the breathing zone of an individual or its dispersion by handling in such manner that direct bodily contact with the deleterious substance becomes imminent. The most imminent exposures to hazardous substances must be considered and evaluated to find just who may be exposed to them. During the conduct of the survey it is generally found that (a) some or all of the industrial employees, (b) certain executive and administrative personnel, or (c) sometimes certain residents in the neighborhood may have some degree of hazardous exposure.

After having evaluated the existence of a health hazard and

established its degree by physical and chemical measurements, the industrial hygienist proceeds to correlate his results of the study for preparation of a written report. This report should explain not only the results of certain analysis but also should contain carefully considered recommendations for the correction of the health hazard. This written report, as prepared by the survey team, will become the official engineer's report of survey. It becomes the basis for future oral discussions and conferences with regard to health hazards in the plant. The recommendations made in this report, naturally, are carefully considered in each case by the company affected, to determine their cost and their practical value for the alleviation of the total elimination of those conditions of exposure deleterious to the health of the individual employee and also the general public health. It should be stressed that such a written report can only be possible if the survey in the field has been conducted in a mannerly and intelligent manner.

The industrial hygiene survey as it is ordinarily conducted requires an inspection and survey of many raw and partially-fabricated materials which enter into the manufacture of a product, and a careful examination and identification of all by-products to which one may be exposed. Having considered the materials to which one could be exposed, the survey must be conducted further to determine the particular way or method in use in which such materials and their by-products become a health menace. It can readily be seen from this reference that a survey deals just as much with the situations, the circumstances, and the duration of exposure to a possibly deleterious substance as it does with the chemistry of the substance or the engineering method of its use. Perhaps most surveys conducted face the prospect of ever-changing modes of manufacture, the possibility that a process may be radically changed, or a more modern method may be installed. Therefore, the survey must be conducted in a manner flexible enough to cope with this constant variation of object of exposure and situation of exposure. Quite obviously the industrial hygiene engineer is forced to learn continually more of the ever-changing methods of manufacture, and to apply new testing techniques and instruments for measurement of physical, chemical, and engineering qualities as they become available. Whenever possible, surveys are conducted in such manner that on-the-spot analyzing and recording types of instruments may be used. However, regardless of by what method the scientific data may be obtained, the survey team must be sufficiently adept and alert to interpret their data intelligently with respect to its relation to a health hazard, if it does exist.

Time is too limited to discuss full details for the conduct of industrial hygiene surveys in all of the industries. Each survey and each industry requires treatment fitting the particular circumstances. However, a few general considerations may clarify somewhat the procedure of a survey. Let us assume that a survey team has entered the gate of some industry for the purpose of conducting an industrial hygiene survey. At this moment we already have overstepped all of the miles of travel and possibly the hours spent in previous visitation for promotion of better industrial health; having now attained the stage

where the industrial hygiene survey may be exploited to show more fully to both labor and management what its specific occupational health problems may be. Upon passing that front gate of industry, it becomes necessary to contact a responsible plant official so that he may be fully instructed on the necessary requirements for the conduct of the survey. At this time a number of routine arrangements should be made, such as securing permission to enter general and restricted manufacturing areas. The survey team may be briefed on what operations run normal and what operations may be expected to close down shortly or become presently inoperative; also what operations may be resumed at a later date, or what new operations may be added in the near future. Perhaps it is the desire of a company official to introduce members of a survey team to certain responsible foremen or superintendents who may be contacted during the course of the survey. In some cases it is desirous to have a working arrangement with certain plant maintenance officials to secure, say, electrical services at hand to get at locations. By proper arrangements previously made, many operations otherwise overlooked may be efficiently tested because management is often quite willing to arrange their own production schedule to accommodate the schedule of the survey team. Special attention should be given to establishing liaison on a progressive working basis with the plant medical, engineering, planning, and research departments. These departments have much valuable information at their disposal which is of great advantage in anticipating what health hazards may exist at the time and also what hazards may eventually be eliminated or perhaps, unfortunately, new ones added. Generally, the medical and insurance records are particularly useful for evaluating past experiences regarding health, while the records of the engineering, research, and development groups may explain more fully those health hazards that may develop as the plant expands to manufacture additional items.

As the survey progresses further, many other details will present themselves, and the opportunity for solution should be carefully watched. Every operation in a plant must be given a preliminary visual inspection by an industrial hygienist to determine if a health hazard may exist, and, if found to do so, further sampling or testing is proper to establish the fact. All operations should be observed when running in a normal manner. Under such conditions it becomes pertinent that all raw and manufactured materials, as well as the by-products, be observed closely to determine what the chemical nature of the dust, fume, gas, or vapor may be. The presence and the effectiveness of control measures for the adequate removal of noxious substances must be carefully noted and measured.

Following this exhaustive inspection of all operations, special collecting and testing technique will be used to quantitate the health hazard, as well as to check the existing control measures for their efficiency. Dust collection and dust counts are in order if silicosis-producing materials, the causative agents of pneumoconiosis, are processed, as, for example, in a mine or processing plant, or where the same material may be freely used as in a foundry, or for abrasive cutting, grinding, and polishing operations. Dust counts may often be

necessary where a siliceous substance is compounded as part of a manufactured product such as brick, tile, glass, rubber, or as a fertilizer filler. In some cases a dust collection followed by a specific chemical analysis may be required, particularly if the dust may have certain toxic properties as, for example, lead dust in a storage battery plant or a paint pigment plant. A dust, fume, and gas collection and analysis may be necessary in the case of certain metal welding operations where the air becomes contaminated, not only by fumes from the welded metal, but also by substances from the coated welding rod or the welding flux. The hazardous situation in the welding environment must be further evaluated for the possibility of skin and eye "flash burns" from ultraviolet radiation, and common heat burns from white-hot metal.

Special sampling techniques and specific analytical chemical treatment is required in the conduct of a survey for each toxic metal such as arsenic, cadmium, mercury, manganese, lead, radium, zinc, etc. Likewise, the occupational disease from each of these requires a different treatment and, in like fashion, the conduct of the survey must be different to fit the peculiarities of the toxic substance. It is required that the survey team has full mastery of the chemical and engineering principles involved in each case.

The survey of an electroplating room may become involved in a special ventilation study of plating tanks and the possibility of their redesign for higher efficiency in removal of a health hazard. This same study may require the collection and analysis of atmospheric contaminants such as hydrochloric, sulphuric, and chromic acids, highly toxic cyanide salts and solutions, with the whole affair often further complicated by excessive drippage and spillage. Overflowing or leaking tanks containing a variety of chemicals, or sloppiness with plain rinse water, all add to the problem of making the plating area a more habitable place.

In many industries a solvents survey must be conducted. Many of the solvents in present-day use are highly toxic but non-inflammable, such as the chlorinated hydrocarbons so often used as dry cleaners in textile cleaning and textile manufacturing establishments. However, we find many of these dry cleaning solvents in use for their same efficient dry cleaning property in metal fabrication, as in metal degreasing tanks. Other solvents in common use may combine a double health hazard because they happen to be highly inflammable, explosive, and highly toxic. In such cases the survey is conducted to show, not only the presence in the atmosphere of a toxic substance, but also the imminent hazard of a disastrous fire or explosion. Neither can we rest in security if we find in a solvent survey that the solvent is non-toxic and non-inflammable, or non-explosive. Such solvents may be in use in situations where an employee may be readily asphyxiated by reason of the solvent displacing too much of the air in confined spaces which employees, nevertheless, may enter at times, such as tanks or poorly-ventilated basements. In a solvents survey particular attention must be paid to the mode of mechanical and manual handling, the use of the solvent in the process, the provision for adequate control

measures such as designed local exhaust ventilation, the storage and transfer of the solvent in tanks or pipelines especially designed to prevent leakage, spillage, and undue loss by evaporation.

In closing I would like to remind you that the need today is greater than ever for the conduct of industrial health surveys. Perhaps their actual number has decreased in some areas of the country. This decrease can only be deplorable, especially since the field is wider open than ever to work out new industrial hygiene routines in so many different operations that as yet have been touched only superficially. The acquisition of new occupational disease by our industrial worker will continue, but we may lack a medical and engineering method of control unless we continue to exploit all of the new operations and processes in use in present day industry.

Collecting and Analyzing the Sample

By LEWIN R. LUTZ
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IN ORDER TO MAKE a correct analysis, a proper, representative, and adequate sample of the material to be analyzed must be obtained. Very likely there are as many incorrect determinations resulting from improper sampling as from the combined errors of manipulation, measurement, and calculation. An improper sample makes a subsequent analysis practically worthless. No analysis can be better than the sample, nor can the chemist improve the quality of the sample. Sampling is as important in the field of the analytical chemist of industrial hazards as it is in other fields. This importance is never to be underestimated, for often comfort, illness, and even life itself depend upon an accurate estimation of the noxious components of a sample presumed to be accurately obtained.

There have been instances in which samples have been taken in such a manner as to produce questionable results. This necessitates a loss of time in repeating the collection of samples in the contaminated areas.

An example of this happened not too long ago when samples of chlorinated hydrocarbons were received in the laboratory for analysis. These samples had been collected in calibrated glass gas collecting flasks. The flasks were equipped with a stopcock at each end. The stopcocks are supposed to be lubricated with a grease consisting of a mixture of starch and glycerine. However, when the samples were received, there was no lubricant on the stopcocks and consequently some were set and when they were finally opened the samples were lost, while others had been jarred open in transit and the samples were also lost. The flasks that were intact and could be used were con-

taminated with dirt on the inside. The analyses on the remaining flasks were determined, however, and the results varied greatly. As the results were both erroneous and misleading, a note was forwarded to the sender and the entire group of flasks were put in first class condition. The samples which were retaken and analyzed indicated that the results were in line with expectations.

The engineers who collect the samples can assist the laboratory greatly in evaluating the toxic hazards present if the proper procedure is followed.

As time will not permit me to cover the entire list of toxic substances I shall mention some of those with which you come in contact and are therefore familiar with.

The first one to be mentioned is free silica or quartz. In collecting silica samples, care should be taken so that they are free from contamination and, at the same time, representative of the settled dust in the area in which the survey is being made. As we all know, the sand and dust found on the beams and window sills in the foundry, or on the working faces of the structures around quarries, or on the ledges around a brick company has been collecting for years, as have also the contaminants of every description. This is readily seen when the samples of settled dust are sieved in preparation for analysis. Because of this contaminating material, it is imperative that extra care should be taken in order to assure correct results. The really ideal method of collecting dust samples which are representative of conditions found in the contaminated area is with an apparatus equipped with either a compressed-air ejector or hand-size vacuum cleaner fan which will draw a sufficient volume of air, measured with a flowmeter, through the precipitating tube at about 50 liters per minute until a visible deposit of dust is obtained. This would keep the samples free from contaminating substances and also give a true picture of the actual conditions in any particular area.

Another toxic substance is lead. Among the more important lead compounds to which workers are exposed are lead fumes and dust. These are found in the general atmosphere of a plant manufacturing batteries. If the lead is in the form of the oxide, as is found in the general atmosphere around the mixing of the lead paste used on the battery plates or around the plate-breaking operation or in the stack gases of the lead-melting cupola, the samples should be collected with an all-glass impinger using nitric acid as the collecting solution, the concentration of the acid depending on the area in which the samples are being taken. If the lead is in the form of fumes, as found around the different lead-burning operations or where the lead is heated in lead pots, then the electrostatic precipitator, with properly-sized pieces of filter papers inserted into the precipitating tube, should be used. The collection of fumes on filter paper facilitates the analytical process as it can be placed in the nitric acid and heated. This insures the solution of the entire sample, whereas, if the lead fumes are collected on the bare precipitating tube, the deposit which collects there seems to have a greasy consistency and is difficult to remove with the acid aided by a rubber policeman. This operation, therefore,