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USE OF CHEMICAL VAPORS—PAGE 6 **NOVEMBER 1950**

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FEATURES

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VIRGINIA ASSEMBLY PASSES INDUSTRIAL HEALTH BILL

THE Virginia General Assembly passed a bill authorizing the Bureau of Industrial Hygiene to survey health hazards in industrial plants.

In the past, personnel of the Bureau have worked with industry only when requested. Most of the industries have welcomed the service, but a small fraction of plant operators have been hostile, refusing entry to the engineers to survey their plants. This situation precipitated the legislation, authorizing entry to industrial plants within the State and authorizing recommendations for the control of toxic exposures injurious to the worker.

The following act was passed by the assembly:

1. The State Health Commissioner or his duly authorized representative of the Bureau of Industrial Hygiene shall have the right of entry at reasonable hours into any industrial or commercial establishment where persons are employed, for the purpose of checking on occupational disease and to take such samples and tests as necessary to establish the degree of hazard existing.

2. The State Health Commissioner may recommend to the industry affected reasonable rules and regulations to control occupational disease as defined by 65–42 and 65–43 of the Code of 1950.

As Virginia becomes increasingly industrialized and as new chemicals are introduced into use, the need will grow for some check on health hazards to the workers. Most manufacturers and workers have been found not to know the actual hazards involved in the materials being handled, although many are quite toxic. It is believed that the studies made under the act will show a need for further legislation to require control of toxic materials.

All of the industrial states have industrial hygiene legislation, in most cases requiring the control of such materials as lead, mercury, and arsenic, carbon

(Continued on page 5)

COVER PICTURE.—Lead burning in a casting shop. An industrial hygiene engineer has set up equipment to test the breathing zone of the worker for toxic fumes. See article on p. 11. Photo by courtesy of TVA.

Field Headquarters of Industrial Hygiene Division, PHS, Holds Open House in Cincinnati

With an all day Open House attended by 170 visitors, the new field headquarters of the PHS Division of Industrial Hygiene in Cincinnati was introduced to industrial hygiene circles on September 14, 1950.

Looking forward to greater increased services by the division to the States, and management and labor, the field headquarters made the opening day into a full scale show of all its equipment and facilities, along with a number of special exhibits set up for the occasion.

The new headquarters occupy 30,000 square feet of space on the entire first floor of a building at 1014 Broadway in Cincinnati. The second floor is occupied by the environmental health center of the PHS, concerned largely with water pollution research problems and related subjects.

Allowing an expansion of all of the laboratory and engineering facilities that the division formerly housed in one of the buildings at the National Institutes of Health in Bethesda, the new station will also give the division room to bring together with the laboratory some of the work that had been done at the division's main office in downtown Washington.

All environmental investigations activities of the Division are now headed out of the Field Headquarters Station. These comprise, at present, laboratory activities including toxicological research, analytical work, and industrial bacteriological research, and the engineering functions of the Division including field investigations, ionizing radiations control and atmospheric pollution control.

The division will now be able to move much faster in several of its current efforts, including the study of health hazards to the uranium miners and mill operators now in progress in Utah, Colorado, New Mexico and Arizona, as well as the study of health hazards to workers in chromate manufacturing now in progress. The laboratory will also assist in the air pollution study of the Detroit-Windsor area being carried out by the International Joint Commission.

Assisting Dr. Lewis J. Cralley, chief of the new field headquarters, are Dr. L. T. Fairhall, head of the toxicology activities and C. D. Yaffe, as head of the engineering functions. The staff also includes chemists, bacteriologists, physicists and technicians.

All but one of the ten members of the advisory committee to the Public Health Service on industrial hygiene were present for the Open House, since the annual meeting of the committee was scheduled for the following day.

Members of the Advisory Committee are: Nelson H. Cruikshank, Andrew Fletcher, Theodore Hatch, Dr. R. H. Hutcheson, Margaret W. Lucal R. N., Dr. Leo Price, Harry C. Read, Paul Scharrenberg, Dr. Harold A. Vonachen, and Vincent P. Ahearn.

Also in attendance were national figures in the field of industrial health and hygiene representing the Federal, State, and local governments, and industry and labor.

Of interest to many of the visitors were the new exposure chambers set up in a special section of the laboratory adjacent to the animal room, equipment used for the detection of ionizing radiation, a new power unit developed for the electrostatic precipitator and the special instruments used for analytical work, the spectrograph as well as the techniques used in bacteriological research were also of unusual interest to guests. Many visitors inquired about the availability of the laboratory for services, and it was explained to them that the laboratory is a national one and will be available to do special tasks for State governments on request through the division headquarters in Washington, as in previous years.

Hosts at the Open House were, left to right, J. J. Bloomfield, assistant chief, PHS, Division of Industrial Hygiene; L. J. Cralley, chief of the field station; and Dr. J. G. Townsend, chief of the division.

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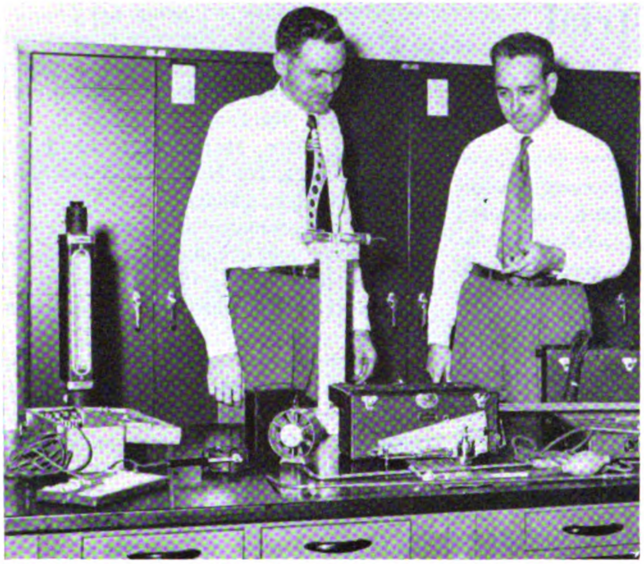


Top left

Mr. H. H. Jones and Mr. R. E. Bales, engineers with the Division of Industrial Hygiene, PHS, explain the uses for the equipment.

Top right

Miss Winifred Devlin, Mrs. Gladys Dundore, and Mrs. Margaret Lucal stop for a chat in their rounds at the Open House. Miss Devlin is nursing consultant for the Division of Industrial Hygiene, PHS; Mrs. Dundore is executive secretary of the American Association of Industrial Nurses; and Mrs. Lucal is a nurse member of the advisory committee.

Physicians Study Infections Among Laboratory Workers

THE first comprehensive survey to be made in this country of the incidence of infection among laboratory and research workers is now being conducted with the assistance of a $3,200 grant from the Division of Research Grants and Fellowships of the National Institutes of Health, Public Health Service.

Drs. S. E. Sulkin and R. M. Pike of Southwestern Medical College, University of Texas, who are conducting the survey, will send questionnaires to all governmental and private laboratories handling infectious agents. Some 15,000 questionnaires, requesting information on numbers and types of infections which have occurred in individual laboratories in the past 20 years, have been sent out.

The demands of modern medicine require increased numbers of laboratory technicians to handle potent disease-producing agents, both in diagnostic work and in research. As a result significant increases in laboratory infections have occurred, according to reports received by the Public Health Service.

Surg. Gen. Leonard A. Scheele says that the purpose of the tabulation is to determine how serious the problem is. "Just how many laboratory infections occur where scientists are dealing with diseases such as tuberculosis, tularemia, epidemic typhus, encephalitis, and Q fever is unknown. A channel for reporting such infections has never been set up."

The National Advisory Health Council, at its June 1950 meeting, unanimously recommended that such a survey be made, after studying a request from a private laboratory for funds to set up safeguards for workers on a PHS-financed project. The council felt that information on useful protective measures should be made available to all

A visitor at Open House looks at a magnified section of a silicotic lung.

Dr. J. G. Townsend, chief of the Division of Industrial Hygiene, PHS, and Brig. Gen. O. B. Schreuder, USAF (MC), discuss recent developments in the industrial hygiene field.

laboratories through a group study of the problem.

Drs. Sulkin and Pike will present results of their survey to the American Public Health Association at its annual meeting in St. Louis, October 30 to November 3. The A. P. H. A. has arranged a special symposium on protective measures against laboratory-acquired infections, and in addition to the report of the survey, will hear discussions of laboratory infections in tuberculosis, brucellosis, and tularemia, mycotic disease, viral and rickettsial diseases, and of general laboratory safeguards.

MASS. OCCUPATIONAL MEDICAL CLINIC REVIEWS WORK

The Occupational Medical Clinic, launched at the Massachusetts General Hospital under the direction of Dr. Harriet L. Hardy, has recently reported on its activities to date. Dr. Hardy is also consultant to the Massachusetts Division of Occupational Hygiene.

The clinic got under way in February 1949, when funds were obtained from the Research Grants Division of the National Institutes of Health, and the Massachusetts General Hospital. With the aim of availing itself of the facilities of a teaching and research hospital to study problems of etiology and pathogenesis in occupational diseases, the staff, augmented by the cooperation of the technical staff of the Massachusetts Division of Occupational Hygiene, attacked a variety of occupational disease suspects. During the first 6 months of operation, the cases under study were chiefly those believed to be caused by cyanide in the case-hardening industry, lead, dusts, tetryl, and thioglycolic acid (*1*). The work on tetryl and cyanide has been published (*2, 3*).

During the next fiscal year the clinic staff continued to study in consultation with other physicians and in the in-patient and out-patient facilities. A number of cases of beryllium disease were observed. Most of them were chronic cases in which the poisoning affected various body systems. Some of the workers had been employed formerly in the fluorescent lamp industry. Much work has been done in determining beryllium in urine and biological tissue by spectrographic methods; also, intensive research has been carried out to study what effect, if any, new drugs, such as ACTH, may have on these sufferers. Of late, attention has been focused on one patient who, although working, does show evidence of this disease contracted from exposure to small amounts of beryllium phosphors in neon sign manufacturing.

Lead is another hazard which has claimed the attention of this study group. Sodium citrate is undergoing trial as a form of treatment and a method of hastening lead excretion. A report of this work is in process of preparation at this writing (*4*). Through collaboration with the Massachusetts Division of Occupational Hygiene, visits to plants using lead are made, and air and urinary lead and urinary coproporphyrin analyses are performed as routine preventive measures.

In the field of pneumoconioses, five cases seen were caused by silica dust and two probably by talc, while two are of debatable origin. Dust counts and X-ray diffraction study are relied on in arriving at the diagnosis. Also, relationship has been established with the Department of Physiology of the Harvard School of Public Health for the purpose of performing pulmonary function tests. X-ray diffraction work is done at the Massachusetts Institute of Technology, and the Division of Occupational Hygiene engineers are often invited to help make plant visits and laboratory examinations.

In summary, 18 months of activity in the field of occupational medicine have been devoted to the development of skill in uncovering current problems of diagnosis in industrial toxicology. The experience and unusual facilities of a teaching and research hospital like the Massachusetts General, with the cooperation of the fact-finding technical staff of the Division of Occupational Hygiene, provide a unique set-up for the study of new and well-known occupational diseases.

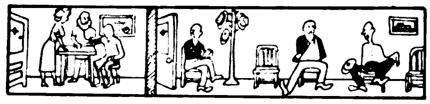
REFERENCES

(*1*) Various authors: Massachusetts provides extensive health service to workers. *Industrial Hygiene Newsletter* **10**: 3–6 (Feb.) 1950.

(*2*) Hardy, Harriet L., and Maloof, Clarence C.: Evidence of systemic effect of tetryl, with summary of available literature. *Arch. Indust. Hyg. & Occup. Med.* **1**: 545–555 (May) 1950.

(*3*) Hardy, Harriet L., Jeffries, W. M., Wasserman, M. M., and Waddell, W. R.: Thiocyanate effect following industrial cyanide exposure. *New England J. Med.* **242**: 968–972 (June) 1950.

(*4*) The treatment of lead poisoning: Clinical and laboratory data collected during the management of four cases with oral sodium citrate. (To be published.)



VIRGINIA ASSEMBLY—

(Continued from page 2)

tetrachloride, benzine, and other solvents, dusts containing free silica, new insecticides, and radioactive materials. Any material can be used if the proper safeguards are followed, as proved by experiences of the Atomic Energy Commission, but without these safeguards much trouble can result. The Bureau of Industrial Hygiene is staffed with experienced personnel who have specialized equipment that would not be practical for each industry to own for evaluating hazards and checking ventilation. Also a library on industrial hygiene and occupational diseases is maintained.

Each year the State pays thousands of dollars through the Industrial Commission as compensation to workers with occupational disease claims. Under provisions of the new law, it will be possible to apprise industry of their hazards, and perhaps prevent these cases.

Whether all industries will take steps necessary to protect their personnel remains to be seen. In any case the law should prove a step toward the protection of workers in Virginia. If the recommendations of the State Health Department are followed voluntarily by industry, an appreciable reduction in the number of annual cases of occupational disease should result.—***Virginia Health Bulletin*, May 1950.**

Comments on Use of Chemical Vapors and Ultraviolet Light for Control of Disease

By Roy Schneiter, Ph. D.*

At the present time acute respiratory diseases account for a very significant proportion of potentially preventable human illness and their effects represent a substantial economic loss to society. The probable relationship of many of these diseases to the airborne route of contagion has stimulated the development of techniques for aerial disinfection. These techniques include chemical vapors, ultraviolet light, and dust suppression measures.

It is regrettable that uncritical publicity in the public and semiscientific press during recent years has resulted in a premature, Nation-wide exploitation of certain chemical mists or vapors and ultraviolet light for the prevention of acute respiratory diseases in schools, office buildings, and other public places where people congregate (*1*).

The Division of Industrial Hygiene is frequently confronted with inquiries from the general public relative to the advisability of installing glycollizing equipment and ultraviolet lights in schools, plants, and other public buildings. Therefore, it is believed that a brief review of the present status of methods for the control of airborne contagion may be helpful to public officials who are confronted with problems in this field.

CHEMICAL VAPORS

There have been numerous scientific investigations on the efficacy of various chemical vapors, mists or aerosols for the disinfection of air in enclosed spaces. Among the substances investigated are the hypochlorites, lactic acid, iodine, formaldehyde, hexylresorcinol, and certain glycols. Although it has been demonstrated that some of these substances exert bactericidal effects in the air, the majority are not adaptable for air disinfection because of their odor, irritant properties, and their deleterious effect on metal and other surfaces.

Propylene and triethylene glycol are more adaptable for general air-disinfection than any of the other germicidal substances, because of their high bactericidal potency, reasonable cost, and freedom from the undesirable characteristics enumerated above.

Under carefully controlled laboratory conditions, it has been demonstrated that concentrations of 0.25–0.5 mg. of propylene glycol or 0.01–0.005 mg. of triethylene glycol per liter of air exert a rapid lethal action against a wide variety of airborne infectious agents. The bacteria found to be susceptible to glycol vapors include pneumococci, types I, II, and III; beta-hemolytic streptococci, groups A and C; alpha streptococci; staphylococci; influenza bacilli; and members of the coliform group of bacteria. The viricidal effects of these vapors have been demonstrated against some of the viruses of influenza, meningopneumonitis and psittacosis.

The glycol vapors are not chemical disinfectants in the ordinary sense. Their bactericidal action apparently depends on hygroscopic properties and their potency is at a maximum in a saturated concentration. The degree of saturation, rather than absolute concentration is the important factor. It should be borne in mind that the glycols are affected by many of the same factors which influence the activity of other germicidal agents and processes. They are most effective at relative humidities between 30 and 55 percent, and there is a progressive increase in the rate of bactericidal action as the atmospheric temperature is increased. Furthermore, the germicidal activity of the glycols is reduced in the presence of organic matter such as dust, dirt, lint and nonpermeable films.

Although extensive studies on the use of the glycols for the disinfection of the air in enclosed spaces such as multiple sleeping quarters, barracks and congested industrial plants have demonstrated that these compounds may effect some reduction in the incidence of respiratory infections, the results reported to date are not sufficiently conclusive to warrant the indiscriminate installation of glycollizing equipment for public use at the present time. There are a number of technical problems to be solved before this process is adequately perfected for general use. These include the development of dependable methods for the vaporization, distribution, and control of glycol concentrations in the air.

ULTRAVIOLET LIGHT

The bactericidal action of ultraviolet light (2,537 Å.) has been well established under carefully controlled experimental conditions. However, it should be borne in mind that the germicidal efficacy of ultraviolet light is influenced by many factors. Its effectiveness decreases rapidly with increasing humidities above 55 to 60 percent. Furthermore, ultraviolet light of sufficient intensity for the rapid killing of microorganisms is injurious to both man and animals. Because of its limited powers of penetration its activity is greatly reduced in the presence of organic matter such as dust, dirt and oil films. Ultraviolet lamps of the type used for air disinfection may also produce ozone in objectionable concentrations, particularly when they are new.

Since direct radiation of sufficient intensity to kill microorganisms in air is also harmful to the eyes and exposed skin of human beings, radiation must be restricted to upper air or to limited applications which do not entail human exposure. Otherwise it would be imperative for workers to wear protective clothing, masks, and goggles.

During the war years extensive studies were conducted on the use of ultraviolet light for the control of airborne infections. Promising results were obtained in specialized situations where direct irradiation could be employed such as in operating rooms, and in pediatric and contagious disease wards. Although studies with indirect irradiation, namely, upper air and floor irradiation, in multiple sleeping quarters and barracks, demonstrated some reduction in the incidence of respiratory infections, the results obtained were not sufficiently conclusive to warrant the indiscriminate installation of

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ultraviolet lights for general use. In such applications of indirect radiation the light intensity must be maintained at or below 5 ergs per cm.^{2} per second at the point of exposure in order to avoid human injury. The excessive time required to kill microorganisms at this intensity greatly reduces the effectiveness of this process.

SUMMARY

In the adaption of new processes for practical use, variable factors are frequently encountered which may reduce the effectiveness of the process below that demonstrated under carefully controlled experimental conditions. This has been particularly true in studies on the practical application of chemical vapors and ultraviolet light for air disinfection. This is further reflected in the wartime studies on the control of respiratory infections in military barracks and other places with congested population. More favorable results were obtained in such installations when concomitant measures for dust suppression were employed and in populations where there was the least opportunity for contact infection.

Independent committees of the American Public Health Association and the National Research Council have reviewed the results of research studies in this field (*2, 3, 4*). The reports of these committees provide a more complete review on the present status of methods for the control of airborne infections. It is the consensus of these committees that the general use of ultraviolet irradiation or disinfectant vapors in schools, barracks, and in specialized industrial environments is not justified at the present time. Furthermore, they indicate that there is an imperative need for further carefully controlled field studies to define the mechanisms of the spread of infectious disease among these types of population.

In conclusion, it is admitted that both ultraviolet light and the glycol vapors exhibit pronounced bactericidal properties, under carefully controlled experimental conditions. However, present knowledge is too limited to make any definite claims or predictions concerning their ability to reduce airborne infections. Present commercial campaigns of exploitation raise the real danger that these methods may be discredited and that the rational development of this important field of air sanitation may be discouraged.

REFERENCES

(*1*) Editor: Commercial exploitation of glycol vaporizers. *Am. J. Pub. Health* **39:** 222–224 (February) 1949.

(*2*) American Public Health Association, Subcommittee for the Evaluation of Methods to Control Airborne Infections: The present status of the control of airborne infections. *Am. J. Pub. Health* **37:** 13–22 (January) 1947.

(*3*) National Research Council, Division of Medical Sciences, Committee on Sanitary Engineering: Recent studies on disinfections of air in military establishments. *Am. J. Pub. Health* **37:** 189–198 (February) 1947.

(*4*) American Public Health Association, Subcommittee on Air Sanitation of the Committee on Research and Standards: Progress in the control of airborne infections. *Am. J. Pub. Health* Part 2, Yearbook 1949–1950, **40:** 82–88 (May) 1950.

TO NURSES IN INDUSTRY

By Heide L. Henriksen, R. N.*

Have you ever given thought to activities which under some circumstances are intolerable drudgery and in other situations, exhilarating, wanted experiences? For instance, one can go through the motions of walking, whether the path be a treadmill or the Appalachian Trail. The same physical capacities are employed, the same amount of calories are needed to sustain strength, the same number of hours may be devoted to the activity, but one's attitude toward his exercise can range from grim endurance to a highly satisfying sense of achievement.

Any job to which one goes day after day may also be an endurance contest or remain a stimulating, creative experience. And nursing is no exception. A nurse, like any other adult, needs to be a participant of a group, working toward a goal in which she can believe and have the opportunity of using her highest skills and endeavors.

"But," you may say, "my management does not want me to do anything but take care of injuries or emergency sickness and, after all, they pay my salary." If your management took "No" for an answer from every hard-to-sell customer, your firm would probably not have its present record of accomplishments. Your management knows its product and its good points, and can marshal many reasons why the purchaser will profit by investing in it. Nurses in industry, who like to work at improving the health of the employee group, at reducing lost time due to sickness, at helping maintain a safe work environment, at joining forces with other health agencies in the community through cooperative planning and referrals, first need to "know their product" and be able to describe it in direct convincing terms. Start with the immediate and the practical, but keep your eyes on your ultimate goal.—Courtesy of ***Nursing in Industry,*** August 1950.

***Miss Henriksen is a Nursing Consultant with the Division of Industrial Health, Minnesota Department of Health.**

FOUNDATION HEAD DIES SUDDENLY

The death of John F. McMahon, managing director of the Industrial Hygiene Foundation, was a great shock to his many friends. The news came to Dr. J. G. Townsend September 15 during the meeting of the advisory committee. Most of the committee members had talked with Mr. McMahon the day before at the Open House for the Cincinnati Field Station, Division of Industrial Hygiene, PHS.

Dr. Townsend sent the following message to Mrs. McMahon:

The advisory committee to the Public Health Service on Industrial Hygiene, holding its annual meeting in Cincinnati today, learned with great sorrow of the sudden passing of your husband, who was so well known and deeply respected by all of us. Speaking for the Surgeon General of the Public Health Service, the Division of Industrial Hygiene of the Public Health Service and the advisory committee, which is composed of representatives of management, labor, the professions, the Government, may I express our most sincere sympathy. The entire field of industrial hygiene will suffer with you in your loss.

J. G. Townsend.

STATISTICAL CONTROL IN INDUSTRIAL HYGIENE LABORATORIES

By A. S. Landry

Department of Industrial Hygiene
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Public Health Service
Lima, Peru

In the field of analytical chemistry there has been initiated, of recent date, a movement of tremendous importance relating to the evaluation of results by statistical methods.

The extent to which this concept has been utilized by chemists working in the field of industrial hygiene is not known, which explains the reason for this presentation. And since the results we obtain directly involve human life, we should be prepared to give the other members of our team, namely the engineers and doctors, a figure indicating the precision of our results.

By this I do not mean an extensive mathematical consideration which could be calculated only by a statistician from the results obtained on a suitably large number of control samples—but rather by means of a relatively simple and so-called "control chart" as described by Clarke (*1*).

"In this [an analysis by runs]," to quote Clarke, "the successive observations are plotted on a graph in which the abscissa represents sequence in time of the observations, and the ordinate, the numerical value of the observations. A line is drawn parallel to the abscissa, which represents the average or expected value of the quantity. In the general case, when the process producing the unit to be measured is under statistical control, the successive points on the graph are observed to vary in a random manner about the average. If, however, one observes a succession of seven points, either above or below the line, or a succession of seven trending either upwards or downwards, the statistical mathematicians have proved this to be an indication of the entrance into the causal system of a new assignable cause, and the observation of such a run, as it is called, is a signal to stop the process and look for the source of trouble."

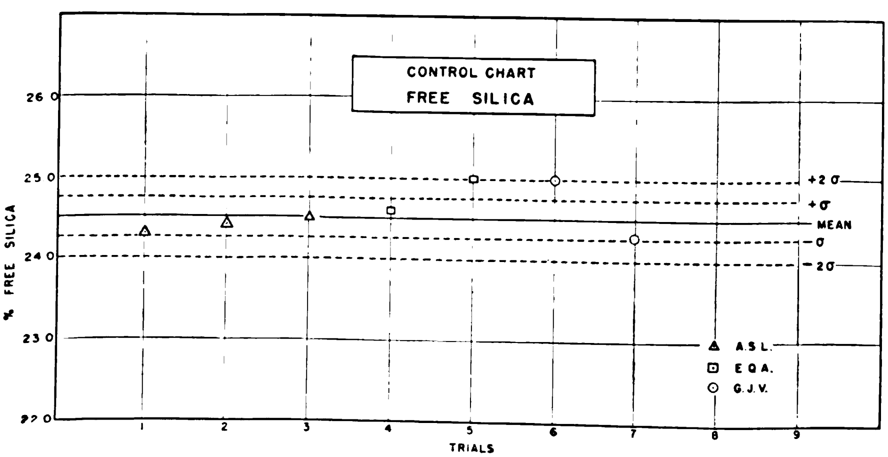
"What has just been described is a control chart. If we add to the graph two other lines parallel to the abscissa, one above and one below the average line, to enclose between them all those points that are in statistical control, then we have an obvious means of determining at a glance whether the process we are measuring is in control. If the points remain between the control limits and show no tendency to runs, it is assumed that the process is under statistical control in the sense that all causes of variation are random, and by their nature, not subject to control."

In our laboratory, I have initiated the use of this "control chart" along several lines, namely: The determination of free silica by my combined chemical-petrographic method, the determination of urinary lead by a spectrophotometric dithizone method, as well as in the polarographic determination of lead and zinc in atmospheric samples.

This has been accomplished by the preparation of synthetic samples which approximate the actual samples as closely as possible in composition and treatment. The data obtained by the various members of the department are plotted as illustrated in the accompanying figure. It may be noted that these control samples should be determined frequently and especially just before undertaking a series of actual samples.

Further, the control limits of the two lines that enclose all points have been taken to be "plus or minus once the standard deviation and plus or minus twice the standard deviation"—in this manner, therefore, we are able to indicate the relative precision of our results. This is a method which we hereby recommend to other workers in the field of industrial hygiene.

(*1*) Clarke, Beverly L.: Statistical methods in the chemical industry. *Chem. & Eng. News* **27**: 1426–1428 (May 16) 1949.



Qualifications for Industrial Nurses Published by AAIN

Two brochures on the desirable qualifications for industrial nurses have been prepared by the American Association of Industrial Nurses. They are entitled *Qualifications of an Industrial Nurse* and *Recommended Qualifications for Industrial Nurses Working Without Nursing Supervision.*

The growing recognition of the importance of industrial health and the increasing need for professional standards for nurses in industry motivated the Association to publish this material. Employers of industrial nurses as well as those concerned with nurses' education should find these brochures valuable. Single copies can be purchased at 10 cents per copy, or 5 cents per copy in quantities over 25. They may be obtained from the American Association of Industrial Nurses, Inc., 654 Madison Avenue, New York 21, N. Y.

Baltimore Studies Dust Control in Seven Asphalt-Paving Plants

During the 1949 operating season, the Bureau of Industrial Hygiene of the Baltimore City Health Department studied seven Baltimore plants that manufacture asphalt paving materials. The purpose of the study was to evaluate the effectiveness of dust suppression methods installed at the beginning of the year when an accelerated production schedule was instituted. A concerted effort with varying degrees of success was made in the plants to meet the following two major objectives:

1. Maintaining a minimum exposure of workers to free silica dust at operations within the plant.
2. Alleviating pollution of the atmosphere with dust.

Adequate health protection for the workers against inhalation of dust was successfully accomplished either by totally enclosing dusty operations or ventilating dust-producing machinery. Considerable progress was made in improving the collection of the outdoor atmospheric contaminants and an effective method was demonstrated notwithstanding some of the inherent disadvantages of the collector. The two problems with their various influencing factors are discussed in more detail.

Interior Dust Control

Crystalline-free silica is a major constituent of sand. The inhalation of this dust may result in silicosis depending upon the number of years of exposure and the concentration of the particles in the air. Since there is no known cure for this disease, it is important to control the quality of the air breathed in by the workers. Weighing and mixing of the heated materials is attended by dispersion of large quantities of dust where workers are constantly stationed. Removal of the dust from these sources was attained in a practical manner by installing exhaust ventilation hoods at these two operations. Other locations (in descending order of importance to health) needing enclosures and usually exhaust ventilation are the screening room, the drier discharge and the top and bottom of the conveying elevator.

The results of these improvements in the working environment had a very favorable reaction on the plant owners and their workers. In a few instances, minor alterations in exhaust hood design would make the machinery more accessible for cleaning and repairing. These few changes are contemplated since the basic idea of dust removal from its origin proved to be worthwhile. There is little doubt that with the elimination of abrasive action of the dust from these locations, the life of the equipment will be lengthened.

Atmospheric Pollution

The extent of the contamination of the atmosphere found outside the seven paving plants under study is unlikely to be detrimental to health, but it may cause discomfort. The nuisance character of the finely dispersed material results largely in property damage and irate neighbors. The degree of the nuisance and attending complaints is dependent upon:

1. Efficiency of the dust-collecting equipment.
2. Population density of the neighborhood surrounding the plant (high, medium, and sparse classification).
3. Physical properties of the materials processed. These factors together with the cost of dust collection were evaluated.

Prior to 1949 the majority of the plants used cyclone dust collectors. The inability of these collectors to retain fine dust was evidenced by numerous complaints even though the volume and type of work did not approach the production schedule of 377,000 tons for the seven plants during the year 1949. Five of the plants are now equipped with commercial collectors, depending upon either wet or dry centrifugal action for dust separation. The sixth plant fabricated its own system utilizing a water and steam scrubbing principle while the remaining plant employed a settling chamber on the drier, and a commercial filtering unit on the cooler dust-laden air from the mixers, weighing hoppers, and the screens.

Comparison of the experience with, and performances of these collectors, together with other pertinent data follow.

Wet Centrifugal Collectors

One of the two plants using a wet centrifugal collector is located in an area of high population density, while the other one is in an area of medium population density. In 1949 no complaints were received against either plant, although their production was 33.3 percent of the total of the seven plants. In 1948, 12 complaints were received when cyclone collectors alone were in use. The new equipment is capable of collecting very fine materials such as stone dust used in bituminous concrete having particle sizes down to 1 micron (0.00004 inch). The cost of the equipment, installation, and maintenance averaged $0.18 per ton of material produced. The water used by two of these collectors in one plant is estimated to have cost less than $300 per year. However, the systems required extensive repairs and were inoperative at the close of the season. The manufacturer of the collectors is confident that with certain modifications the equipment will have a longer life under the severe conditions imposed by the heavy production schedule called for in Baltimore.

Dry Centrifugal Collectors

Two of the three plants using dry centrifugal collectors are located in areas of high population density, while the third is in an area of medium population density. Altogether in 1949, 27 complaints and 1 petition signed by 90 persons were received. Twenty-one of the complaints and the petition were against one plant using a large quantity of stone dust over a period of several weeks. In 1948, 11 complaints were registered against these 3 plants. During the past year their production was responsible for 38.6 percent of the total production of the seven plants. It is doubtful if these dry centrifugal collectors are satisfactory on paving dust of sizes lower than 25 microns (0.001 inch). Particles of this size approach the respirable range and cause widespread complaints since they are distributed over a large area. Larger particles are likely to settle on or near plant property, depending upon stack height and atmospheric conditions. A redeeming feature of this type of collector is the relative long-life expectancy. One plant has been using this system for 3 years without appreciable maintenance. The average cost of the equipment, installation, and maintenance based upon the production in 1949 was $0.19 per ton of product.

Water and Steam Scrubber

The plant which fabricated its own water and steam scrubbing collector at a cost of $0.07 per ton of material produced in 1949 is located in an area of medium population density. Three complaints were received in 1949 as against two in 1948 when a cyclone separator was in use. The new water and steam scrubbing collector is more susceptible to excessive wear than the commercial wet centrifugal collector. Since data on the performance characteristics of the water and steam scrubbing collector are not available most plants should be discouraged against attempting to construct their own dust separating systems.

Cloth Filter and Settling Chamber

The one plant employing the two collecting systems, a cloth filter and a settling chamber, is located in a sparsely populated area. No complaints were received in 1949 and only one was recorded in 1948. A dust-settling chamber connected to the drier exhaust appears to function satisfactorily when sand and crushed rock are handled. Observations were not made on the drying of stone dust since this material is yet to be handled in this plant. Dust from operations within the plant is collected quite effectively with a cloth filtering unit which will retain particles less than 1 micron in size. Since cloth does not become unstable until used at elevated temperatures of about 180° F. the filtering unit should last for several years. However, the equipment and installation cost was $0.30 per ton of material produced in 1949 by this plant.

Conclusions

1. Mixers and screening rooms should be either ventilated or totally enclosed.

2. Dust from dumping fine materials from trucks or hot storage bins should be kept at a minimum by performing this intermittent work in an enclosure on the outside.

3. To avoid a repetition of the prevalence of complaints from handling finely divided materials, those plants in areas of high population density should install a commercial wet type dust collector, and even the plants in areas of medium population density should consider the installation of such equipment.

California Reports More OD Cases Among Agricultural Workers

TWELVE percent of all the occupational diseases reported in California in 1949 affected workers in agriculture. Between 1948 and 1949 the rate of reported occupational disease increased among agricultural workers from 4.8 to 5.4 per thousand workers, while among workers in manufacturing industries the rate decreased from 7.8 to 6.3. The increased rate of occupational disability in agriculture in California during 1949 parallels the increased use of agricultural chemicals.

During the year the Bureau of Adult Health received reports of 300 cases of illness in workers exposed to these chemicals. Agriculture, and the closely allied food-processing industry, accounted for 20 percent of the 1949 reports. These figures do not record the total incidence of industrial disability in this important industry, since only an estimated 45 percent of the workers in agriculture are covered by Workmen's Compensation.

During 1949 a total of 12,536 diseases attributable to occupational exposure were reported. Fatalities during this period numbered 105. A third of the persons disabled by industrial illness were absent from work 1 day or more. Half of the cases reported were occupational dermatitis, with poison oak the principal agent causing skin disease.

While new occupational diseases appeared, resulting from agricultural chemicals, beryllium, and other relatively new agents, the older occupational diseases continued to take their toll. For example, 90 cases of lead poisoning occurred during the year, and 68 cases of carbon monoxide poisoning.—***Occupational Health Bulletin***, [1949 Annual Report]. Bureau of Adult Health, California Department of Public Health.

NATIONAL SMOKE ABATEMENT WEEK OBSERVED WIDELY

National Smoke Abatement Week, the last week in October, was celebrated this year for the second time. It saw increasing concern in various parts of the Nation by growing numbers of people and organizations with the entire problem of cleaner and healthier air.

Charles N. Howison, chairman of the Smoke Abatement Committee, said: "The main purpose of National Smoke Abatement Week is to focus attention upon the need for control of air pollution from all its various sources, including smoke, soot, fly-ash, noxious fumes and gases; and to serve as a starting point for year-round smoke abatement and air pollution control activity by public officials, in the schools, in the factories, by railroads, apartments and homes, and by civic organizations."

Mr. Howison said further: "While air pollution, including smoke, is a serious economic and health problem in many industrial areas, unnecessary smoke also represents wasted fuel, which is a drain on the industrial resources of these communities and our Nation. Since our highly industrialized economy requires the consumption of large quantities of all types of fuels, our Nation cannot afford to waste these fuels through inefficient combustion and firing methods. In other words, victory begins at home, and one way we can all help to speed the day of victory and peace in this period of national emergency, is to prevent the wasting of our national (fuel) resources."

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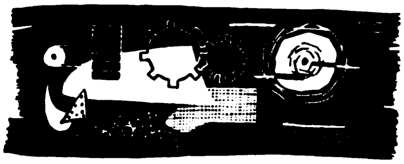
Studies of Health Hazards in Industry

By J. J. Bloomfield



This article is one of a group of lectures which Mr. Bloomfield gave to a class of physicians in Rio de Janeiro, Brazil. In view of the constant demand for basic material on industrial hygiene techniques and for practical help in this field, a number of these lectures are being printed in the Industrial Hygiene Newsletter.

This is the third in the series. In the first article, which appeared in the September issue, Mr. Bloomfield discussed types of plant surveys, illustrating with the Public Health Service study of mercurialism in the hatters' fur-cutting industry. The second article covered the classification of environmental exposures. The next one in the series will be on the subject of pneumoconiosis-producing dusts.

METALLIC POISONS

There are certain dusts in industry which have a systemic effect upon the human body. Chief among such dusts are those of the heavy metals group, notably, lead, mercury, radium, and others. The Public Health Service has investigated several such dusts and one of these, lead, will be discussed at this time.

The toxic effects of lead on the human organism have been reported in very early writings, and the medical literature is replete with observations on this type of poisoning. That the early writers were keen observers is attested by the fact that little of importance has since been added to our knowledge of the clinical picture of lead poisoning. However, as a result of clinical research, considerable valuable data are available on the action of lead upon body tissues and therapeutic methods for the treatment of plumbism. In addition, studies of the health of workers in the lead trades have contributed information on this subject.

In the past, many severe lead poisoning cases were described but such cases are seldom seen today. Whenever early signs of lead poisoning appear, prompt medical attention is usually given. A steady decrease in cases of fatal poisoning from lead and also in the milder forms of such poisoning has resulted from a more widespread appreciation of the potential hazards of exposure to lead or its compounds and to the use of medical and engineering control procedures. Substitution of machine methods for hand labor has also aided in reducing the incidence of lead poisoning.

A review of the literature in recent years, however, indicates that lead poisoning has not disappeared, even though its incidence has lessened. For example, lead poisoning was found among typesetters in the United States in 1936; among solderers, metal finishers, and welders in automobile body plants in 1938; and among glass workers in 1940. In that year, also, lead poisoning occurred among workers cutting structural steel painted with lead-containing paints.

When lead enters the body through any portal and is taken into the tissues, lead absorption has taken place. Persons not employed in lead industries are constantly absorbing lead by ingesting small amounts present in foods and are also inhaling minimal quantities of lead present in the atmosphere. When absorbed lead causes subjective symptoms with objective findings, then lead poisoning or lead intoxication may be said to be taking place.

In spite of all the work done, very little is known of the biochemistry of this type of poisoning. We know very little about what goes on between active lead absorption and the onset of clinical symptoms of lead poisoning. About all we know is that deposition of lead occurs to some extent in the bones and that the person may show some anemia. Much more extensive investigation must be made of these phenomena, and more precise methods of measurement must be devised, before a satisfactory explanation is obtained.

In industry, lead enters the body chiefly through the respiratory organs, to a lesser extent through the digestive tract, and very rarely by absorption through the skin. A notable exception to the absorption route is tetraethyl lead and its related organic compounds.

Primary Production of Lead

The only ore of commercial importance is galena, lead sulfide (PbS). The ore is mined, crushed, and separated from waste rock by flotation techniques and from other sulfides by selective flotation methods, thus producing a concentrate which often contains 90 percent lead sulfide. The concentrate is roasted to remove most of the sulfur after the addition of sand, granulated slag, pyrite, and recovered flue dust from early smelting operations. This produces a sinter which is mixed with coke, limestone, scrap iron or waste and placed in a blast furnace from which molten lead and slag are tapped.

This crude lead may contain some gold and silver, copper, antimony, and bismuth. In the refining of the crude product, these valuable metals are separated by adding zinc to the molten lead. The silver and gold collect in a crust, and this is skimmed off. The lead is heated again to drive off traces of impurities and is then cast into pigs.

Control of Hazards

In all of the production jobs the principal hazard occurs during occasional clean-out work. General warm air in the concentrator and smelter is controlled to a large extent by proper ventilation. Exhaust ducts and hoods are provided wherever possible, and excess dust is dampened. The walls of the furnace must be scraped occasionally to remove accretions. Fine dust is recovered in bag houses, where the bags are shaken mechanically to recover the lead dust. This is moistened and reused as part of the charge to the sintering machines or roasting furnace. Men engaged in clean-out work should wear approved respirators and should work for only short periods.

Smelting and Refining

The hazards in these operations are no different from those in the primary production and refining operations. The operations are designed for the recovery of scrap lead or its alloys.

Consumption and Use

In a normal year about 230,000 tons of lead are used in its compounds, and 486,000 tons are used as the metal, or a total of approximately 700,000 tons per year are consumed in the United States. The storage battery industry is the largest single user of lead products.

The principal lead compounds and the lead itself are made by a few large basic manufacturers. These then are sold to many intermediate manufacturers who make the products used by the ultimate consumer.

CONTROL OF THE LEAD HAZARD IN STORAGE BATTERY INDUSTRY

We will consider this industry because it is the largest user of lead and the most important from the standpoint of lead absorption hazards.

The production process in the lead storage battery industry may be summarized as follows: Lead or lead-antimony ingots are melted and cast into grids and miscellaneous parts. The lead oxides are mixed with sulfuric acid to form a paste which is spread on the grid to form plates. These are often double plates which are dried and then finished by removing the center strip of metal and cleaning the edges of excess paste. The plates are then assembled in positive and negative groups and "burned" (welded) together with a connecting strap. One positive and one negative group are then interleaved, and separators are placed between the plates. During the manufacture of SLI batteries, these combined groups or elements are assembled and sealed in the container, which is then filled with electrolyte. The forming process which converts the raw oxides into active materials may follow pasting (plate forming), group burning (group forming), or the assembling of the battery (case forming).

The U. S. Public Health Service has conducted two large-scale field studies of this industry. In the first study, from June 1928 to November 1930, a field office was established in a storage battery plant to transcribe the case records of all applications for compensation for lead poisoning. The occurrence of cases was related to the atmospheric lead concentration prevailing in the departments in which the cases were contracted. Eighty-five recipients of compensation and 25 nonaffected workers were given medical and hematologic examinations, and a hematologic study was made of about 500 lead exposed workers.

The incidence of plumbism was roughly proportional to:

1. Duration of exposure in months.
2. Atmospheric lead concentration.
3. Lead concentration times duration of exposure.

The results of this study, indicating the number of compensable cases of plumbism per 100 men per month in 3 departments with specified atmospheric lead concentrations, showed that the incidence of plumbism was highest in the mixing department where the atmospheric lead concentration averaged 120 mg. per 10 m.^{3} of air; next highest among pasters who were exposed to an average of 50 mg. per 10 m.^{3}; lower among burners who breathed air contaminated by 5.7 mg. per 10 m.^{3}; and lowest among casters whose exposure averaged 1.2 mg. per 10 m.^{3}

In 1936–37–38, the U. S. Public Health Service conducted its second large-scale study of this industry at the request of the National Battery Manufacturers' Association.

In 1936, a preliminary study was made in 26 storage battery plants employing about 6,000 workers and producing more than 10 million batteries annually. This study covered more than 10 percent of the estimated 200 storage-battery plants functioning at that time, and covered about 50 percent of the workers in the industry. The data obtained in this study were used to select 13 plants for detailed engineering studies, and, from this latter group, 6 plants were selected for detailed medical studies. The engineering phase was complete. The lead exposure of each occupation was determined, and the efficiency of control measures was also determined.

These data then were used with the medical findings to evaluate the physiologic effect of the environment. Seven hundred sixty-six workers were examined. Blood specimens from each worker were divided for hematologic studies, chemical analysis of lead content, and the Kahn test. A urine sample taken at the time of examination was subjected to the usual chemical and microscopic tests in the field laboratory and the remainder was sent to Washington where the chemical analyses of blood and urine were carried out.

No cases of disabling plumbism were seen. Nine men, all exposed to atmospheric lead concentrations in excess of 1.5 mg. Pb per 10 m.^{3} of air, were diagnosed as cases of incipient plumbism. All had a lead line and other symptoms of plumbism, and all had abnormally high reticulocyte, stipple cell, and polychromatophilia values. Their blood and urinary lead concentrations were consistently high. Diagnosis of lead absorption was made for 168 men who were less affected than those with incipient plumbism, but presented a combination of signs, symptoms, and abnormal laboratory findings indicative of early plumbism.

Cases of early plumbism, including both incipient plumbism and lead absorption, were classified in terms of the atmospheric lead concentrations associated with their occupations. Individual lead exposure values were calculated by an engineer after careful consideration of the worker's entire occupational history. Thus classified, the percentage of workers with early plumbism increased with increasing atmospheric lead concentration. Fewer than 4 percent of the men exposed to less than 0.75 mg. Pb per 10 m.^{3} of air and 54 percent of the workers exposed to more than 3 mg. Pb per 10 m.^{3} of air were diagnosed as cases of early plumbism.

General Considerations

From the two studies of the storage battery industry conducted by the U. S. Public Health Service and from the work of other investigators, certain general statements can be made with regard to this type of industrial poisoning.

Safe human lead exposure, whether in industry or elsewhere, may be defined as a degree of exposure which, while resulting in lead absorption, does not produce any injurious effects upon the human organism. For present purposes, however, it is necessary to define safe industrial lead exposure in much more specific and practical terms. Any such definition at present is empirical.

somewhat tentative, and limited in its application. Nevertheless, practical experience and systematic investigation have demonstrated that certain levels of occupational lead exposure and absorption are compatible with normal healthy existence and activity, and that any ill effects resulting from such lead exposure and absorption are so tenuous and vague as to be purely speculative in character. There are good reasons for the belief that present standards will be acceptable in practice for a long time to come.

As defined by air analysis, 1.5 mg. of lead in 10 cubic meters of air, as measured by standard methods, will prevent cases of disabling lead intoxication among workers who work regularly in such exposures, and even cases of questionable or mild intoxication should be rare.

Lead intoxication occurs rarely, if at all, and only in its mildest manifestations among regularly employed industrial workers, if the mean urinary lead concentration of representative groups of such workmen is kept below 0.10 mg. per liter and if the exposure is controlled so uniformly that individual results are generally below 0.15 mg. per liter and very rarely in excess of 0.20 mg. per liter.

With regard to blood levels, it may be said that mean blood lead concentrations as high as 0.07 mg. per 100 grams of whole blood are compatible with complete health and well-being.

In the case of "stippled" erythrocytes, as determined by standard methods, this value has been set most commonly at 800 to 1,000 per million erythrocytes, or, as often expressed, at 10 to 12 "stippled" erythrocytes per 50 microscopic fields.

In the final analysis, a diagnosis of lead poisoning is arrived at on the basis of: (1) The facts with respect to the lead exposure, (2) the clinical picture of the illness as revealed by the patient's history and symptoms, and by the physician's careful physical examination, and (3) the results of laboratory procedures that confirm the potentially hazardous character of the patient's exposure to lead compounds. Lead intoxication may exist without any of the physical signs, such as pallor, weakness, abdominal pain and colic, paralysis, and so on. However, one cannot ignore these various signs.

In the Public Health Service study of lead storage battery industry, the laboratory tests yielded far more significant results than any of the classic symptoms mentioned above. For example, the prevalence of albuminuria among the lead-affected group was twice as great as among nonaffected workers. It would seem that this simple test should be used in conjunction with the hematologic ones in detecting early changes among lead-exposed workers. More recently, the Scandinavian literature indicated that the amount of porphyrin in urine is a much more reliable test for early detection of lead poisoning than the basophilic aggregation test or stippled cell counts.

On the basis of the Public Health Service studies, it does not seem appropriate to designate certain critical values for blood urinary lead concentrations as having diagnostic significance. Instead, it appears that the more the blood-lead or urinary-lead values of an individual deviate from the range of values of unexposed people, the greater is the likelihood that such an individual will be found to have other evidence of lead-induced bodily changes.

Recovery from lead poisoning is usually complete, leaving no partial or complete disability. In the uncomplicated gastroenteric type, regardless of the severity of the colic, spontaneous recovery occurs in a few weeks, the colic usually subsiding in one week to ten days. An ample diet and a generous supply of liquids, particularly milk, is advantageous.

Deleading of a patient is still a moot question. Some clinicians believe in eliminating that portion of the lead which may be readily available for rapid excretion in order to shorten the period of convalescence and disability. Other investigators do not believe in deleading on the assumption that the recurrence of lead poisoning without further lead exposure is rare after the complete subsidence of the episode of intoxication. It is their contention that the excessive quantities of lead are eliminated spontaneously from the body.

In summing up this subject, we now know a great deal about lead poisoning and lead absorption, and we have demonstrated time and again that expert medical supervision of workmen, as well as careful and frequent study and control of their environment, can eliminate the danger from exposure to lead and its compounds.

REFERENCES

American Public Health Association: Occupational Lead Exposure and Lead Poisoning. A Report prepared by the Committee on Lead Poisoning of the Industrial Hygiene Section of the American Public Health Association. 1790 Broadway, New York 19, New York. 1943.

Cantarow, Abraham, and Trumper, Max: Lead Poisoning. Williams and Wilkins Company, Baltimore, Maryland, 1944.

Dreessen, W. C., Edwards, T. I., Reinhart, W. H., Page, R. T., Webster, S. H., Armstrong, D. W., and Sayers, R. R.: The control of the lead hazard in the storage battery industry. Pub. Health Bull. No. 262. Government Printing Office, Washington, D. C., 1941.

Fairhall, L. T.: Inorganic industrial hazards. *Physiol. Rev.*, Vol. 25 (January) 1945.

Fairhall, L. T.: Toxicology of the heavy metals. *J. Ind. State Med. Assoc.* 41: 917–921 (September) 1948.

Russell, A. E., Jones, R. R., Bloomfield, J. J., Britten, R. H., and Thompson, L. R.: Lead poisoning in a storage battery plant. Pub. Health Bull. No. 205. Government Printing Office, Washington, D. C., 1933.

Filipino Physician Studies Industrial Hygiene at Pittsburgh

Dr. Emmanuel T. Gatchalian of the Philippines received a fellowship from the Public Health Service under the Philippine Rehabilitation Act and, after a summer of field work in the United States, has entered the School of Public Health of the University of Pittsburgh. He will major in industrial hygiene and public health administration.

As a senior student and a young graduate, Dr. Gatchalian served in the Remedios Charity Clinic of the Catholic Women's League from 1942 to 1945, during the Japanese occupation. Among the patients were sick American internees from the Santo Tomas Camp, who were allowed to be transferred to the clinic-hospital.

ARSINE POISONING IN THE SMELTING AND REFINING INDUSTRY*

By Kenneth M. Morse [1] and Alfred N. Setterlind

ABSTRACT

SIX deaths and several cases of acute poisoning due to arsine occurred during the early part of 1949. As a result, the industrial medical and hygiene profession has been alerted to the danger of arsine poisoning in the smelting and refining industry. Arsenic-bearing dross produced in the lead refining process was implicated in these cases. The Division of Industrial Hygiene of the Illinois State Department of Public Health investigated two fatal cases occurring in Illinois and studied the manufacturing processes involved, the chemistry of the arsine evolution and measures for the elimination and control of this apparently overlooked hazard of the industry.

Medical literature contains many reports of arsine poisoning, but evidently the first instances of arsine poisoning, involving the use of aluminum for the removal of arsenic and antimony in the refining of lead, are the cases in Indiana reported by Spolyar and Harger (*Arch. Ind. Hyg. and Occup. Med.* **1**: 419 1950), and those reported by Nau (*Southern Med. J.*, April 1948).

Intentional or accidental wetting of the arsenical dross caused this material to evolve arsine and hydrogen with considerable production of heat. Workmen engaged in shoveling the dross or spraying hot ingots with cooling water later developed the symptoms associated with arsine poisoning. Lethal effects and red blood cell destruction were not prevented by administration of BAL.

Previous reports of arsine poisoning in industry indicate that the most frequent cause is the cleaning out of tanks and tank cars that have contained mineral acids, either hydrochloric or sulfuric. The action of acids on arsenic-bearing metals has been responsible for most of the reported cases. The wetting of tin dross with water was involved in 30 cases with 12 deaths in the period 1923–41, inclusive. However, prior to 1948, apparently no cases involving the lead refining process were recorded.

The lethal action of arsine is believed to be due to (*a*) hemolysis of red blood cells with liberation of toxic arsenic compounds; (*b*) blockage of the kidney tubules by the products of hemoglobin breakdown; and (*c*) decreased oxygen carrying capacity of the blood. After inhalation of the gas, red cell destruction appears in from 6 to 36 hours; the early symptoms are those of anoxemia, while later ones are due to the effort of the body to excrete the debris of red cells which clog the liver and kidneys. First symptoms include headache and nausea, followed in 4 to 6 hours by passage of dark or bloody urine. Jaundice appears in 24 to 48 hours and anemia occurs with loss of red cells, which may fall below 2,000,000. Suppression of urine follows. In the cases reported here, total suppression of urine appeared 5 days before death in one case, and 2 days after exposure in the other.

In the two fatal cases investigated by the authors, manifestations of poisoning included vomiting, nausea, abdominal cramps, rapid destruction of red cells, leucocytosis, and anuria. The workmen in these cases were engaged in removing, manually, dross formed on top of a kettle containing molten lead in which aluminum had been mixed. The dross was transferred into ingot molds suspended over troughs of cooling water. To speed up chilling, the men sprayed the ingots with water, a not uncommon practice in this plant.

Case Descriptions

Case No. 1, a man 25 years old, was exposed on one day and returned to work the following day. The second day's work did not involve an arsine exposure. Returning from work the second day, the patient complained of abdominal cramps, nausea, and generalized pains. The patient was anuric from the time he returned home from work. After treatments by the family physician which provided no relief, the patient was hospitalized on the fourth day after exposure. At this time the plant physician examined the patient and found him confused and disoriented. Red blood count was 1,500,000; hemoglobin 51 percent. Lead poisoning was suspected; however, relatively few stippled red cells were found. Treatment included intravenous fluids, calcium gluconate, and several doses of BAL. Continuous gastric lavage was initiated the sixth day following exposure. Death occurred on the seventh day following exposure.

Case No. 2, a 44-year-old man, did not return to work the day after exposure. The evening of the third day following exposure the patient was hospitalized. Marked hemolytic anemia was indicated by laboratory tests: Red cell count 2,700,000; hemoglobin 10 grams; white cell count 16,600. The patient was completely anuric. Analysis of blood showed 0.024 milligram arsenic per 100 grams and 0.055 milligram lead per 100 grams. The patient was drowsy, disoriented, and uremic; anuria continued until about a week before death; a small amount of urine was excreted during the last week. The patient expired on the twenty-fourth day following exposure.

Processes Investigated

In order to find means of elimination and control of the hazard, the process of lead refining with aluminum was investigated. The principle of this refining process is that aluminum added to a molten lead-arsenic-antimony-tin alloy combines with the arsenic and antimony in fixed proportions, which rise to the surface as a dross. In practice, 1 part of aluminum is added to 4 parts removable impurities, the metal to be treated being maintained at 1,200°–1,300° F. and stirred rapidly. Cooling is then allowed to occur to permit the dross to rise to the surface, after which the temperature is brought up to 700°–900° F. to aid in skimming. The dross at this point is known as "wet dross" due to its

*Presented at the 1950 meeting of the American Conference of Governmental Industrial Hygienists. The complete article has been printed in *Archives of Industrial Hygiene and Occupational Medicine*, Aug. 1950.

[1] Mr. Morse is Chief and Mr. Setterlind, Chief Chemist, of the Division of Industrial Hygiene, Illinois Department of Public Health.

silvery appearance and spongy consistency. This may be cast into ingots to facilitate handling; the product is comparatively dust free and solidifies on cooling. An alternate process consists in the addition of sawdust on the reheating phase of the cycle to produce a granular, black, dusty dross—the so-called sawdust concentrate. Part of the lead contained in the dross ingots is recovered by sweating out the occluded metal in a liquating furnace; the final dross contains about 50 percent lead.

Tests for arsine carried out during plant operations of the ingoting process showed (*a*) that wetting of the dross caused a strong arsine reaction; (*b*) that under normal operations arsine would not be present in the breathing zone of the worker, unless a driving rain, deliberate wetting, or other means of introducing water was in effect; (*c*) that the development of arsine from the dross could be detected on very humid days directly over the dross ingots; and that (*d*) some alteration in processing was necessary to produce a dross, or so treat it, that it would not react with water to form arsine.

Measurements of arsine concentrations developed within 3 feet of the sprayed dross ingots in the breathing zone of the workers gave values of from 70 to 300 parts per million parts of air. Concentrations of 1.0 to 2.1 parts per million existed 30 feet from the ingots. The American Conference of Governmental Industrial Hygienists' maximum allowable concentration for arsine is 0.05 part per million.

Studies of gas production from "wet dross" and "sawdust concentrate" showed that no stibine was formed: Evolution of gas starts more quickly and proceeds at a greater rate in the case of the "wet dross" as compared to that made by the sawdust process. The latter, however, maintains its peak rate for a longer period of time. Liquating the "wet dross" was found to be relatively ineffective as a means of reducing arsine hazard.

Investigation of conditions required for arsine evolution brought out that hydrolysis of aluminum arsenide is probably not the cause of arsine formation. It was found that mixtures of finely powdered lead and aluminum evolve hydrogen in contact with water. It was demonstrated that aluminum metal dispersed into lead, whether in the molten state or by mechanical mixing of finely ground powder will produce hydrogen when brought into contact with water; should an arsenic compound be present, arsine will also be produced.

Recommendations

A practical method was developed for stabilizing dross so that it would not react with water. This consists in roasting sawdust treated dross at 1,800° F. for 1 hour, with riffling. A dustier dross is produced, but the increased lead hazard can be controlled by ventilation.

It is recommended that (1) all sources of water be removed from the aluminum treatment area; (2) that the "sawdust concentrate" method should be employed in the process; (3) that all dross should be immediately roasted for at least 1 hour, or longer, until the dross is not capable of forming arsine when wetted. In the event that the material cannot at times be processed, it should be stored in metal containers, which will preclude wetting under any condition; (4) exhaust ventilation should be provided for the aluminum treatment kettle and for the skimming operation; (5) workers should be instructed on the hazards of the work and to report any discoloration of urine or feeling of nausea immediately; and (6) periodic blood tests for red and white cell count should be conducted on all workers engaged in the process.

Bolivian Industrial Hygiene Team Studies Tin Mining Industry

Approximately one-fourth of the 2,400 workers in a large Bolivian tin mine showed symptoms of silicosis during a recent exhaustive study of the industry, an official Bolivian report has disclosed.

Dr. Guillermo Guerra, chief of the Department of Industrial Hygiene and Safety of the National Bureau of Social Security of Bolivia, said in his report on the study that he was recommending many changes in the processes in the tin mines, improvements in ventilation methods, more frequent and complete physical examinations of the workers, better housekeeping methods in the mines and plants, and more protective clothing for the workers.

This environmental study of the San José tin mine in Bolivia has been recognized already as one of the most comprehensive ever made in a South American mine. It was carried out by engineers and physicians of the young Bolivian Industrial Health and Safety Department and was generally patterned after the early mining studies made by the Public Health Service in this country.

It is gratifying to observe the excellent progress being made toward improving industrial health in Bolivia.

This is one of the dustiest operations in the Bolivian tin mines. Workers on this job are now required to wear respiratory protection from gases and dusts.

GOOD AND BAD PRACTICES IN SAFE EYE WEAR*

By Hedwig S. Kuhn, M. D.

THE Joint Committee[1] is receiving increasing evidence that substandard safety eye wear is being used in numerous plants throughout the country. This fact has been brought to the attention of the committee by its members in travel and visits to many plants, in conferences with various sections of the National Safety Council, and by individual safety groups in the United States.

Protective eye equipment must be standard; it must be designed to meet specific hazards; it must be made according to accepted specifications and possess a stated quality of material. Otherwise such equipment cannot and does not properly protect and serve the interest of the employee and the employer. A special and very representative group worked out minimum recommended practices as published by the National Safety Council, July 1947.

It has been found in the main that small plants without benefit of safety personnel or professional eye consultants have too often been influenced by nonprofessional factors in choosing safety eye wear. They have not been fully aware of the importance of strictly adhering to the standards and practices formulated by experts in the field.

It is frequently difficult to get the cooperation of employees in observing the safety rules, and occasionally an employee may express a liking for a type of eye wear which is not always approved merchandise. Here the safety man, in order to protect the employee with something he will wear, occasionally yields. This is bad practice as it cancels out prestige of authority, general safety rules, and carries by word of mouth to other plants, producing unrest.

Unsafe protective eye equipment sometimes gets into a plant because an outside personal contact (friend or relative) may want to introduce merchandise of an inferior quality which management and/or the safety man may not even realize is inferior or how extremely detrimental such a purchase can be. Economic pressure and false economy also influence procurement of protective eye wear. Persons responsible for safety programs should not be forced by management to purchase materials solely on the basis of price, if this means obtaining substandard equipment.

The man responsible for safety in industry is the key to a successful and ethical program utilizing protective eye wear. When his responsibility for specifying safety requirements is subordinated to other factors, or he permits dilution of his responsibility for safety requirements, the basic principles for safeguarding employees are tragically jeopardized.

The Joint Committee would like to ask every professional eye man who has any relationship to industry whatsoever, to support, to urge, to police (if necessary) management's insistence on the use of standard quality protective eye wear, as the support so given to safety, ethics, and plant procedures is of tremendous value. It will help the National Safety Council, the ethical optical companies and those manufacturers of industrial safety equipment also handling standard safety eye wear to demonstrate conclusively to management and/or to their customers that quality merchandise is essential; that the profession stands behind its use, and that insistence on standards is not merely a commercial sales argument.

*Reprinted from *Transactions, American Academy of Ophthalmology and Otolaryngology*, March-April, 1950.

[1] Members of the Joint Committee on Occupational Ophthalmology represent the Section on Ophthalmology of the American Medical Association and the American Academy of Opthalmology and Otolaryngology.

AVAILABLE PUBLICATIONS

The following publications are available for free distribution: "Science in the Control of Water-borne Wastes" and "Industrial Application of Audiology". They may be obtained from the Industrial Hygiene Foundation, 4400 Fifth Avenue, Pittsburgh 13, Pa.

"We Need to be Unified" and "AAIN—A Thumb Nail Sketch". They may be obtained from the American Association of Industrial Nurses, Inc., 654 Madison Avenue, New York 21, N. Y.

"Your Guide to Safety as a Food Store Employee"; "Your Guide to Safety as a Crane Operator"; and "Your Guide to Safety as a Salesman-Driver" may be obtained from the Association of Casualty and Surety Companies, 60 John Street, New York 7, N. Y.

RECOMMENDED READING

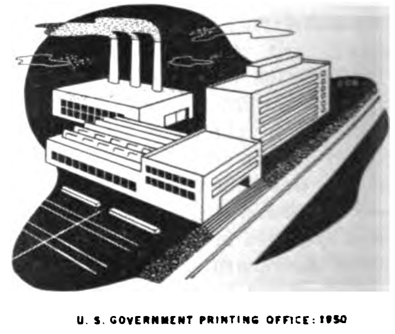
Committee of the American Nurses Association and the National Organization for Public Health Nursing on Nursing in Medical Care Plans: Guide for the Inclusion of Nursing Services in Medical Care Plans. 1950. 31 pp. (Processed.)

Cralley, Lewis J.: Atmospheric Pollution Control in Petroleum Refineries. *Lectures Presented at the Inservice Training Course in Air Pollution*, February 6–8, 1950. University of Michigan School of Public Health, Ann Arbor, 1950. Pp. 97–100.

Employers' *New* Requirements: Sick Pay, Health Benefits, [and] Life Insurance. Analysis 72. Research Institute of America, Inc., 292 Madison Ave., New York 17, N. Y. (April) 1950. 47 pp.

[Knapp, Margaret]: Cancer Nursing, a Manual for Public Health Nurses. National Cancer Institute and New York State Department of Health, 1950. 88 pp. Copies may be obtained at $1 each from Health Publications Institute, Inc., 216 North Dawson St., Raleigh, N. C.

Sitgreaves, Rosedith, and May, Irving: Potential Sources of Error in Blood Lead Determinations Due to Different Methods of Blood Sampling. *Arch. Ind. Hyg. & Occup. Med.* 1: 467–470 (April) 1950. Reprints are available from the Division of Industrial Hygiene, PHS, Washington 25, D. C.



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