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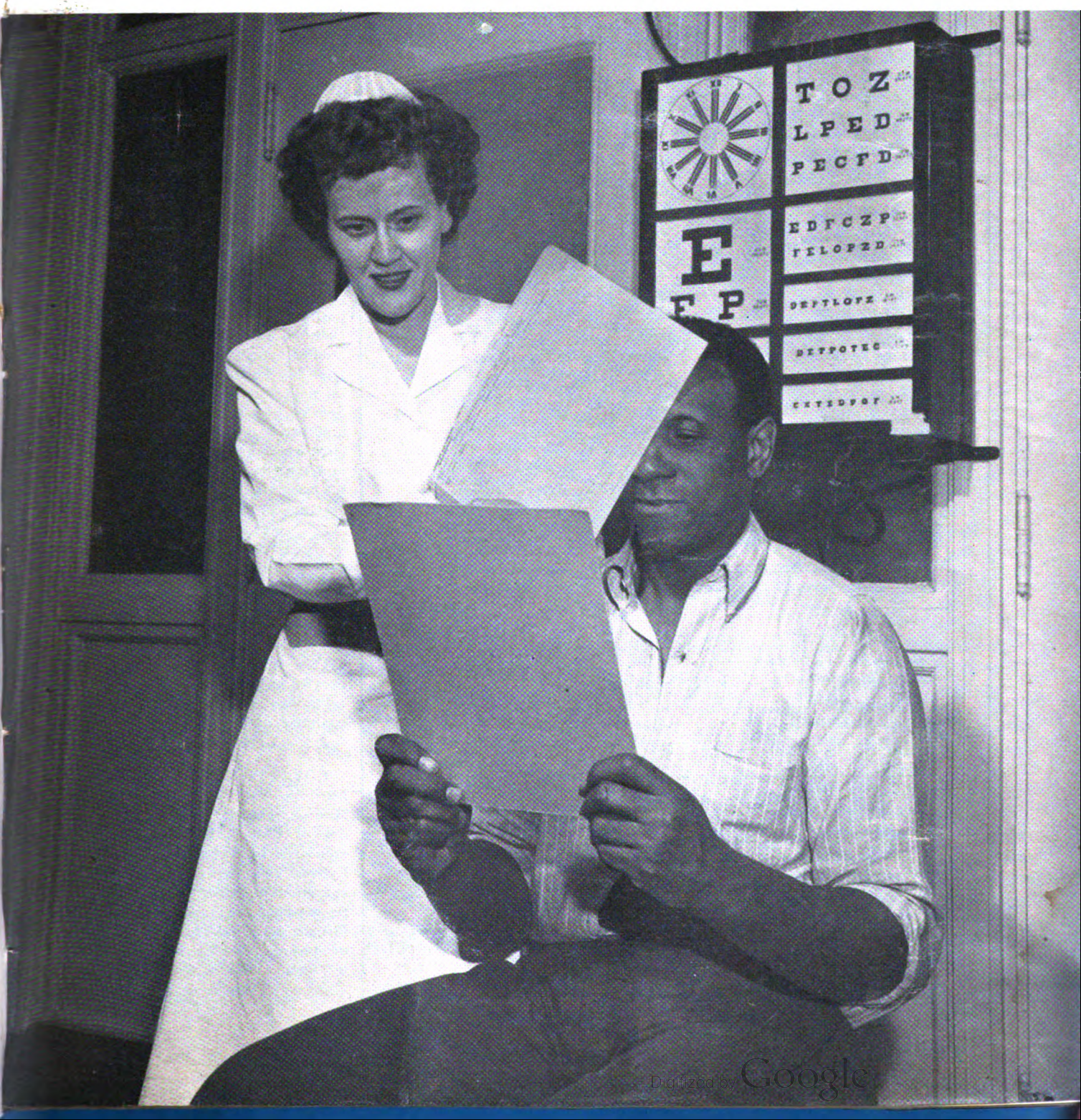

INDUSTRIAL HEALTH MONTHLY

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Public Health Service
Division of Industrial Hygiene

FEATURES—Indiana Issue

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Articles in this publication are indexed in the *Current List of Medical Literature.*

The printing of this publication has been approved by the Director of the Bureau of the Budget, March 16, 1951

Dr. Dale Cameron New Staff Member, Division of Industrial Hygiene, PHS

DR. DALE C. CAMERON has been appointed to the position of chief of the Cooperative Health Services Branch of the Division of Industrial Hygiene, PHS.

Formerly assistant director of the National Institute of Mental Health, Dr. Cameron has recently completed a 1-year postgraduate course at the Johns Hopkins University School of Hygiene and Public Health, where he was awarded the degree of Master of Public Health. Prior to that, he served for 1 year as consultant to the fact-finding staff of the Midcentury White House Conference on Children and Youth, assisting in the preparation of the health section of the fact-finding report.

A native of Hendley, Nebr., Dr. Cameron took his B. A. degree in 1933 and his M. D. degree in 1936 at the University of Nebraska. He then interned at the U. S. Marine Hospital at San Francisco and served successively at marine hospitals at Evansville, Ind., and New Orleans, La. After training in field studies and investigations at the Colorado Psychopathic Hospital at Denver, he was assigned to the Public Health Service hospital at Fort Worth, Tex., and then to the U. S. Coast Guard Academy, where he specialized in psychiatry and surgery. He last held the position of assistant director of the National Institute of Mental Health.

Dr. Seward E. Miller, chief, Division of Industrial Hygiene, Public Health Service, said that Dr. Cameron's rich background in psychiatry will be drawn on heavily in the development of a program of mental health and human relations in industry.

"The interest of the Public Health Service in such a program," Dr. Miller said, "has been given impetus through recommendations of the Advisory Com-

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COVER PICTURE—Miss Eve Caton, head nurse at the American Can Co.'s Hudson plant in Jersey City, N. J., is one of the 12,000 registered nurses employed by United States industries. Eye testing is part of the preplacement examinations given by the plants that try to match the man for the job. Jim Parker, after passing both the regular eye test and the close reading test, went to work in the shipping department. Courtesy of the American Can Co.

INDIANA PHYSICIAN REPORTS ON FIVE YEARS OF EXPERIENCE WITH EMPLOYEE HEALTH SERVICE*

THE EMPLOYEE health service of the Indiana State Board of Health was started on January 1, 1945. The objectives outlined in 1945 have been fulfilled, and the program has expanded from the standpoint of service, budgets, and space allotment.

By way of review, the program includes preplacement medical examinations of all new employees, record keeping, medical care of occupational injuries and diseases, immunization programs, and industrial toxicological consultation to all division and bureau directors. This last service is particularly valuable to laboratory directors when new laboratory procedures are contemplated.

The present population is 425 employees, of which 60 percent are women. About 325 are housed in our central building, and the others are in the five branch offices located throughout the State.

Five-Year Summary

During this period a total of 5,015 services were given through this program. Of these, 447 were complete preplacement examinations. As a result of such examinations, we found that we had to reject, for medical reasons, only one applicant who had an open case of tuberculosis. Thus, when one is looking for *abilities* instead of *disabilities*, one finds that the rejection rate can be very low. Of the persons with disabilities, we hired 17 with cases of arrested tuberculosis, 3 with diabetes, 5 with advanced heart diseases, 10 with severe hypertension, and 3 with severe paralysis from polio, one of which is a wheelchair case. An epileptic and a deaf mute have also been hired. All have been placed by our Personnel Division on jobs compatible with their disabilities.

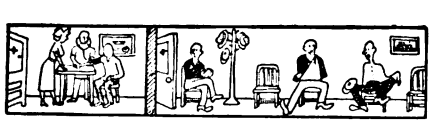
In this period of time, 2,409 70-millimeter chest films were taken as a screening procedure. On follow-up of the suspicious films, four active cases of tuberculosis were found. All were minimal lesions, and the patients were not ill at the time of the yearly routine chest survey. One patient was a physician, and the other three were laboratory workers. In each instance, the tuberculosis was arrested in less than 2 years. During the course of a year, no contact cases were found through X-ray surveys conducted every 3 months.

Because of the rather high incidence of active tuberculosis found as well as other pulmonary pathology, such as metastatic and primary cancers of the chest, we are of the belief that routine X-rays should be done every 6 months. The findings noted occurred during the 12-month interval between films. By decreasing the interval to 6 months, we may be able to pick up the early malignant lesions which we have not done to date.

In addition to the annual chest survey, the preventive medical program calls for routine immunization of all field personnel for typhoid, tetanus, and smallpox. Some personnel, on a volunteer basis, have been given influenza vaccine for the past 3 years.

The chief occupational diseases uncovered in this 5-year period were dermatitis, brucellosis, typhoid, tuberculosis, rabies, carbon monoxide poisoning, X-ray anemias, heat exhaustion, and the other illnesses to which a person may be exposed in a chemical laboratory. The common occupational injuries were 343 lacerations including two cut tendons, 49 burns, 20 foot injuries, 67 eye injuries, 3 back injuries, and 2 hernias.

In the 5-year period we have had 16 compensation cases. Fifteen were based on injuries, and one involved tuberculosis of the chest in a laboratory worker working with bacillus tuberculosis. Of a total of $12,349.50 spent on this group, $6,600.00 was paid as disability claims, and the remainder was for hospital and referred medical services. Cases included back injuries in auto accidents, hernias, fractured arm, sprained wrist and ankle, and chest injuries, all sustained while on duty.



Health Service for All Employees

These facts serve as illustrations that organizations such as State boards of health have as many industrial medical problems as would a small plant of comparable size. In most agencies of this type the basic framework for the proper care of such situations exists in the industrial hygiene division, and in my opinion such services should be available to the employees. We recommend such procedures to private industries—why not do it ourselves?

At the beginning of the program, we stated that such an installation can be a laboratory for the physician and the nurse wherein they may work out new techniques. This point can be illustrated by the fact that we changed our record system three times and our eye testing procedure four times, revised our drug list four times, and completely changed our physical plant twice to insure more privacy and flow of work. In a plant, changes cannot readily be made, but in a laboratory such as this, one can do it at will and thus arrive at a satisfactory solution to the problem under question.

When industry first became concerned about influenza vaccine, particularly from the standpoint of reactions and time loss, we used this "laboratory" to get our own answers. We asked for volunteers among our employees, and 124 responded. Each individual was given 1 cc. of influenza vaccine (centrifuged) and a 3 by 5 card with his name on it. He was requested to jot down all reactions on this card and to return it within 2 days.

Summary of the data turned in showed that 52 percent reported no reactions, while 48 percent reported one or more reactions. Of the group reporting reactions, 88 percent noted "sore arm" as the only reaction, while the rest reported multiple generalized reactions such as muscle aches, temperature, and nausea. Only four persons lost time. Two lost one day each, and two lost one-half day each. Of the 124 persons in this series, we found that some 3 percent may be expected to lose one-half day to one day from this procedure. Thus, with these data, we felt

*Speech given at Industrial Health Conference, Atlantic City, N. J., by Louis W. Spolyar, M. D., Director, Division of Industrial Hygiene, Indiana State Board of Health.

that we could advise industry to undertake such immunizations if an influenza epidemic appeared likely.

Administrative Details

There is no specific budget for this employee health service covering equipment, drugs, services, and compensation claims. These are paid from the so-called other operating funds of the State board of health, thus no charges are made against the Division of Industrial Hygiene budget. Over the 5-year period, the cost of this service was $6.50 per employee per year. This does not include fixed charges, such as salaries of clerical or professional personnel. If one were to prorate such charges, then the unit employee cost per year would be approximately $10, which is less than most private industrial groups spend.

The case load averages 6 people per day and 10 minutes per case. Redressings may take a few minutes, whereas physical examinations may take 30 to 45 minutes.

So much for the work done. What are some of the headaches? First, it takes at least an hour a day out of the physician's time from a schedule that is already crowded with field work, administration, reports, conferences, meetings, and teachings. This can be a real problem unless work is delegated to other divisions and associated personnel. The Tuberculosis Control Division should schedule, take, and read all chest X-rays. Other physicians on the staff must pinch-hit in the medical department when one is busy or out, and arrangements must be made to refer some of the compensation work to private physicians. The Nursing Division should assist with the various routine nursing problems.

Another and a very important headache is the number of office calls that come in on purely personal matters. Employees report injuries that occurred at home for which they want treatment at the Board of Health. They request various prescriptions or ask for a diagnosis of nonindustrial illness and treatment. It is difficult to set and carry out a firm policy of rejecting any such work; but, unless it is done, the industrial hygiene physician is swamped with work that belongs to the family physician. Sound and ethical medical relationships must exist with medical

(Continued on page 119)

Three Men Overcome by Hydrogen Sulfide in Starch Plant

By Louis W. Spolyar, M. D.*

WHILE draining a gluten vat in a starch manufacturing plant, three men were overcome from what appeared to be a hydrogen sulfide exposure. Final cleaning of this wooden 12-foot tank (see photograph) was accomplished by having a man go into the tank to remove the sludge from the drain. This procedure was undertaken at 8 p. m. after all the liquid was drained, and by 8 : 25 p. m. this employee "passed out" in the bottom of the tank.

*Director, Division of Industrial Hygiene, Indiana State Board of Health, Indianapolis.

The night supervisor saw the man slump, and he promptly went into the tank to remove the helpless employee. After placing the unconscious man on his shoulder, the supervisor ascended the ladder, but as he neared the top of the ladder, he lost consciousness and both men fell back into the tank.

An employee watching this procedure immediately left to get more help. In the meantime, another employee came into this area, found the two men in the tank, and promptly went into the tank after them, only to succumb shortly. When the rescue party and

An unconscious worker, overcome by hydrogen sulfide, is removed from a wooden gluten vat. Photograph by courtesy of *Indianapolis Star*.

police emergency squad arrived, oxygen-containing masks were used, and the men were removed from the tank. The police emergency rescue squad applied artificial respiration, following which all three were promptly placed in ambulances and sent to the hospital.

En route to the hospital, the man who entered the tank to rescue the first worker died. Clinically, the two surviving men were unconscious for 2 days and showed marked respiratory embarrassment. A working diagnosis of hydrogen sulfide poisoning was made, and they were treated accordingly.

Autopsy revealed a skull fracture as the cause of death of the one employee. The fracture was sustained as he fell into the tank while ascending the ladder. The two surviving men made a complete recovery in 7 days.

Since the tank was aerated immediately after removal of the men, all field studies were deferred to the following morning. Studies showed no more than 10 p. p. m. H_2S in the vat at that time. Samples of the sludge were taken to the laboratory for further studies. A 200-gram sample was placed in a 5-liter jar, and within 4 hours 300 p. p. m. H_2S was demonstrated. After nine hours, concentrations exceeding 400 p. p. m. were found. No sulfur dioxide was found.

A sample of the material was sent to the bacteriological laboratory for further study. Dr. S. R. Damon reported the following: "The first sample received was a fluid collected from the adjoining vat and from this no organisms were recovered which were characterized by their production of hydrogen sulfide."

The second specimen received was sludge collected from the bottom of the vat in which one or more workmen had been overcome by H_2S gas. From this sample we isolated several different kinds of organisms, but none of the bacteria was notable for H_2S production. A fungus was also recovered which produced large amounts of H_2S in culture. This fungus has been identified as of the Goetrichum species.

Following this study, it was found that this tank had been idle for 10 days whereas normally it was emptied every 2 or 3 days. The foreman had been out for a few weeks due to a heart attack, and this caused production changes, such as not using the tank. To prevent a similar instance from occurring again, safe procedures were developed through a conference with the plant and State Health and Labor departments.

Epidemiological and clinical findings lead us to believe that these workers were exposed to sublethal concentrations of hydrogen sulfide. From laboratory studies one gains the impression that the hydrogen sulfide may have been generated by the Goetrichum species of fungus.

Study of Building Brick Industry in Indiana Reveals Need for Dust Control*

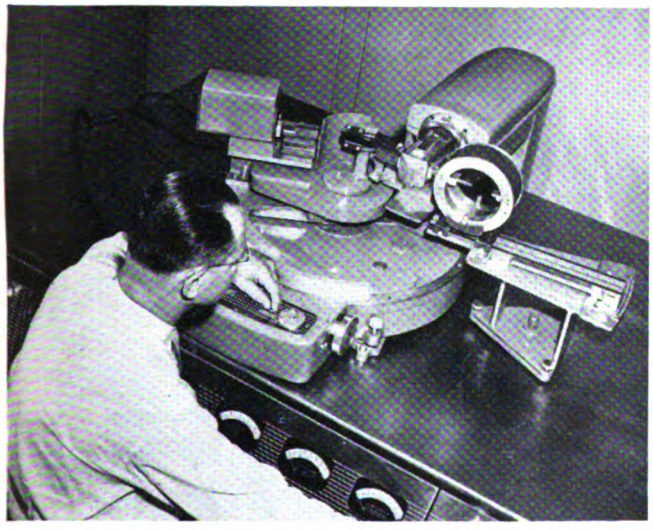
A DUST study made in 22 Indiana plants manufacturing common brick revealed dust concentrations well above the allowable limit, resulting in the widespread adoption of dust-control methods to protect the 1,425 workers employed in these plants.

The study was made by industrial hygienists in the Indiana State Board of Health after a preliminary analysis showed that the free silica content of the clays used in one plant varied from 35 to 40 percent. These figures are much higher than any reported in the literature.

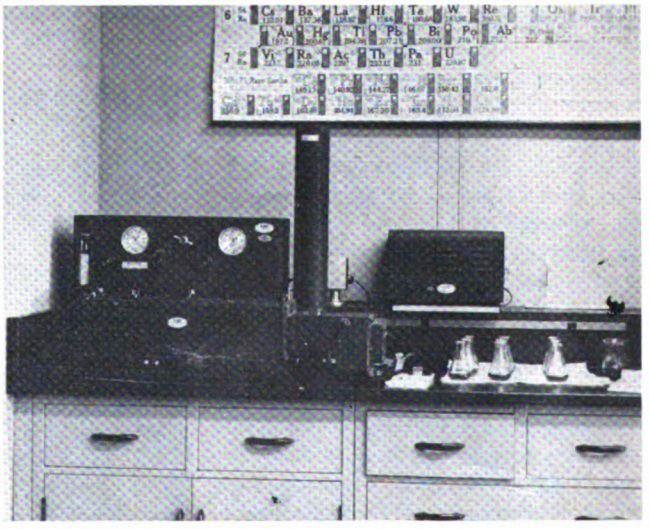
According to the standards promulgated by the American Conference of Governmental Industrial Hygienists, the allowable atmospheric concentration of dust recommended is 20 m. p. p. c. f. when the free silica content of the dust varies between 5 and 50 percent. Dust concentrations exceeding this figure were found in nearly all operations in the Indiana brick industry.

Two hundred ninety-six dust counts and 96 free-silica determinations were reported. The dust counts varied from

*** An article on this study appeared in *Archives of Industrial Hygiene and Occupational Medicine*, December 1950. Reprints are available from Dr. L. W. Spolyar, Indiana State Board of Health, Indianapolis 7, Ind.**



Dr. L. W. Spolyar, director of the Division of Industrial Hygiene, Indiana State Board of Health, at work on the new X-ray diffraction machine which is used for the analysis of crystalline materials. Courtesy of the *Indianapolis Star*.



The spectrophotometer is another piece of new equipment recently installed in the Indiana Industrial Hygiene Laboratory, now located in a new building at 1330 West Michigan Street, in Indianapolis.

5 to 7,000 m. p. p. c. f. The free silica content of the clays and shales varied from 20 to 47 percent.

The following recommendations were made for controlling the dust problems in this industry:

(1) The possibility of sprinkling the raw materials with water or wetting agents prior to dumping at the crusher should be investigated. This would reduce the dust loading not only at the crusher but at subsequent operations.

(2) Crushers, dry pans, and mullers should be isolated, partially or totally enclosed, and exhausted. In other industries using similar equipment, enclosure and local exhaust ventilation have been successfully applied.

(3) All screens should be isolated, totally enclosed, and exhausted.

(4) All conveyors and elevators, whether belt, bucket, or screw, should be enclosed and exhausted.

(5) All pug mills should be exhausted.

(6) Owing to the high dust concentrations in the air exhausted from the various operations, suitable dust-collecting devices should be incorporated in the ventilation system. With failure to do this, not only may an atmospheric pollution problem be created, but also the dust-laden air may be drawn back into the plant because of the presence of ventilation equipment within.

(7) The use of a portable exhauster for exhausting a kiln during stacking and unloading should be investigated. A portable exhauster may be mounted on a dolly. This could be equipped with permanent piping except for a short section of flexible pipe which would be inserted into the roof opening of the kiln. The size of the exhauster will vary with the size of the kiln; however, an exhauster with a capacity of 5,000 to 10,000 c. f. m. would be ample in most cases.

(8) Only washed sand should be used as a dusting material in the kilns.

(9) Workers who must work in dry pan or muller pits or who must clean kilns should wear United States Bureau of Mines approved type A respirators.

(10) Floors should be constructed of impervious materials to facilitate cleaning. Floors should be cleaned at least once per shift.

(11) The superstructure should be cleaned at least once a year.

Generation of Phosgene in Degreasing Operation Causes Death of Indiana Man*

By Louis W. Spolyar, M.D.; J. F. Keppler, B. Ch.E.; H. E. Bumsted, B. Ch.E.; and R. N. Harger, Ph.D.[1]

BECAUSE of a group of unusual circumstances, a man was accidentally exposed to a lethal concentration of phosgene while installing and operating a chlorinated solvent degreaser.

It happened this way. The manager of a small plant had purchased a second-hand chlorinated hydrocarbon degreaser and some used solvent directly from another establishment located in a nearby Indiana city. An employee of the receiving plant was then ordered to install the machine in a recently purchased small, one-story frame house located behind the plant. The house, a five-story dwelling, was converted for industrial use by removing all the room partitions, thus producing one large room some 25 feet wide and 40 feet long. The degreaser was installed along the south wall of this room near a double set of windows.

Installation by this employee and his helper began at 7 a. m. Within half an hour, the machine had been installed and some 7 to 12 gallons of the used solvent had been poured in. This produced a fluid level slightly above the electric hairpin coils on the bottom of the tank. When the solvent began to boil, the two men started to degrease a basket of small aluminum disks. During this initial trial run, the electricity would "kick off" frequently. At 8:30 a. m., the helper left and went into the main plant. The one employee was alone in this building for the rest of the morning.

At 10 a. m., the employee working on the tank also went to the main plant and reported that fumes were escaping from this tank and he wanted the manager's opinion as to whether or not he should connect the water line to the copper coils so as to obtain condensation. The vendor plant had informed the receivers that the coils would help reduce fumes if they got into trouble. The plant manager told the employee to turn off the machine and that he would personally investigate this problem later. Whether or not the tank was turned off at that time is a point that cannot be established because the operator died within an hour after conference with the manager.

Summary

Through a series of errors, trichlorethylene was used in a perchlorethy-

*Printed in full under the title "Generation of Phosgene During Operation of Trichlorethylene Degreaser" in *Archives of Industrial Hygiene and Occupational Medicine.*

[1] Dr. Spolyar, Mr. Keppler, and Mr. Bumsted are with the Division of Industrial Hygiene, Indiana State Board of Health.

Dr. Harger is consultant in industrial toxicology to the Indiana State Board of Health and professor of toxicology, Indiana University School of Medicine.

lene tank on which the electric limit controls were set for perchlorethylene. The sump thermostat was broken. A space heater was located near the tank and the temperature of the space heater and stack gases (about 920° according to the manufacturer) was not enough to break down trichlorethylene to phosgene, the break-down temperature being 752° to 932° F. Under test conditions, high concentrations of phosgene and trichlorethylene were found. Under adverse weather conditions, back pressure in the stack smoke pipe could develop. The stack barely protruded through the roof and was so located as to produce poor draft. The autopsy findings were consistent with exposure to phosgene although circulatory collapse from trichlorethylene must be considered as a possible cause of death.

EMPLOYEE HEALTH—

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colleagues, else the entire program is likely to fall through. This situation is not peculiar to official agencies. The same problems exist in the plant medical departments. Thus, at first hand, the industrial hygiene physician actually sees and works with problems that the plant physician has each day. He gets a glimpse of industrial medicine, as is, and not what he may think it is from textbooks and conferences. With this in mind and experience gained he becomes a better consultant.

Such services are sound and well within the reach of most States where the basic framework is set up in the industrial hygiene departments. The "know-how" of what constitutes good industrial medical service is present and, if applied, equals that found in any private industrial program. Based on standards developed by the American College of Surgeons, our service has been certified as adequate and acceptable. This point is made merely as an illustration, to *emphasize* that every medical director can use his experience in his own State organization to develop an acceptable medical service as measured by standards applicable to all industrial groups. In summary, then, I am still of the opinion that we should practice what we preach and do the very things we advocate that private industrial groups do—render an industrial medical service to all workers.

Indiana Worker Dead From Accidental Exposure to 2-Amino Pyridine

WHILE attending a production fractionating column, an 18-year-old employee accidently spilled a galvanized bucket full of 2-amino pyridine over his arms and lower extremities. The bucket was used as the receiving receptacle for the 2-amino pyridine as it came off the distillation column. This occurred at 10:30 p. m., May 1. The employee continued to work in wet overalls until midnight, and then went home. By 2 a. m., May 2, he became ill, the illness being manifested by dizziness, headache, difficulty in breathing, semiconsciousness, and mild convulsions. He was promptly hospitalized, and during his stay in the hospital he developed increased respiratory difficulty, cyanosis, and unconsciousness. The patient died at 6 a. m. on May 3, and was autopsied at 9 a. m. on the same day. Grossly the autopsy showed engorgement of all cerebral vessels, hepatization of the lungs, hemorrhage in the liver, and a mildly dilated heart. Microscopic sections have not been studied.

Very little information was found on the toxicity of 2-amino pyridine. It appears that the chemical may be a pulmonary irritant and also possibly a depressant to the respiratory center. Studies reported on frogs and cats indicate that it is toxic even if not lethal.

This chemical is liquid as it leaves the fractionating column and then quickly crystallizes on cooling. The crystals are then shoveled into a centrifuge and all excess liquor extracted in this fashion. To minimize the hazard in the future, the employees were again instructed to immediately wash if skin contact was experienced. Further, the chemical was collected in a drum as it left the still, thus avoiding further handling in the liquid stage. Local exhaust systems are being designed for the effluent end of the still and for the centrifuge operation.

Whether or not skin absorption occurs could not be established in the literature or through this case. Skin of this patient appeared normal. Due to the fact that this compound readily vaporizes, it may be assumed that the respiratory hazard is the greatest. We believe that all such exposures should be adequately controlled by good engineering practices and by prompt attention to personal hygiene.—Louis W. Spolyar, M. D., Director, Division of Industrial Hygiene, Indiana State Board of Health, Indianapolis.

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CADMIUM THE KILLER

By Walter H. Poppe, Jr.*

In Wisconsin since the first of this year, there have been two industrial deaths attributed to the inhalation of cadmium fumes. This is a very alarming fact when one considers that medical literature reports only 60 such cadmium poisoning cases from the years 1858 to 1945 and that only 10 of these cases resulted in fatalities (*1, 2*).

Cadmium is widely used for electroplating other metals. It produces a silver-white coating that takes a high polish and protects the base metal from corrosion. Plating with cadmium does not create any more of a health hazard than plating with many other commonly used metals. The trouble starts when heat is applied to metallic cadmium or its salts, either with a welding torch or by some other means. The two deaths which occurred in Wisconsin this year will illustrate this point.

In the first case, a cadmium-plating tank was being changed over for use as a zinc tank. There was a coating of cadmium, probably cadmium salts, on the lining of the tank which did not yield easily to scraping or chipping. An employee resorted to the use of an acetylene torch and his death resulted.

In the second case, an employee was engaged in spot welding cadmium plated steel. He died in a hospital 6 days after his exposure to the fumes which resulted from this application of heat to cadmium.

If the extremely toxic nature of cadmium fumes had been appreciated and proper local exhaust ventilation or approved type respirators had been used in conformance with the *General Orders on Dusts, Fumes and Gases* issued by the Industrial Commission, these men would not have died.

Cadmium-plated metals can be confused easily with electro-plated zinc coated metals; but, unlike zinc, the oxide of cadmium formed when the metal is heated in air is brown, while the similar oxide of zinc is white. Thus, cadmium provides its own mark of identification.

Should there be any doubt in anyone's mind whether a metal is cadmium or zinc plated, a sample of the metal in question should be submitted to a competent chemical laboratory for analysis. Welding should never be performed on a metal or plated metal of an unknown identity.

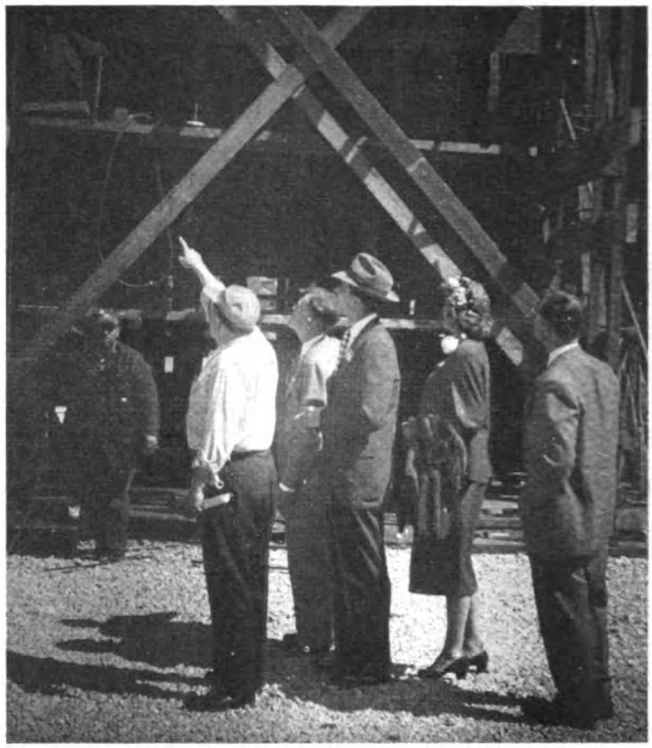
There are spot checks that can help to determine whether or not a piece of metal is cadmium or zinc coated. A cadmium plated object will form a yellow-gold film when heated gently with a welding torch, whereas a zinc coated object will turn smoky dark gray. Another method is to apply a drop of concentrated hydrochloric acid on the metal surface; then allow a few seconds for the acid to dissolve the coating. To the spot where acid was applied, add a drop of ammonium hydroxide which has been saturated with hydrogen sulfide. A bright yellow precipitate will indicate the coating is cadmium, while a white precipitate will indicate a zinc coating.

Feigl suggests the use of diphenylcarbazide (*3*). An alcohol solution of this material buffered with a saturated aqueous sodium acetate solution will form a red-violet precipitate in the presence of cadmium, while no precipitate is formed in the presence of zinc.

It is recommended that these spot tests be used on known pieces of cadmium and zinc-plated materials so that

*Mr. Poppe is an engineer with the Industrial Hygiene Division, Wisconsin State Board of Health, Madison 2. This article was printed in two State publications, *Wisconsin Nurses in Industry* and *Wisconsin Safety News*, to warn as many persons as possible of the dangers of applying heat to cadmium without proper protection.

Wisconsin Physicians and Nurses Tour Plants



Tours through Wisconsin plants were an important part of the 1951 in-plant clinics arranged for physicians, nurses, and others interested in industrial health and safety. The Marathon Paper Co., Allis-Chalmers Manufacturing Co., Aluminum Goods Manufacturing Co., and the Manitowoc Shipbuilding Co. were hosts for the plant tours. Attention was focused on potential health hazards, particularly occupational diseases that might result from exposure to certain hazardous substances.

Two-hour scientific sessions and dinner meetings followed the tours. Some of the subjects covered were these: Pitfalls in medical testimony, changes in the Wisconsin Workmen's Compensation Act, varicose veins and their association with industrial disabilities, and pneumoconiosis.

Sponsors for the clinics were the Wisconsin State Medical Society, the Industrial Hygiene Division of the Wisconsin Board of Health and the Industrial Nurses' Section of the State Nurses' Association.

the user will become familiar with the results and be able to distinguish the difference between these two metals. Do not take it for granted that box labels are correct. Boxes labeled cadmium-plated may contain zinc-plated objects, and the same may be true of boxes labeled zinc-plated.

The maximum allowable concentration for chronic or prolonged exposure to cadmium has been set at 0.1 milligram per cubic meter of air. While there is some disagreement on this limit between authorities in the field of toxicology, there can be no mistake about the effects of acute exposure to high concentrations of the fumes of this metal. They are often fatal.

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NEW STAFF MEMBER—

(Continued from page 114)

mittee to the Public Health Service on Industrial Hygiene, urging that studies be conducted in this field. The strain of increased defense production adds a further compelling note to the need for work in mental health in industry. We are fortunate in obtaining the services of such a highly qualified officer to initiate these studies and to develop preventive techniques."

In addition to this new activity, Dr. Miller added, Dr. Cameron will be responsible for the review of State plans and programs in industrial hygiene, the supervision of statistical studies and analyses, the development of informational and educational programs aimed at protecting the health of the worker, and the promotion of the increasingly important and expanding studies of industrial medical care services.

Dr. Cameron is a Fellow of the American Psychiatric Association, and a member of the American Medical Association, the Group for the Advancement of Psychiatry, and the Southern Psychiatric Association.

*"HAVE YOU A PROBLEM TO AIR?"**

By Edward J. Otterson [1]

IF YOU want to try to correct an air problem in your plant, you should be insistent that the installation is properly designed and will definitely correct the problem. That is just common sense, you may say. But many exhaust systems in plants have been found to be mere figureheads.

A classic example of this was found in one plant that was attempting to exhaust solvent fumes. Canopy hoods hung above the tables. The hood ducts ran over and stopped with their open ends a foot short of a time-honored wall fan. The fan was valiantly but hopelessly trying to bridge the gap. It would be much the same thing as running a water pump with a length of pipe missing and hoping, that by some strange miracle, the water would flow from the pipe to the pump.

There is nothing too mysterious about exhaust systems. The Industrial Commission has embodied in its code on "Dusts, Fumes, Vapors, and Gases" two essential requirements which, when applied, will aid in obtaining satisfactory results. These two factors, found in Order 2016, specify the required air velocity at the point where it enters the hood and the static pressure, or so-called "suction," in the ducts. They boil down to this.

The velocity of the air traveling toward the hood should be high enough to capture the offending dusts or other contaminants and remove them from the plant atmosphere. That is requirement number one and is exactly why you are installing the equipment in the first place. If it will not do this, you might as well shut off the fan and save what little you can on your heating bill.

Static pressure, the other "must," is a direct function of the air velocity in the duct. The higher the static pressure, the faster the air is traveling through the duct. This is important, particularly in the case of dusts, where the air velocity must be high enough to transport the dust to the collector. Too low an air velocity results in dust accumulation at various points in the system, until the duct becomes plugged. This can be doubly troublesome when the dust is combustible, thus producing a fire hazard.

The static pressure, since it is an indication of the air velocity in the duct, also has a relationship to the rate of air movement into the hood. For any given hood, the higher the static pressure in the hood duct, the faster the air contaminant will move into the hood. This air movement, or "face-velocity," is defined as "the velocity of air motion in the plane area within the outer run or edges of the hood and at all points of the source of contamination."

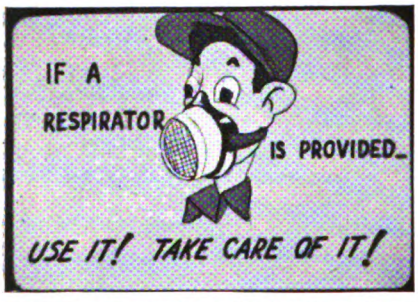
In other words, if you have a 5-foot-square hood open on all sides and 3 feet above the table top, you have four plane areas, each equal to 15 square feet. If the hood is lowered to within 2 feet of the table top, each plane area is now equal to 10 square feet. What essentially has happened is that you have decreased the areas that a given amount of air must pass through as it enters the hood and thus have caused it to move faster. Bringing two sides of the hood down to the table top will halve the plane area or double the air velocity at the plane area.

Then, last but not least, put the exhaust hood as close as possible to the contaminant that is being given off. By doing this, you will capture the contaminant at its source. When your wife cleans her rugs, she puts the vacuum cleaner down on the rug where the dirt is. You would not expect her to do a very good job of cleaning if she walked around the room holding the vacuum cleaner 3 feet off the floor. You would expect even less cleaning to take place if she walked over, turned on a wall fan and then stood, expectantly waiting for the dust and dirt to whisk out of the rug and be gone.

So when you have a local exhaust ventilation problem, be certain that whoever is going to design it is aware of the Industrial Commission codes. Send in the plans, in triplicate, to the Industrial Commission for approval. It is better to get rid of a headache than to add to the one you already have.

***Wisconsin Safety News*, April–May–June 1951.**

[1] Mr. Otterson is an engineer with the Industrial Hygiene Division, State Board of Health, Madison, Wis.



Texas Uses Cartoon Color Slides on Radiation Safety Programs in Plants

HOW far a worker can go with radiations before he gets into trouble is depicted in a series of humorous cartoon color slides recently made by the Industrial Hygiene Section of the Texas State Department of Health.

The message contained in each slide is entirely factual, written in simple diction to interest the employee and obtain his cooperation in protecting himself against harmful radiations.

The slides may be borrowed from the Texas District engineering offices in Austin, Fort Worth, and San Antonio. They are available for short loans from Mr. Pope Lawrence, Division of Occupational Health, Utah Department of Health, State Capitol, Salt Lake City 1, Utah; and Mr. Simon Kinsman, Radiological Health Training Section, Environmental Health Center, Public Health Service, 1014 Broadway, Cincinnati 2, Ohio.

Texas Conference on Industrial Health Set for September 27–29

THE FOURTH Annual Gulf Coast Regional Conference on Industrial Health will be held September 27 through the 29th in the Rice Hotel at Houston, Tex. The Houston Chamber of Commerce is one of the conference's principal sponsors.

Sessions on industrial health and on industrial wastes and stream pollution will be held concurrently on September 28, while the September 29 sessions will be devoted to industrial nursing subjects. In 1950 more than 400 persons attended the conference.

Detailed programs of the meetings may be obtained from the Texas State Department of Health, 410 East Fifth Street, Austin 2, Tex.

Air Sampling Instruments Studied by Committee

A 39-PAGE report was made by the Committee on the Standardization of Air Sampling Instruments at the thirteenth annual meeting of the American Conference of Governmental Industrial Hygienists. Chairman of the committee was H. E. Bumsted, engineer with the Division of Industrial Hygiene, Indiana State Board of Health.

Published papers, questionnaires, and personal experiences were used as a source of information for the report, which is divided into four main sections, namely:

(1) Stack sampling methods and instruments.

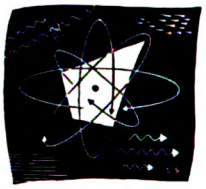
(2) Further studies on the M. S. A. electrostatic precipitator.

(3) Report on mobile lead analyzer.

(4) Reported troubles with field instruments.

Texas Civilian Defense Instructors Take Course On Radiological Health

A SPECIALIZED short course covering radiological health problems is being offered to persons responsible for civilian defense training in Texas by the State health department. The first course was given June 11 to 15, the second, July 9 to 14, and the third, August 13 to 18.



The course is designed to indoctrinate supervisory personnel and local instructors with the essentials of radiological defense and to enable them to conduct educational and training programs in radiological monitoring within their own geographical area, industry, or department.

Those persons eligible to attend are:

(1) Supervisory or professional personnel of local health departments.

(2) Representatives of counties or cities where radiological defense is not vested in local health department.

(3) Representative of State departments engaged in civilian defense.

(4) Fire or police training officers or instructors.

(5) Members of industrial medical or safety departments contemplating an in-plant program.

The programs cover basic theory of radiation and radiation detecting instruments, the use and maintenance of instruments, the harmful effects of radiation, radiation protection, and recommended permissible radiation dosages. Lectures are supplemented by laboratory work and practical exercises in calibration and application. Time is alloted to a review of basic physics, chemistry, and mathematics required for essential calculations. While previous education in any of the natural sciences is quite helpful, every effort is made to begin each topic with a sufficiently elementary introduction to establish a sound and clarifying background for the specialized subject matter. Films and other training aids are used to acquaint future instructors of the existence of this material.

CALIFORNIA

Community Action. — The Sacramento League of Women Voters promoted interest in the industrial health of their community by requesting the Bureau of Adult Health to supply a speaker to discuss the problems. As a result, a meeting was held at which representatives from the League, the Community Welfare Council, the Chamber of Commerce, the County Medical Society, and the local health department participated. A probable result of the conference will be the establishment of a broad committee to review the situation in Sacramento and to work closely with the health officer in developing interest in improving health in industries. It is hoped that this will be followed by specific fact-finding studies of industrial health in Sacramento and a well-planned program integrating all of the community resources.

Local Health Departments.—A number of local health departments in California, in addition to Los Angeles City and County, now have some activities in industrial health. Oakland City Health Department has a sanitarian who has had experience in the field and is competent to carry out many industrial hygiene procedures. San Mateo has recently set up the position of Industrial Hygienist and, it is hoped, will shortly fill it. San Diego some time ago employed a public health engineer who hopes to devote some time to industrial hygiene. This department has been keenly interested in the field, and its nurses, sanitarians, and physicians have been involved at one time or another in specific activities.

X-ray Survey.—Early results from the mass X-ray survey in Contra Costa have already yielded a surprisingly large number of occupational diseases of the chest, including silicosis and silico-tuberculosis. Occupational histories are being taken, and visits to the patients' physicians are being made by one of the Bureau's physicians. The response has thus far been excellent. A final report on this project will be prepared upon completion of the analysis of the data.

Multiphasic Project.—Last year the International Longshoremen's Union and Waterfront Employers concluded an agreement to set up a health fund for medical care. In California, the contract for care was given to the Permanente Health Plan. The health fund then approached the State Health Department for advice concerning the taking of a multiphasic health inventory of longshoremen in the bay area. After some months of delay, activity was recently renewed, and several meetings have been held to plan the project.

Participating in the meetings have been representatives of the fund, the union, the Permanente Hospital, the United States Public Health Service, the State Health Department, and the State Bureau of Vocational Rehabilitation. Items to be included in the study will be: history, chest film, blood sugar, serologic test for syphilis, electrocardiogram, hemoglobin, blood pressure, and urine analysis. Site of the project will probably be the union's hiring hall. It is scheduled to start in early summer, 1951. Planning for utilization of resources and personnel is now in progress.

LOS ANGELES (City)

Occupational Disease Reports—In a group of reports most recently analyzed, there was an unusually large number of severe cases of occupational diseases. The causes were carbon monoxide, carbon tetrachloride, perchlorethylene, cyanide, carbon dioxide (from dry ice), and beryllium (fluorescent lamp).

A high proportion of occupational dermatitis cases was also reported. Some of the causes listed were fiberglass, shoe cement, cleaning solvent, car polish, sycamore trees, sulfur dioxide in pipeline, and harsh soap in a factory washroom.

One of a few other interesting cases was a report of post-traumatic nerve deafness in one ear of a worker who was assigned to cleaning boiler tubes with an air drill. Another was a report of pharyngitis in an electrotyper who was operating a silver nitrate solution. Reports in the realm of oddities were: (1) Dermatitis involving 7 days' lost time attributed to use of drawing pencils; (2) 14 to 21 days' lost time by a laborer who developed chemical burns on the hands from use of a tar derivative and other substances employed in beautifying dogs.

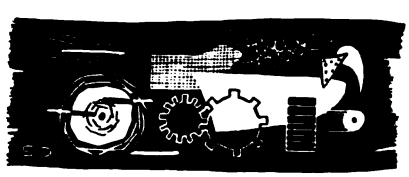
MASSACHUSETTS

Personnel. — Engineer Richard I. Chamberlin has resigned from the staff of the Massachusetts Division of Occupational Hygiene to accept a position with an insurance firm.

Enrique Quino, as an exchange student with the Institute of Inter-American Affairs, has been spending a month observing and studying the field and laboratory methods used by the chemists in the Massachusetts Division of Occupational Hygiene. Upon his return to Lima, Peru, Mr. Quino will be employed in industrial hygiene activities.

Training—The staff of the Massachusetts Division of Occupational Hygiene will hold a session on industrial hygiene on Thursday afternoon, August 9, at the University of Massachusetts in Amherst. This is part of a summer field training course for students at the New England Field Training Center.

Industrial Nurse Consultants Sarah E. Almeida, R. N., and Gertrude J. Hornung, R. N., have completed a 2-semester-hour course in "Occupational Diseases and Injuries." This advanced course for nurses in industry was given by Dr. George E. Morris.



FABRICS FOR DUST COLLECTORS TESTED FOR EFFICIENCY

By H. I. Miller, Jr.[1]

A SERIES of simple field experiments in testing bag type dust collector fabric for pressure drop and dust retentivity were sufficiently successful that the principles involved ought to be widely applicable.

The particular instance concerned attempts to increase the capacity and the bag life in a collector handling hot toxic metallic fume in the presence of water vapor and 1 or 2 percent sulfur dioxide. Experience and research (*1*) had shown that the tensile strength of wool bags in such service is continually reduced with time of exposure to heat and to chemical action until failure occurs. A heavier wool fabric, at proportional extra cost per bag, might more than offset the loss described.

In fact, test bags 18 percent heavier hung in the existing baghouse had lasted up to 50 percent longer; but no one knew whether these bags filtered comparably because of the difficulty in measuring either air flow through such a bag in place or the amount of dust collected. Operators thought that the heavier cloth meant inevitably higher resistance to flow. Yet, if the idea is correct that a filtering mat of dust on the dirty side of the fabric really does the work (*2*), then the fabric itself offers very little resistance to flow.

A purely comparative type of test was set up employing a sample of fabric in current use as the standard, and, or with, two other fabrics. Dust-laden gases were taken at a single point in the region just below the tube sheet where the gases enter the bags, the larger particles having settled out. The sample, taken at constant rate, was evenly divided into three parallel streams of equal volume and velocity which passed through three equal cloth areas.

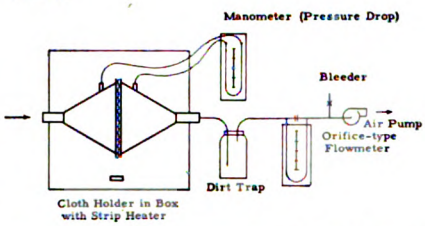


Figure 1.—Arrangement of Equipment—Schematic.

Arrangement of equipment is shown diagrammatically and in two photographs. To keep all gases and cloths similar in temperature and above dew point, an inclosing box with strip heater was used. Dirt traps successfully protected the flowmeters, which were frequently calibrated. Relative order of position of the cloth sample holders was changed after each run to offset the effect of any tendency of dust to follow any one stream. None was observed.

First run was made with samples of new cloth, dried at 90° C., desiccated, and weighed before being placed in the holders. Sampling was done continuously and simultaneously, until the pressure drop across the cloths was around 3 or 4 inches water gage, somewhat more than that normally reached in the baghouse. Rate of flow through the cloths was 2 lineal feet per minute, that proposed for the baghouse with increased capacity. Immediately on termination of sampling, the cloths were carefully removed so as not to jar loose any of the adhering dust (negligible loose dust lying in the holder was observed in the range of grain loadings and pressure drop encountered), placed in a desiccator for transfer to the oven, and were again dried, desiccated, and weighed, the difference in weight being the dust retained. The cloths were then shaken free of dust by hand, were dried, desiccated, and weighed, and the sampling procedure repeated. Additional runs were made until the relationship patterns of *pressure drop vs. time* became repeatedly similar and the cloth was then considered stabilized. Some 15 to 25 hours of sampling time were required for stabilization.

A variety of cloth was tested, and the results were surprisingly good considering the crude method and some fluctuation in grain loading of the gases. Typical time vs. pressure drop curves for beginning and end of a test series are shown. No. 1 cloth is the standard.

[1] **Mr. Miller was formerly Industrial Hygiene Engineer with the St. Joseph Lead Co. Present address, c/o Catalytic Construction Co., Widener Building, Juniper and Chestnut Streets, Philadelphia 7, Pa.**

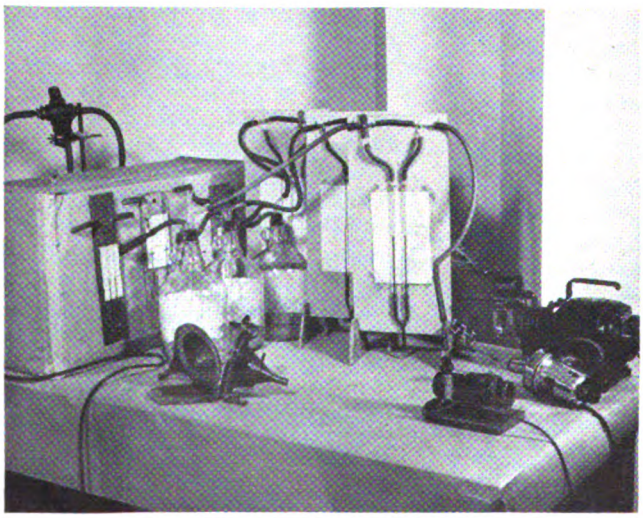


Figure 2.—Arrangement of Equipment—Actual.

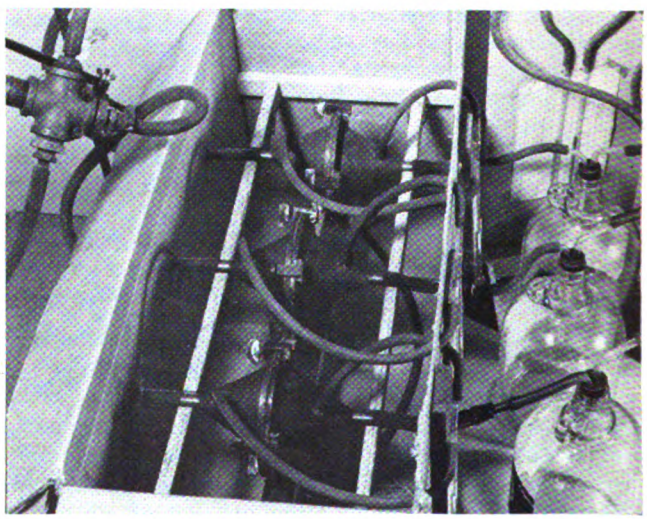


Figure 3.—Assembly of Cloth Holders.

During the first run No. 1 (slightly more open weave) apparently lost some of its dust mat by pass-through at 2¾ inches water gage. During the fourth and fifth runs, which resemble each other, the cloth is considered to be stabilized. Note that No. 1 now exhibits much the greatest pressure drop and its retentiveness is comparable to that of No. 2. Now if a bag of No. 2 fabric shows excellent life when hung in the collector, it is worth making an appreciable investment in bags of No. 2 cloth for replacement. In large capacity collectors, thousands of dollars per year are involved for routine repair and replacement, without provision for increased capacity.

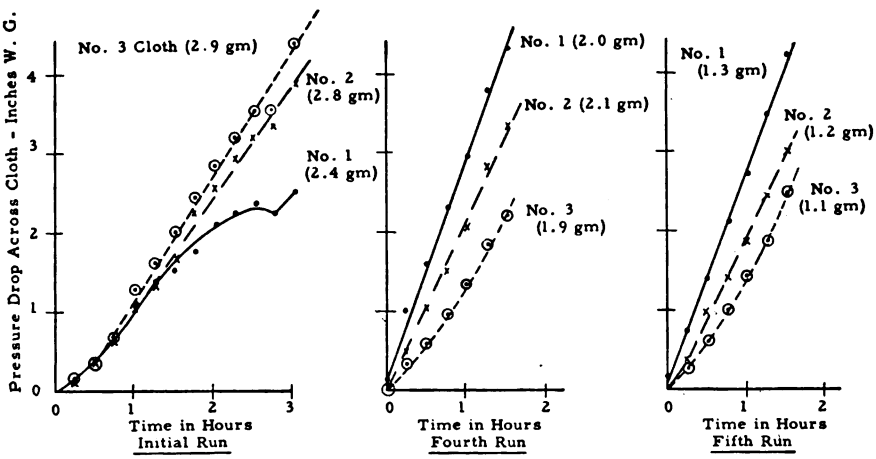
Such tests are particularly useful when comparing dissimilar fabrics, such as wool with synthetics, napped with unnapped, or woven with felted. In any such change, operating characteristics particularly frequency and duration of shaking, may have to be radically changed. Indications of the necessary changes would be noted as a result of testing.

References

(*1*) Donoso, J. J., and Labbe, A. L.: Modern baghouse practice for recovery of metallurgical fumes; *Jour. Metals*, **188**: 792, 1950.

(*2*) Wieschhaus, L. J.: Filter type dust collectors; *Chem. Eng.* **54**: 113, 1947.

Figure 4.—Comparative Pressure Drop (inches of water) and Retentivity (grams).



New Group to Evaluate Medical Services in United States Industries

THE AMERICAN Foundation of Occupational Health has taken over recently the evaluation and approval of medical services in industry which has been conducted by the American College of Surgeons for the past 20 years, according to Dr. Paul R. Hawley, Chicago, director of the college. The foundation is setting up a board of governors to guide it in the new project.

The trustees of the American Foundation of Occupational Health are the president, secretary, and managing director of the Industrial Medical Association. Dr. Edward H. Carlton, medical director of Inland Steel Co., is the immediate past president and Dr. A. G. Kammer is the new president, installed at the last annual meeting; Dr. Arthur K. Peterson, medical director of R. R. Donnelley & Sons Co., is the secretary; and Dr. Edward C. Holmblad is the managing director and treasurer.

The trustees propose to continue the same type of plant evaluation and approval that the American College of Surgeons has conducted, and to expand this service if and when additional funds become available. On its last approved list of medical services in industry, published on December 31, 1950, the college includes the names of 1,459 industrial establishments—63 percent of the 2,293 plants representing over 6,045,000 employees which had been surveyed. Dr. Gaylord R. Hess, who has been in charge of the activity for the college, will continue to direct it for the American Foundation of Occupational Health.

Navy Medical Officers and Industrial Hygienists Discuss Common Problems

THE third annual Navy Industrial Health Conference convened in Atlantic City in April to provide an opportunity for Navy medical officers and industrial hygienists to discuss common problems and goals with co-workers and to afford an exchange of ideas on professional and technical aspects of occupational medicine and industrial hygiene. The keynote of the meeting was "Maximum Productive Efficiency Through Health Conservation." One hundred and seventeen naval officers and civilian personnel attended the meeting as representatives from the various shipyards, ordnance plants, air stations, test centers, and field offices of the Navy.

In his address before the opening session, Rear Adm. C. J. Brown, Deputy Surgeon General of the Navy, said: "The Navy was not first—and *it has not been last*—in taking advantage of the knowledge that has been garnered through the years by the pioneers in this field of occupational health. Today, in this period of industrial mobilization, the Navy has a health program that can meet the challenge for its third of a million civilian workers in approximately 300 Navy industrial establishments. The benefits of industrial hygiene are also equally provided to the thousands of military personnel engaged in industrial occupations, both aboard ship and at shore establishments.

"The mobilization effort finds us with a decade of experience in the administration of a modern type of occupational health service. Navy management, as that of private corporations, has found that healthful working conditions and constructive medical services are good business. They result in improved employee morale—and that can be translated into improved employee productivity."—**Chas. P. Bergtholdt, industrial hygienist, U. S. Naval Gun Factory, Washington 25, D. C.**

Studies of Health Hazards in Industry

PHYSICAL HAZARDS

Human Reactions to Atmospheric Environment (Physiologic Principles)

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 Health Monthly.**

AIR CONDITIONING, in the broadest sense, includes the control of temperature, humidity, radiation, air movement, and air cleanliness. In practical application, it involves control of any or all of these items. It is distinguished from ventilation in that the latter includes only the process of supplying air to, or removing air from, any space by natural or mechanical means.

To appreciate the relationships between air conditioning and the control of diseases, it is necessary to consider the physiologic principles involved. The physiologic reactions to environment also are closely related to psychologic reactions. In spite of much work that has been done on pnysiologic effects of environment, the psychologic effects can not be completely explained.

Chemical and Physical Changes

When people live or work indoors, certain physical and chemical changes occur in the air around them. Although the oxygen content of the air diminishes and the carbon dioxide increases, it has been well established that these changes are significant only when the air space is confined, as in submarines, ammunition storage "igloos," or similar places.

Although the body gives off odors, moisture, and heat, there is no evidence that man contributes any toxic volatile material to the air. Loss of appetite and energy may result in stale air because of odors which have accumulated. These esthetic or physiologic reasons may make it desirable to utilize ventilation or air-conditioning systems to eliminate or control odors from occupancy or from activities such as cooking and use of certain chemicals.

When human occupancy is the only source of contamination, enough outdoor air is needed to the extent that objectionable body odors or tobacco smoke can be removed. The odor concentration will depend upon such factors as the dietary and hygienic habits of the occupants (frequently related to their socio-economic status), the outdoor air supply, air space per person, temperature, relative humidity, and the odor-adsorbing capacity of air-conditioning processes.

The Code of Minimum Requirements for Comfort Air Conditioning prescribes definite minimum requirements on cubic space which are used by designing engineers. These requirements are minimum but not necessarily adequate requirements.

Various individuals have tried to duplicate the invigorating qualities of outdoor air by the use of ozone, ionization, or ultraviolet light. To date, the results of their work have been inconclusive or negative.

Physical Impurities in Air

Contaminants in the air of the working environment in the form of dusts, fumes, smokes, mists, fogs, vapors, and gases may produce irritant or systematic effects if present in high concentrations. Pollens and pathogenic organisms from infected persons may also present health hazards when air-borne.

The effects on the human system of such materials vary widely, and, since examples have been given in preceding articles, it is not necessary to explore physiologic response to them at this time. Generally, excessive concentrations of contaminants within the workspace may be controlled by use of air conditioning or ventilation methods.

Thermal Interchanges Between the Body and Its Environment

Body temperature depends upon the balance between heat production and heat loss. Heat resulting from oxidation in the body (metabolism) maintains the body temperature well above that of the surrounding air in a cool or cold environment. At the same time, heat is constantly lost from the body by radiation, convection, and evaporation.

The human body possesses remarkable powers of adaption to a narrow range of atmospheric conditions. Under these conditions, the body experiences a sensation of comfort. As skin and body temperatures rise or fall above or below an optimum, complex adaptive mechanisms come into play, chiefly associated with redistribution of blood supply between the skin and deeper tissues (in a cold environment) and with sweat secretion (in a hot environment). The reactions involved in cold and in hot environments are on the whole radically different in nature. The mechanisms of adjustment involved are extremely complex and . . . a complete understanding of their operation is still lacking.

High Temperature Hazards

When body temperature rises progressively, men will continue to work until body temperature reaches 101°–103° F. When these body temperatures are exceeded, men work with declining efficiency and are liable to heat exhaustion, heat cramps, or heat stroke.

Heat exhaustion is a circulatory failure in which the venous return to the heart is reduced so that fainting results. Early symptoms of heat exhaustion may include fatigue, headache, dizziness when erect, nausea, loss of appetite, abdominal distress, vomiting, shortness of breath, flushing of face and neck, pulse rate above 150, fever well above 102° F., glazed eyes, and mental disturbances. Recovery is usually prompt when the patient is removed to a cool place and kept lying down for a time.

Heat cramps are painful muscle spasms in extremities, back, and abdomen due at least in part, to excessive loss of salt in sweating. This mani-

*Mr. Bloomfield is industrial hygiene consultant to the Institute of Inter-American Affairs, Lima, Peru.

festation of illness due to heat is greatly reduced by drinking water containing 0.1 percent salt or by proper use of salt tablets.

Heat stroke, or sun stroke, is a serious effect of exposure to great heat. The body temperature climbs rapidly to excessive levels often above 105° F. when, for unknown reasons, free sweating suddenly stops.

The deleterious physiologic effects of high temperatures exert a powerful influence upon physical activity, accidents, sickness, and mortality. Both laboratory and field data show that physical work in warm atmospheres is a great effort and that production falls progressively as the temperature rises.

Acclimatization

Some acclimatization to hot conditions is possible. In tests made at the Research Laboratory of the American Society of Heating and Ventilating Engineers, subjects were required to perform light work under very hot conditions for a 4-hour period each day. It was found that the ability of a new subject to endure these conditions showed daily improvement for a period of at least 2 weeks. However, after acclimatization was completed, a recess of several days had no effect on the endurance of the subject. Individuals differ widely in their capacity to acclimatize. Acclimatized men lose these capacities in a few weeks of temperate climate, even though they are vigorously active. Acclimatization to dry heat increases the capacity to sweat and conserves salt by secreting a dilute sweat.

Deterioration of performance and other ill effects may arise during prolonged exposure to heat when men cannot get sufficient rest and sleep each day. Acclimatization to extreme conditions involves a strain upon the heat-regulating system and interferes with the normal physiologic functions of the human body. Thousands of years in the heat of Africa do not seem to have acclimatized the Negro to temperatures exceeding 80° F. The same holds true of northern races with respect to cold, although the effects are mitigated by artificial control. Some persons believe that the human organism can adapt itself to a wide range of air conditions with no apparent discomfort or injury to health. In the light of present knowledge of air conditioning, these views are not justified.

Upper Limits of Heat for Men at Work

In very hot conditions, humidity is the limiting factor, and the wet-bulb temperature is very important.

At the Armored Medical Research Laboratory at Fort Knox, Ky., a study was made to determine the upper limits of environmental conditions under which a man can perform certain work. Thirteen enlisted men, thoroughly acclimatized to the hot conditions, served as subjects. During each test, the subjects were required to march for 4 hours at the rate of 3 m. p. h., carrying 20-pound packs, under a wide range of environmental conditions, which were rated as relatively easy, difficult, and impossible, on the basis of the physiologic reactions of the subjects at the end of the 4-hour period.

The need of air conditioning for workers in hot industries is recognized. The type of system needed depends upon a study of the particular working and environmental conditions. In some hot industries, the worker himself, rather than the atmosphere, can be cooled by placing him in a small booth or semi-enclosure and blowing cooled air over him, or by circulating cooled air through a loose-fitting suit worn by the worker.

Comfort and Efficiency

The main purpose of air conditioning is to establish a degree of thermal comfort. Everyone has experienced the loss of interest in mental work at high temperatures and humidities; physical work under such conditions is not impossible if the mind is willing. Although many people will admit the existence of good correlation between thermal comfort and mental activity, it is not easy to show a loss of physiologic or psychologic efficiency under the influence of conditions slightly above or below the "comfort zone." (Recent experiments in work efficiency show that special incentives may overcome the effect of a most uncomfortable environment.)

Although the literature contains reports of investigations that demonstrate either increased or decreased productivity under slightly uncomfortable air conditions, there has been no complete separation of the physiologic and psychologic effects of the environment. Therefore, the designing engineer should not attempt to justify expenditures for "comfort" air conditioning on the basis of physiologic efficiency because the results are highly unpredictable. Wartime experience proved that some of the most "ideal" combinations of temperature, humidity, and air motion resulted in widespread complaints of monotony, indicating the complex psychologic aspects of this problem.

Although our knowledge of the physiologic effects of the environment is still far from complete, one of the useful results of physiologic research is the concept of "effective temperature" and its related "comfort chart," both of which have widespread application today.

Effective Temperature Index

Sensations of warmth or cold depend not only on the temperature of the air as registered by a dry-bulb thermometer, but also upon the temperature shown by a wet-bulb thermometer, upon air movement, and upon radiation effects.

Effective temperature is an empirically determined index of the degree of warmth perceived by trained subjects on exposure to many different combinations of temperature, humidity, and air movement. This index does not take into account the presence or absence of substantial positive or negative radiation between the body and its environment. Further studies of radiation effects may result in the development of a new index of thermal comfort which will combine the effects of temperature, humidity, air movement, and radiation.

The numerical value of the effective temperature index for any given air condition is fixed by the temperature of slowly moving (15–25 f. p. m.) saturated air which induces a like sensation of warmth or cold. For example, any air condition has an effective temperature of 60° F. when it induces a sensation of warmth like that experienced in slowly moving air at 60° F. saturated with moisture. The effective temperature index cannot be measured directly but is determined from dry- and wet-bulb temperatures and air-motion observations by reference to an effective temperature chart or tables.

Comfort Zones

An effective temperature line defines the various combinations of conditions which will induce like sensations of warmth. It does not necessarily follow that like sensations of comfort will also be experienced along the entire length of an effective temperature line. Some degree of discomfort may be experienced at very high or very low relative humidities, regardless of the effective temperature. It has also been found that the optimum effective temperature varies with the season and is lower in winter than in summer.

The summer and winter comfort zones indicate conditions under which 50 percent or more of the people are comfortable. The summer comfort zone extends from 66 ET to 75 ET; a maximum of 98 percent of the subjects were comfortable at 71 ET.

The winter comfort zone extends from 63 ET to 71 ET with a maximum of 97 percent feeling comfortable at 66 ET.

It must be emphasized that these comfort zones apply to inhabitants of the United States only, that the lines do not apply to rooms heated by radiant methods or to theaters, department stores, or similar places where the exposure is less than 3 hours. The entire matter is most complex and is being investigated further.

APHA Committee on Atmospheric Comfort

The American Public Health Association Committee on Atmospheric Comfort has been engaged for some time in drafting a report on Thermal Standards in Industry. The Section Council on Industrial Hygiene of the American Public Health Association outlined the purpose of that report as follows: "To study the effects of temperature, humidity, and air movement on workers and to recommend standards in operational zones devoid of contaminants." This committee does not attempt to develop ventilation standards because of the existence of another APHA Committee on Industrial Ventilation. The final report of the Committee on Atmospheric Comfort has not received final approval, but some of the committee's thinking will be of interest.

In connection with currently accepted space allotments for industrial workers, the committee states that the entire problem needs reexamination from the epidemiological standpoint. All present standards are empirical. The minimal requirements generally accepted now are a floor area of 40 square feet per person with an air space of 400 cubic feet per person and an operable window area of 10 percent of the floor area served. Mechanical ventilation is indicated where these standards cannot be met or where excessive heat, moisture, dusts, fumes, mists, or gases contaminate the air.

Legislation in the various States and cities have varying requirements, also empirical. (A minimum air space per worker of from 200–500 cubic feet and a minimum window area of from 5–15 percent of the floor area served by windows.)

The need for reexamination of this matter arises from the fact that recent studies indicate that the incidence of infection in crowded quarters is related more closely to the number of persons occupying a given room than to floor area or cubic space per person.

The committee points out again, as does the work of the ASHVE Research Laboratory, that concepts of thermal comfort have changed considerably since a few years ago. It is no longer believed that thermal comfort is a matter of body heat balance alone. Its preliminary report states that: "A state of comfort exists when heat regulation is accomplished with a minimum of physiologic adjustment, or when an individual is entirely unaware of heat or cold."

Because of the impossibility, to date, of combining the four environmental factors (temperature, radiation, humidity, and air movement) into a single index that would indicate the degree of warmth, or comfort, this group has found it necessary to urge simplification by combining air temperature, "mean wall" temperature, and radiation into the so-called "environmental temperature," by the use of a globe thermometer.

This globe thermometer should be used wherever excessive radiation is encountered. Furnaces and heated vats are typical causes of high radiant heat conditions. Under normal conditions radiation could be neglected, as its effect is small.

This committee report also is considering air movement, drafts, upper limits of temperature and humidity in hot industries, outside air supply, limitations of hours of work in extreme heat, engineering methods of controlling heat hazards, medical methods of controlling heat hazards, limitation of hours of work in cold industries, and control of occupational cold hazards. The subject of clothing is considered under the various sections on control.

References for Section on Human Reactions to Atmospheric Environment—Physiologic Principles

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(3) Witheridge, W. N.: Environmental Factors and Fatigue in Competence. Chapter 5 in *Industrial Hygiene and Toxicology*, Volume I, edited by F. A. Patty. Interscience Publishers, Inc., New York, 1948.

(4) Winslow, C.-E.A. and Herrington, L. P.: *Temperature and Human Life*. Princeton University Press, Princeton, N. J., 1949.

International Congress on Occupational Medicine Scheduled for Portugal

AMERICAN physicians and surgeons specializing in occupational medicine have been invited to attend the Tenth International Congress on Medicine for Workers to be held in Lisbon, Portugal, from the 9th to the 15th of September 1951.

Patrons of the meeting are the President of Portugal, Marshall Carmona, and the Prime Minister, Dr. Antonio de Oliveira Salazar. Requests for further information and registration blanks may be obtained from the Portuguese Embassy, Washington, D. C.

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