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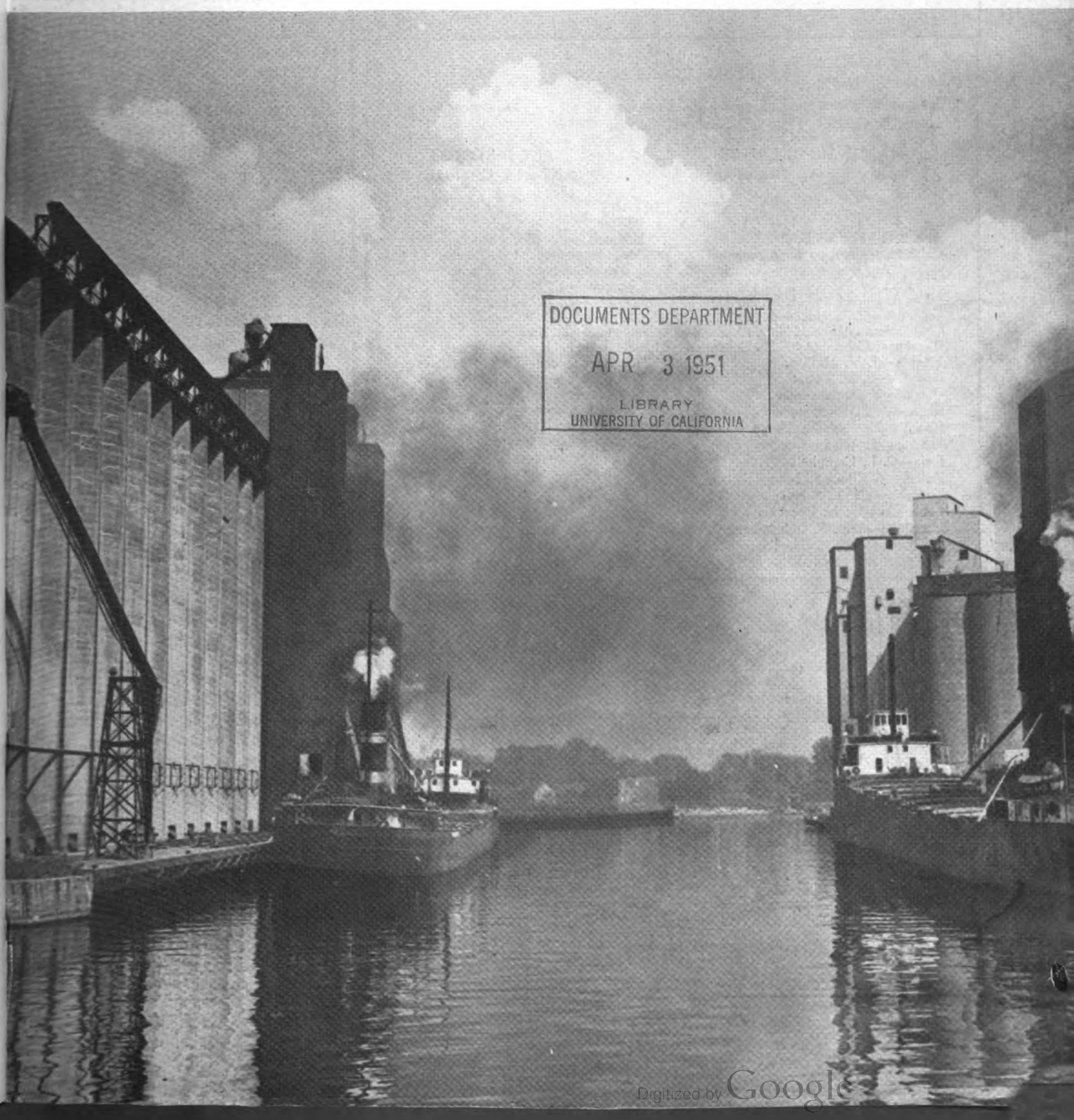

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Division of Industrial Hygiene

FEATURES

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Dr. Seward Miller, New Chief, Division of Industrial Hygiene, PHS

DR. SEWARD E. MILLER has assumed his new duties as Chief of the Division of Industrial Hygiene, Public Health Service, succeeding Dr. J. G. Townsend, who has been assigned to the Institute of Inter-American Affairs. Dr. Townsend will be chief of the Institute's field party, in charge of health programs in the Republic of Panama.

Dr. Miller has enjoyed a succession of responsible positions. For the past year he has served as Regional Director of the Federal Security Agency's Region V, with headquarters in Chicago. Prior to that appointment, Dr. Miller had held the position of chief of laboratory services in the Public Health Service's Communicable Disease Center at Atlanta, Ga.

Born in Perry, N. Y., August 16, 1905, Dr. Miller received his B. S. degree in 1927 and his M.D. in 1931 from the University of Michigan, then served his internship in the Public Health Service. In 1934 he received a commission in the Reserve Corps and 2 years later was appointed to the Regular Corps.

Dr. Miller's early assignments were in the Marine Hospitals in New Orleans, San Francisco, Seattle, Norfolk, and Baltimore, where he specialized largely in pathology and laboratory work. He later spent 5 years in Atlanta developing the laboratory for the Communicable Disease Center. Placing great emphasis on improved laboratory diagnostic medicine, he established over 20 short refresher courses to train laboratory workers, both technicians and physicians, in the latest laboratory diagnostic methods.

At the present time, Dr. Miller is revising Dr. Francis P. Parker's 1948 edition of the *Textbook on Clinical Pathology*, and expects to have it ready for an early printing this summer. The text has been widely used in university courses for teaching purposes and by practicing physicians for reference material.

American Medical Association, the Miller is a member are the American Society of Clinical Pathologists, the American Medical Association, the American Public Health Association, Association of Military Surgeons of the United States, and the American Public Welfare Association.

New York Staff Protects Workers' Health by Research, Education and Service to Industry

PROTECTION of the lives and health of the working men and women in New York State by technical study and control of the occupational health hazards inherent in their work and through the prevention of occupational diseases is the primary responsibility of the Division of Industrial Hygiene and Safety Standards of the State Department of Labor. Hand in hand with the prevention of occupational disease goes a more general program of health maintenance and the promotion of better health among workers.

Because New York is one of the largest industrial states in the United States, with an extraordinary diversity of industries, it is worthwhile to observe its sundry activities and the methods employed in the handling of industrial hygiene problems. This feature provides only a bird's-eye view of the plant studies, the technical consultations, the laboratory chemical analyses, the examination for official approval of blueprints for industrial ventilation and new buildings, the development of industrial code rules, the educational activities, and many other services provided by the staff of physicians, chemists, engineers, a nurse, and a nutritionist—29 in all.

The professional staff is organized into five units—medical, chemical, building plan, engineering, industrial hygiene engineering, and codes. This specialization, made possible by the size of the Division, is believed to be of fundamental importance in carrying out an effective industrial hygiene program. As individuals and as teammates, industrial hygiene physicians, chemists, and engineers help to solve the problems of the Labor Department in the maintenance of safe and healthful working conditions, and also the problems of employers, unions and workers, insurance companies, industrial physicians and nurses, plant chemists, ventilation and construction engineers, and others.

In the solution of the technical problems, the Division of Industrial Hygiene in New York is greatly aided by its broad legal powers, and by the close integration of its work with the other divisions of the Labor Department. Of first importance is its power to develop industrial code rules on the basis of its own field experience. When promulgated by the Board of Standards and Appeals, these code rules supplement the labor laws of the State and provide a basis for the legal enforcement of industrial safety and health standards by the Division of Industrial Safety Service, through its staff of approximately 325 factory inspectors. The Division of Industrial Hygiene is called upon for assistance with the technical problems which arise in this enforcement work. The factory inspectors, in turn, in their visits to plants act as "eyes" for the technical staff of the Division of Industrial Hygiene, providing current information as to the existence of health hazards which are new or require further study.

When an industrial hygiene engineer finds that a health hazard exists, he considers all the possible methods of eliminating it. One of the fundamental methods is a change in handling or processing materials, but if that is not possible, special clothing may be supplied to the worker. This man is wearing heavy rubber gloves to protect his hands when he pours the toxic chemicals used in film and paper production.

COVER PICTURE.—The Port of Buffalo is a funnel for the Nation's shipping traffic in grain, ore, and manufactured goods. All photographs in this issue by courtesy of Division of Industrial Hygiene and Safety Standards, New York State Department of Labor.

Sample Field Studies Indicate Diversity of Health Hazards on Jobs

Insecticides

In the manufacture of paradichlorbenzene in one of the plants investigated, workers were found to be engaged in a variety of operations, each requiring special study for purposes of control. After being heated into molten form, the paradichlorbenzene was poured into metal molds. Some of it was dissolved in a mixture of carbon tetrachloride and benzol for packaging in bottles, as a spray; in other operations, the paradichlorbenzene was pressed into cakes or it was packaged as pure crystals and in larger lumps. Then the pressed cakes were wrapped in cellophane by hand. There was thus exposure not only to the dust but to the vapors of this chemical and to the vapors of the solvents used.

Air tests revealed high concentrations of paradichlorbenzene in the air and exposure to concentrations of carbon tetrachloride and benzol beyond accepted maximum allowable concentrations. The control measures included not only necessary ventilation of appropriate design and capacity but also the substitution of less toxic solvents for those in use. Trichlorethylene was tentatively suggested as a possible substitute for the carbon tetrachloride; and purified low-boiling naphtha, as a possible substitute for the benzol. In so doing, it was recognized that the naphtha would increase the flammability of the mixture, but experience in the dry-cleaning industry had demonstrated that the addition of small quantities of a chlorinated hydrocarbon to naphtha greatly reduced its flammability.

The Division of Industrial Safety Service is regularly reporting to the Division of Industrial Hygiene the names of all plants in which factory inspectors find that toxic insecticides are being handled. These are promptly in-

vestigated, and management is instructed in ways and means of safeguarding the health of workers.

Dry-Dyeing Industry

A special study was made of the dry-dyeing of net textiles and laces to determine whether or not a solvent hazard existed. The operation is a simple one, consisting essentially of submerging by hand the material to be dyed into a solution containing an oil soluble dye dissolved in a mixture of petroleum naphtha and xylol in an open tub.

The material is removed by hand and swung briskly back and forth to remove some of the solution, then hung up to dry on lines strung up for this purpose. When all the work was done indoors without benefit of proper exhaust ventilation, air tests revealed that workers were exposed to excessive concentrations of solvent vapors. All such plants are now required to install adequate ventilation.

Benzol

In the control of industrial solvents, certain of them, such as benzol, recur frequently among the problems. A case of aplastic anemia developed only a few months ago in a worker employed in the manufacture of fishing tackle, fly lines, and artificial bait. The best means of control is substitution of a less toxic solvent, and this is urged wherever possible. The alternative is the installation of adequate exhaust ventilation, which is frequently very costly. The Division was gratified to have succeeded in developing a solvent mixture containing toluol, xylol and gasoline, which one of the large rubber companies in the State found practicable as a substitute for the benzol which it had been using.

Fire as well as explosion is a hazard in a dye manufacturing plant. Here an industrial hygiene chemist is testing for carbon tetrachloride vapors to determine the extent of the exposure in the breathing zone of a worker during the processing of a dye product.

A recent concerted drive to eliminate the use of benzol in all plants manufacturing shoes and slippers in New York has been successful in providing protection against benzol poisoning for a large number of workers in an industry where small plants predominate and the safe use of benzol is impracticable.

Dermatitis in a Textile Plant

An outbreak of dermatitis occurred in a plant engaged in garnetting wool, rayon, and nylon mill wastes and baling the finished shoddy. Between 140 and 150 workers were employed, all males, 54 of whom were directly concerned with the garnetting process.

Medical investigation disclosed that, over the years, there had been an average of from 2 to 3 cases of a skin condition, medically known as furunculosis, among the garnett "fixers"—men who were engaged in cleaning, stripping down, and lubricating the 18 garnetting machines. At the time of the study, 15 men were affected.

The nature of the outbreak, the occupational history, the character and distribution of the skin lesions, established a diagnosis of furunculosis due to lubricating oils. A detailed program for prevention and control was outlined.

Radiation

In New York State, radium dial painting has dwindled markedly since the last war. But X-ray and radium are increasingly used for the detection of flaws in large castings in foundries and in laboratories to which some of the smaller castings are sent for examination. The fluoroscope as an inspection device is used to good effect for the detection of misplaced nails in shoe manufacture.

Radium-Coated Static Eliminators

In such industries as printing, packaging, or rubber coating of fabrics, the use of radium coated bars for the elimination of static has done away with

Using a midget impinger, an industrial hygiene engineer takes samples of the air in the breathing zone of the worker to determine the presence and extent of hazardous dust.

the fear of fire, which was always a matter of great concern. However, the exposure of workers to various types of radiation given off by the static eliminators has substituted for the fire hazard a potential hazard to health.

An intensive study has been completed of a large book printing plant which had installed a considerable number of these radium bars in its pressroom. Excessive exposure to radiation was found both by instrument surveys of the workroom and by the use of a photographic film carried by each worker to register the extent of individual exposure.

A careful evaluation of the various operations on each type of press was undertaken, and measurements of radiation dosage were made at all points where the pressmen might have to stand in the course of their work. Among other things, it was found that certain of the bars were so located as to expose the men unnecessarily to radiation far in excess of what is considered a safe dosage.

As a result of this study, it was possible to move the bars to safer locations and to provide better shielding. Furthermore, it was found that still better shielding in some instances could be obtained by a redesign of the housing on which the radium strips were mounted.

Dust Control

As part of its program to control silicosis, the Division of Industrial Hygiene assists in the routine enforcement of industrial code rules, particularly those covering rock drilling, foundries, stone cutting, and stone

crushing operations, by providing the Division of Industrial Safety Service with all necessary dust counts. Control of silica dust in the manufacture of abrasive soaps and powders was the subject of special study last year, and about 100 plants were investigated.

There is always a great deal of road construction going on in New York State, also much mining, quarrying, and tunneling. A considerable number of rock samples are therefore submitted to the chemical unit each year, for free-silica determination by the laboratory. The free-silica content of the rock determines in each instance the dust concentrations which will be permitted in the breathing zones of workers on the job.

Unexpected discovery of cases of silicosis among workers in dental laboratories created special interest in another type of exposure to silica dust. These cases were discovered by the Division in a plant manufacturing dentures. In the process of manufacture, intricate castings were ground by the use of small carborundum wheels of special design. Occasionally, however, silica sand in a sand blast cabinet was used for this purpose.

Investigation disclosed not only that the ventilation was improperly designed and inadequate, but also that the discharge pipe terminated directly outside one of the windows of the grinding room, thereby permitting ready recirculation of the exhausted dusty air in the workroom. When the results of the study were made known, these conditions were corrected.

A variety of other types of dust was the subject of special study during the past year. These included particularly beryllium, mica, methyl methacrylate plastics, fertilizers, insecticides, and flour bleaches.

Corduroy Dust

One of the more unusual investigations was concerned with dust created by a number of thread-cutting machines used to put nap onto corduroy. This operation is accomplished by automatically picking up and cutting the top threads of the fabric as it passes through the machine. A certain amount of dust, which is mainly cotton lint, is created in the process. In the particular installation under study, the dust not only surrounded the workers engaged in these operations, but also filtered through the floor boards into a research laboratory on the floor below. Upon recommendation, dust control measures were put into effect.

Manufacture of Surfacing Materials

The Division had done considerable work in a plant to control the silicosis hazard. A follow-up investigation revealed improvements so marked as to be worth recording.

This concern was engaged in the manufacture of a large variety of surfacing products, including water-base paints, plasters, fillers, sizing, whiting, soluble colors, and other materials. Most of the products have a common base (whiting) with various ingredients added. On analysis by the chemical unit, the filler base was found to contain 8.3 percent free silica.

The base materials were mixed with glue and prepared in one building; mixing and bulk packaging was done in another; and still another building was used for the packaging of smaller quantities of these materials for household use.

Dust counts at each operation in each building revealed that the plant had followed many of the recommendations previously made by the Division and conditions had materially improved. Raw material was now received powdered and bagged instead of in bulk, thereby eliminating dusty grinding and screening operations. This also eliminated exposure to dust of high silica content in connection with the facing of large sandstone grinding wheels. This operation was formerly done in the plant.

In addition, the firm purchased two industrial vacuum cleaners, one for the building in which bulk packaging was being done and one for the grinding building. A careful housekeeping routine was in operation with the result that the work spaces, ledges, and corners were far cleaner than ever before.

Tunneling, mining, and quarrying present many health and safety hazards which New York State industrial hygienists are called upon to investigate. The free-silica content of rock to be drilled must be determined, ventilation must be checked in underground work, and many other precautions taken.

Air Pollution

Although the labor laws, which confine the official scope of the Division's activities to places where people work, have precluded direct participation in the enforcement of air pollution control laws and ordinances, nevertheless, there has been a widespread demand for advisory services in this field. These services have included the drafting of air pollution control legislation and regulations for a number of municipalities in the State; appearance at public hearings on the adoption of local legislation, and assistance in setting up the initial organization of the local enforcement agency. City, county, and State agencies have utilized the Division's field services for making investigations of local air pollution problems and recommending control procedure to the enforcement agency requesting this assistance. In two recent instances, local school boards received help in choosing sites for new school buildings free from nearby sources of pollution.

Engineers Search for Clues to Ventilation Problem in Spraying

A plant in upstate New York, which had begun the manufacture of wooden radio cabinets, sent a rush call for engineering assistance. Their problem was that they had just installed about 10 elaborate and expensive spray booth systems to remove paint vapor and mist from the workroom and some of the booths were discharging contaminated air back into the workroom.

Two Division engineers were assigned to the problem and after arriving at the plant began looking for clues to the strange behavior of these booths. The workmen were spraying properly, that is, standing upstream from the work and directing the spray gun onto the work at an angle so that the overspray ricocheted downstream toward the rear of the booth. The air distributing baf-

fles were installed properly, the fan was mounted correctly, rotation was in the right direction, and horsepower and speed were adequate. Air velocity measurements revealed good air movement into the booth except at the sides where the air movement was outward, carrying with it vapor and mist from the spraying operations.

The engineers, having eliminated the booth and its inside piping from possible blame, decided to examine the discharge piping on the roof. There they discovered that the weather caps on the faulty spray booths had been installed practically flush with the discharge pipe, creating a high back pressure, while the caps on the properly functioning spray booths were installed correctly. The cap installation was corrected on the spot and a recheck of the booths revealed them to be functioning properly.

Physicians Study Relationship of Cancer to Job

While basic causes of cancer are still obscure, it has been of considerable interest that, in industry, it is known that specific types of cancer are caused by exposure to known chemicals, under certain circumstances. Cancer of the bladder, for example, is known to be produced by exposure to a substance called beta naphthylamine, an intermediate in the manufacture of aniline dyes; skin cancer can be produced by tars and certain heavy oils; cancer of the lungs may result from exposure to chromes; cancer of the bones and the blood, by exposure to radiation.

The occupational histories of approximately 4,500 cancer patients at Roswell Park Memorial Institute, Buffalo, N. Y., have been obtained and studied by the Division of Industrial Hygiene. Over 150 different occupations and industries are represented, and about 400 different chemicals and some potentially abnormal environmental factors have been considered in the occupational exposures of these patients. These preliminary data are being coded at present by the Division of Cancer Control, New York State Department of Health, for analysis by cancer site. It is anticipated that a total of 6,000 patients will be studied in this way.

A pamphlet entitled, *Occupational Cancer—A challenge to the physician*, published by the New York State Occupational Cancer Committee, has been distributed to every physician in the State of New York.

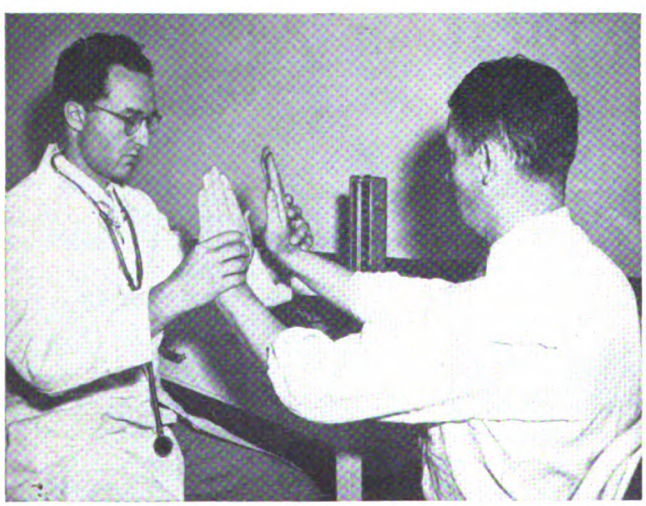
Examination of Plans for Ventilation and New Construction Saves Time and Money

THE control of health hazards in industry, which is the special responsibility of the engineering unit, is not confined to the application of industrial ventilation. But ventilation always plays a major role. Much of this work was done in connection with examination of plans for industrial ventilation submitted to the Division for examination and approval, in connection with inspectors' "orders." Requests for assistance also come from plants desirous of installing ventilation, in compliance with legal requirements. Others want to carry out recommendations by the Division of Industrial Hygiene and Safety Standards in connection with its technical studies of health hazards.

Because of this unusual experience, the engineering unit is in a position to render a great service to both large and small plants. It is frequently possible to suggest a better system which will cost no more than the plant had expected to spend, as good a system for less money, and above all, a system which, when once installed, will not only outlast the one originally contemplated but also will be more efficient and less costly to install and operate.

Ventilation for New Process

Recently, the authorized contractor for a large manufacturer of aluminum houseware came into this office for advice in laying out an exhaust system for a new process. This process involved the anodizing and subsequent dyeing of stamped aluminum houseware. The company was anxious to get this



Physical examinations, both preplacement and periodic, are essential to control of industrial health hazards. In this photograph, the worker, who has been exposed to lead fumes, is being examined by the plant physician for evidences of "wrist drop." The first evidence is a weakness of exterior muscles of the wrist.

Water is frequently used to allay dust that might cause silicosis, or to remove potentially hazardous sprays such as that pictured here. A mist of chrome paint suspended in the air is drawn by suction fans into water running over a cleft in the wall. Note also the downdraft ventilation.

new process into operation since commitments had already been made for the distribution of the product.

The matter was discussed with the company's engineer, and an efficient exhaust system was developed. The design was complicated, however, by the fact that the tanks to be exhausted were large; and further by the fact that they were already being put in place, and insufficient space had been allowed for a ventilating system. After study of the needs of this new process, a design was finally developed which could fit into the small space allowed, and which would not interfere with smooth operation of the process. This contribution saved the company the expense of relocating the tanks, which would have been necessary for an exhaust system of conventional design, and losses due to delays in meeting the production schedule.

Paint Dip Tanks

During a visit to a concern which submitted plans for local exhaust ventilation at paint dip tanks, it was noted that the dipped parts were air-dried in the same room. The solvent vapors released at this air drying operation were a much greater potential health and fire hazard than those released at the dipping operation. The dip tank hoods were redesigned, so that they provided not only local ventilation at the tanks but also sufficient and well distributed general room ventilation to control vapors released at the air drying operation. In this manner, the need for an additional ventilation system was eliminated.

Building Plan Examination

An activity of the Division which goes to the very root of prevention is the examination for approval of plans for all new construction in New York in connection with factories, mercantile establishments and places of public assembly. Examination of such plans for compliance with New York labor laws and industrial code rules makes it possible to include in the original construction provisions for health and safety, which would be far more expensive and less effective if put in later as an afterthought.

Chemical Plant

A large chemical concern, having many plants in New York, has made it a practice to regularly consult Division engineers with reference to ventilating problems when drawing up plans for new buildings. Several new plants and plant additions were begun by this company in New York during the past year. In each instance, a plant engineer discussed proposed exhaust ventilation with the Division engineer while the work was still in the blueprint stage. Each of the processes was carefully evaluated and points of air contamination located and studied. Effective ventilation was agreed upon and final plans approved. When each building went up, it had incorporated in it necessary exhaust ventilation for all operations to be carried out. Considerable money was saved in this way as compared with putting in ventilation after the building was completed and machinery installed.

Workers Protected by 38 Industrial Code Rules

The fact that the Division of Industrial Hygiene and Safety Standards is in a position to develop standards for the maintenance of health and the prevention of industrial accidents, by the preparation of industrial code rules based on its technical knowledge of these problems, has contributed greatly to its effectiveness in protecting the health of workers in New York State. There are at present in New York a total of 38 industrial codes, which are enforced together with the labor laws by factory inspectors.

The most important accomplishment in the field of codes last year was the completion of the Elevator Code. Existing rules applied only to elevators installed in factories and mercantile establishments. A revision has been proposed to provide coverage for motion picture houses, bowling alleys, circuses, and other places of public assembly, where potential fire and panic hazards exist.

Blood tests, urine examinations, and X-rays are often routine parts of physical examinations in certain industries. A physician is counting the blood cells in a specimen taken from a worker exposed to benzol vapors.

Educational Activities Essential To Improve Health Status of Workers

Maintenance of good health among workers is a positive thing which cannot be approached solely from the standpoint of prevention. Work of the Division staff therefore includes improvement of plant medical services and the improvement of plant feeding facilities and workers' nutrition.

The program is directed toward broadening the vision of industrial physicians, industrial nurses and management in these important fields. It also provides them with specific information as to such matters as the physical setup, personnel requirements, and procedures necessary for the attainment of these broader objectives and the cost involved.

In-Plant Medical Services

Visits by the medical unit to plants always include the plant medical office, where the Division physicians discuss the medical program with plant physicians, particularly as it relates to medical surveillance of workers exposed to toxic chemicals. The industrial nurse discusses every detail of the program with the plant nurse, paying special attention to good record keeping and proper reporting.

A special bulletin on plant medical services and the role of the industrial nurse has just been completed and will soon go to press.

Small-Plant Problems

It is the small plant, constituting over 80 percent of all plants in New York State, which provides the most difficult problems in industrial nursing. Some of these problems arise from the fact that the small plant is often not interested in the nurse's professional license, education, or previous experience. The nurse is used to help with the switchboard, the payroll, hiring new employees, and a variety of odd jobs. There is little concept on the part of management in many of the smaller plants

as to the amount or type of space to be allotted to the medical office, the equipment or personnel to be provided, or the need for a good record system.

In-Plant Feeding Facilities and Nutrition

In selling the importance of good industrial nutrition, particularly to small plants, the industrial nursing consultant is of great assistance to the nutritionist of the Division, through her close association with the work of the plant nurse.

During the past year, increased food costs in many plants so greatly increased cafeteria deficits as to threaten their existence. This provided an opportunity for the nutritionist to give practical guidance to plant cafeteria managers in ways and means of reducing these deficits. In one plant, changes in menus, measurement of portions served, the introduction of better inventories, record-keeping systems and cost accounting reduced food losses to management from $2,000 per month to $500 per month. This saved the cafeteria for the plant.

Publications

The current field experience and research work of the Division are presented in its official publication, the *Monthly Review*, which has a distribution of about 4,000.

The engineering unit has made over 50 industrial ventilation designs to help plant engineers with their problems. A sample has been reproduced on this page, and a list of these designs as well as copies of the designs are available.

Anyone interested may write for a list of available publications. Address the Division of Industrial Hygiene and Safety Standards, State Department of Labor, 80 Centre St., N. Y. 13, N. Y.

Ventilated Soldering Bench
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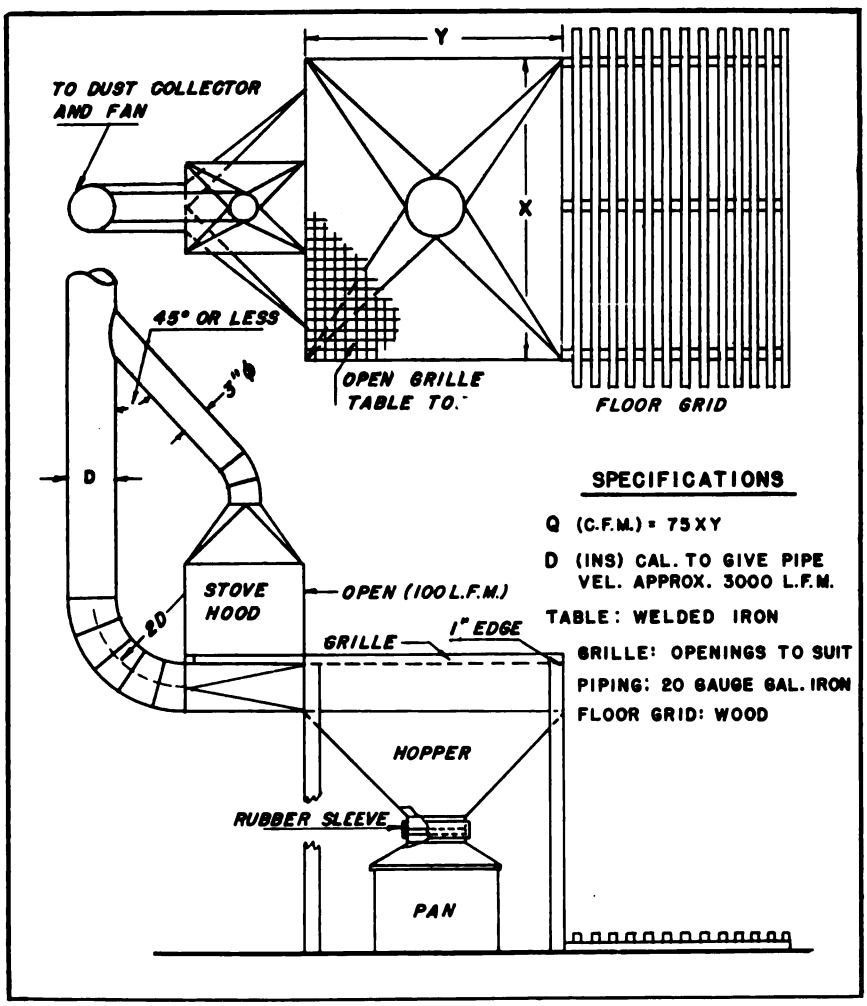


Atlanta Gives 36,000 Citizens Seven Health Tests in 3 Months

MORE THAN 236,000 persons in Atlanta and vicinity were tested for seven diseased conditions in an outstanding public health accomplishment during 1950. As a result, nearly 50,000 persons were found with diseased or abnormal health conditions.

These unfavorable physical conditions were, in the most part, discovered in their beginning stages, when treatment offers more hope for early and complete recovery. Thousands of cases of incipient disease have been prevented from developing by the early discovery of beginning symptoms. Most of the persons diagnosed as having a diseased condition, as a result of the Greater Atlanta health tests, were able to continue their daily activities.

This gigantic health testing project was accomplished in 76 actual testing days from April 4 through June 29. An average of over 3,000 persons were tested daily in from 7 to 14 testing stations established over Atlanta.

The plan of multiphase health testing had its inception in Savannah in 1945. At that time, in order to increase the tempo of tuberculosis and syphilis case-finding, a combined testing program for these two diseases was initiated. The success of the project led to establishment of a similar State-wide service, which has resulted in more than 600,000 Georgians being tested for syphilis and tuberculosis.

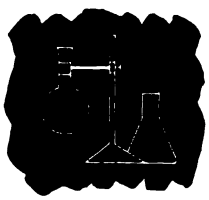
The sevenfold tests for diseased conditions included in the Greater Atlanta screen test for health were the serologic test for syphilis; blood sugar determination for diabetic conditions; hemoglobin test for anemia; chest X-ray for tuberculosis, heart abnormalities, and other pathologic conditions of the chest; a check for height and weight; and examination of the mouth, teeth, and gums.

Those persons found by the multiphase tests to have indications of abnormal health conditions were referred to their private physician, dentist, or health department for further confirmatory or diagnostic tests. Although final tabulations are not yet available, the momentous accomplishments of the Atlanta health project are indicated by preliminary findings.—***Georgia's Health*, December 1950.**

Detroit Engineers Suggest New Type-Cleaning Solvent For Use in Printing Establishments

By George M. Hama*

ANALYSES of a number of type cleaners now on the market indicate that some of these cleaners contain highly toxic and dangerous constituents. Possibly the most commonly used constituent is benzene (or benzol). This material has been preferred as a type cleaner because of its excellent ink-dissolving property and its quick evaporation rate. The high fire hazard associated with its use, however, has somewhat limited its popularity.



Another objectionable property is its high toxicity. If large amounts of benzene vapor are inhaled, unconsciousness may result quickly and suddenly. Such exposures are frequently fatal. At fairly low concentrations, such as are frequently encountered in the printing industry, the poisoning may be of a slow and insidious nature taking place gradually over a period of years. The damage in these chronic cases is done to the blood-forming structures. Usually no dramatic illness occurs in the low concentration exposures, and the worker is not generally aware of any sense of ill health until serious damage has already taken place.

Because of the fire hazard associated with the use of a straight benzene cleaner, certain municipalities have restricted its use (unless some material is mixed with it to reduce its flammability). By mixing carbon tetrachloride with benzene, the fire hazard can be reduced; and the good ink-dissolving properties and fast evaporation rate can be retained. This mixture, however, is a highly toxic material. Exposures to moderate concentrations over long periods of time often result in permanent damage to the liver. Benzene and carbon tetrachloride are both so highly toxic that it is difficult to get general ventilation rates high enough to control the vapors to a safe concentration. Local exhaust ventilation entailing the use of hoods and slots is often not practical in the printing industry because of the variety of locations in which the type cleaner is used.

Petroleum fractions are often used as type cleaners. The more volatile fractions, such as naphtha and gasoline, dry quickly but have considerable fire hazard. They also are not very effective in dissolving dried ink. The heavier, less volatile fractions do not have dangerous fire hazard associated with their use; however, they tend to leave an oily residue and dry very slowly and, for these reasons, have been found unsatisfactory by many printers.

The following formula resulted from an investigation by the Bureau of Industrial Hygiene, Detroit Health Department, to meet the above-listed requirements. A number of cleaners were tried and abandoned when it was found that they failed to satisfy the requirements of the printers. The following formula was submitted to a number of print shops, and their candid opinion as to its practical use solicited. Most printers testing this formula have found it satisfactory for type cleaning. The evaporation rate of this formula is fairly fast, but not quite as fast as a carbon tetrachloride and benzene mixture. Many printers using the formula stated its ink-dissolving property to be as good as benzene. It has an odor which is slightly objectionable to some employees. The Detroit Fire Department classes this material as a class III liquid (flash point above 80° F.). The formula for this type cleaner is:

50 percent methylene chloride (technical grade),

50 percent commercial toluene.

Although the toxicity of this material is considerably less than type cleaners containing carbon tetrachloride and benzene, like all solvents of this type, it should be used only where good general ventilation is provided. Air determinations made by the Detroit Bureau of Industrial Hygiene for toluene and methylene chloride indicate that in the average print shop with good window or mechanical ventilation, the exposure levels will be safe. In confined shops with poor natural ventilation, mechanical ventilation should be provided.

*Mr. Hama is an engineer with the Bureau of Industrial Hygiene, Detroit Department of Health, 1151 Taylor Avenue, Detroit 2, Mich.

Kentucky Division Checks Indoor Auto Racing Arena For Carbon Monoxide

By N. E. Schell*

BEFORE either the fire department or insurance underwriters would permit indoor Crosley Auto Races scheduled for the winter season in the Louisville Armory, the Kentucky Division of Industrial Health was consulted.

Information was obtained on race heat schedules, maximum fuel consumption per race, exhaust gas volume (cubic feet of CO) per gallon of gasoline used, indoor race track volume, and the existing ventilating system.

We also asked for a test race prior to the regularly scheduled opening, whereby conditions of the race itself might be simulated so that atmospheric carbon monoxide levels and general air movement could be actually determined.

Analysis of the data which were submitted suggested that 200 p. p. m. carbon monoxide would not be exceeded (even without mechanical ventilation) at any time in the Armory building. In the preliminary test race, CO measurements confirmed these calculations; thus, 100 p. p. m. of CO was never exceeded during these tests except within 10 feet directly to rear of auto exhaust pipes where 400 p. p. m. of CO was obtained.

As a final step in assuring the safety of all participants and spectators, the Division carried out a third recommendation, namely, that atmospheric carbon monoxide and lead evaluations be made at the edge of the arena during the various racing heats on the first two scheduled racing shows. The following results were obtained in these evaluations: In the 4-car heats the tests for carbon monoxide showed 15 p. p. m. of air; and in the 12-car heats the tests showed 35 p. p. m. The tests for lead in the 6- and 12-car heats showed the presence of 0.06 mg. per cu. m. During the second show the tests indicated the presence of more carbon monoxide, that is 20 p. p. m. in the 4-car heats and 85 p. p. m. in the 12-car heats. Since the maximum allowable concentration of carbon monoxide is 100 p. p. m., the auto races were declared not a health hazard in that respect.

*Mr. Schell is an industrial hygienist with the Division of Industrial Health, Kentucky Department of Health, 620 South 3d St., Louisville.

LETTERS FROM THE READERS

From Warren D. Wilt,
Safety Coordinator,
Civil Service Commission,
Detroit, Mich.

"I READ with interest the article 'Occupational Hazards in Sewage Handling Plants,' as published in the December 1950 issue of the *Industrial Hygiene Newsletter*. The article brought out some of the difficulties encountered when hydrogen sulfide is present or there is a deficiency of oxygen. These are indeed important factors to consider. However, in my past 15 years of experience with sewage handling and treatment plants, most of the time as a safety engineer, I have found another problem more prevalent—that of explosive gases and their control.

"Wherever you have sludge digestion, you will find in part some of the following gases: CH_4, CO_2, H_2, N_2, H_2S, and O_2; and occasionally PH_3 is present. Methane (CH_4) constitutes a large part of the volume of gases produced. Methane, being colorless, odorless, tasteless, and nonpoisonous, can be detected only with instruments. Personnel working in contaminated areas have a tendency to become careless and question instrument readings. This creates a human problem.

"The common methods of purging gas-contaminated areas are ventilation by dilution or venting off the gas at the source. Dilution creates a problem as the gas may be above the H. E. L. and by dilution is brought through the explosive range, which is 5 to 15 percent by volume, before the concentration becomes harmless. A danger point is being created while the concentration is between 5 to 15 percent by volume and has to be controlled. Actually, a harmless situation due to concentrations above the H. E. L. is changed into an extremely hazardous condition by inducing air containing oxygen. It is always desirable to vent the toxic or combustible gases directly from the source to a safe area.

"The article mentions explosion-proof fixtures under item 3 of Recommended Safe Practices. Since sewage treatment or disposal plants deal with digested sludge and possible petroleum wastes, it is necessary for safe operation to have all the wiring explosion proof with the underwriters' approval on all fixtures. Vapor-proof wiring and fixtures do not afford the protection needed. Static collectors are a must on flexible belts. Suitable grounds depend on the individual installation. It is desirable to have all grounds connected to a common ground so as to avoid trouble between equipment of different potentials and a spark gap between this equipment.

"Wherever sewage is handled, we find wells, manholes, sump pits, and many places where conditions are conducive to digestion of sludge, which in turn produces toxic and combustible gases. Combustible gas creates as much property and human hazard as the toxic gases.

"Two types of testing methods are used for determining the presence of combustible gas: flame safety lamp and the combustible gas indicator or detector. The flame lamp is safe when the sample of unknown atmosphere is taken to the lamp which is in a gas-free area. The lamp is designed chiefly to detect deficiencies of oxygen. It is not a safe practice to take a burning flame into a highly explosive atmosphere. The flame arrestors on the lamp are not efficient enough to trust. A combustible gas indicator or detector is a safer instrument. A study is now being made on the effects of pressures such as encountered in some tunnel work on the combustible gas indicators.

"When an article is published on 'Occupational Hazards in Sewage Handling Plants' and stresses only H_2S and O_2 deficiency, I am wondering if we might not create, in the minds of small operators, the impression that they are the only true hazards that exist."

Editor's Note.—The Federation of Sewage Works Associations in 1944 issued a Manual of Practice No. 1 entitled *Occupational Hazards in the Operation of Sewage Works*. This booklet, which is about 50 pages in length, was prepared under the direction of the Committee on Sewage Works Practice by the Subcommittee on Occupational Hazards. It discusses thoroughly the nature of the hazards in the operation of sewage works, including the prevention of physical injuries and body infections and prevention of dangers from noxious gases and vapors, oxygen deficiencies, chlorine leaks, and fire and explosion prevention.

Air Pollution Studied by Steel Companies

Steel companies have been helping to lessen the air pollution in their communities in increasing instances during recent months. Now a new attack on the problem has been launched by the Industrial Hygiene Foundation at Mellon Institute in Pittsburgh, under the sponsorship of the American Iron and Steel Institute.

Steel companies will make their data and equipment available to scientists from the Foundation. New methods and devices for collecting samples of air will also be put to work. The program calls for an expenditure of $20,000 within 6 months to study steel mill processes and atmospheric conditions surrounding many plants. The results of this preliminary research will determine whether a concerted effort by the steel industry in developing air-pollution control is needed, and if so, along what lines.

Among the first problems to be solved is the development of standard, practical tests for measuring dust and gas from furnaces. Data are now being collected to describe the quantity and quality of these wastes from several metallurgical processes and their ultimate "natural" disposal.

A smog chamber will be used, into which controlled amounts of sulfur dioxide, water vapor and various pollutants have a catalytic action can be injected. Preliminary work already has been done on this project. Results will promote a better understanding of the effect, if any, of smog on various aspects of health. Immediate research is being done in appraising smog incidence by locality.

Electrostatic precipitators for dust particles are now used in a number of plants. This equipment polarizes the dust in a stream of air and attracts the particles to metal plates with an opposite charge. Coke oven doors have been altered to reduce smoke leakage. Much of the smoke discharged from coke ovens normally comes when the coal is put in. A "smoke sleeve" has been designed to funnel this waste to a nearby oven where carbon is dissipated and gases are carried off. Control of the cloud of dust, which occurs when materials in a blast furnace slip, has been studied for years.

Women Physicians of Many Countries Report on Occupational Problems of Housewives and Domestic Employees

DERMATITIS, backaches, and psychological problems are the most common of housewives' occupational ailments, according to the reports of women physicians from all over the world, who met last September in Philadelphia.

Better designed and better built homes with furniture designed to fit the needs of the housewife or domestic worker was a recommendation made by this international group. The physicians also recommended that women should learn better muscular coordination in preparation for the varied duties of housekeeping, which involve lifting, carrying, and standing.

Dr. Gerda Seidelin of Denmark said, "Teaching of muscular coordination and training of the muscles mainly used for housework, along with adequate structure of kitchens and utensils, would probably be of the greatest avail in preventing many diseases of the locomotor system. Already existing fibrositis, low backache, and aching feet and legs can often be relieved by muscular re-education.

In her article, "Occupational Diseases of the Housewife," Dr. Herdis Gundersen, of Norway, says: "The housewife, like all other occupational groups, is liable to certain disease, and when considering these it must be kept in mind how great stress she is often subject to, and how long working hours she has."

"Foot trouble is often seen," she says. "Prevention may be forwarded by sitting down when possible, wearing reasonable shoes, and taking foot exercises. Swollen legs and varicose veins are also frequent. Disorders of the back are often caused by overwork, anxiety, and bad planning."

Dr. Gundersen goes on to say: "Rheumatic diseases and eczema are also fairly frequent in the domestic worker, and drafty dwellings and the constant immersion of the hands in water, together with allergic conditions, contribute to diseases of her occupation." Dr. Gundersen urges the necessity for a program for regular medical examinations of the housewife, as is often done in other occupational groups.

Well-fitting shoes and comfortable clothing were also suggested by physicians from Denmark, Great Britain, and other countries as contributing factors to better health for housewives.

Dr. Doris Odlum, of Great Britain, who has written on the "Psychological Aspect of the Pathology and Hygiene of Housework," says, "In order that women may derive satisfaction and emotional fulfilment from their lives in their homes, it appears to be necessary that certain conditions should exist, such as:

"*Food* should be obtainable in adequate quantity and quality and variety without too much trouble with shopping and with adequate facilities for cooking it.

"*Independence.*—The woman resents having to share with other women, particularly her kitchen; living with mothers and in-laws is also a cause of trouble.

"*Space.*—Overcrowding prevents the housewife in doing proper work, and tidying and cleaning become very difficult.

"*Unnecessary work.*—Gives cause to frustration and dissatisfaction, which again lead to excessive fatigability, dyspepsia, sleeplessness, feeling of tension, undue anxiety and apprehension, irritability and fear of being alone. Another problem is raised by the fact that women in domestic service are so lowly estimated."

In Denmark the opinion has also been stated from several quarters that some of the psychological troubles found in housewives are due to their feeling relatively incompetent, and that the best prevention against this would be to train women better for housework, and contribute in every possible manner toward obtaining greater estimation for housework.

India reports that there is very small incidence of disease among housewives, but it is stressed that gynecological disorders are caused by the fact that the women have to start work very soon after their deliveries. Physicians from other countries also emphasize the need for a wider understanding of physical care of mothers before and after deliveries to prevent gynecological disorders and low back pain.

Legislation on the number of working hours, the wages and the housing of housemaids was also reported on by various countries. The answers showed that as yet the laws protecting domestic employees are far from uniform in the different countries. In the Philippines, wages are protected, but neither working hours nor housing are specified. However, in Switzerland, wages are covered by legislation and there are strict rules for housing and sanitary conditions, but working hours may extend as long as 14 hours, with 2-hour breaks. Overtime work is paid extra, and the employee must be properly fed.

Civilian Defense Subject of ACGIH Seminar, April 23

"INDUSTRIAL Hygiene Mobilizes for Civilian Defense" is one of the important subjects to be discussed during the 1951 Industrial Health Conference scheduled for April 21 to 28 at Atlantic City, N. J.

Speaking at this symposium, which is a part of the American Conference of Governmental Industrial Hygienists' program, are leaders of National, State, and local governmental organizations, as well as a representative from Canada.

Those on the panel are Dr. Robert H. Flinn of the National Security Resources Board, Washington, D. C., Mr. K. M. Morse, Division of Industrial Hygiene, Illinois Department of Public Health, Dr. W. G. Fredrick, Bureau of Industrial Hygiene, Detroit Department of Health, and Dr. K. C. Charron, Industrial Health Division, Department of National Health and Welfare, Ottawa, Canada.

Also scheduled for April 23 are other interesting and important topics. "Previewing New Construction—A Technique for the Control of Health and Safety Hazards" will be presented by Dr. Leonard Greenburg, Executive Director of the Division of Industrial Hygiene and Safety Standards, New York State Department of Labor.

Speakers from the Division of Industrial Hygiene, Public Health Service, will be Miss Margaret Klem, who will give a talk on "Voluntary Health Insurance for Industrial Workers," and Dr. Harry Heimann, whose subject is "Health and Air Pollution—A Study on a Limited Budget."

F. J. Vintinner to Speak on Effect of Coal Dust on Lungs

DR. F. J. VINTINNER, Director of the Division of Industrial Hygiene, New Hampshire State Department of Health, is scheduled to speak April 24 at the Industrial Health Conference in Atlantic City. He will address a joint session of the American Conference of Governmental Industrial Hygienists and the American Industrial Hygiene Association.

Dr. Vintinner's subject, "Effect of Coal Dust and Smoke on the Lungs with Special Reference to Susceptibility to Pneumonia Animal Experiments," is based on the work that he did on a doctoral dissertation when he was studying at Johns Hopkins University.

Mr. M. Eisenbud, speaking on "The Epidemiology of Beryllium Intoxication," will follow Dr. Vintinner on the program the morning of April 24. Mr. Eisenbud is the Director of the Health and Safety Division, United States Atomic Energy Commission.

Committee Releases Report on Method to Determine Lead in Air

The Committee on Standard Methods of the American Conference of Governmental Industrial Hygienists has released copies of a report on the recommended method for the determination of lead in air.

This procedure, which was developed by Mr. A. N. Setterlind of the Illinois Bureau of Industrial Hygiene, was given exhaustive tests by a considerable number of collaborating laboratories. Dr. Hervey B. Elkins, chairman of the committee, reports the results of this work as excellent.

Copies of the mimeographed report are available from Mr. Setterlind at the Division of Industrial Hygiene, Illinois Department of Public Health, 1800 West Fillmore Street, Chicago 12, Ill.

Dentists To Discuss Prepaid Dental Care in Industries

The wide variety of arrangements for furnishing dental care to industrial workers will be the principal theme of the forthcoming meeting of the American Association of Industrial Dentists. The meeting will be held in Atlantic City on April 25 and 26, as a part of the 1951 Industrial Health Conference cosponsored by the five professional associations in the industrial health field.

Among the speakers will be Dr. Harry H. Dougherty, dental director, of an industry-sponsored program, and Dr. Robert Berman, dental director of a union-sponsored program. Mr. Melvin Dollar will describe the dental service phase of a consumer-cooperative prepayment medical-care plan, while Dr. Bissel Palmer will outline an experimental dental society prepayment dental-care plan.

With the mounting interest in dental services for workers and in prepaid dental care, this meeting should be of particular value in showing the alternative approaches for the needs in this field.

Ventilation Manual Printed by ACGIH

The Committee on Industrial Ventilation of the American Conference of Governmental Industrial Hygienists has had printed recently its *Manual on Industrial Ventilation.*

It is a 162-page loose-leaf publication with 60 full-page hood designs. There is a section on comfort ventilation and the latest data on dust and fume control, all of which make it a valuable book for architects, engineers, contractors, and others.

Copies are obtainable for $3. Make checks payable to Committee on Industrial Ventilation, ACGIH, and mail the order to K. M. Morse, Illinois State Health Department, 1800 West Fillmore Street, Chicago 12, Ill.

NAM Names Health Safety Committee

An industrial health and safety committee was named by the Board of Directors of the National Association of Manufacturers when the board met recently in New York. Committee assignments were as follows:

1. Present extent of in-plant health and safety practices.

2. Examination and appraisal of developments and trends in the field of government-controlled health and medical programs.

3. Formulation of sound principles as the basis for employer cooperation and expansion of voluntary, prepaid health and medical facilities and care.

4. Appraisal and formulation of measures designed to assist employers in expanding and improving in-plant health and medical facilities and care for employees.

5. Study of special problems involved in rehabilitation and employment of the physically handicapped and older workers.

California

Educational Activities.—The bureau chief gave a talk to the staff at the Herrick Memorial Hospital in Berkeley on the subject of "What Modern Physicians Should Know About Industrial Hazards." A lecture was also given to the class in toxicology at the University of California School of Pharmacy on the subject, "Functions of the Bureau and the Public Health Problems of Economic Poisons."

At the request of the State Department of Education, an article was prepared for trade school books on occupational health hazards of bakers.

An instrument-use seminar of five half-day sessions is being conducted by the bureau for personnel in the Los Angeles office and laboratory. The purpose is to maximize the understanding and use of the various sampling and analysis instruments. In addition to instructors from the Bureau, an engineer from the Los Angeles Department of Water and Power will discuss the various light measuring instruments.

The industrial hygiene class at the University of California School of Public Health visited the Bureau to become personally familiar with activities of an industrial hygiene nature as they are carried out by a State agency. Technical equipment was demonstrated and discussed. In this manner, the practical application of industrial hygiene in the field is coordinated with the theoretical application learned in the classroom.

Los Angeles City, California

Fluorescent Lamps.—From time to time we continue to receive inquiries on the safe disposal of fluorescent lamps. For householders and small establishments discarding a tube occasionally, we suggest wrapping the tube in burlap, or a number of layers of newspaper, wetting down thoroughly, crushing with a brick or other heavy object, then discarding the entire wet mass as such.

A case discussed with Dr. Gilman by a San Pedro physician shows what can happen when the tube is discarded intact. A man employed by a private trash collector tossed a burned out fluorescent lamp into the heap of trash already on the truck. The tube exploded and showered the man's eyes with fine pieces of broken glass. There was immediate cleansing out of particles from both eyes. His physician sought advice from Dr. Gilman and this division, on the course to follow, when, 5 days after the incident there was still a marked conjunctivitis. From physicians experienced in beryllium hazards, we could learn of no special treatment to supplement what had already been done for the patient.

Kansas

Personnel.—Mr. William S. Johnson resigned recently to accept a position with the University of California at the Los Alamos atomic research project.

Massachusetts

Seminar.—Members of the staff of the Massachusetts Division of Occupational Hygiene participated in another all-day seminar on March 29, for students at the New England field training center at the University of Massachusetts. Leading the discussions were Director John B. Skinner, Clarence C. Maloof, M. D., and Sarah E. Almeida, R. N.

Engineer Richard I. Chamberlin recently presented an illustrated talk before a group of industrial safety engineers at Holyoke. Mr. Chamberlin's topic was "Atmospheric Contaminants and Their Control."

Oregon

Personnel.—Mr. William T. Wise, chemical engineer, recently joined the staff of the Industrial Hygiene Section, Oregon State Board of Health, as industrial hygiene engineer. Mr. Wise obtained both his bachelor's and master's degrees at the Massachusetts Institute of Technology.

Air Pollution.—An act for the control of air pollution has been introduced in the State legislature. This act, which would place control under the State Sanitary Authority, a division of the State Board of Health, was drawn up by a subcommittee of the Governor's Committee on Natural Resources, which included representatives of industry, agriculture, municipalities, and public health. It is modeled after the sanitary authority act controlling stream pollution.

Insecticides.—Dr. R. R. Sullivan and Mr. K. N. Flocke discussed the toxicity of insecticides and precautions at a short course for airplane sprayers and dusters given by the Oregon State College.

Pennsylvania

Health Education.—Health fairs have been held recently in Bethlehem and York, sponsored in each case by local health and civic groups. The purpose of these fairs has been to provide a means of health education for citizens in these areas and to offer each the opportunity to obtain a chest X-ray.

Among the many exhibits shown was that of the Bureau of Industrial Hygiene's Division of Air Pollution which displayed its mobile laboratory, atmospheric sampling devices, and meteorological equipment.

Texas

Civilian Defense.—Activities in civilian defense have been accelerated, evidenced by a number of lectures and motion pictures presented to a local health unit, an air tour club, a meeting of district elementary school teachers, a meeting on disaster preparedness, a sanitation training group and a water and sewage works association meeting. Radiation detection instruments were displayed and discussed at a postgraduate course on Disaster Preparedness for Atomic Warfare, sponsored by the medical branch of the University of Texas. Approximately 200 physicians were in attendance at this course.

Studies of Health Hazards in Industry

By J. J. Bloomfield*

CHEMICAL HAZARDS

Benzol Vapor

THE hydrocarbons of the benzene series, known as aromatic hydrocarbons, are usually classified under anesthetic gases and vapors which injure chiefly the hematopoietic system. They usually are derived from the destructive distillation of coal and are, therefore, byproducts of the illuminating gas and coke industries.

Production

The first fraction of distillation of coal is known as "light oil," or crude naphtha, and is collected up to 170° C. This contains, as principal constituents, benzene, xylene, toluene, pyridine, and thiophene. It is redistilled into 90 percent benzol, 50 percent benzol and solvent naphtha. This entire fraction is sufficiently volatile under ordinary conditions to cause poisoning from inhalation of vapors.

On redistillation of this "light oil," a fraction separated between 80° and 110° C. consists chiefly of "90 percent benzol." The fraction collected between 110° and 140° C. consists principally of the same two hydrocarbons, but in different proportions, together with xylene, and is known in the trade as "50 percent benzol." Pure benzene is obtained by purification of the "90 percent benzol."

Uses

Benzene is used extensively in industry: In airplane dope; as a solvent for gums, resins, fats, rubber, and alkaloids; in the blending of motor fuels; in the manufacture of aniline dyes, artificial leather, and rubber cement; in the extraction of oil and fats; in the drycleaning, electroplating, enameling, engraving, lacquering, and paint and varnish industry; and in many other tasks.

Under many of the conditions in which benzene is used, including its manufacture, there is opportunity for escape of the vapor only as a result of an accident. When such an accident occurs, acute benzene poisoning may result if severe exposure is experienced.

When benzene is employed as a solvent or dry-cleaning fluid or in a paint, the benzene is allowed to evaporate in the air of the workroom. If the workroom ventilation is inadequate, continuous or repeated inhalation of benzene vapors may lead to chronic benzene poisoning.

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

***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.**

Toxicology

Acute poisoning from benzene, as observed clinically, is of three general types, depending upon its severity. In all three the anesthetic action is predominant. Inhalation of very high concentrations of benzene vapors may result in the rapid development of unconsciousness, followed in a short time by death from respiratory failure. With somewhat lower concentrations, the sequence of events is less rapid, and the display of symptoms, correspondingly more extensive. There may be dizziness, weakness, apprehension, collapse, and unconsciousness. These symptoms, common to all anesthetics, may be replaced by violent excitement. Death may occur from respiratory failure during the inhalation of the vapors. With most anesthetics, removal from the vapors before death has occurred, and the application of suitable treatment, are followed by recovery. This may occur with benzene. But there may also be a third type of poisoning in which death occurs from several hours to several days after the exposure, usually without recovery from coma. Presumably, this delayed death results from the specific toxic action of benzene which is discussed below under chronic poisoning.

Acute Physiological Response to Various Concentrations of Benzene*

Response	*Parts of benzene vapor per million parts of air*
Slight symptoms after several hours	1,500 to 3,000
Maximum concentration that can be inhaled for 1 hour without serious disturbance	3,000 to 4,700
Dangerous to life in ½ to 1 hour	7,500
Rapidly fatal for even short exposure	19,000 to 20,000

In its anesthetic action benzene is only slightly more powerful than gasoline. But this parallelism does not hold in regard to chronic effects. Prolonged inhalation of benzene and its homologs, in concentrations too low to produce any immediate intoxication, may lead to subacute and chronic poisoning directed particularly against the hematopoietic system, although a similar condition does not follow from exposure to petroleum distillates.

Benzene, after being absorbed into the body, is chiefly eliminated through the lungs when fresh air is breathed. During the time that it stays in the body, however, a portion of that present is oxidized. The oxidation products, combined with sulfuric and glycuronic acids, are eliminated in the urine. The ratio of organic to inorganic sulfate in the urine may be used to estimate the degree of exposure to benzene.

In producing chronic poisoning, the action of benzene or its oxidation products is mainly upon the red marrow of the bones. This tissue is concerned with the formation of important blood elements: red cells, white cells (leukocytes), and the platelets which are essential for the clotting of the blood. The benzene may first stimulate the marrow so that there is an increased number of white cells; but with continued exposure this stimulation, if it occurs, gives place to depression, and these elements of the blood are diminished. The most constant diminution is

*The concentrations given here are for immediate acute effects only; exposure of several hours or days to concentrations lower than those mentioned here may lead to chronic poisoning.

in the red cells; that of the white cells may be somewhat less marked and more variable.

The decrease of red cells, when severe, causes symptoms typical of anemia: weakness, dizziness, rapid pulse rate, pain over the heart, and shortness of breath. The diminution in the number of white cells may be accompanied by decreased resistance to infection, weakness, and ulcers in the mouth and throat. The decrease in platelets results in a delay in the clotting time of the blood, which may lead to bleeding from mucous membranes, hemorrhages under the skin, and other signs of purpura.

There is considerable variation in susceptibility to chronic benzene poisoning; this variation would appear to depend upon the resistance of the red bone marrow and on the possible presence of other conditions which put a strain upon this tissue. The changes seen in chronic benzene poisoning may occur from disturbances of the bone marrow from many causes other than the action of benzene. Young people of both sexes, and particularly pregnant women, appear to have the greatest susceptibility to chronic benzene poisoning.

The maximum concentrations suggested as permissible for daily exposure to benzene vapors range from 30 to 75 and 100 parts per million parts of air. Regardless of care taken to regulate the concentration of benzene in the air, it is desirable, in view of the wide individual susceptibilities to this substance, to have frequent medical examinations of all employees who are regularly exposed to benzene fumes. This examination should include a determination of the organic sulfates in the urine and a count of the red and white blood cells.

Medical Control

Dreessen has recommended that occupational examinations of exposed employees, including blood studies, should be made at intervals of approximately 1 month, gauging the frequency to severity of exposure. The ratio of inorganic to total sulfates should be determined. A reduction would indicate the existence of exposure to benzene. In case, upon repeated examination, the percentage of organic sulfate is 30 percent or more, the concentration of benzene in the air of such operations should be determined and reduced by appropriate engineering methods.

Johnstone points out that the literature reveals that there appears to be no uniformity of opinion regarding the pattern that the blood picture assumes in chronic benzol exposures. He also states that there is no definite laboratory basis for a diagnosis of this poisoning in spite of extensive animal experimentation and many clinical reports since 1897. He feels that a more accurate basis for diagnosis will be derived if there is further controlled investigation of a large series of cases in which the degree and length of exposure is known and which would entail a hematological, pathological and postmortem study.

In spite of the varied pictures presented by the literature on chronic benzol exposures, two facts are clear: (1) that anemia invariably results from exposure and (2) that leukopenia is not a common early finding. Furthermore, if leukopenia is present, other abnormalities of the blood picture are also seen. Such observations should discourage the confinement of diagnosis to a white-cell count alone, as is frequently done.

Diagnosis

One of the chief difficulties in differential diagnosis of benzene poisoning lies in the necessity to differentiate it from various anemias, chiefly pernicious anemia. The establishment of a diagnosis depends upon the following.

1. *History of exposure.*—(*a*) Concentration. (*b*) Duration. A short, abrupt, severe concentration is likely to produce immediate intoxication from which the patient ordinarily recovers quickly. Prolonged exposure to insidious amounts has the more damaging effect, but the actual exposure should be proved.

2. *Analysis of the atmosphere.*—This must be done under the exact conditions of the alleged exposure.

3. *Analysis of the exact solvent and the conditions of concentration in which it was allegedly used.*—It has been previously intimated that solvents change their benzene content from time to time as well as their trade names. In an effort to substantiate or deny exposure, the analysis of the benzene content should be of the substance in use at the time of the alleged exposure, not at the time of the trial. Many employers assume that the chemical content of a solvent they buy is standardized and constant, whereas in reality it frequently is not.

4. *A complete blood count.*—A white blood count alone is insufficient proof for or against the diagnosis of this poisoning. A diminution of the red cells and an increase in their size are better criteria than dependence upon the reduction of the leukocytes, particularly early in the disease. As for the change in the size of the red blood cells, one must be sure to rule out pernicious anemia, since this phenomenon appears in that condition as well as in certain other toxic poisoning, as has lately been realized in the blood picture of those exposed to methyl cellulose in the "fused collar" industry. The mean corpuscular volume and the concentrated hemoglobin content are additional confirmatory findings.

5. *Signs and symptoms.*—The average case should show the variations of these as enumerated. The typical case will neither show a clinical picture with no significant laboratory findings, nor will it reveal an abnormal and indicative blood picture without signs or symptoms. Here again the history of exposure is all-important.

6. *Biopsy.*—Biopsy may be resorted to in medicolegal controversy. It must be evaluated with the blood study and the history of exposure. This may also be said of autopsy findings.

Control

Constant vigilance by the use of periodic physical examinations and by atmospheric analyses should be the established procedure wherever benzene constitutes a hazard. The routine white-cell count commonly used should be replaced by a complete blood count. Only those individuals in good physical condition should be permitted to work where a benzene hazard may be encountered.

Individuals so employed should be rotated from one job to another, and, upon detection of the least variation from their normal condition, the workers should be removed from the exposure. Workers should be instructed to report to their medical department for examination whenever they notice any bleeding from the nose, gums, or other mucous membranes, or whenever any unaccountable cutaneous hemorrhages or discolorations are observed.

In many jobs in industry, safety engineers have had excellent results in the

(Continued on page 64)

DERMATITIS AMONG ENGRAVERS INVESTIGATED AND REPORTED

SEVERAL cases of dermatitis of the hands and forearms had been reported among the workers who were working on treated glass plates in a negative engraving room of a Government agency. The Division of Industrial Hygiene, PHS, was called in for advice.

Though sporadic cases were usual, there had been an unusual increase in the number of workers affected in the last 4 months. This number approximates 10 in that period affected by varying degrees of dermatitis from moderate to mild. In general, dermatitis had occurred on the skin areas which would directly contact the treated glass plates when the worker was leaning on the plate in the course of his work.

It was noted that this posture of leaning on the plate was universal among these workers. In order to protect the glass plates from perspiration, various materials were used to lean on. Loosely woven cloth and porous paper mats were used most commonly. These materials would obviously contact the chemicals on the glass which are almost dry but still in a slight sticky state and some of the chemicals would be transferred to the fabric. Since these mats are turned over and over in the course of a day's work and leaned upon, it is probable that skin moisture would extract some of the chemicals from the cloth or paper. Also, there are occasions when the skin directly contacts the treated glass, especially on the side of the hand and fifth finger which is rested on the plate when the worker etches the negative with his instrument.

There were three types of chemically treated glass plates contacted: (1) Glass coated with an emulsion of carbon black, turpentine, and asphaltum; (2) glass coated with a mixture of ammonium bichromate, egg albumen, red, yellow and blue dyes; (3) glass coated with ammonium bichromate, egg albumen, silver nitrate, sodium sulfide and a developer, hydroquinone (Pitman processed).

In the above-treated glass plates, there are two main cutaneous chemical hazards, the ammonium bichromate and hydroquinone. The chromate compound is the more important of the two, but hydroquinone is a known skin irritant also, especially if acted upon by the oxidation action of chromic acid (of which there is a small amount in the ammonium bichromate) to change it to quinone, a more powerful skin irritant.

In order to minimize contact with the glass plates, it is suggested that (1) the protective cream already in use be continued, though it should be understood that its preventive action is not to be relied upon; (2) protective cloths should be used to lean upon, these cloths being impervious and of such material that only one side be used, for example, a blue-colored rubber on one side and a white cotton material on the other; these cloths should be washed frequently; and (3) as an alternative protective device, plastic sleeves would be effective, although these would probably interfere with the exacting work of these employees.

Incidentally, another important cutaneous hazard was noted on a visit to the rooms where the glass plates were sensitized with chromate solution. The men who pour the ammonium bichromate and albumen over the plates with a tin cup which has a spout were not protected from the solution which occasionally drips from the spout, contaminating the hands and forearms of the workers. It is suggested that the men engaged in this operation wear cotton-lined rubber gloves and plastic sleeves. The sleeves would also protect these same men when they fasten down the sensitized plates after whirling them dry. In this operation their forearms contact the chemically treated glass and would again be a source of dermatitis from ammonium bichromate.—**Dr. W. F. Edmundson, Division of Industrial Hygiene, PHS.**

CHEMICAL HAZARDS—

(Continued from page 63)

prevention of accidents by carrying on a continuous educational campaign among the employees regarding the dangers which exist in certain types of employment. Unfortunately, in many of our larger industries, the tendency has been not to inform workers about the dangers of various occupational diseases. Many serious cases of poisoning from benzene and other noxious materials could be prevented if the employees knew of certain early signs or symptoms. Whenever a far-advanced anemia is found in an individual who has for some time noticed bleeding and certain symptoms of general malaise, a failure of education is indicated.

Proper ventilation of workrooms is extremely important. Periodic inspection of hazardous occupations carried out by qualified industrial hygiene personnel can greatly assist industry in maintaining safe working conditions.

Whenever the possibility exists of hand contact with benzene, synthetic rubber gloves should be worn by the workers.

Detection

Most industrial hygiene agencies employ the MSA benzol indicator to check atmospheric concentrations of benzene vapor. The instrument can be readily calibrated and is a portable device so that there is no appreciable difficulty in evaluating various specific exposures within industry.

Air containing benzene vapor also may be collected in a nitration acid composed of equal volumes of concentrated sulfuric acid and fuming nitric acid. The benzene is converted into m-dinitrobenzene and is determined by subsequent analysis in the laboratory. There are many chemical and colorimetric methods.

(Carbon monoxide will be discussed in the next issue.)

Ten-Day Workshop for Nurses Announced by University of Pittsburgh

"Special Health Problems in Industry" is the topic of a nursing continuation center workshop planned by the University of Pittsburgh School of Nursing for the period from May 21 through June 1, 1951.

Eleven consultants on as many specialties are scheduled to lecture, according to an announcement by Assistant Professor Glenna G. Walter, who is in charge of industrial nursing. The cost of the course will be $31.50 per person. Applications should be mailed to Miss Mary Louise Brown, Instructor, Nursing Education, 2816 Cathedral of Learning, University of Pittsburgh, Pittsburgh 13, Pa.

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