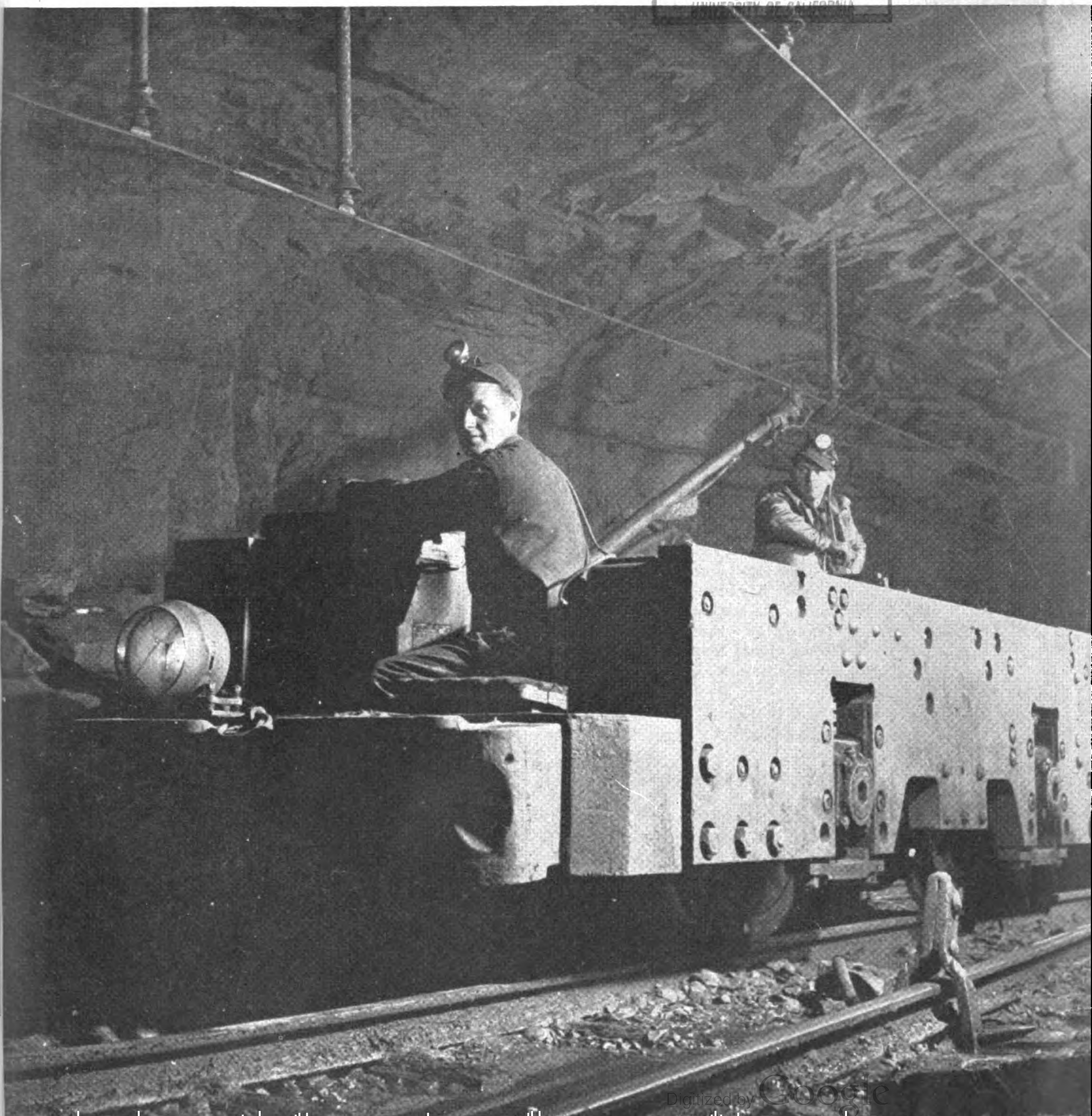
occupational health

JULY 1953

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE • Public Health Service



To the Readers

We regret to announce that because of a reduction in our appropriations we have found it necessary with this issue to suspend publication of *Occupational Health.*

This break will be bridged insofar as possible by *Public Health Reports*, an official monthly periodical of the Public Health Service, to which articles of importance on occupational health will be channeled. Former contributors to *Occupational Health* are urged to continue sending pertinent news to this Division for dissemination through *Public Health Reports* or other channels which may be made available.

It is hoped that contact will be maintained with this Division by those readers who wish to receive news releases, bulletins and other informational matter that may be issued from time to time.

Paid subscribers to *Occupational Health* will in due time receive from the Government Printing Office a cash refund on the unexpired portion of their subscriptions. Those readers who wish to see a sample copy of *Public Health Reports* before subscribing to it may request a copy from the editor. The price is $4.25 a year for domestic mailing; 75 cents additional for foreign mailing. Free official subscriptions are available to directors and supervisors of public health programs and to institutions training public health personnel.

Acknowledgment is gratefully made to the readers of *Occupational Health* who answered the questions in a recent readers' survey. At first thought, in view of the suspension of the publication, the survey might be considered a total loss. However, because of the excellent cooperation of those who received the questionnaire, the analysis of the replies will serve as a base guide for any subsequent service which may be possible in the future. Of the 3,771 surveys which were mailed to readers, 60 percent were returned, with many helpful comments and recommendations. A report on this study will be made available to those who request it.

Space has been set aside on page 109 in which you may indicate interest in maintaining ties with this Division, either through a subscription to *Public Health Reports*, or through general mailing from this Division, or both.—*Division of Occupational Health, Public Health Service, Department of Health, Education, and Welfare, Washington 25, D. C.*

A Plant Physician in Nova Scotia Reports to his Company Superintendent

DEAR Sir: During the year 1952, the employment was very large as exemplified by the number of physical examinations made at the Emergency Hospital. Even with the increase of new employees, the accident cases reported to the hospital were slightly less than those of last year.

The number of cases treated at the hospital which were results of accidents and illness incurred outside our plant was higher, proving that the men are making more use of the medical services available to them. Of course, if there is a serious medical condition found, the employee is referred to his own doctor.

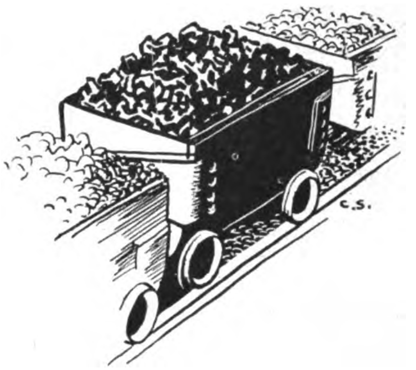
Now that we have our own X-ray equipment at the hospital, even with a large survey of new employees, we are able to report to the employment office within 48 hours on the fitness of the men.

The urine and blood examinations, made in the laboratory of St. Rita Hospital, have been most efficient, satisfactory and prompt, thereby expediting our reports on the employees' physical fitness.

Although we have had a vision test for new employees since 1946, we continue to have eye accidents. During the past year we have had at least two cases of workers who complained of affected vision after having had minor injuries around the upper part of the face. Our specialist found the vision very defective, and in both cases he thought it might be secondary to the reported accident.

During this past year a job evaluation survey has been made on the plant. To utilize this information, I believe that a job placement plan, which will consider mental and physical fitness, should be put into operation to insure the men of getting jobs they are best qualified for and to insure the company of getting the full value of their salary dollar. Our physical fitness standards have been in operation for the last 6 or 7 years and have stood the test well.

In my opinion, safety is a state of mind, much more important than a mechanical safeguard instituted for protection. Therefore, education is a prime factor in stopping accidents. The following quote is taken from an address by C. M. White, president of the Republic Steel Corporation:



"Look back on our experience in safety. In the beginning we spent large sums of money safeguarding belts, flywheels, all sorts of moving parts. We sought safety through mechanical devices. And still accidents did not decrease as rapidly as they should have. Men still kept on getting hurt.

"Then we started working with the men. Through personal contact by supervisors, we began to teach safety, to show that safety prevented accidents or death with the accompanying family hardships. We showed them it was smart to be safe. This brought gratifying results. The steel industry today is the fourth safest industry in the United States."

The men were better this year about wearing protective clothing, yet we still had a series of serious metal burns about the feet due to the lack of wearing asbestos gaiters which are provided. These burns are painful and very protracted in healing.

When you read the hospital financial report, please note that this includes the dental services, also X-ray films, development and reading of the films. The summary of the report is as follows:

Out-patient department dressings	19,796
Ward dressings	1,892
Total dressings	21,688

Number of ward patients	130
Number of hospital days	839
New cases	6,177
Number of N. P. A. cases	1,421
Number of eye cases	306
Number of ambulance calls	226
Number of accident X-rays	142
Number on compensation	47
Number of physical examinations	1,011
Examinations in connection with lead	85
Number of major operations	13

Below is a list of some of the proper types of precaution which, if used, might prevent considerable hardship and suffering on the part of our employees:

(1) Asbestos clothing where there is a danger of hot metal spilling or splashing.

(2) Proper types of respirators where there is a dust or gas hazard. The following is where the dust hazard is greatest: silica brick plant, sintering plant, blast furnace, new mixer, foundry and where there is a heavy atmosphere of dust at the coke ovens.

(3) The wearing of goggles. We had last year approximately 900 eye cases. Many of these had to be sent to the eye specialist's office for which we pay the specialist's fee. The time lost between the man's leaving his employment, coming to the emergency hospital, going to the specialist and returning, is approximately three hours. That, at your basic rate, is a very expensive proposition, and I feel that properly fitted goggles would save much pain, hardship and cost.

During the past year, as you know, the toll of officials of the corporation in what you might call their most efficient active time of life was very heavy.

Medical officers believe that a periodic check-up of these men in important positions in the corporation should be made. As the old saying goes "a stitch in time saves nine."—**J. G. B. Lynch, M. D., chief medical officer, Sydney Steel Plant, Dominion Iron and Steel Limited, Sydney, Nova Scotia, Canada.**

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Occupational Health—A Joint Industry and Public Health Responsibility

By Charles D. Yaffe

THE absence of occupational health activities in local health departments must be attributed in large part to their own actions, or perhaps we should say inactions. Three reasons, in my opinion, are largely responsible for such inaction: (1) A lack of funds, (2) a lack of technically qualified personnel, and (3) a lack of appreciation of the possibilities.

The first of these, the lack of funds, is an ever-present problem and one which the majority of health agencies will never solve to their complete satisfaction. Nevertheless, despite budgetary restrictions, most health officers manage to conduct programs in activities in which they believe.

With respect to the personnel problem, there is definitely an acute shortage of individuals suitably trained and skilled in industrial hygiene. This poses a difficult problem, particularly for state agencies. As indicated earlier, the number of industrial hygiene personnel in private industry has increased in the past two decades from a handful to literally thousands. In its search for people to fill these jobs, industry has not hesitated to lure competent physicians, nurses, chemists, and engineers from official agencies through increased financial rewards. Industry realizes the value of industrial hygiene and has been willing to pay for it. There should be no bemoaning this migration from public to private payrolls. Rather it should be welcomed, since it provides a means for achieving the objective of bringing about improved health conditions within the plant. Official agencies should be willing and should even plan to serve, to some extent, as a source of supply for industry.

Many of these people I have mentioned might be classed as industrial hygienists, or individuals who are specialists in the field of occupational disease prevention and control. In other words, their work is or has been predominantly in conformity with the early or classical definition of industrial hygiene. In recent years the concept of industrial hygiene has been broadened to encompass problems of health in industry which are not limited to occupational exposures to environmental hazards. This broader concept, which is now being referred to as occupational health, can be illustrated by the following statement from the second edition of *An Introduction to Public Health* by Mustard.

"Medicine has been inclined to approach the subject (industrial hygiene) in terms of occupational diseases; public health has had a broader approach, regarding workers as individuals who, because of the combined hazards of occupation and industry, including economic disadvantages, constitute a group for which special precautions must be exercised. The precautions applied relate to those hazards peculiar to a given occupation or industry, or both, plus ordinary public health practices in such fields as nutrition, tuberculosis, and syphilis, being concerned not only with working conditions but with the worker's home and its environment, with his family, their recreation and health education, and their ability to obtain medical, nursing, dental, and hospital care."

Under this broader point of view, occupational health involves the integration of industrial hygiene with all other public health activities. If we accept this philosophy, it quickly becomes apparent that most, if not all, of the local health department personnel are in a position to contribute to portions of an occupational health program. If the state public health agency has qualified personnel to furnish guidance and assistance, the local agency can accomplish a great deal, even in the absence of specialists on its own staff.

The third and perhaps basic reason for inaction in occupational health has been a lack of appreciation of the possibilities. If the health worker stops to consider the scope of occupational health, such as stated by Mustard, he cannot fail to perceive the opportunities which present themselves through industry. A little developmental work in the field of occupational health can produce rich returns for local health agencies.

The progress on the part of industry has naturally been primarily in large companies. From a practical point of view, we cannot expect smaller concerns to operate full-time comprehensive programs in the field of occupational health. These establishments can do a considerable amount through various approaches, such as employment of consultants or the development of cooperative programs with neighboring small plants. Such methods have been attempted, however, by relatively few companies, but it is unquestionably in the small plant area that the greatest need for assistance exists. It is in this small plant area that the local health departments can make their greatest contributions.

It has often been said that the industrial plant offers a convenient opportunity to bring public health to a large group of the adult population in the same way that the schools may be used to promote health among our children. This is true, but it must be realized that a school is established and maintained primarily for educational purposes, while the fundamental purpose of industry is to produce goods or services and to earn money. Consequently, industry cannot be approached in the same fashion as our schools. It is necessary to demonstrate that any proposed health activity will produce definite returns in the form of increased productivity, reduced sickness, or increased good will. These benefits are usually most clearly illustrated by measures which reduce or prevent occupational health hazards and can be demonstrated by State or local agencies offering technical services in industrial hygiene.

These services furnish a means for

(Continued on page 111)

Selections are printed here from a paper presented by Mr. Yaffe at the Wisconsin Association for Public Health, Milwaukee, Wis., March 30, 1953. Mr. Yaffe is senior sanitary engineer, Division of Occupational Health, Public Health Service, 1014 Broadway, Cincinnati 2, Ohio.

INDUSTRIAL MEDICINE SERVICES IN ITALY

By R. Vigliani

IN Italy, occupational health protection is provided for by law through the inspectorate of factories, which is a part of the Ministry of Labour and Social Welfare. About 30 physicians working as medical inspectors of factories ascertain whether or not the acts and decrees which have been issued regarding industrial hygiene and the prevention of occupational diseases and accidents are fulfilled in the different industries.

The Compensation Act provides that workers employed on processes included in the schedule of compensable diseases must be covered by insurance. This compulsory insurance is offered by the National Institute for Insurance against Accidents and Occupational Diseases.

Italian manufacturers, at the beginning of the century, founded a free society to improve prevention of accidents and occupational diseases. Composed at first of engineers, the society was later converted into a National Organization for the Prevention of Accidents (Ente Nazionale per la Prevenzione degli Infortuni or E. N. P. I.), which is now recognized by law as an organization for the public interest. This organization now has a technical section, a medical section and a propaganda section.

The technical section carries out the supervision of lifts, centrifuges and outdoor staircases, gives technical advice on problems of occupational hygiene and accident prevention, and promotes meetings and congresses of those who are concerned with studies on safety.

The propaganda section tries to make employers and workers more safety-conscious, by means of pamphlets, tables, periodicals, articles, moving pictures and so on.

The medical section is charged with medical examination on commencement of employment and periodic check-up on workers exposed to industrial hazards. To perform this task it has instituted twelve industrial health clinics where workers are examined by a physician who has specialized in occupational diseases and by other specialists. Moreover, the medical section of the E. N. P. I. provides for the health service (physician, nursing staff and medical material) in many factories. The medical section also owns two mass miniature X-ray mobile units to perform chest examination of workers exposed to hazards of silicosis and asbestosis.

All activities of the E. N. P. I. (except the control of lifts, centrifuges and outdoor staircases, which is compulsory) are optional; that is to say, industries can either commit their medical services to the E. N. P. I., or organize them by themselves.

The income of the E. N. P. I. is derived from payments made by the industries in return for the different medical and technical services. Moreover, the E. N. P. I. receives every year 2 percent of the income of the Accident Insurance Institute (I. N. A. I. L.), which is logical considering that the prevention of accidents and occupational diseases is of the utmost advantage for the I. N. A. I. L.

Sanitary Services in Factories

Industries involving hazardous or unhealthy working processes must organize (if they are not associated with the E. N. P. I.) a factory medical service. Also, many large industries where there are no particular hazards have their own medical services. For instance, the Montecatini Incorporated, which employs more than 60,000 workers in 150 factories and mines, has a medical service carried on by 17 full-time and more than 100 part-time physicians. The FIAT has also its own medical services, with a staff including five or six full-time and about a dozen part-time physicians.

While driving along a highway in Italy in August 1952, the editor observed these two men wearing respirators at their dusty rock crushing jobs. With their permission, this photograph was made.

The number of industries which have their own medical services is increasing, although as yet there is no law that compels every industry to organize a medical service in its factories or that establishes the rights, duties or professional training of factory physicians.

It is impossible to tell exactly how many full-time and part-time factory physicians there are now in Italy, although the figures would give valuable information; the Italian Society of Industrial Medicine, which includes only a small number of them, now has almost 500 members.

University Teaching

There are now, in Italy, four university chairs of industrial medicine, in Milan, Naples, Padua and Siena. In other universities there are professors who are charged with teaching industrial medicine. Generally, this teaching is given in the medical clinics and is concerned with occupational diseases. Three postgraduate schools (in Rome, Milan and Naples) confer, after a 2-year training, a degree as specialist in industrial medicine. A fourth school will shortly be started in Turin.

In Milan the teaching of industrial medicine and the training of specialists are carred on in the Clinic for Occupational Diseases of the University (Clinica del Lavoro).

Clinic for Occupational Diseases in Milan (Clinica del Lavoro)

The clinic was instituted in 1910 by Prof. Luigi Devoto as a postgraduate clinic for the study and treatment of occupational diseases. It is therefore the oldest of its kind in the world. The Clinic for Occupational Diseases in Milan is a hospital with 120 beds, laboratories, and a hall where lectures are held.

The clinic receives workers affected by occupational or internal diseases. As a rule, there are in the clinic 20 to 30 patients with occupational diseases, but one can forecast that, as the number of compensated occupational diseases has lately been brought from 8 to 42, there will be in the future a considerable increase in the number of such patients.

The needs of the clinic, as a hospital, are met through an administration which is charged with the care of the building, the food for the patients, and the provision of nursing personnel, drugs and all that is necessary as diagnostic aids (X-ray plates, reagents and so on). The hospital fees are paid to this administration by the patients themselves or by the different institutes which are charged with their insurance against disease.

The scientific activity of the clinic is supported by the University of Milan, which provides the pay for the professor of occupational medicine (director of the clinic), seven assistants, a librarian and a secretary, and gives a financial contribution for scientific research. As this contribution is small, means for research have been obtained through agreements with the E. N. P. I., the I. N. A. I. L., and the Montecatini and other industries.

The E. N. P. I. supports a center for the study of pneumoconiosis to which five secretaries are attached. All miniature films (about 100,000 yearly) taken by the two mobile units of the E. N. P. I. are sent to this center and are examined by the director and the radiologist. The results are sent back to the different factory physicians. The center to date, possesses more than 650,000 miniature films, relating to about 200,000 workers.

The I. N. A. I. L. has equipped a center for studies and research on occupational diseases, spending about $22,000 for scientific equipment. Moreover, it grants to the clinic a yearly allowance of about $13,000.

The Montecatini has instituted, in the clinic, a laboratory of industrial hygiene for the study of every problem of medicine or hygiene concerning its mines and chemical factories; this laboratory owns two mobile units equipped with two Gempco mass miniature X-ray units and it is well equipped with scientific apparatus. Its yearly budget is about $25,000.

As a whole, the staff of the clinic comprises a director, 7 physicians as paid assistants, 14 physicians as voluntary assistants (unpaid), 4 full-time chemists, 2 full-time and 5 part-time technical assistants, 1 full-time technical assistant to the radiologist, 1 part-time mineralogist engineer, 4 full-time technicians, 1 full-time photographer, 1 full-time librarian, and 8 full-time stenotypists.

In addition, a pathologist, a dermatologist, an oculist, and otorhinolaryngologist, a gynecologist, a neurologist and a psychologist act as consultants to the clinic.

The clinic is frequented by many intern physicians, by the physicians who attend the school for training in occupational medicine, and by about 30 medical students.

The clinic is concerned with:

(a) The study of patients.

(b) Studies and research which are of interest to the E. N. P. I., the I. N. A. I. L. and the Montecatini.

(c) Other research of scientific or practical interest in the field of occupational medicine.

The clinic also has an advisory function in relation to the many industries which ask for the solution of specific problems regarding hygiene and prevention or diagnosis of disease.

As the building and laboratories of the clinic were rather old, it was decided to renew them thoroughly. Renewal is now in progress and will be completed by next summer, to be carried out at a cost of about $200,000.

The Clinic for Occupational Diseases issues a monthly journal, *La Medicina del Lavoro*, founded in 1901. It is the oldest and most widespread Italian journal wholly devoted to problems of industrial medicine.

Graduate School of Industrial Medicine at the Clinica del Lavoro of Milan

The postgraduate training of physicians in occupational medicine is, in Italy, of 2 years' duration. In Milan only 25 physicians can enlist every year for specialization in industrial medicine; they must attend the different courses and later take an examination in the pathology of occupational diseases, industrial hygiene, social insurance, occupational dermatology, the pathology of infectious and parasitic diseases related to work, physiology of work, psychology of workers, occupational surgery; moreover, they have to do practical work and visit a number of factories.

After having passed their examinations, the candidates must prepare a thesis on a subject regarding one of the branches studied. They are then given a degree as specialists in occupational medicine. This degree is, unfortunately, not essential in order to practice as a medical inspector of factories or as a factory physician, even full time. However, industries and the medical inspectorate of factories, the I. N. A. I. L. and the E. N. P. I. are asking more and more for physicians who have the degree.

A clinic for occupational diseases similar to the one in Milan, though smaller, exists in the University of Naples. Two others, even smaller, are in Genoa and Padua.

The Italian Society for Occupational Medicine organizes every year a National Congress of Industrial Medicine; the next one, the 20th, will be held in Florence in September 1953.

In Italy the following journals, besides *La Medicina del Lavoro*, are devoted solely or chiefly to occupational medicine: *Rassegna di Medicina Industriale* (Torino); *Folia Medica* (Napoli); *Revista degli Infortuni e delle Malattie Professionali* (Roma); *Lavoro e Medicina* (Genova).

Mercury Poisoning, Silicosis Discussed by Italian Physicians

Reported by S. Laham

Speaking to guests at the Nineteenth Italian Congress of Occupational Medicine, which was held in St. Vincent, September 1952, Professor Vigliani reported 300 cases of chronic mercurial poisoning in Italian hat factories.

These cases occurred in small epidemics in the workshops where the concentration of mercury in the air varied between 0.5 and 1 mg per cubic meter.

The second report of the Congress dealt with diseases of the respiratory tract of sulfur workers. Professor Grasso-Biondi and Doctor Sorrentino presented a paper on their study of different sulfur deposits and of the control of the pollution of the atmosphere in certain work places. During the period 1941 to 1951, they observed 400 cases of acute intoxication and made 6,000 ra-

Professor Laham teaches at the University of Paris.

diographs of Sicilian sulfur mine workers. This study revealed the frequency of signs of chronic bronchitis, the rareness of pulmonary tuberculosis, and the absence of pulmonary fibrosis.

Reporting on the study of silicosis, Professor Parmeggiani and Drs. Perretti, Occella, and Zurlo stated that the slow development of silicosis does not allow a direct relationship to be established between the dangers of the actual work and the frequency of the cases observed in an industry. Having made a critical study of dust sampling methods, the authors concluded that methods must be standardized. Results of 651 dust determinations and 1,240 chemical analyses of dusts, effected in the industries of northern Italy, were discussed.

The congress concluded with a visit to the magnesite and anthracite mines. Professor Castellino was elected president of the Italian Society of Occupational Medicine to succeed Professor Vigliani. The next congress will be held in Florence in September 1953.

Helsinki Center Conducts Research, Treats Patients

IN its second year of service, Helsinki's Institute of Occupational Health treated in its hospital ward a total of 744 patients, according to an annual report issued by the director, Dr. Leo Noro. The report on the Occupational Medical Foundation and the Institute of Occupational Health is made in one publication.

The foundation, supported by industry, insurance companies and workers' organizations, was created to assist in and perform research, to disseminate information and instruction, and to carry out field work in the sphere of occupational diseases, work accidents, occupational and industrial hygiene, vocational guidance and other branches related to occupational medicine.

The function of the institute is as follows:

(1) To examine and develop methods of occupational hygiene for the protection and improvement of the mental and physical health of workers.

(2) To carry out, at the request of the authorities and private persons, occupational health surveys in plants and other examinations in the field of occupational hygiene and health work.

(3) In the capacity of occupational hygiene expert, to assist the central and local government authorities and institutions working for the improvement of the health of the workers.

(4) To confer, by request as far as possible, with physicians, technical officials and social workers, trade union officials and other comparable persons, about questions connected with social medicine and occupational health.

(5) To be a diagnostic and clinical center for occupational diseases.

(6) To operate by agreement as a health center in Helsinki for certain plants, state institutions, vocational schools and other schools and institutes to the extent required by research and information activity.

(7) To arrange courses in occupational health and social medicine.

(8) To disseminate occupational health information and instruction in cooperation with state institutions and private associations and organizations.

(9) To carry out other functions in the field of the institute entrusted to it by the board of the foundation.

During the year, the following subjects were under investigation: cobalt-dermatitis in the pottery industry, organization of industrial medical services, intoxications caused by chromium, carbon monoxide poisoning, pneumoconiosis, the frequency of eye trouble in different occupations, tuberculosis in certain occupations, physiology of athletic training, the effects of *Sauna* (Finnish steam bath) on circulation and physical fitness, methods of assessing physical fitness, gastric secretion in hypoglycemia, and the effects of alcohol on working capacity.

Results of research in various fields have been published, some in English, and are available from Dr. Leo Noro, Työterveyslaitos, Huopalahdenkatu 1, Helsinki, Finland.

Chrome Ulcers Caused by Rust Inhibitor in Cutting Oil

The development of chrome ulcers following exposure of the skin to chromic acid and its alkaline salts is well known. The frequent occurrence of chrome ulcers on the skin of workers exposed in those operations where chrome compounds are used constitutes a major problem. In such operations the cause is known and appropriate measures for control can be instituted. But occasionally the cause of cutaneous ulcers or nonhealing wounds is not known and a chrome compound is not suspected. This report deals with just such a situation.

The chief chemist of a manufacturer of coolants and lubricants requested aid of the Division of Occupational Health of the Los Angeles City Health Department with the following problem. A soluble cutting oil had been prepared to meet requirements of certain grinding and threading operations, and had been found well fitted for these processes. Shortly after its introduction in a number of plants, workers began complaining of nonhealing wounds and small ulcers on the hands. This necessitated withdrawal of the cutting oil from the market. (It should be mentioned that, in these particular operations, minute abrasions and puncture wounds from fine metal particles were of common occurrence. Prior to the use of the new cutting oil there had been no complaints of nonhealing wounds or cutaneous ulcers.)

When the complete formula was supplied, it was learned that sodium chromate was present as a rust inhibitor in 0.5 percent concentration. In actual use the oil was diluted with from 20 to 100 parts water. Even at these minute concentrations it was thought that enough chrome could get into open wounds to produce tissue damage. After the sodium chromate was replaced by another rust inhibitor, and the changed formula was tried experimentally in one plant; there was no recurrence of cutaneous ulcers or nonhealing of wounds.—**Harold Price, M. D., medical consultant, Division of Occupational Health, Los Angeles City Health Department, 6501 Fountain Avenue, Los Angeles 28, Calif.**

OCCURRENCE OF RADON IN NON-URANIUM MINES IN COLORADO

By P. W. Jacoe

ALTHOUGH uranium in large deposits is not as abundant as many other metals, it can be found in minute quantities widely diffused throughout the earth's crust. This is particularly true in mineralized drifts of sedimentary origin. A number of theories have been advanced as to the source of uranium in the Colorado plateau area as well as the small amounts of uranium in other deposits such as gold, silver, lead and zinc-bearing ores.

Uranium prevails in the uranite classification of ores associated with copper, phosphorus, calcium, arsenic, barium, vanadium, lead, and in the uranate classification associated with lead, thorium and bismuth. It is assumed then that the contingency is favorable for the existence of sufficient uranium in non-uranium mines to cause detectable quantities of radon to be evolved. This assumption was verified in a limited study of nonuranium mines in Colorado. It is possible then that a similar situation may be found elsewhere in the United States, particularly in Connecticut at the feldspar quarries, in the mica mines of North Carolina, and in findings in Llano County, Tex., Pennsylvania, and South Dakota.

Some of the mines studied are situated in areas where small amounts of pitchblend have been discovered and they are located within 30 miles of these small deposits. It is possible that the radon found enters the mine air by one or both of two methods: First, large exposed areas contain enough radium on the surface to generate detectable amounts of radon; second, water from ore deposits could travel great distances under pressure to the mine, and the radon trapped in the water is released as the pressure diminishes. This is possible in both small and large mines as the ratio between exposed surface and air volume is nearly constant. On the other hand, appreciable quantities of radon have been found in mines located several hundred miles from the nearest known deposit of uranium bearing ore. This might indicate the possibility of the existence of undiscovered ore bodies in these areas. From this then, it is evident that at least two further steps should be added to the study program. These are: (1) The analysis of spot samples of the ore and wall material for uranium; and (2) the analysis of mine water for radon content at the point of entry into the mine. Water analyses have been recently included in the program; however, insufficient data have been obtained for presentation at this time.

In the preceding description the element uranium has been used rather than radon because, although we are concerned with radon, it is necessary to verify the presence of the parent materials in tracing sources. No attempt has been made to establish the degree of equilibrium between uranium and radium. However, it can be safely assumed that with little or no air movement, equilibrium is rapidly accomplished from radium to radon and hence down the series to radium G. This is true, of course, under undisturbed conditions. A paper by Duncan Holaday (*1*) on the same study in uranium mines shows that the equilibrium between radon and its immediate daughters is greatly disturbed by ventilation, although the longest half-life encountered is only 26.8 minutes.

The study so far has not produced a set pattern through investigation of the geological environment. The actual radon content of a few nonuranium mines approaches the levels found in some uranium mines with similar conditions of ventilation. Radon has been found in clay and coal mines as well as metal mines. Several mines have been studied where high concentrations were expected because of adjacent ore deposits, yet very small amounts of radon were found. In other instances, the exact opposite held. The presence of radon in coal mines might be accounted for by the fact that uranium has a great affinity for carbonaceous material. An interesting condition was found in a small abandoned lead mine where the radon content was less than 10 micromicrocuries per liter and the mine water had no radon in it, yet a short distance away are free flowing natural springs containing 1,200 micromicrocuries per liter of radon.

The areas studied can be placed into four categories; namely, tunnels, metal mines, clay mines, and coal mines. These include large as well as small mines. Sampling is generally done in areas showing the best possibility for the existence of radon, for the most part where there is little perceptible air movement in dead-end drifts and raises. It has been found that, although radon is detected in areas of low air movement, its concentration may be reduced so that it becomes undetectable in well-ventilated haulage ways.

Since only a very small fraction of the total alpha activity delivered to the lungs comes from radon, the need for the determination of Ra A-C_1 is of prime importance. It is also evident that the tolerance for radon of 10 micromicrocuries per liter of air is meaningless in this work, since over 99 percent of the total alpha activity comes from Ra A–C′ and is always present in amounts dependent on the degree of equilibrium established with radon which in turn is dependent on ventilation. A great number of workers have been exposed for many years to concentrations considerably in excess of 10 micromicrocuries per liter. It remains for further epidemiological studies to determine the extent of damage, if any, to these workers. By studying selected groups of workers who have been and are being exposed to certain amounts of radon and its daughters, perhaps up to 500 micromicrocuries per liter, a safe yet more significant tolerance for total alpha activity delivered to the lungs can be determined.

Mr. Jacoe is chief of environmental control services, occupational health section, Colorado State Department of Public Health, Denver, Colo.

This is a partial report of a study made by Colorado State Department of Public Health, assisted by a grant from the National Cancer Institute. The complete paper was presented at the annual Industrial Health Conference held in Los Angeles in April 1953.

Reference

(*1*) Unpublished paper. Mr. Holaday is an engineer with the Occupational Health Field Station, U. S. Public Health Service, Box 2537, Fort Douglas Station, Salt Lake City, Utah.

OCCUPATION AND HEALTH

By Seward E. Miller, M. D.

Speaking at the annual meeting of the Home Office Life Underwriters Association, Dr. Seward E. Miller presented data on the relationship of occupational environment to health. The section of the speech reproduced here is that on occupational health hazards.

YOU have indicated a desire for information on the health hazards of some selected occupations and industries. I indeed regret that I am generally unable in the discussions that follow to cite specific rates. At best, therefore, such information can assist you only in developing your judgment or "informed guesses" in this area where few figures exist.

Chemical Solvents

Probably the most widespread chemical hazard in American industry is the exposure of workers to solvents. They are indispensable in the manufacture of paints, varnishes, paint removers, plastics, adhesives, artificial leather, synthetic tiles, rubber, and many more important products. They are used in printing and photoengraving colors, extraction of fats and oils, dry cleaning, and solvent degreasing operations. Their number has increased greatly in the last half century.

Today, many rank high as industrial poisons since they are volatile, often not appreciable by the senses of sight and smell, and so may be inhaled unknowingly, with resulting disability or death. However, such tragedies are becoming infrequent through the use of adequate control measures which begin with insistence on caution in the handling of solvents. Nontoxic solvents are substituted for toxic ones wherever this is possible in the industrial processes. Arrangements are made to prevent the escape of vapors into the workroom by the use of completely closed apparatus, when possible.

Lead Poisoning

The use of lead and its compounds is so widespread in industry that over the years many studies have been made of the health hazard, and methods for control of this hazard have been developed. Prolonged exposure to minute quantities occurs in workers with metallic lead, painters on exterior work or interior work without sandpapering, in plumbers and makers of plumbing goods. On the other hand, many men are exposed to fairly large quantities of soluble lead in lead smelting, lead burning, production of oxides, mixing paste, pasting plates for storage batteries, making litho-transfer paper, sandpapering lead-painted surfaces, chipping off lead paint, or burning through lead-painted steel with an acetylene or welding torch.

Control measures consist of adequate ventilation and plant sanitation. Medical controls are essential. They require immediate medical examination to assure correct diagnosis in all cases of illness and regular weekly or fortnightly examinations for all men exposed, including chemical examination of the urine or blood, or both.

Tetraethyl lead presents a serious problem of its own. It differs from other compounds of lead used in industry in that it may cause toxic symptoms by absorption through the skin as well as by inhalation. This is the mixture which is added to motor fuel to eliminate knock. Those exposed are the workers who produce the compound, the workers who blend it with gasoline, and, to a lesser extent, garage employees and auto repair men. The symptoms are severe and unmistakable and demand immediate medical attention to avert death.

Effects of Radiant Energy

The hazard of radioactive elements is a comparatively recent development in industry. Danger by exposure to X-rays from photographic or fluoroscopic devices was realized and controls were formulated. The hazard from fumes, gases, and dusts of radioactive ores in mining and processing has been recognized and is under investigation to develop proper preventive measures and safeguard the health of workers.

An example of a significant radiation hazard is the shoe-fitting fluoroscope. Over 2,000 of these machines were installed in stores in the United States, many of them with defects which permitted leakage of X-ray radiation potentially harmful to customers using them, but especially to salesmen subject to continued, extended periods of exposure. Demonstration of this hazard led to the adoption of state and local health codes to abolish or minimize the risk through regulations for construction, location, and operation of these machines.

Fluoroscopy and radiography have long been of value in industry for detecting defects in castings and other products of metal or rubber. The hazard here to the worker was exposing his hands or body directly to the rays or acquiring too much radiation through improper use of equipment, or the use of faulty equipment.

The development of atomic energy has opened the way for its application in industry and has vastly increased the number of workers exposed to this hazard. Radioactive isotopes are now in fairly wide use in industry, hospitals, and research laboratories. Workers may suffer from exposure if close to the source of radioactivity, particularly if the equipment is defective. Harmful effects range from acute burns to serious chronic blood disease, anemias, leukemias, and cancer.

Preventive measures entail strict environmental regulations; complete protection of the body surface; absolute cleanliness in the plant and facilities for immediate cleaning up of accidental contamination of working surfaces, floors, and containers.

Instruments to measure radioactivity are installed in workrooms, and regular checking of workers' badges (dental film worn on clothing) is carried out.

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Also, regular physical examinations with periodic blood analyses are made. Such controls have proved gratifyingly successful; so it is possible to live and work with these new radioactive materials without undue hazard to life or health.

Ferrous Foundries

The Division of Occupational Health, with the cooperation of the Illinois State Department of Public Health, in 1949 conducted a full year's study of the environmental and clinical aspects surrounding ferrous casting in 18 representative plants. Clinical studies of 2,000 foundrymen revealed data of significant pulmonary fibrosis in 9.2 percent. It is likely that in many cases the pulmonary fibrosis observed was due in great part to higher dust concentrations which probably existed 10, 15, or more years previously in the foundries, since environmental studies of the plants determined that the foundries were now clean, housekeeping was adequate, and dust suppressive measures were employed. However, there was some room for improvement, and recommendations were presented regarding the housekeeping, maintenance, and remodeling of exhaust systems, and dust collecting equipment.

Health of Arc Welders in Steel Ship Construction

In recent years, we have studied the health of workers in the modern steel shipbuilding industry. More specifically, the main objective of the study was to determine the clinical nature of the respiratory symptom complex occurring in electric arc welders, its prevalence, cause and prevention, and its comparison with the metal fume fever or zinc chills experienced by welders of galvanized metal.

Based on the observations of the study, it was concluded that the gases and fumes generated by welding of steel induced certain symptoms and other possibly related changes, such as welders' siderosis and a slightly lowered blood pressure. However, these health deviations caused only temporary clinical disability; no permanent disability or residual effects could be demonstrated. There was no indication that welding fumes, under the conditions observed, predisposed to pulmonary tuberculosis.

Fluorosis

Fluorine and its compounds are widely used in industry in etching glass, clouding electric light bulbs, and pickling metals and wire. They enter into the composition of artificial fertilizers, insecticides, and even the agent for separating uranium isotopes.

They are highly caustic and erosive in the form of vapor, liquid, or dust. Recommendations to protect workers from their effects are as varied as the industries in which they are used, but they have in common one important objective—to guard against and minimize contact and exposure. They include exhaust ventilation to remove gases as near as possible from the point of origin; mechanical, rather than manual, handling; strict enforcement of rules for wearing protective clothing, goggles, and respirators, and coating the hands with lanolin. Prompt treatment must be given burns and other injuries.

Chromate-Producing Industry

A recent comprehensive clinical and environmental study by the Public Health Service evolved findings which indicate that, of the 897 workers examined in the 6 plants investigated, 10 were considered as having bronchogenic carcinoma. Their mean age was 54.5 years and their mean period of exposure to chromate, 22.8 years. This experience gives a rate for bronchogenic cancer of 1,115 per 100,000 persons for chromate workers, which is far above that found among a comparison group. Perforation of the septum was found among 56.7 percent of the chromate workers.

Recommendations were presented for prevention and control. The environmental problems involved were generally typical of the chemical industry. Adequate dust control features should be incorporated in the designs of all new equipment; old equipment should be redesigned to include more complete enclosure of process equipment and conveying systems, as well as greater use of local exhaust ventilation; housekeeping should be perfected to prevent accumulation of dusts and spillage. Personal protective devices should be used until the air concentration can be reduced to a safe level in certain areas or in special hazardous operations.

Medical controls recommended provided that all employees who have worked 5 years or more in the chromate industry should be X-rayed every 3 months and their films should be read by a competent roentgenologist. Also, the study of the morbidity and mortality experience of workers in chromate plants should be continued. The local health department should follow up all chromate workers who have worked in the industry 5 years or more.

Anthrax in Industry

Recent increase of human anthrax in certain industries prompted the Public Health Service to study the situation. The disease is an acute infection, generally transmitted by contact with imported goat hair, carpet wool and goat skins, though animal hides other than sheep and goats are occasionally responsible for anthrax infections. Workers affected in greatest proportion are those in the carpet industry, the apparel industry (processing hair cloth, woven and pressed felts), and the leather-processing industry. Investigation showed the increased incidence as being among workers handling hair and wool.

Preventive controls recommended included adequate ventilation and dust suppression; labeling imported bales with anthrax risk tags; daily cleaning of premises; protective clothing for the entire body; adequate locker space, one each for work clothes and street clothes); adequate washing facilities; also, medical facilities for early diagnosis and treatment; and education of workers in the cause, nature and control of the disease, plus the need for reporting all skin abrasions and lesions when noted.

Studies of Beryllium and Its Compounds

Recognition of the grave consequences of exposure to beryllium and its compounds accelerated studies in the last several years to control this menace to the health of workers employed in extracting the metal from its ore, and in various manufacturing processes, notably that of fluorescent light bulbs.

Among recognized syndromes are conjunctivitis, irritation of the upper respiratory tract, dermatitis, subcutaneous tumors, and acute and chronic disease of the lungs. The pulmonary lesions are the more serious and disabling. Primarily through the findings of a medical advisory committee with representation from the Public Health

(Continued on page 111)

Evaluation of Long-Term Radiation Exposures

By Duncan A. Holaday

THIS article presents some data on the biological significance of small doses of radiation, both to the individual and to the general population, points out some of the sources of radiation to which an average person may be exposed, and suggests several items with which health departments might be concerned.

Since the studies by Muller (*1*), it has been known that radiation induces inheritable changes, or mutations, in animals. Mutations are transmissible variations in a characteristic, and the slightest detectable changes would be included in studies such as those of Muller. In contrast to most radiation effects which indicate that small radiation doses are not additive, genetic studies indicate that fractional irradiation doses have a cumulative mutagenic effect. Tests with fruitflies and with mice show that approximately the same mutation rates are produced whether the exposure is a single dose or an accumulation of small doses. The existence of this cumulative action is all-important in assessing the genetic effect of radiation exposures.

Data obtained by Russell (*2*) in his genetic studies on mice allow comparison with the Drosophila figures and more realistic estimations of the mutagenic effects of irradiation in man. His results indicate that every mouse which has one parent whose germ cells were exposed to 200 r will carry one new mutation. Therefore, the dosage required to double the spontaneous mutation rate in mice will be about 30 r.

To translate these results from mice to man requires a few more assumptions, but it has been calculated that the radiation dose required to double the spontaneous human mutation rate is somewhere between 30 and 80 r. As Plough (*3*) points out, this figure is of no importance except to indicate the order of magnitude of the genetic effect of radiation. He concludes that the available experimental data suggest that the offspring of a human being whose germ cells have received a total dose of between 30 and 80 r may be expected to show a 100 percent increase over the mutations which will appear anyway.

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The spontaneous mutation rate calculated by Wright (*4*) implies that 1 out of every 100 persons will normally carry a new mutation. The hazard of even a slight increase in the number of deficient offspring is one that is worthy of serious consideration by every person whose germ cells are exposed to radiation. Plough's summation is that we cannot contemplate with equanimity an increase in the number of defectives.

The last conclusion is one with which all of us would agree. As previously pointed out, the survival of the race as a whole is not likely to be influenced by widespread irradiation, but the effect on the individual will be quite important.

Sources of Radiation

Industry is constantly increasing its use of X-ray machines and radioactive materials, and so the group of potentially exposed workers is being enlarged. Such installations can be designed and controlled so that no one need receive more than the maximum permissible dose. At 0.3 r per week this level would result in an exposure of 15.6 r per year. Workers in carefully monitored installations receive total exposures far less than this.

Several investigators have studied the average radiation doses from common diagnostic procedures used by radiologists (*5*). Some of these values are as follows: chest, large X-ray, 0.1 r; chest, photofluoroscopic observation, 1.0 r; pregnancy, lateral examination, 9 r; gastrointestinal series, 4.0 to 50 r; average dental film, 5 r, and fluoroscopic examination, 10 to 20 r per minute. Some examinations, particularly fluoroscopic, run much higher than these figures, depending on the equipment and procedure used. For a complete discussion of this subject, the references listed should be studied. It must be remembered that these exposures are to limited parts of the body and cannot be compared directly with maximum permissible doses based on whole-body exposures.

In addition to the above radiation sources, we still encounter a few instances of the use of radiation for such trivial purposes as the removal of unwanted hair. I am not aware of any recent studies of radiation doses from such equipment, but the exposures are undoubtedly high. Obviously, if enough radiation is delivered to hair follicles to destroy their function, permanent damage is done to neighboring tissue.

The diagnostic procedure figures make interesting reading compared with those quoted in the first part of this paper, from which it was calculated that a lifetime radiation dose of from 30 to 80 r would double the spontaneous mutation rate. It seems that some of our population may have a fair chance of receiving such a dose.

The data which have been assembled on radiation exposures and their possible effects deserve thoughtful consideration by all public health groups. The geneticists who have studied this subject have spoken out in plain words, and their opinion should be given more than passing attention.

Responsibilities of Health Officers

Health departments are responsible for the well-being of the people, and members of such departments should consider the implications from the information given in this paper and what effects such information might have on their activities. What is the real importance of this potential health problem compared with the many other fields of public health in which these officials must also work? Should they attempt to see that all industrial and medical radiation sources are periodically surveyed and that proper records are maintained of the exposures of personnel? Would it be desirable to set up controls over the distribution and use of natural radioactive elements, such as are exercised by the Atomic Energy Commission over the artificial materials produced? Plough suggests that every person should carry a record of his X-ray exposures from which a physician could always determine the total dosage he has received. Is such a universal personal record necessary? If not, what measures are indicated?

Some conclusions are readily apparent, of which the most striking one is the almost complete lack of knowledge of the sources of radiation exposure. If a person is an industrial worker, it is possible that his occupational exposure is known and recorded. However, the chances are certainly against anyone's knowing what dose he may have received from diagnostic procedures, and the total background radiation from all sources is almost certainly unknown. No health department would be content if it were similarly uninformed about the quality of the water supplied in its areas.

Just what are the radiation sources in any particular area, and where are they located? Are all the X-ray machines situated in hospitals, in the offices of physicians and dentists, and in industrial establishments? How about the quarters of veterinarians, for example? Who checks these X-ray machines and sees that they are properly safeguarded? Is any effort made to measure and record the exposures of the people who use these machines? Where has the 600 gm of radium that was made into luminous paint in the last 10 years come to rest? After World War II some enterprising surplus dealers disposed of large amounts of self-luminous tape. What about the articles made from this tape, which made interesting souvenirs for children of all ages and were readily sold?

Some State and local health departments can answer most of these questions, and all should be able to do so. All health departments should also have adequate information on the amounts of natural radioactive elements that are present in air and water in their communities. It would be very interesting to know what levels of radon are normally present and how atmospheric conditions affect these concentrations. As pointed out by the Detroit industrial hygiene group, atmospheric inversions can change the concentrations of radioactive materials drastically. Data also indicate that the radium content of water is affected by treatment schedules. Again, information on the concentration of radioactive material in source and tap water would be useful. Some of the data will require effort to obtain, but it is not an impossible task.

The methods of evaluating exposures to radiation are well known and are reasonably reliable. Special techniques are required to measure the radioactivity of air and water, but the equipment for doing this work is available from the United States Public Health Service and from several universities. The total exposure from medical and dental uses of X-rays would have to be estimated by studying the medical and dental records of a sufficient number of persons, but it should be possible to make an order of magnitude guess on this subject. The barriers to determining the radiation doses received from the environment in which people live and work do not appear to be insurmountable.

The results of such a study would indicate whether there now is any appreciable number of persons exposed to radiation in biologically significant amounts and how much of an increase in radiation would be required to reach such a level. It also would permit the responsible agencies to make reasonable plans for their future programs in this field. Without base line information of this type, it is extremely difficult to chart any course.

If such a study did reveal the existence of a number of persons who had been or would be exposed to possibly significant amounts of radiation, the logical next step would be to see if biological damage did occur. If a statistically valid number of persons could be studied over a number of years, we could unravel some very perplexing problems. All of us would be happier to have more data for use in establishing maximum permissible dose levels, and any information on the genetic effects of radiation in humans would be a valuable addition to our present store of knowledge on the subject.

In summary, the salient points of this problem are as follows:

Our best available information shows that for many of the biological effects of radiation there is a threshold dose below which no permanent damage will occur. For certain effects, such as the production of mutations, shortening of the life span, and possibly carcinogenesis, there is no lower threshold.

Animal experiments and such data as we have on humans indicate that moderate radiation doses will increase the normal mutation rate. Furthermore, for this particular effect all radiation exposures are additive.

Calculations of radiation doses from various sources, such as the industrial and medical use of radiation, indicate that it is possible for an average person to be exposed to biologically significant amounts of radiation.

In these circumstances, it would be advisable for all health departments to obtain data on the location of sources of radiation in their areas, on the levels of radioactivity in air and water, and on control and protective measures employed. Such base line information would permit an intelligent appraisal of the extent of the present and future problems that may be created by the use of radiation and would permit the responsible agencies to determine what their course of action should be. Any time spent in accumulating these data would be well invested. Questions involving determinable facts cannot be decided by disputation, after the manner of Aristotle, but can be decided by unearthing the pertinent data and logically analyzing the facts.

References

(*1*) Muller, H. J., in Symposium on Radiobiology: The Basic Aspects of Radiation Effects on Living Systems, edited by J. J. Nickson, New York, John Wiley & Sons, 1952, Chap. 17.

(*2*) Russell, W. L.: X-ray induced mutations in mice, Cold Spring Harbor Symposium, *Quant. Biol., 16:* 327, 1951; Oak Ridge National Laboratory Quarterly Progress Report, Nov. 10, 1951, written for the U. S. Atomic Energy

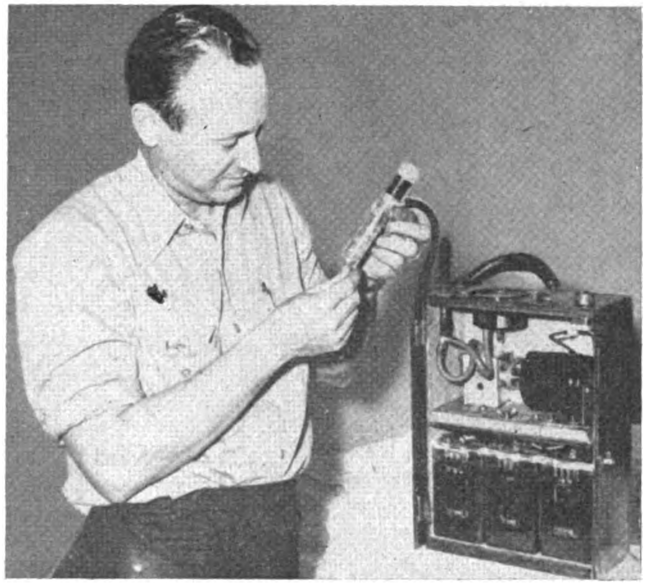
Commission, Oak Ridge National Laboratory, Oak Ridge, Tenn., 1951, p. 55; also in Symposium on Radiobiology: The Basic Aspects of Radiation Effects on Living Systems, edited by J. J. Nickson, New York, John Wiley & Sons, Inc., 1952, Chap. 22.

(3) Plough, H. H.: Radiation tolerances and genetic effects, *Nucleonics, 10:* 16, 1952.

(4) Wright, S.: Discussion on population genetics and radiation, *J. Cell. & Comp. Physiol., 35:* 187 (Supp. 1), 1950.

(5) Handloser, J. S., and Love, R. A.: Radiation doses from diagnostic X-ray studies, *Radiology, 57:* 252, 1951. Miller, R. S.: Some Potential Hazards in the Widespread Use of Roentgen Rays in Pediatrics, Project Report 191, University of Rochester and U. S Atomic Energy Commission, 1952.

ARKANSAS ENGINEER IMPROVISES IMPINGER PUMP



To make an impinger pump for as little cost as possible was the aim of an Arkansas engineer, Clarence N. Overcash. Although it is used mainly for sampling, it has many uses in industrial hygiene studies. Anyone interested in obtaining further information may write Mr. Overcash, Division of Industrial Hygiene, Arkansas State Board of Health, Little Rock.

Publications and Reprints Available

Sick absenteeism among a sample of member companies of Industrial Hygiene Foundation, 1951 and 1950. Reprinted from Transactions 17th Annual Meeting of Foundation. Available from Division of Occupational Health, Public Health Service, Department of Health, Education, and Welfare, Washington 25, D. C.

Saltzman, B. E.: Colorimetric microdetermination of cadmium with dithizone with improved separation of interfering metals. *Analytical Chemistry, 25:* 493 (March) 1953.

A procedure for the microdetermination of cadmium by dithizone in chloroform solution is presented with innovations to give more stable colors and much greater tolerance to interfering metals. Improved separation of interfering substances is achieved by the use of small amounts of cyanide as a suppressing agent and tartaric acid as a stripping medium. Two extractions are made from strongly alkaline solution. Stable colors are obtained and losses due to decomposition are controlled by using hydroxylamine in the extractions and reducing the time of contact of the chloroform with the alkali. Purification of reagents is unnecessary. The simplified procedure determines cadmium spectrophoto-metrically in a volume of 15 ml with a sensitivity of 0.05 microgram. Separation of thallium, previously disregarded, is made possible by the development of a special procedure which transposes the dithizonate of thallium with cobalt.

Reprints are available from the author, an engineer with Division of Occupational Health Field Headquarters, Public Health Service, 1014 Broadway, Cincinnati 2, Ohio.

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DIAZOMETHANE, A POISONOUS LABORATORY CHEMICAL

THE requirement that broad public health significance be attached to investigations of dangerous chemicals by the Public Health Service results in comparative neglect of hazards associated with many laboratory chemicals that often may never attain wide industrial application, but nevertheless are commonly used by synthetic organic, biological, and pharmaceutical chemists. These groups are expanding to large proportions as a result of increased emphasis on research and development of new organic chemical products. To be sure, the laboratory scale of chemical procedures usually insures use of relatively small quantities of materials, yet often the chemicals are highly poisonous, and the chemist intent on achievement is notoriously callous to personal dangers inherent in their use. Moreover, the laboratory chemical of today may be the industrial chemical of tomorrow.

Diazomethane, a very effective methylating agent, is selected as typical as one of these potentially dangerous laboratory chemicals. Already two fatal cases of poisoning have been reported in recent years, and it is possible that other fatal or near-fatal cases may have occurred without having been reported.

Diazomethane, azimethylene, CH_2N_2, is a yellow gas with a peculiar musty odor. It is easily condensed to a liquid which boils at —23° to —24° C. The liquid diazomethane, as well as its concentrated solutions, may explode violently on heating or in contact with the rough surfaces of glass or particulate matter. In ether or benzene, in both of which diazomethane is readily soluble, the danger of explosion is much decreased, but even the ethereal solution will explode with severe heating. Diazomethane is usually prepared from methylnitrosourethane (which is a

Adapted by Dr. H. E. Stokinger from data compiled on the toxicity of diazomethane by Dr. L. T. Fairhall. Dr. Stokinger is a toxicologist with the Occupational Health Field Headquarters, 1014 Broadway, Cincinnati 2, Ohio. Dr. Fairhall, formerly with the Public Health Service and now retired, may be addressed, P. O. Box 92, Pine Orchard, Conn.

have reported irritation of the eyes, dizziness and denudation of the mucous membranes. In one case, vapor from an ethereal solution of diazomethane was found to be severely irritating to the skin, and the fingers became so tender that it was difficult to pick up small The reaction is fast, usually quantitative, and can be carried out at room temperature without the addition of other reagents. It is excellent, therefore, for use with sensitive compounds, as it reacts in neutral solution. While its toxicity and danger have limited its employment in the past, there is an increasing tendency to apply diazomethane in many of the complex and difficult syntheses now demanded of the chemist.

Of the several methods that have been adapted to the analysis of diazomethane, that of Marshall and Acree (1) is considered the best. The diazomethane solution is cooled, treated with 1/10 N benzoic acid and after the reaction is complete, the excess benzoic acid is titrated with 1/10 N barium hydroxide solution. Other methods consist of adding an excess of iodine and determining the amount used in the reaction, or by adding an alcoholic solution of hydrochloric acid (which reacts to form methyl chloride and nitrogen) and measuring the amount of nitrogen evolved.

Diazomethane is undoubtedly one of the most dangerous products of the chemical laboratory—not only because of its explosive nature, but particularly because of its toxic effects. Since it was discovered in 1894 by V. Pechmann, a succession of chemists have drawn attention to its noxious properties. V. Pechmann apparently became eventually sensitized to diazomethane. Others

commercial product—a yellowish red liquid boiling at 70° C./23 mm). When this is treated with sodium methoxide, diazomethane is readily evolved. Diazomethane is a powerful methylating agent, especially useful for the methylation of phenols and carboxylic acids. objects. Chest pains, fever and severe asthmatic effects have been reported from contact with the gas. It has been reported, furthermore, that hypersensitivity results from contact with this substance and that further contact brings on attacks of asthma and associated symptoms.

The first case of serious poisoning in the literature from exposure to diazomethane was reported by Sunderman and his associates (2). In this case a chemist was exposed to diazomethane gas and required hospitalization for two weeks before recovery. Severe pulmonary edema resulted from the powerful irritant action of the gas. LeWinn (3) has recently reported a death from exposure to diazomethane vapor. The victim (also a chemist) was distilling diazomethane under a laboratory hood and inadvertently inhaled some of the gas. The effects were not immediate, but began to be apparent on the following day. The symptoms were those of a fulminating pneumonia, and the patient died about 100 hours after exposure.

At autopsy, there was gross involvement of the respiratory system. Histologic examination of the trachea and main stem bronchi showed the ciliated epithelium to be almost entirely lost and the mucosa thickened by edema and congestion. There was enormous engorgement of the capillaries and small veins. In the lungs there was widespread acute congestion. The pathologic diagnosis was acute ulcerative tracheobronchitis, bronchiolitis and bronchiolar pneumonia with secondary changes in the heart, kidney and liver. It does not appear from the reports of these two cases that either of the chemists was careless or exposed to any especially large amount of diazomethane. This points up all the more the deadly character of the substance.

A certain amount of animal experimental work has been reported with reference to diazomethane. Sunderman and his associates (2) exposed guinea pigs to the vapor of diazomethane evolved in desiccators and noted the typical asthmatic type of respiration which resulted. Autopsy revealed the pronounced irritant action of the gas on the mucous membranes of the lungs. Flury and Zernik (4) found, with cats as experimental animals, that 175 parts per million of the gas dispersed in 2 percent ether vapor (as diazomethane vapor mixed with air is violently explosive) invariably led to death within 3 days.

In view of the dangerous and insidious nature of diazomethane, it is suggested that it be handled with all the precautions that are adopted in working with arsine, or similarly acting highly toxic substances.

REFERENCES

(1) Marshall, E. K., and Acree, S. F.: Über die quantitative Bestimmung von Diazoalklen. *Ber., 43B:* 2323 (1910).

(2) Sunderman, F. W., Connor R., and Fields, H.: Diazomethane poisoning. *Am. J. M. Sc., 195:* 469 (1938).

(3) LeWinn, E. B.: Diazomethane poisoning; report of a fatal case with autopsy. *Am. J. M. Sc., 218:* 566 (1949).

(4) Flury, F. and Zernik, F.: *Schädliche Gase.* Julius Springer, Berlin, (1931), p. 420.

Industry and Public Health Responsibility—

(Continued from page 100)

showing industry the value of industrial health. If such services are properly carried out, industry will develop a respect for, and confidence in, the agency and will be more than willing to listen to any proposal for expanded health programs. This is not a rapid procedure, but the time spent in developing such relationships will, in the long run, produce results of more lasting benefit.

Occupational health is a joint industry-public health responsibility. While it can still do a great deal more, I believe we should recognize that industry in recent years has come more than half way to meet the public health agency in shouldering this responsibility. The State agencies have worked valiantly to carry their share of the burden. It is apparent, however, that the local health department must contribute more fully to this field if the responsibilities of all are to be met.

Occupation and Health—

(Continued from page 106)

Service, preventive measures have been formulated which reduce the incidence and promote early detection of symptoms of the disease. The controls recommended are more rigid than is usual in industry. Besides strict rules of plant housekeeping, appropriate ventilation and provisions for protective clothing and adequate locker and washing facilities, they include periodic physical examinations, every 6 months for those having intermittent or continuous exposure, and every week as well as at termination of employment for those exposed in plant areas known to have produced manifestations. Most important has been the widespread substitution of nontoxic material and the elimination of beryllium from many industrial processes.

Insecticides

After the war, numerous chemical insecticides were marketed for agricultural purposes, the organic phosphates being the most toxic. Their use became widespread at once, and, as reports of poisoning cases multiplied, public health agencies were called on to help formulate control measures. In the chemical manufacturing plants controls are excellent and the hazards are rather easily controlled. However, the widely dispersed agricultural users, such as fruit growers, nurserymen, florists, tobacco growers, and farmers, with varying equipment and techniques of application, presented quite another problem.

Preventive information calling attention to the deadly quality of organic phosphates was widely dispensed. They may be absorbed not only by inhalation and ingestion, but also through the unbroken skin. Precautions recommended were common sense methods to guard against contact by wearing of protective clothing, complete cleanliness of person and clothing, and the wearing of respirators while mixing or spraying.

Since dusting is frequently done by airplane, the pilot-applicator and his ground crew are subject to exposure. A number of cases, some fatal, have been reported. These workers must wear protective masks throughout their operations.

Effects of Prolonged Low Exposures

Today there remain unanswered the effects on health of continuous or long-time exposure to minute or small quantities of various toxic chemicals in our environment, particularly the constant inhalation of small amounts of toxic chemicals by our industrial workers. What are the possible relations to chronic disease? Is the life span shortened? We simply do not know the answers to these questions and probably will not find them out easily or soon.

RECOMMENDED READING

Ashe, W. F., Largent, E. J., Dutra, F. R., Hubbard, D. M., and Blackstone, Morris: Behavior of mercury in the animal organism following inhalation. *AMA Arch., Ind. Hyg. & Occup. Med., 7:* 19 (January) 1953.

Division of Occupational Health, Public. Health Service, Federal Security Agency: Health of Workers in Chromate Producing Industry. *Public Health Service Publication No. 192.* U. S. Government Printing Office, Washington, D. C., 1953.

Dolin, B. H.: Insecticides and rodenticides. *Month. Rev., New York State Dept. of Labor, 32:* 13–16 (April) 1953.

Dunlap, J. W.: Human engineering: what it is and what it can do for you. *Factory Management and Maintenance, 3:* 96 (January) 1953.

Felton, J. S.: Nursing in industry. *Nursing Outlook, 1:* 222–224 (April) 1953.

Radcliffe, J. C.: Noise. *Occup. Health Rev., 4:* 3–6 (March) 1953.

Sodeman, W. A.: *Pathologic Physiology, Mechanisms of Disease.* W. B. Saunders Co., Philadelphia, Pa., 1950.

Talvitie, N. A.: Colorimetric determination of vanadium with 8-quinolinol (application to biological materials). *Analytical Chem., 25:* 604 (April) 1953.

Thorn, G. W., et al.: Medical progress: pharmacologic aspects of adrenocortical steroids and ACTH in man. *New England J. Med., 248:* 588, 632, 1953. (2 installments.)

COVER PICTURE.—An electric locomotive hauling cars with iron ore at Wabana, Newfoundland, where the Dominion Wabana Ore Ltd. operations are located. Photograph by courtesy of National Film Board, Ottawa, and Dr. J. G. B. Lynch. **(See article by Dr. Lynch, p. 99.)**

Noise Reduction Course Offered

To give engineers and scientists a working knowledge of means for noise reduction in industrial plants and buildings, a 2-week special summer program on noise reduction will be presented at the Massachusetts Institute of Technology during the 1953 Summer Session from Monday, August 24, through Friday, September 4.

The program will be divided into ten lectures supplemented by the field trips and round-table discussions. For further information, write the Registrar, Summer Session, Massachusetts Institute of Technology, Cambridge 39, Mass.

Wanted: Engineers by University of Washington

Chemist or chemical engineer for industrial hygiene and air pollution projects. Experience in inorganic microdeterminations desirable. Recent graduate acceptable. Beginning salary $3,600–$4,500.

Industrial hygiene engineer for industrial hygiene and air pollution surveys. Formal training in industrial hygiene desirable. Recent graduate acceptable. Beginning salary $3,600–$4,500. Address Ross N. Kusian, Director, Environmental Research Laboratory, E306 Health Sciences Building, University of Washington, Seattle 5, Wash.

Illinois County Studies Incidence of Diabetes in Three Industries

In a study of the incidence of diabetes among industrial workers, the Adams County Health Department in the State of Illinois and the County Medical Society, sponsoring agents, tested 1,121 persons. Of the 47.5 percent of the men and women employed in 3 industries, 4 persons were found positive and were referred to their family physician for further study. The remainder were notified of their freedom from the disease.

In addition to the discovery of previously unknown cases, such projects undoubtedly tend to bring about a greater community awareness of the dangers of diabetes.—Reprinted from *Illinois Health Messenger*, *25:* 28 (April) 1953.

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