The American Ceramic Society

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CERAMIC ABSTRACTS

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ABSTRACTERS

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General

Ceramic laboratories: Georgia School of Technology. ANON. *Ceram. Age*, 34 [1] 12 (1939). Massachusetts Institute of Technology. *Ibid.*, [2] 44. New York State College of Ceramics. *Ibid.*, p. 45. Rutgers University. *Ibid.*, [3] 78. University of Illinois. *Ibid.*, [1] 13.—The laboratories are briefly described and illustrated. F.G.H.

Ceramic schools. Current survey of status and progress. ANON. *Ceram. Age*, 33 [6] 171–91 (1939).—A comprehensive survey of ceramic schools throughout the country is given. The course of instruction, the teaching staff, the research staff, and the student body of each of the following schools are described: Georgia School of Technology, University of Illinois, Massachusetts Institute of Technology, Missouri School of Mines, New York State College of Ceramics, North Carolina State College, University of North Dakota, Ohio State University, Pennsylvania State College, Rutgers University, Virginia Polytechnic Institute, University of Washington, University of Oklahoma, West Virginia University, and Carnegie Institute of Technology. Illustrated. F.G.H.

Contract law for engineers. L. T. PARKER. *Combustion*, 11 [2] 33–34 (1939).—P. explains implied and expressed contracts, as interpreted by the higher courts, with particular reference to the employment of engineers and personal services rendered by them. The liability of employers in such cases is illustrated by a number of court decisions, some of which are cited. H.E.S.

Control of speed is important factor in cement manufacture. ANON. *Concrete, Cement Mill Ed.*, 47, 238–39 (1939).—Early devices were friction driven. Later, variable-speed motors were used. Now a vari-pitch speed changer is used which is operated by a small pilot motor and which is either automatically or remotely controlled. New power self-synchronizing drives may be used to keep a kiln and the kiln feeder in synchronism. W.D.F.

Development of central-heating systems. LUIGI RANZI. *Gesundh.-Ing.*, 60 [50] 753 (1937).—R. describes the development of modern central-heating systems. A new type of installation is explained, and various examples are calculated. W.D.K.

Effect of condensate extraction on efficiency of the heat cycle. W. M. MEIJER. *Combustion*, 11 [2] 30–32 (1939).—M. contends that the value of high superheat as a means of improving the efficiency of steam power plants is being overestimated and recommends the use of high initial steam pressures at moderate initial superheat combined with the mechanical extraction of condensate at appropriate stages of the expansion. H.E.S.

Fatalities from silicosis and asbestosis; their incidence in industry. ANON. *Iron & Coal Trades Rev.*, 139 [3732] 336 (1939).—The annual report of the Chief Inspector of Factories shows that from 1935 to 1938 inclusive, deaths from the two lung diseases in the refractories industries and in the manufacture of pottery have been approximately constant, i.e., 68 in 1935, 56 in 1936, 83 in 1937, and 60 in 1938. Sandstone quarrying and dressing took 40 lives in 1935, 43 in 1936, 19 in 1937, and 27 in 1938. Preventive measures have aided in a generally small decrease; some of these measures are as follows: (1) use of alumina for flint in china bedding, (2) use of alumina for siliceous material in parting powders, (3) use of nonsiliceous abrasives for sand or flint in blasting, (4) use of nonsiliceous material for kieselguhr in the slow cooling of steel, and (5) use of nonsiliceous material for silica brick for lining steel and other furnaces. See "China—," *Ceram. Abs.*, 18 [2] 54 (1939). M.H.

Gas heating installation. H. DIETRICH. *Gesundh.-Ing.*, 60 [45] 677 (1937).—D. surveys the developments of gas heating after the World War and discusses the gas single-heating system, the gas central-heating system, special gas tanks, tanks with built-in burners, rentability and gas prices, and the experimental capacity of a boiler on a low pressure steam-heating system and on a warm water heating system. Results of conducted experiments are stated. W.D.K.

Handling and disposing of recovered fly ash and dust. J. T. DEUTSCH. *Combustion*, 11 [5] 22–24 (1939).—Three methods are reviewed, including the vacuum, the sump, and the introduction of the dust by means of a water-cooled ram into a slagging-bottom furnace near the level of the molten slag. The last method is discussed in detail. H.E.S.

Health damage by means of industrial dust. OTTO SCHULTZ. *Gasmaske*, 11, 57–60 (1939).—Pure coal dust is not dangerous; neither is silicon carbide nor corundum dust. Tin, copper, bronze, and aluminum dust make slight alterations in the lungs, and iron oxide makes stronger alterations, but none of these dusts affects the health. Of the dangerous dusts, free silica usually causes silicosis, which is the most widespread and dangerous disease, after only a 5- to 10-year exposure. Asbestos dust causes asbestosis by mechanical irritation. Lung cancer is caused by radioactive dust. The symptoms are like those of silicosis. Chromate dust or mist causes nasal sores and also cancer. It has a long latent period, up to 24 years. Thomas slag causes a severe lung inflammation, as it reduces the resistance of the body to bacteria. This can occur immediately after exposure and has a high fatality. Pyrolusite causes a different lung inflammation. Glass wool acts in a similar manner to asbestos. Over sensitiveness to flour, grain, hair, etc., causes asthma. Certain fungi can grow in the lungs. Methods of prevention are discussed generally. W.D.F.

Healthy air, a guide for plant superintendents and workmen. OTTO ELSNER. *Gesundh.-Ing.*, 60 [44] 676 (1937).—A review issued by the German Society for Labor Protection gives the various kinds of air contamination and testing. Natural and artificial air-conditioning methods are discussed from the viewpoint of health, and a special chapter describes the airing of workshops, offices, etc. W.D.K.

How benzol poisoning may be avoided. ANON. *Gesundh.-Ing.*, 60 [52] 795 (1937).—Forming benzol vapors must immediately be caught by suction. A good supply of fresh air is necessary during the cold season, and the air should be replenished with prewarmed air. Benzol vapors are heavier than air and, for this reason, sink to the floor. When installing a new air-ventilating system, therefore, suction openings should be located in the floor or near it. Pieces treated with a benzol-containing solution should be dried in a well ventilating drier cupboard or special drying rooms. Benzol-containing vessels must be kept covered. W.D.K.

Improved system in the application of noncondensing or extraction turbines. H. W. CROSS AND E. S. WELLS, JR. *Combustion*, 11 [1] 32–35 (1939).—Since electrical output is definitely established by the energy drop between initial and exhaust conditions and by the quantity of steam flow, increasing the total steam pressure at the throttle for a given pressure increases the available energy and consequently the electrical output. The application of a combined desuperheater and feed-water heater at the exhaust is advantageous in realizing gains from the use of higher temperature steam. Examples demonstrating the possibilities inherent in such systems are illustrated and explained. H.E.S.

Lighting for special industrial purposes. W. R. STEVENS. *Trans. Illum. Eng. Soc.* [London], 3 [1] 3–16 (1938).—S. describes installations requiring special lamp fittings for explosive and moisture-ridden atmospheres and the use of special sources of light, such as carbon dioxide discharge, daylight tubes, special daylight tungsten filaments, and high-voltage fluorescent tubes, for color matching surfaces and special inspections. H.K.R.

Living and working conditions in the tristate mining district. EVAN JUST. *Mining Congr. Jour.*, 25 [11] ~~44–45~~ (1939).—Dust in the mines is kept within safe limits by wetting down, spraying, and ventilation. Above ground, dust from "chat piles" is practically nonexistent as they are coarse material. On windy days dust is blown from a few flat accumulations of sand. Road dust, however, actests water hardness has been developed by the German Society for Chemical Apparatus. W.D.K.

Surface heat losses from outside furnace walls. J. G. COUTANT. *Heat Treating & Forging*, 25 [9] 463 (1939).—Aluminum paint reduces heat loss from furnace walls. See *Ceram. Abs.*, 19 [1] 16 (1940). S.S.

BOOKS AND SEPARATE PUBLICATIONS

A.S.T.M. Standards, 1939. AMERICAN SOCIETY FOR TESTING MATERIALS, Philadelphia, Pa. Price to nonmembers $8.00 one part, $15.00 two parts; $22.00 three parts.—The book is in three parts: I, *Metals: Ferrous and* nonferrous metals are discussed; methods of chemical analysis are not given. General testing methods are presented. II, Nonmetallic materials—constructional. This part includes cementitious materials, concrete and aggregates, masonry building units, ceramics, refractories, pyro and tile, thermal insulating materials, timber preservatives, paints, varnishes, and lacquers, road materials, waterproofing and roofing materials, and soils. General testing methods and thermometers are described. III, Nonmetallic materials—general. Fuels, petroleum products, electrical insulating materials, rubber textiles, soaps and detergents, paper, plastics, and water are covered. General testing methods are given. Available from Amer. Soc. Testing Materials, 260 S. Broad St., Philadelphia, Pa. F.F.

Finding List for United States Patent, Design, Trade Mark, Reissue, Label, Print, and Plant Patent Numbers. M. RANDALL AND E. B. WATSON. University of California Press, Berkeley, 1938. 31 pp. Price 35¢. Reviewed in *Mech. Eng.*, 61 [5] 402 (1939). F.G.H.

Report of the Department of Scientific and Industrial Research, 1937–1938. H. M. Stationery Office, London. Price 3s. Reviewed in *Pottery & Glass Record*, 21 [4] 89–90 (1939).—Methods have been developed for assessing weathering characteristics of clay products fired under various conditions. Work on clay roofing tile has been continued. Investigations on refractory materials include (1) the pressing process and its relation to the texture of clay, silica, and sillimanite brick; (2) the drying of clayware; and (3) the firing operation. A careful study of the smoke emission from various intermittent kilns firing blue and brindled heavy clay products has been made, and suggestions are advanced for its reduction and control. Laboratory work aiming at relating the conditions of atmosphere and temperature with the color of blue-firing clays has also been undertaken and has progressed satisfactorily.

Drying cracks are due to differences in moisture content established in different parts of the clay body, especially between the surface and the interior. Differential shrinkage thus occurs as drying proceeds, and stresses are produced. The direct method of studying the problem consists in determining the fastest rate at which particular shapes of a given clay can be dried with safety, and the variation of that rate with such factors as the temperature and the size and shape of the body. There is an optimum temperature at which drying is most readily carried out; the smooth nature of the relationships between greatest safe rate of drying and the dimensions of the test pieces suggests that an ultimate understanding of the phenomenon of cracking will be achieved.

A theory of the mechanism of the flow of water through plastic clay during drying has been developed, in which the force causing the flow is regarded as a repulsion between the clay particles which are separated in all directions by water films. A measure of this repulsion is obtained from the moisture contents assumed by the clay when various pressures are applied through porous pistons into which the water is allowed to escape. This pressure is an exponential function of the moisture content as is also the "aqueous conductivity" or the rate of flow of water through unit volume of the clay under unit pressure. On this basis the distribution of moisture content at any time throughout a drying shape can be theoretically calculated, the analysis being analogous to that of heat diffusion. A strict solution is not possible, but experiments on a number of clays show a means of approximation which permits the calculation of moisture-content distribution in bars drying from one end only. The experimental verification of the theoretical results confirms the hypothesis.

Many years' study of electrical insulation and the materials used therefor has greatly improved the reliability and the advantageous selection, preparation, and use of insulating materials. Better insulators have been developed, thus reducing the size and eventually the cost of electrical apparatus of all kinds without loss of quality.

The suitability of certain glasses for use in the manufacture of telephone insulators is shown. The degree of homogeneity in optical glass is almost completely determined by the temperature conditions prevailing during the annealing process. An investigation has been made of the maximum temperature gradients in an annealing oven consonant with the production of substantially homogeneous optical glass. The cooling schedules of the annealing process were experimented with to determine the minimum period of annealing for glass of high optical quality.

Methods of producing light etch marks on glass have been developed, and an optical system to enable the degree of polish of a glass surface to be assessed has been devised. The preparation of filing materials for etched lines, required to be unaffected under specified conditions, is described. A.B.S.

Silicosis and Asbestosis. Edited by A. J. LANZA. *Oxford University Press*, New York, 1938. 439 pp. Price $4.25. Reviewed in *Mech. Eng.*, 61 [5] 405 (1939).—The medical and public-health aspects of these industrial dust diseases are comprehensively presented in this book, to which several physicians have contributed. The history of the diseases, their symptoms and diagnosis, their pathology, and their prevalence in various occupations are discussed, as well as methods of prevention and control. Each section has a bibliography. F.G.H.

composition and properties of the solid and liquid phases, and the gas phase. P.B. & E.S.

Prevention and treatment of lead poisoning. IMRE HELLER. *Orvosi Hetilap*, 83, 639–41 (1939); *Chem. Abs.*, 33, 8329 (1939).—In Hungarian Pb works, Pb poisoning occurs in 100 to 200 of 10,000 laborers annually. Lead accumulated within the human organism can be mobilized by modifying the Ca/P balance cautiously. This was done in clinical experiments by a diet poor in Ca and 3 to 10 gm. Na phosphate given each second day for 3 to 4 weeks. Any secondary effects of phosphate can be balanced by the administration of thiosulfate from time to time.

Silicic acid gels: IX. CHARLES B. HURD AND HARRIS W. PATON. *Jour. Phys. Chem.*, 44, 57–62 (1940).—The effect of a change of pH on the time of set of gels produced by mixing solutions of sodium silicate and acetic acid is discussed. For Part V see *Ceram. Abs.*, 15 [3] 108 (1936). R.A.G.

Theory of light scattering. S. PARTHASARATHY. *Phil. Mag.*, 29 [193] 148–53 (1940).—P. shows that the scattering of light observed by Krishnan in binary liquid mixtures ("Molecular. . . ," *Ceram. Abs.*, 17 [3] 119 (1938)) is purely molecular, while no scattering arises from clusters, if any, at the critical solution temperature. No new theories as, e.g., those of Frenkel, Gans, or Müller, appear to be necessary to explain Krishnan's results. R.H.

BOOK

Science Front, 1939. F. SHERWOOD TAYLOR. Cassell & Co., Ltd., London. Price 7s 6d. Reviewed in *Times Lit. Supp.*, 39 [1984] 79 (1940).—T. describes recent developments in science, including theoretical researches and technical inventions. Illustrated. K.W.W.B.

PATENTS

Cadmium-red manufacture. WALTER F. MEISTER (Interchemical Corp.). Can. 387,430, March 12, 1940 (June 18, 1937; in U. S. July 9, 1936). G.M.H.

Enamels and glazes and method of producing. CARL OBERLÄNDER AND F. H. ZSCHACKE (Sioto G.m.b.H.). U. S. 2,194,246, March 19, 1940 (May 20, 1936).—A preparation for improving enamels, glazes, etc., comprises a magnesium borosilicate having substantially the following composition: silicic acid 30 to 50, boric acid 10 to 30, magnesium oxide 15 to 35, and alkali compounds 10 to 20%.

Magnesium titanates and method of making. J. A. PLUNKETT AND EUGENE WAINER (Titanium Alloy Mfg. Co.). U. S. 2,196,325, April 9, 1940 (March 5, 1938).—A calcined synthetic magnesia-titania composition containing chiefly finely divided magnesium titanate chemically combined with 3 to 12% of silica and alumina, the ratio of silica to alumina ranging from 8:1 to 12:1, of particle size substantially all within the range of 0.5 to 2 microns, and having a refractive index of about 2.15.

Production of beryllium compounds. CARLO ADAMOLI (Perosa Corp.). U. S. 2,196,048, April 2, 1940 (March 29, 1937).—A process for the production of beryllium oxide from minerals containing beryllium and for the cyclic recovery of the reacting agent employed consists in powdering the beryllium-bearing ore, mixing the powder with an alkali bifluoride in an amount corresponding to 2 mols. of bifluoride for every BeO molecule present in the ore, adding water to form a paste, compressing the paste to briquettes, heating the briquettes to a temperature between 550° and 800°C. to cause the fluorine to combine with the beryllium to form a double alkali fluoride, leaching the reaction product with pure water at a temperature of about 90° to 100°C., adding alkali hydroxide to the alkali beryllium solution to precipitate beryllium as beryllium hydrate and form neutral alkali fluoride, separating the neutral alkali fluoride, calcining the beryllium hydrate to beryllium oxide, and treating the neutral alkali fluoride with a strong acid other than hydrofluoric to convert the neutral alkali fluoride to the corresponding acid fluoride.

Pure titanium dioxide. W. W. PLECHNER AND A. W. HIXSON (National Lead Co.). Can. 386,985, Feb. 20, 1940 (Oct. 12, 1937). G.M.H.

Pure titanium oxide. W. W. PLECHNER AND A. W. HIXSON (National Lead Co.). Can. 386,625, Jan. 30, 1940 (March 7, 1938). G.M.H.

Titanium pigment manufacture. ROBERT W. ANCRUM AND ASSUR G. OPPEGAARD (National Lead Co.). Can. 386,623, Jan. 30, 1940 (Nov. 29, 1937). G.M.H.

Zirconium oxide and method of making. C. J. KINZIE AND D. S. HAKE (Titanium Alloy Mfg. Co.). U. S. 2,194,426, March 19, 1940 (July 23, 1937).—A crystalline zirconium oxide obtained by the calcination of a zirconium-oxygen-carbon compound without substantial grinding of the calcined product characterized as an essentially white powder and as being essentially white in color and consisting of crystal particles having their length greater than their width and their thickness less than their width, an index of refraction of about 2.3 to 2.4, and an adsorbed colorless carbon content of about a stoichiometric equivalent of 1.64% carbon dioxide.

General

Absorption of lead and arsenic through skin. ANON. *Jour. Amer. Med. Assn., Queries & Minor Notes*, 114, 604 (Feb. 17, 1940).—Lead and arsenic absorption through the skin does not occur to an appreciable extent in contact with aqueous solutions of these compounds in concentrations below 0.5 mgm. per 100 cc. of solution. It is unlikely that significant quantities could be ingested because of contaminated hands. F.S.M.

Clinical studies in asbestosis. M. J. STONE. *Amer. Rev. Tuberc.*, 41, 12–21 (Jan., 1940).—This report is based upon examination of 180 persons formerly employed in the opening, carding, spinning, and weaving departments of an asbestos brake lining plant. F.S.M.

Compensation for industrial injuries and occupational diseases. E. R. KOONTZ. *Jour. Amer. Med. Assn.*, 114, 563–69 (Feb. 17, 1940).—K. gives an excellent discussion of a few of the many legal and medicolegal phases of compensation laws of prime importance to physicians interested in the field of industrial medicine. Tables show the compensability of occupational diseases, limitations of time and cost of medical and hospital benefits in compensable injuries and diseases, and the determination of medical matters under compensation laws; all data are given by states. F.S.M.

Consider the audience. S. MARION TUCKER. *ASTM Bull.*, No. 103, pp. 27–29 (March, 1940).—T. stresses the importance of presenting papers effectively. The causes of complaints are considered. The preparation of a technical paper is taken up with regard to the content and style. The manner of presentation is also considered. The audience must be considered first in technical paper presentation. F.F.

Dust-control systems for the metal-finishing industry. RICHARD T. PAGE. *Metal Cleaning & Finishing*, 10 [8] 530–47 (1938).—Dust is undesirable in any industry. Many of the metal-finishing processes, e.g., sandblasting, grinding, buffing, polishing, etc., are outstanding dust producers. Control procedures discussed are (1) personal respiratory protection, (2) substitution of a less harmful material causing the dust, (3) wet methods, (4) complete enclosure of the dusty process, (5) segregation of part of the equipment, (6) improved ventilation, (7) partial enclosure under negative pressure, and (8) local exhaust ventilation. A detailed study of dust-collection systems is presented. Air motion is discussed, and a table of air speeds in ducts necessary to convey various materials is given. A table shows the minimum thickness of metal for straight exhaust piping. Fans and cleaning apparatus

investigations are of considerable importance and frequently accompany the chemical work. The department is equipped for complete mineralogical examinations by microscopic and other processes used in determining rocks, minerals, ores, and concentrates of all types. It is frequently possible from the results obtained to offer opinions upon the commercial value of a mineral product or to give advice on methods of preparation for the market. Chemical and mechanical analyses can also be made of soils.
K.R.

Fatal subacute occupational lead poisoning. WERNER EHRHARDT. *Arch. Gewerbepath. & Gewerbehyg.*, 9, 407–13 (1939).—Industrial lead poisoning as a rule is a chronic poisoning. Characteristic symptoms appearing suddenly, like the colic and intestinal stoppage, show that the poison has been at work in the system for a long time. Acute poisoning as an industrial disease is seldom encountered. E. reports an acute case which came to the Berlin Clinic for Industrial Diseases and discusses its manifestations. On Dec. 4, 1938, a sprayer of lead, 49 years old, was brought to the clinic in a dangerously ill condition. Very carefully and fully he was examined; the next day he died. For several weeks as an occasional worker he had been spraying cable muffles in a cable plant. The workspace was 3 x 4 x 3m.; the spraying was expected to be done under a hood. The worker used a spray pistol in which a lead wire was inserted and the propane gas flame mixed with air, which was introduced into the pistol at the same time, melted the lead wire. The molten lead was at once ejected by the pressure of the air, spraying the muffles revolving in front of it. During this process the worker was expected to wear a mask and to manipulate the pistol through slits. About the middle of November he had been seized with violent pain and vomiting; he was off from work for 8 days and resumed work again late in November. The hood apparatus was then out of repair; three other men working in his absence in the same small space, with very low suction in the ventilating apparatus, caused the returned worker to ask for the night shift where he could be alone. On November 30 he was overcome with the same violent symptoms as before. Being somewhat better by the next night, he insisted on working, only to return home in the same condition, with additional symptoms; his wife noted that his face was as black as lead. E. details the man's further breakdown and the efforts of the company physician in palliation; these failing, the victim was transferred on Dec. 4 to the Occupational Clinic. The plant conditions under which the lead spraying took place were examined and reported on by E. after the autopsy. A large hole was found in the left side of the framework supporting the hood through which the sprayed lead had been escaping into the small enclosure; lead dust lay heavy on the glass valves of appliances carrying the cables; the clothing and shoes worn by the various shifts were loaded and sodden with the scattering lead dust; the mask of the worker was in disrepair, so that he might not have worn it on his final night shifts. He must have breathed the lead dust in its most finely divided particles, i.e., in almost molecular form. Such an aerocolloid condition is taken up by the organism with special ease and constitutes the highest possible risk to the subject. The lungs in this case were permeated with it, and the blood readily carried this fatal dust to the entire system. From the evidence derived from the illness, the autopsy, and the plant, E. concludes that the poisoning could be called acute but also subacute, the worker evidently having been sensitized by his first attack and the subsequent exposures, massive in character, sustained December 1 and 2. An inspector testified that, after being placed on the night shift, this worker had done the work of three ordinary men on the spraying. Hence his constitutional resistance was utterly broken down beyond repair. The lead content of the urine was 2140 γ in 10 gm. of dry feces, 490 γ in 10 gm. of the liver, and 370 γ in 10 gm. of the kidneys.
K.R.

Fuel gas generator. HARRY A. CURTIS, RALPH B. STITZER, AND WILBER J. DARBY. *Ind. Eng. Chem.*, 32 (6) 757–62 (1940).—Developments in the use of electrical energy as a source of heat for the carbonization of coal are described. Illustrated.
F.G.H.

Glass industry of Ohio. ARTHUR S. WATTS. *Ohio State Univ. Eng. Expt. Sta. News*, 11 (4) 10–13 (1939).—Ohio is the third largest glass-producing state and has twenty glass plants. In 1797 there was a glass plant on the Ohio river; by 1825 they were all over the state. The production of hollow glassware has increased twenty times since glass blowing machinery has been introduced. Ohio is an important producer of flat glass. Today this is drawn from the tank as a continuous flat sheet. Other important products are electric light bulbs, fiber glass, and glass blocks for use in building construction.
W.D.F.

Plant laboratory. K. SPINGLER. *Tonind.-Ztg.*, 62 (44) 492–93 (1938).—The plant laboratory has the following tasks: the testing of raw materials and half-finished and finished products, the working out of new formulas, improvement of old shapes and construction of new shapes, and local research.
W.K.

Prevention of industrial dermatitis. J. V. KLAUDER, E. R. GROSS, AND H. BROWN. *Arch. Dermatol. & Syphilol.*, 41, 331 (Feb., 1940).—Much of the industrial skin disease is caused by the methods of cleaning the skin. Skin cleansing, methods and materials used, and the use of protective applications are studied. Formulas for eight protective applications are given. Substitutes for mechanic abrasive soap are listed. Various kinds of soaps and detergents, such as triethanolamine soap, naphthenic acid soap, and sulfonated oils, are discussed. The detergent properties of the vegetable meals are not sufficiently appreciated.
F.S.M.

Pyrophyllite dust; its effect and control. M. F. TRICE. *Amer. Inst. Mining Met. Engrs. Tech. Pub.*, No. 1179; *Mining Tech.*, 4 (3) 13 pp. (1940).—North Carolina is the only commercial source of pyrophyllite at present. Pyrophyllite occurs associated with quartz, together with chloritoid and sericite. All the pyrophyllite marketed is ground; it is classified by air separation. It is mined by open-cut, glory-hole, and underground methods. At only one operation has work been carried on since 1920. Underground, the free silica content of the dust is 35%; 80% of the particles are less than 3 microns in size; dust concentration rises to 500 million particles per cu. ft. when drilling. X-ray examination was made of 101 workers; of those with over two years' exposure, 35% were affected; two died. The lesions were the same as those produced by free silica alone. The threshold dust concentration allowable underground is 10 million particles per cu. ft. Drilling is done wet; stopes are ventilated by "ventubes." Above ground, tight housing for machinery and exhaust ventilation have been installed. These procedures give the required results.
W.D.F.

Recent Commission findings. ANON. *Ohio Industrial Commission Monitor*, 13, 41–42 (March, 1940).—An employee of a steel foundry worked from May, 1922, to June, 1939, in the cleaning department in the foundry, where his duties required him to remove hardened sand from castings by use of a pneumatic hammer. A dust count in the room showed an exposure well below the accepted safe standard, but the dust contained approximately 20% of free silica. The Claims Referee was of the opinion that the exposure to silica dust was well established, and the claim was approved as compensable by the Silicosis Referees. Acting under the provisions of an amendment to the Occupational Disease Act effective May 26, 1939, the Commission granted an award of $6500 to the widow and minor children, payable at the maximum rate of $18.75 per week.
F.S.M.

Recent developments in relation to silicosis. LEROY U. GARDNER. *Ind. Med.*, 9, 45–51 (Feb., 1940).—Certain tentative conclusions derived from experimental work upon silicosis in progress at the Saranac Laboratory for some years are recorded. As a basic doctrine, G. considers that it is still true that only certain forms of free silica and the group known as asbestos (fibrous silicates) are capable of producing fibrosis in a normal lung. The trend of some of the Saranac experiments, however, has altered certain concepts previously regarded among research workers as fixed. Inhaled chrysotile asbestos fibers now appear to be irritating, not because they are silicates, but because they are stiff fibers, mechanically irritating to the lungs. Grinding them down very finely so that few of the fibers were longer than 3 microns practically destroyed this irritating property. Even with an average atmospheric concentration of 125 million particles per cu. ft. of air, no fibrosis developed. If the effect of asbestos on the lung were entirely chemical, a decrease in particle size might be expected to increase tissue response. Large particles of free silica have little effect on the body, but small particles increase the reaction of body cells. The histology of early asbestosis, as detailed by G., does not suggest chemical injury. Among dozens of different silicate minerals, only the group of five known as asbestos are unique in having fibrous structure and in being commonly recognized as pulmonary irritants. The group varies in chemical composition within itself more markedly than, as a group, from other silicates. Chrysotile asbestos has the same chemical formula as a nonfibrous silicate, serpentine, which is physiologically inert. In mills that fabricate asbestos textiles there may be much fine dust, but if the dust is composed of serpentine and very short chrysotile fibers, clinical asbestosis will not develop. Free silica dusts, unlike those from asbestos, cause a chemical form of irritation in laboratory animals. G. describes the two histological stages which characterize the tissue reaction in such animals after inhaling excessive quantities of pure quartz or flint dusts in an extremely fine state. In human subjects, only cases of rapidly developing silicosis show evidence of this two-stage reaction. The solubility hypothesis, however, hitherto rather widely used in interpreting silica reactions in the lungs, is declared to rest entirely on indirect evidence. It has never been possible to prove that silica dissolved within the body, because the soluble material immediately combines with local tissue elements. Soluble silica detected in the urine and the blood is now generally accepted as more likely derived from food and drink than from inhaled dust. G. describes many of the Saranac experiments whose outcome individually and collectively is difficult to reconcile with the theory of silica solubility. No fibrosis has ever been produced by single or repeated injections of soluble silica in its various forms. Evidences of specific toxicity exerted by silica upon living tissues have been manifested through long series of experiments lasting years; many concrete examples are given. Intravenous experiments immediately fatal to guinea pigs produced no symptoms in dogs. The toxic effects of quartz have been more or less neutralized by adding small amounts of different substances, e.g., colloidal aluminum hydroxide which gives complete protection in a 0.03% dilution. Particle size is discussed as having new and unexpected relations with both highly toxic and merely slow fibrotic conditions. G. is cautious about drawing final conclusions from animal experiments alone, but he does begin to correlate his experimentally derived facts into a coherent silicosis etiology. K.R.

Relation between the thermal expansion and the properties of ceramic products. W. H. Earhart. *Ohio State Univ. Eng. Expt. Sta. News*, 12 [2] 25–28 (1940).—The composition of a body may be modified to obtain a desired thermal expansion. The thermal history also affects the thermal expansion; certain compositions fired at low temperatures have less expansion than the same body fired at higher temperatures. Thermal expansion may be measured directly on a bar or by the interferometric method. Bodies with a considerable amount of high-expansion quartz in low-expansion clay may show dunting tendencies on cooling. Beta-quartz expands on cooling and may also set up strains. The abrupt quartz inversion point at 573°C. may be destructive. Quartz and clays have fairly uniform thermal expansions, but the feldspars are variable. Hotel china, sanitary ware, and floor tile all have thermal expansion curves lying close together. The quartz present does not seem to affect them. A quartz grain shrinks more rapidly on cooling, and it is thought to pull away from the remainder, so that it does not fill its recess in the body completely on cooling. W.D.F.

Report of Committee on Ceramic Education. N. W. Taylor, *Chairman*. *Bull. Amer. Ceram. Soc.*, 19 [6] 220–21 (1940).

Report of Committee on Publications. John D. Sullivan, *Chairman*. *Bull. Amer. Ceram. Soc.*, 19 [6] 222–23 (1940).

Report of Committee on Research. Arthur A. Wells, *Chairman*. *Bull. Amer. Ceram. Soc.*, 19 [6] 214–18 (1940).

Report of Committee on Sections and Divisions. M. E. Holmes, *Chairman*. *Bull. Amer. Ceram. Soc.*, 19 [6] 221–22 (1940).

Report of Committee on Standards. John W. Whittemore, *Chairman*. *Bull. Amer. Ceram. Soc.*, 19 [6] 218–20 (1940).

Roentgenologic aspects of bronchomycosis. H. P. Doub. *Radiology*, 34, 267–75 (March, 1940).—The signs and symptoms of the bronchomycoses are similar to those of tuberculosis and they are often at first thought to be tuberculous in origin. D. describes some of the more prominent Roentgen signs of the various bronchomycoses. F.S.M.

Silicosis. E. R. Hayhurst. *Merck Rept.*, 49, 6, 8, 9, 28, 30, 32 (April, 1940).—H. gives an excellent short review of silicosis. F.S.M.

BOOK

Engineers and Engineering in the Renaissance. William Barclay Parsons. Williams & Wilkins Co., Baltimore. 661 pp. Price $8. Reviewed in *Science News Letter*, 37 [12] 192 (1940).—P. discusses the amazing engineering achievements produced during the Renaissance. P.G.H.

PATENT

Coating and coloration of granulated materials. N. P. Harshberger (Bakelite Building Products Co., Inc.). U. S. 2,202,002, May 28, 1940 (June 2, 1936).—A roofing granule has on the exterior thereof a coating comprising a hardened high-alumina cement containing principally calcium aluminates or calcium alumina ferrites and substantially free of free lime in amount to produce objectionable efflorescence in exposure, the surface of the granule being also substantially resistant to chipping and wear and stable with respect to a bituminous bond.

been taken of the advanced training centers in heavily industrialized communities, showing that there is evidently small demand for this field of practice. F.S.M.

I. Lead content of human blood. II. Lead as a poison. J. N. M. CHALMERS. *Lancet*, 238, 447-50, 482-83 (March 9, 1940).—Tompsett's method of determination was used. Blood was obtained from 20 normal people and 50 hospital cases, all with no known exposure to lead, and also from 44 factory workers with a definite lead exposure while manufacturing white lead and storage batteries. The blood of the controls showed a lead content which varied from 30 to 90 μgm. per 100 cc. with a mean of 57. The lead workers, who presented no symptoms of poisoning, had blood lead values ranging from 60 to 192 gm. per 100 cc. with a mean of 104. Augmented concentrations of lead in blood indicate increased absorption of lead but do not constitute evidence of plumbism; they are a useful estimate of the degree of exposure. Clinical findings must still continue to govern the diagnosis of lead poisoning. There is a discussion of the problem and also of the value of milk in the diet of lead workers. With a high calcium diet, there is less lead absorbed from the gut than with a low calcium intake. Since, industrially, most lead enters the body through the lungs, the calcium probably acts by helping to fix the lead in the bones and thus prevent it from circulating in the blood. Though of great value, blood studies and similar biochemical investigations must not be given too much consideration. F.S.M.

Lungs of cement workers. S. CACCURI AND L. DI-PRISCO. *Folia Med.*, 26, 7-20 (1940).—A review is given of Italian literature on the subject which seems to give a less favorable picture of the health of cement workers than is found in other countries. Histories of seven cases are given which show silicosis in grades 1 and 2 and emphysema. Tuberculosis was not found. F.S.M.

Manufacture of fired clays (brick, tile, and pottery). A. COULHON. *Argile*, No. 197, pp. 13-21 (1939); No. 198, pp. 3-9 (1940).—C. discusses the raw products used in the manufacture of fired clay products, the formation of clays, and their characteristics and composition. M.V.C.

Mechanism of development of lead anemia: IV, Physiochemical nature of the splenic and liver substances which decrease erythrocytes. S. KIN. *Jour. Med. Coll. Keijo*, 9, 101-107 (1939).—After injection with lead acetate, the spleen and liver seem to contain some specific chemical substances which are able to decrease the number of erythrocytes. K. attempted to determine the physiochemical nature of these substances which were obtained from the splenic and hepatic veins after injection of the lead. The anemic action of the splenic substance disappeared after heating for an hour at 100°. The substance was soluble in water, but did not dissolve in ether and alcohol; it was adsorbed easily by animal charcoal or kaolin. Its action was also retained after ultraviolet radiation for 3 hr. F.S.M.

Metabolism of nucleoproteins in lead poisoning. G. MICHETTI AND F. MOLFINO. *Rass. Med. Applicata Lavoro Ind.*, 10, 562-82 (1939).—Original research on ten cases of lead poisoning shows that there is a pronounced tendency to uric acidemia; this becomes more acute as the poisoning tends towards chronicity. No relation was seen between the degree of uric acidemia and kidney function, and no such connection is likely to exist in cases of recent lead poisoning. F.S.M.

Nature of anthracotic foci. Experimental research. A. C. SAVELLINI. *Folia Med.*, 26, 21-32 (1940).—S. gives a review of the literature and of the views of some French and Italian workers who are of the opinion that the greater part of the "anthracotic" pigment in the lungs is not truly anthracotic but iron of hemolytic origin. Animal experiments by S. lead to the conclusion that carbon and iron participate in the common anthracotic focus; some contain carbon and some iron only. F.S.M.

Occupational dermatoses under the Illinois Workmen's Occupational Diseases Act. H. R. FOERSTER. *Illinois Med. Jour.*, 77, 79-85 (Jan., 1940).—After analyzing various sections of the Illinois law, F. concludes that "any skin disease may therefore legally be an occupational disease in Illinois." F.S.M.

Preventing economizer corrosion. F. J. MATTHEWS. *Brit. Clayworker*, 48 [573] 132-34 (1940).—M. discusses the causes of corrosion and gives suggestions for the maintenance of the economizer. R.A.H.

Priceless possessions. L. GREENBURG. *Nat. Safety News*, 41, 26-27 (Jan., 1940).—There were 1843 cases of compensated eye injuries in New York State in 1938 and the cost was $1,163,000. Of these, 80% were caused by foreign matter entering the eye and could be avoided by the simple and cheap method of wearing goggles. Ventilation controls are needed for eye hazards of toxic dusts and fumes, and in the past year the Division of Industrial Hygiene has passed and approved 2000 sets of plans for such control in factories. Special goggles are needed for protection against radiant energy, and fatigue of the eyes can be lessened or eliminated by proper illumination. G. discusses these sight-saving means and methods for promoting their adoption. F.S.M.

Two fatal cases of pulmonary asbestosis. E. C. VIGLIANI. *Rass. Med. Applicata Lavoro Ind.*, 11, 26-32 (1940).—The first of these cases concerns a woman who worked for thirty years in a factory using asbestos in the manufacture of cord. The second woman worked for seven years in an asbestos factory. Her susceptibility to colds increased while she was working and she suffered all her life from bronchitis and asthma. She died at the age of fifty, with symptoms of a lung disease, nearly thirty years after having stopped work. The autopsy showed interstitial sclerosis of the lungs and asbestosis bodies. F.S.M.

Unemployment benefits no bar to workmen's compensation. ANON. *U. S. Dept. Labor, Monthly Labor Rev.*, 50, 670 (March, 1940).—An employee receiving unemployment benefits under the Unemployment Compensation Act is not disqualified from recovering compensation for the same period under the Workmen's Compensation Act, according to the Supreme Court of Michigan. F.S.M.

SEPARATE PUBLICATIONS

Basophilic Aggregation Test (for Lead Absorption and Lead Poisoning). ANON. Ohio Dept. Health, Adult Hyg. Div., 1940. 7 pp.—The technique and interpretation of results of the basophilic aggregation test are given in a concise form. F.S.M.

Legal Aspects of Engineering. W. C. SADLER. John Wiley & Sons, Inc., New York. 631 pp. Price $4.00.—This is a direct application of the case method to engineering problems, three hundred cases being selected after 6500 legal cases actually dealing with engineering problems were carefully analyzed. Cases dealing with compensation are of the most interest. S. gives a general discussion of the subject. Cases are given to illustrate the following points: elimination of defenses, hazardous employment, employer-employee relation, accidents arising out of and in the course of employment, proximate cause, award, dependency, and jurisdiction. F.S.M.

Manual of Industrial Health Hazards. J. B. FICKLEN. Service to Industry, West Hartford, Conn. 175 pp. Price $4.00.—F. presents methods for the evaluation of industrial hygiene exposure resulting from many dusts, vapors, and gases. The first chapter gives principles which are basic procedures for making surveys and describes sampling devices. The other chapters are given over to the materials or groups of materials which may cause industrial disease. For each substance, F. gives the occurrence and uses, certain physical properties, the clinical symptomatology it produces in man, the physiological responses of man to various concentrations, the concentrations allowable in the air of the workplace, and a simple method of estimation in air. Numerous references are given. An appendix includes useful constants, formulas, and instructions for the preparation of standard solutions. F.S.M.

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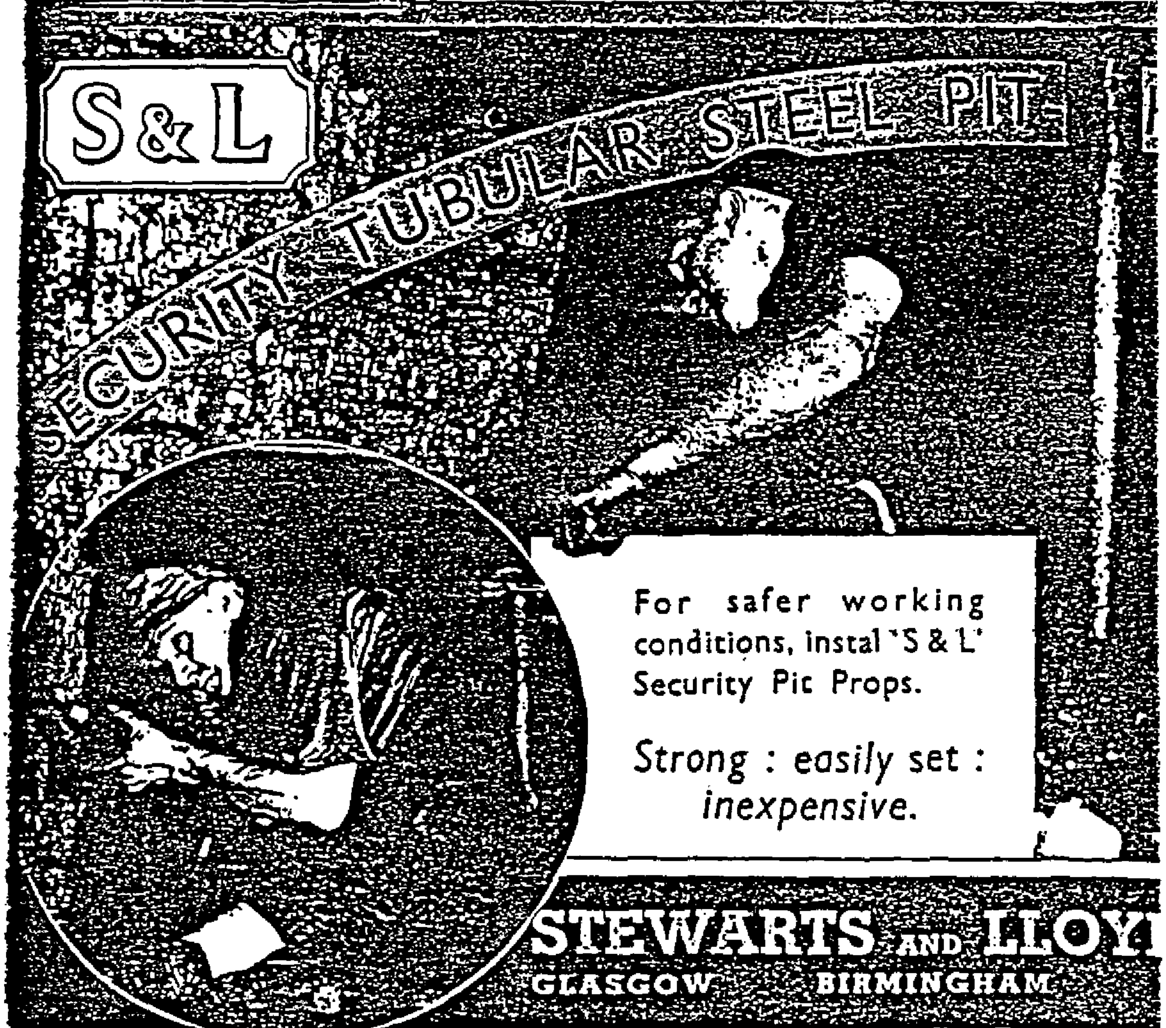
IRON & COA

TRADES REVIE



THE
IRON & COAL TRADES REVIE
LONDON: SEPTEMBER 8, 1939

Iron-Ore Extraction in the Midlands*

OPEN CAST WORKING AND UNDERGROUND MINING

The appended description of iron-ore extraction in the Midlands has been taken from the Report* of the Committee on the Restoration of Land Affected by Iron Ore Working, and deals with methods of removing the overburden, and winning in underground workings

METHODS OF SURFACE WORKING

ALL ironstone in the Midlands was originally got by hand either at outcrops or not more than 15 to 20 ft. below the surface. The reinstatement of such land for agricultural use immediately after the working presented no difficulty. No great masses of subsoil had been disturbed; the topsoil was merely thrown on one side and then returned without any cost for haulage. At the turn of the century small steam excavators with a short-arm jib were introduced for the purpose of removing the overburden, but all land was still restored by hand. When a quarry was about to become too deep for restoration it was abandoned or mined. Excavators were then introduced for removing the ore itself. In the expansion of development due to the War, the American long jib and mechanical digger with a wide dumping radius was introduced. About this time some areas were first left unrestored. This was at first not so much due to technical difficulties as to a company going out of business.

The position became serious when, in the 'thirties, Stewarts and Lloyds left Scunthorpe and came to Northants. Since they were latecomers they found all the areas of easily got ore controlled by other firms, and they were forced to lease areas of deep overburden. They began work on these with an electrical excavator which, with a 9 cub. yd. bucket (1 cub. yd. represents very approximately 1 ton), a dumping radius of 101 ft., and a dumping height of 68 ft., could deal with overburden up to about 60 ft. in depth.

Ironstone is won by a number of different machines whose operations have somewhat different effects. They include the dragline which works on the principle of a rake; the excavator or "digger" with a short arm (the "jib") dumping on to a conveyor or wagons; the long-jib excavator which dispenses with the latter, and the Lubecker (land) dredger which can dump sand or other very light soil evenly. The dredger creates no problem of levelling because of the number of small bucket loads dumped, but for this reason it is only efficient in sand or light soil. There are a great number of combinations of these machines, with or without hand labour, which are used in different quarries, and it would be difficult to give a complete account of them. The following are descriptions of the work in three quarries which are representative of certain typical conditions.

(1) A 1½ cub. yd. dragline at A (Fig. 1) removes the 2-ft. overburden (including 9 in. of topsoil) and deposits it at C in a very shallow "hill and dale" formation which is then levelled by the ⅝th cub. yd. dragline at C. The operation is then completed by a 4-cub. yd. steam navvy following up behind dragline A and loading the ironstone into wagons B. The face at D gradually recedes as the ironstone is removed. The working is like a movable cliff.

(2) A short jib excavator may be used in conjunction with a conveyor as in Fig. 2.

The excavator A removes overburden from the face B and then empties the load into a small truck, or dumping tram, on the steel-framed conveyor at C. This runs up to the other end at D and tips over. The function of the conveyor is therefore to move the dumped overburden away as far as possible so that there is no danger of the navvy which is removing the ironstone becoming buried. The overburden is dumped by the conveyor in a ridge and furrow formation similar to that which results from the use of a long jib excavator but in a rather more wavy line.

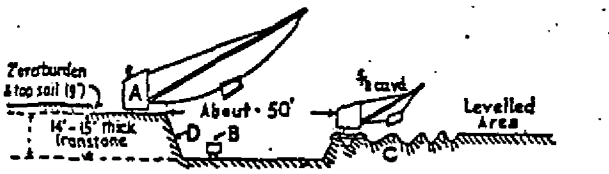


Fig. 1.—Drag-Line Method of Extraction.

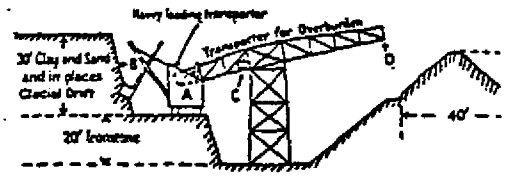


Fig. 2.—Short Jib Extractor and Transporter

(3) The overburden can be removed and dumped by a long-jib excavator. The sketches (Fig. 3) are of a 9-cub. yd. excavator at work. These machines are the largest in Europe, and they have an output of about 500 tons per hr. each. In fact the whole area assumes the aspect of having gigantic furrows, which are locally known as "hill and dale." The ridges consist predominantly of subsoil, and in them the topsoil is irretrievably lost. The size of these furrows depends on the size of the navvy used for the excavation. Where the largest navvies are in use, the distance from crest to crest is from 40 to 50 ft., the depth varying from 10 ft. to 16 ft., but where smaller excavators have been used in the past, the crest to crest distance is between 20 ft. and 30 ft., and the depth from 6 ft. to about 10 ft. The shape and size of the hills and dales depend not only on the type of machinery used for putting the material across, but also on the angle of repose of the dumped material. The natural angle of repose of any particular soil composition will generally only be found where it is free to trickle; e.g., on the slope of the dumped material stretching down to the quarry floor. Measurements are often made of this angle for different materials and combinations of materials, because it is this angle that determines the distance between the top of the dumped overburden and the face of the excavation. These measurements show that an average angle of repose is 1½ horizontally to 1 vertically, although it may be flatter in boulder clay where there is a good deal of slipping and steeper in limestone. The angle of actual hill and dale is nearly always flatter than the angle of repose proper because the material is partially spread as it is emptied from the excavator.

The size of hill and dale varies alsc with the depth of overburden, since the excavator used varies generally depth of the overburden to be wor can therefore talk of a "normal" and dale for a particular depth of if it is understood that only a very ge tionship is meant. The general ten matter of importance in connection costs of levelling. When the cut is a final gullet is left. This may be al of 200 to 300 ft. wide and 60 ft. de may form a considerable difficulty i access to the quarry, particularly for restoration work.

Local Objections to Large Exc

It is the operation of these mach has alarmed local opinion and which attention to the whole question of working of ironstone in this country. reaction to the coming of the largest has been to suggest that they are not It is seen that ironstone was won be machines came and it is suggested ought, in view of the devastating co to be a reversion to older methods o covery of yet newer ones. If it is poin reply that ironstone could not be got ally at 60 ft. depth by the old met sometimes argued that, if the prod put to it, they could invent new meth would abolish or modify hill and dale. engineering developments as they app Committee from the evidence put be included:—

(1) An attempt might be made to im excavator. The present performance o function of the radius of the jib an angle of repose of the dumped soil. cause these two factors are fixed, that dale formation occurs. If the length could be varied slightly with each buc then hill and dale of the present would not be formed and a surface wo which, if very irregular, would be much level. If the length of the jib were however, so as to give a choice of which each bucket could be emptied, th of the entire machine, which is alrea 500 tons, would be increased to an imp extent. Further, if any attempt were dump material anywhere near the exca angle of repose of the tipped soil wo that the excavator itself would be burie

(2) A new conveyor might be desig position of which could be altered betw load placed on it by a small excavat witness suggested this, but the Commit it an unlikely development. The pre veyors cannot be used where there is of overburden of more than 40 ft. b the strain which would be imposed arm of the conveyor when the truck was away from its point of support. It w be easy, therefore, to design a convey would produce better results with an ov of 60 ft. or more in depth than are the present one with an overburden of

* H.M. Stationery Office, York House, Kingsway, London, W.C.2. (Price 2s. net.)

Fatalities from Silicosis and Asbestosis

THEIR INCIDENCE IN INDUSTRY

The problems associated with silicosis and asbestosis amongst industrial workers are receiving close attention. The former has tended to increase, and the latter, on balance, to decrease, in recent years

A SECTION of the Annual Report* of the Chief Inspector of Factories dealing with health refers to the question of dust and its effects, including silicosis and asbestosis. It is pointed out that for some years past, particulars of the total number of deaths from these two causes, which have been investigated by the Department, have been given and brought up to date. These figures have been specially useful from the practical point of view in aiding the installation of preventive measures of the necessary standard in processes exposed to risk. Of much importance and more general interest, however, is the trend of mortality rates from these diseases with or without tuberculosis, which does, when comparison is made after a number of years, reflect the effectiveness of the preventive measures installed. For this purpose, comparison of the figures of two successive years is of no value and sometimes misleading.

Table I shows deaths attributed to silicosis (with or without tuberculosis) during the last four years, together with the industries concerned. In factory cases, the cause of death has been borne out by departmental investigation. The variety of industries will be noted, and if space permitted to give in detail the precise occupational history in each case, the very widespread nature of the risk would be still more evident. For example, refractories' industries include amongst the 52 fatalities three whose occupation was that of repairing the silica brick linings of steel furnaces or converters, one a pot maker in a glass works, one an engine driver in a silica brick works, and one a grinder of refractory bricks, the remainder being associated with processes in the getting, crushing, grinding and manufacturing of refractory materials.

TABLE I.—*Deaths from Fibrosis of the Lung, including Silicosis and Asbestosis (England and Wales), 1935–38.*

Disease and industry.	1935.	1936.	1937.	1938.
Silicosis :—				
Refractories industries ..	12	9	19	12
Pottery, manufacture of	56	47	64	46
Sandstone quarrying and dressing	40	42	19	27
Sandstone masons ..	61	58	74	58
Metal grinding	28	24	12	25
Sand blasting	14	10	13	7
Steel dressing and cleaning of castings ..	1	4	3	3
Stone, pebble, flint, and sand crushing ..	1	1	4	6
Scouring powders, manufacture of ..	1	2	—	1
Enamel and glass makers	—	1	—	—
Compo mixer (Tripoli) ..	1	—	—	—
Abrasive-wheel manufacture	1	—	—	—
Millstone dressing ..	—	—	1	1
Slate dressing with sand	—	—	—	1
Electrician at steel foundry	—	—	—	1
Slate quarrying and dressing	3	6	10	7
Granite quarrying and dressing	1	—	1	1
Tunnel mining (sewage works, etc.)	3	—	2	2
Grave diggers	1	—	—	—
Coal mining	111	120	137	177
Gold mining (South Africa)	16	4	16	12
Tin mining	25	24	20	20
Iron ore (haematite) mining	12	8	16	13
Lead mining	2	1	1	1
Copper mining	—	—	1	1
Barytes mining ..	2	1	1	2
Mining engineers ..	—	1	2	2
Total : silicosis ..	393	365	416	430
Asbestosis	15	11	13	9
Other cases of fibrosis ..	535	544	534	503
Grand total ..	943	920	963	942

The table also shows the fatalities from asbestosis and asbestosis with tuberculosis coming to the Inspector's knowledge and investigated during the years in question. The figures given under "Other Cases of Fibrosis" are the number of cases in which "Fibrosis of the Lungs" was entered on the death certificates as the primary cause of death, these figures being supplied by the courtesy of the Registrar General. It has not been possible to investigate all the deaths from fibrosis of the lung; but in the majority the occupation of the deceased appeared not to have involved risk from silica or asbestos, and it is well recognised that fibrosis may be due to causes other than the inhalation of dust. These returns are indispensable since, from time to time, they provide the starting point of further investigation which provides valuable information.

Silicosis and Asbestosis and Cancer of the Lung

In recent years the suggestion has been made in medical publications that there is some relationship between silicosis or asbestosis and cancer of the lung. The question is a difficult one, and the figures available are not yet large enough for it to be safe to draw conclusions from them. In exploring this question the field to be covered is wider than appears at first sight. Major points which will have to be settled are: Does silica or asbestos or the fibrosis of the lung they produce tend to inhibit cancer of the lung or to produce it? If the latter, do either of these two substances act as specific carcinogenic agents like tar, or is it that the disease they produce only prepares the soil for the occurrence of cancer? The following information has been collected from the Inspector's records. No case has been included in which a post-mortem examination has not been made.

Among 943 fatal cases in which silicosis or silicosis with tuberculosis was present, cancer of the lung was associated in 23 cases (2.4 per cent.). Of these 23, in 17 it was considered that the cancer was the primary cause of death, and in 6, silicosis or silicosis with tuberculosis. Among 347 deaths which were investigated during the same period owing to the possibility of silicosis being present, post-mortem examination revealed no silicosis but cancer of the lung was found in 17 cases (4.9 per cent.).

Similarly with asbestosis, among 103 fatal cases in which asbestosis or asbestosis with tuberculosis was present, cancer of the lung was associated in 12 cases (11.6 per cent.). Of these 12, in 6 it was considered that the cancer was the primary cause of death, and in 6, asbestosis or asbestosis with tuberculosis.

It is clear from these incomplete figures that extended inquiry and collection of data and evaluation of age incidence and age distribution are necessary before any conclusions can be arrived at.

The importance of the most careful post-mortem examination is emphasised by a recent case in which naked-eye examination revealed only advanced asbestosis, but what appeared to be a small blood clot in a bronchus turned out on microscopical examination to be a carcinoma, and also another case in which silicosis, tuberculosis and primary carcinoma were all present in the lungs.

Substitution of Siliceous by Non-Siliceous Materials

In processes in which the risk of silicosis is serious and uncontrollable or only partially controllable, the prevention of silicosis lies either in substitution by harmless materials or at the last resort in prohibition of the process. have been made therefore to find and int efficient substitutes for siliceous materials tain processes. Progress has been made direction in the following processes—in a considerable extent; in others it is conf technical experiments in the processes Alumina for flint in china bedding; (2) ai for siliceous material in parting powder non-siliceous abrasives for sand or flint in ing; (4) non-siliceous material for kie used in the slow cooling of steel; and (5 siliceous material for silica bricks for linin and other furnaces.

* H.M. Stationery Office, York House, Kingsway, London, W.C.2. (Price 1s. net.)

Hydraulic Stowing in Indi

(Concluded from page 335.)

livers sealing water to the suction gland sand pump. Sealing water may be led storage at the colliery itself when the rive flood as the river water then contains an ciable quantity of sand; but in dry periods year, when a large basin has been exc clean sealing water is obtained direct fr river. The suction pipe is submerged attached by a special flange to the pump raised or lowered by a winch mounted pontoon. By this arrangement flexible ho is not needed on the suction side, an quantity of sand to water is regulated e

From the delivery side of the pump th and water mixture is conveyed by means armoured flexible hose pipe to a line of steel pipes in 18-ft. to 20-ft. lengths, fitt Victaulic joints; the pipe range is carr floats in the stream. The pipeline delive sand-water mixture into a conical separ the rate of 8 tons per min. The sand mixture is fed on to screen plates with holes; the velocity of the incoming mix so reduced that sand is deposited in the of the separator and fairly clear water through the slutes at the sides of the sep The sand contains too much water, howe be delivered direct to the belt conveyo the sand is further dewatered on a dryin

Sand-Drying Device

The sand-water mixture—by weight a mately 4 parts of sand to 1 of water— from the bottom of the separator thro control valve over a distributing plate o 4 ft. wide drying belt. The drying belt c of a series of shallow trays, 2 in. deep, on rollers; each tray contains a mixt graded slag which is kept in place by ¼ in iron plates perforated with ¼ in. holes. belt is driven at a speed of 40 ft. pe Three rollers or squeezers are placed equidi along the upper belt surface, and a se prongs placed in series along the belt to sand over as it is carried forward. The and prongs help in the dewatering of the whilst the slag in the trays allows water but not the sand.

The sand issuing from the drying be tains by volume approximately 10 per c water. The sand is delivered from the the drying belt direct on to a 28-in. tro belt conveyor which delivers it into the bunker. The belt conveyor elevates th 43 ft. in 130 ft. run to the top of the b on account of this grade only fairly dr can be carried.

The sand is delivered by the belt convey a specially constructed bunker holding a mately 1,000 tons. On the underside bunker runs the single rail around whi sand buckets of the aerial ropeway gr after being delivered from the rope. O side there are 7 shutes which deliver the buckets; the regulator at the bottom shute controlling the sand outflow to the is of a simple type, and is kept in plac balance weight. A one-ton capacity bu filled in 3 secs. through one of the shute

Luxemburg : Iron and Steel Output 1939

Pig-iron output in Luxemburg in July 154,848 metric tons (153,563 tons in June 1 117,904 tons in July, 1938). Steel product 177,649 tons in July, against 157,461 tons ; and 110,393 tons in July, 1938. A total of naces were in blast on July 31.

This magazine is published to promote sound thought upon and concerning industrial medicine and traumatic surgery. To that end it will contain news items, reports, digests, ...er presentations, together with ...tors' comments. The editorial policy is to encourage frank discussion. On this basis contributions are invited.

Industrial Medicine

Reg. U. S. Pat. Off.

The [illegible] rs will exercise care in checking on the accuracy of data printed, but in all other respects articles and opinions of which expression is allowed are the opinions of their authors—the editors reserving in all cases the right to comment on the same, in the current or any subsequent issues, as they may be inclined.

The Journal of Occupational Diseases and Traumatic Surgery

With which are consolidated "The Industrial Doctor" and "International Journal of Medicine and Surgery."

The Science, the Law and the Economics of Industrial Health

Volume 9 — FEBRUARY, 1940 — Number 2

General Motors Corporation Medical Conference

—Dayton, Ohio, November 2 and 3, 1939—

THE recent MEDICAL CONFERENCE OF GENERAL MOTORS PHYSICIANS, held at the Biltmore Hotel, Dayton, Ohio, November 2 and 3, 1939, omprised five meetings and 18 presentations.

The Program was as follows:

Thursday, November 2:

MORNING SESSION: Chairman, M. M. SHAFER, M.D., Medical Director, Frigidaire Division, Dayton.

1. "Recent Developments in Relation to Silicosis," U. GARDNER, M.D., Saranac Lake, New York.

A Plan for the Control of Tuberculosis in Industry," IAX BURNELL, M.D., Medical Director, AC Spark Plug ivision, Flint, Michigan.

3. "X-Ray in Industry," M. WILLIAM CLIFT, M.D., urley Hospital, Flint, Michigan.

4. "Preliminary Report on Hygiene Studies of Weldg," L. B. CASE and V. J. CASTROP, Industrial Hygiene aboratory, General Motors, Detroit.

AFTERNOON SESSION: Chairman, A. L. BROOKS, M.D., Medical Director Fisher Body Division, Detroit.

5. "Recent Developments in the Occupational Dermases," MARION B. SULZBERGER, M.D., New York City.

6. "The Course of Disabling Morbidity among Indusial Workers, 1921-1938," WILLIAM M. GAFAFER, D.Sc., S. Public Health Service, Washington, D. C.

7. "The Industrial Nurse," HAROLD M. JAMES, M.D., edical Director, Delco Products Division, Dayton.

8. "The Doctor's Part in the Personnel Program," EORGE A. COBURN, Personnel Director, Delco-Remy Divion, Anderson, Indiana.

EVENING SESSION: Chairman, WALTER M. SIMPSON, M. D., Director, Kettering Institute for Medical Rearch, The Miami Valley Hospital, Dayton.

9. "Relationships of Industrial Medicine to Private ractice," STANLEY J. SEEGER, M.D., Chairman Council on dustrial Health, American Medical Association.

10. "Unfinished Business," C. F. KETTERING, Director eneral Motors Research Laboratories, Detroit.

riday, November 3:

MORNING SESSION: Chairman, G. L. BIRD, M.D., Medi-...al Director General Motors of Canada, Ltd., Osha...rio, Canada.

11. "... Practical Approach to Supervision of Mental ealth in Industry," F. S. PARNEY, M.D., Chief, Division of dustrial Hygiene, Dept. of Pensions and National ealth, Ottawa, Ontario, Canada.

12. "An Example of Industry's Participation in the ...ti-Syphilis Campaign," P. J. OCHSNER, M.D., Medical Director, Fisher Body Lansing Division, Lansing, Michigan.

13. "Study of the Factors of Employability, Especially Disabilities and Infirmities of the Elderly, and Problems Arising from Employment of the Same," GEORGE A. PAUL, M.D., Medical Director, Hyatt Bearings Division, Harrison, New Jersey.

14. "Early Diagnosis of Acute Appendicitis," C. RUSH MCADAM, M.D., Medical Director, Fisher Body St. Louis Division, St. Louis, Missouri.

AFTERNOON SESSION: Chairman, F. B. WISHARD, M.D., Medical Director, Delco-Remy Division, Anderson, Indiana.

15. "Relationship of the Length of the Inguinal Ligament to the Occurrence of Inguinal Hernia," C. M. HILLENBRAND, M.D., Medical Director, Harrison Radiator Division, Lockport, New York.

16. "Hernia in Industry; Review of the Cases During the Past Ten Years," R. L. JOHNSTON, M.D., Medical Director, Inland Mfg. Division, Dayton.

17. "Antiseptics and Their Action," R. M. FREEMAN, M.D., Medical Director, Linden Division, Linden, New Jersey.

18. "Management of Fractures of the Spine," R. W. POBORSKY, M.D., Medical Director, Electro-Motive Division, La Grange, Illinois.

Except for DR. SULZBERGER's address on "Recent Developments in the Occupational Dermatoses" all of the papers given at this Conference are included here in full text, in the order of their places on the Program:

Recent Developments in Relation to Silicosis

LEROY U. GARDNER, M.D.,
Director, The Saranac Laboratory for the Study of Tuberculosis,
Saranac Lake, New York

WHEN your Chairman asked me to speak of new developments in the field of silicosis I was perplexed because all but a few of the pathological, clinical and diagnostic aspects of this disease are now well established. I realized that you had become better acquainted than I with the practical problems of diagnosis because you were dealing with them every day. After some deliberation I decided to tell you of some of the experimental work in progress at the Saranac Laboratory and to permit myself to speculate as to its significance. These experiments are incomplete and no conclusions are possible now, but perhaps they may ultimately lead to a better understanding of the action of irritant dusts upon the lungs.

As far as I have been able to discover, it is still true that only certain forms of free silica and the group of fibrous silicates known as asbestos, are capable of producing fibrosis in a normal lung. Many other silicates have been incriminated by roentgenologists, but when autopsy specimens have been examined it is discovered that there is associated chronic infection or that the inhaled dust contains significant quantities of free silica.

I shall first compare the action of chrysotile asbestos with that of quartz upon experimental animals and review considerable evidence bearing on their respective modes of action. A few of these observations now have practical significance; others may prove to be quite unrelated to the pneumoconioses found in human beings.

FOR the last year or two we have been coming to the conclusion that inhaled *asbestos* fibres are irritating not because they are *silicates* but because they are stiff fibres which mechanically irritate the lungs. Unlike the free silicas, these minerals will not stimulate fibroblasts in any part of the body; only those in the lungs are affected. It was inferred that these organs were affected because the movements of respiration are so much more rapid and continuous than those of other viscera. Then it was discovered that if asbestos was ground very finely so that few of the fibres were longer than 2μ in length the irritating property of the asbestos was practically destroyed. Inhalation experiments with such fine chrysotile asbestos have now been continued for three years. No fibrosis has developed in spite of the fact that an average atmospheric concentration of 125 million particles per cubic foot of air has been maintained. In contrast I would point out that in a previously reported experiment[1] one third this concentration of long fibre asbestos dust produced well marked fibrosis after about two years.

If the effect of asbestos were chemical, one would expect that a decrease in size would accelerate tissue response. With free silica large particles have little effect, but as their size decreases cellular reaction becomes more vigorous and even constitutional symptoms may ensue.[2] With fibrous asbestos the reverse is true.

The histology of early asbestosis does not suggest a chemical injury. Even under the most extreme conditions that can be created by artificial injection there is no preliminary phase of tissue necrosis with infiltration of leucocytes as occurs with high concentrations of very fine quartz. The connective tissue cells merely multiply very slowly in areas where the asbestos fibres are caught in the bronchioles. As collagen forms and contracts, the air spaces are obliterated by scar tissue. In experimental animals, at least, this change is not a progressive one after cessation of exposure to the dust as is the case in the response to quartz. Perhaps the reason is the deposition of the peculiar iron-containing coating on the surface of the inhaled fibres giving rise to the characteristic "asbestosis bodies." Dr. Timothy Leary considers[3] that the resultant smooth rounded ends of these bodies are no longer capable of scratching the delicate surfaces of the air spaces.

Finally it is most suggestive that among dozens of different silicate minerals only the five known as asbestos, which are unique because they are fibrous in structure, should be commonly recognized as pulmonary irritants. The variation in chemical composition within this group is greater than that between them and many other silicates. In fact chrysotile asbestos has the same chemical formula as a non-fibrous silicate, serpentine, which is physiologically inert. Obviously irritation would seem to be associated with the physical, rather than the chemical, composition of these minerals.

One point of practical significance may be indicated by these observations, namely, that very finely ground asbestos is not dangerous. This conclusion has support in clinical observation, for it has long been known that at the Thetford mills there was no clinical asbestosis even though in former years the atmosphere was very dusty and the dust was extremely fine. The fact that fabrication of fibres of the same mineral in American plants could produce disease was one of the puzzling features of this disease. But these experiments offer a plausible explanation. The fine dust in the mills is composed of serpentine and extremely short chrysotile fibres; that in the spinning and weaving mills contains many more long fibres.

IN THE case of *free silica* everything points to a chemical form of irritation although the solubility hypothesis as now conceived is not compatible with all the observations that have been made. In experimental animals inhaling or injected with excessive quantities of pure quartz or flint in exceedingly fine state of subdivision, it can be observed that tissue reaction takes place in two stages. First there is an acute inflammation resulting in necrosis. Following it there is healing with fibrosis in the form of a granuloma whose end product is the silicotic nodule. The collagen laid down by the connective tissue cells is modified in a peculiar way analagous to that in the tanning of leather, and this is responsible for the characteristic hyalinization of silicotic fibrosis. Incidentally, leather has been tanned with silica and sections of such leather reveal that the collagen has undergone a similar hyaline transformation. In human subjects only cases of rapidly developing silicosis show evidence of a two-stage reaction. In those with ordinary chronic disease, degenerative changes are slight and overshadowed by the formation of connective tissue.

The solubility hypothesis is based solely upon indirect evidence. It is known that colloidal silica is toxic and that quartz will dissolve to some extent in slightly alkaline fluids of the same pH as those of the body. But it has never been possible to prove that silica has dissolved within the body, because the soluble material is immediately combined with local tissue elements. It is now generally accepted that the soluble silica detected in the urine and blood probably comes from ingested food and drink rather than from inhaled dust.

WE have made a good many experiments whose results are difficult to reconcile with the solubility hypothesis. They do not necessarily invalidate it because we may not have all the facts and do not know how to interpret them. For example, we have found that cellular reactions begin within 15 to 30 minutes after injecting fine particulate silica. In the test-tube traces of dissolved silica are only discoverable by an exceedingly sensitive colorimetric reaction after 12 to 24 hours. Possibly "vital" factors may accelerate the process, but no means of evaluating them has yet been discovered. No one has ever produced fibrosis by single or repeated injections of the various forms of soluble silica. The effect is apparently not due to the quantity of silica dissolved, for many of the inert silicates in vitro are more soluble than quartz or flint. Evidences of alteration of the surface of quartz particles long in contact with living tissue have thus far escaped detection.

In years of experimenting to discover the mechanisms by which free silica exerts its peculiar effects upon living tissues we have repeatedly observed evidences of a specific toxicity. Guinea pigs, injected intraperitoneally with large doses of fine quartz particles are often obviously sick for some hours. When Mr. Cummings and Mr. Redlin[2] were seeking an avenue for the quantitative introduction of silica they tried intravenous injections into rabbits and discovered the method which we now use as a standard for comparing reactions to different dusts. But incidentally they found that these animals would die very promptly if the unit dose of quartz particles were too large. These deaths were not embolic because they did not occur with large particles but only when the quartz grains were 3μ or less in diameter, and they did not develop on injecting suspensions of other minerals ground to the same size.

Mr. Dworski and Mr. Delahant have extended these early observations in a long series of experiments that have yielded interesting though puzzling information. They have shown that fine silica injected into the left side of a guinea pig's heart acts like a strong poison.

Symptoms of shock followed by death within a few minutes to one hour occur when a 400-gram guinea pig receives an intracardiac injection of 3 or 4 cc. of a 1% suspension of 1 to 3μ quartz particles in physiological salt solution. The reaction is specific in that it is not produced by quartz particles of larger size and it has not been observed on injecting suspensions of several other minerals ground to the same particle size.

Symptoms are initiated even before completing the injection by the onset of rapid, labored respiration. The skin of the face and extremities becomes pale. The animal displays uncoordinated muscular movements and sporadic convulsions terminating in death if the dose is sufficient. When smaller doses are administered complete recovery takes place.

Autopsy of fatal cases discloses an intense engorgement of the spleen, omentum and subperitoneal tissues which are deep purple-red in color. The liver, and in fact practically all the remainder of the body, is almost bloodless. Counts of ear-vein blood show only about half the number of leucocytes present just before the injection and a corresponding reduction in red blood cells. The blood no longer clots. There is no hemolysis.

Animals that have recovered from one reaction seem to acquire a tolerance so that in some instances at least twice the former dose may be injected without symptoms. The degree of tolerance, however, varies widely in different individuals.

These symptoms are not influenced by the injection of adrenalin. They are not reproduced by transfusing the blood of an animal dying in shock into another one of the same species. They are only exhibited on injecting suspensions of quartz particles less than 3μ in diameter. They are not produced by injecting the supernatant salt solution from which the quartz particles have been removed by centrifugation. The severity of the reaction does not vary with the age of the particle suspension, although the amount of soluble silica increases on standing.

The toxic effects of quartz can be more or less effectively neutralized by adding small amounts of different substances. Colloidal aluminum hydroxide gives complete protection in a dilution of 0.03%; colloidal ferric hydroxide is much less effective. Animal charcoal cannot be injected, because it flocculates with the quartz and produces emboli. The finely ground metallic aluminum, used by Denny, Robson and Irwin[4] in the prevention of silicosis has no influence upon acute intoxication. Further experiments are in progress to verify the conclusion of these authors that aluminum coats the surface of the quartz particles with insoluble material.*

Recent observations indicate that all species of animals are not equally susceptible to intravenous injections of quartz. Dogs, which develop silicotic fibrosis very slowly and under conditions not yet defined, tolerate intravenous injections of comparatively large doses of fine quartz without symptoms of any kind. Rabbits, guinea pigs and white rats all die of shock.

Soluble colloidal silica in dispersed phase is also

* Subsequent experiments have shown that sterilizing suspensions of metallic aluminum by heat destroys their power of neutralizing the action of silica. Unheated suspensions of the metal are just as effective as the hydroxide.

toxic, and intravenous injections produce the reactions just described with extremely small doses. With larger ones death occurs promptly with symptoms referable to the respiratory tract. The lesions are then confined to over-distention of the lungs and subpleural petechial hemorrhages.

THE results produced by injecting particulate silica into the circulation all suggest a relationship to a large amount of mineral surface suddenly brought into contact with the blood or tissues. This is borne out both by the absence of reaction to large particles in excess of 3μ in diameter and possibly by the observations on neutralization. Any effect due to preformed soluble silica liberated in the suspension before injection has been eliminated, and no active soluble silica could be demonstrated in the blood of an animal dying in shock by transfusion into a second host. Everything now suggests an effect taking place very rapidly at the interface between the quartz and some element in the blood or tissues. Whether this is due to the very rapid production of colloidal silica in this location or to unique electrical properties of quartz is still a fascinating subject for speculation. In the same category is the demonstration of the tolerance conferred by previous injections.

The manifestation of acute toxic symptoms by those species of animals which develop silicotic fibrosis most readily and their absence in the dog, which appears to be much more resistant, suggests that these immediate reactions may have some bearing on the etiology of silicosis. Until more is learned about the reactions in the dog no inference is possible.

The influence of particle size is just as significant in the production of advanced silicotic fibrosis as it is in eliciting acute symptoms of intoxication. Many injection experiments have convinced us that quartz particles over 3μ in diameter are of little or no physiological significance. The fact that the lungs of persons exposed to most dusts contain few particles larger than 10μ in diameter has been responsible for the establishment of this size as the maximum important in dust counting. As a matter of fact we know that with some dusts there may be many larger ones. While it would be just as well that any large fragments should be excluded from the lungs, it is felt that only ones 3μ or less in diameter are responsible for causing silicotic fibrosis.

We have long maintained that particles of this size are irritating because they present a sufficient surface of silica to the fluids. Recently Mr. Dworski decided to test this reasoning further by injecting graded doses of different sized quartz particles which would all present the same total surface area. He found, however, that regardless of the total surface, silicotic reaction only developed when the size of the particles was 3μ or less. On examining his material it was discovered that with particles 4 to 5μ in diameter or larger there were only two to four visible in a thin section of each phagocyte. These cells appeared to be quite uninfluenced by the ingested material. In the case of particles 3μ or under the number inside each phagocyte was countless, and there was marked evidence of degeneration of the cytoplasm of these cells. In other words, the effect of surface area had to be exerted inside of the cell and not upon the body fluids as a whole. Extracellular quartz seemed to have little influence, and even intracellular particles of a large size produced no visible evidence of irritation.

THIS observation brings us back to the cause of these progressive changes. Apparently they are initiated with degeneration in the primary phagocytes, an effect which is exactly paralleled in the histogenesis of tuberculosis. Some years ago I published a paper calling attention to the similarities between silicosis and tuberculosis.[5] In both of these diseases the primary irritants, quartz grains or tubercule bacilli, as the case may be, intoxicate the phagocytes. In tuberculosis the cells thus poisoned are commonly designated as "epithelioid cells;" in silicosis the morphological effect is similar. Visible fat droplets accumulate in the cytoplasm and the elements stainable by supravital dyes undergo rearrangements in characteristic patterns. Giant cells of the Langhan's type are produced in each disease by stimulation and repeated multiplication of the nucleus. In each disease many cells die and their degenerated products are liberated in the tissue spaces. Incidentally it is the pabulum of necrotic cells in silicotic lesions on which tubercle thrive so well, an effect which is responsible for the high frequency of complicating tuberculous infection in silicotics. In the tubercle it is in the necrotic or caseous tissue that tubercle bacilli are most frequent. Perhaps they not only cause such caseation but they themselves thrive on it. Coincidentally more cells migrate to the area and proliferate to form the granulomatous nodule that is characteristic of each disease.

Finally the production of necrotic tissue, high in lipoids, by two very dissimilar primary irritants recalls the experiments of Fallon[6] and his hypothesis that it is these lipoids which are directly responsible for the formation of the granuloma. He showed that the injection of such lipoids, freed at least partially of contaminating silica particles, was capable of producing a granulomatous nodule.

Such mechanisms may be involved in the production of both silicotic nodules and tubercles. It still remains to demonstrate the nature of the primary injury by each of these irritants, and it is this problem that will probably engage our attention for some time to come.

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A Plan for the Control of Tuberculosis in Industry

MAX R. BURNELL, M.D.,
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IT IS a proud day when it can be stated that one of the safest places to be in this country is at work. Statistics from the National Safety Council seem to bear this out. The reduction in the frequency and severity accident rates in our industrial institutions has been nothing short of remarkable. Prevention has been the watchword.

With such improvements, the consideration of the medical departments in industry has more recently been drawn to the general health of its employees. Attention to the control of tuberculosis has been a very major issue. We believe that in no adult group throughout the country can so much be accomplished in prevention and early recognition of this disease as in our industrial institutions.

Legislation varies in the different States regarding occupational disease but the ultimate objective of this legislation is clear: The general health of the employee must increasingly become the responsibility of the employer. While the status of tuberculosis has been debated by many legislative bodies, silico-tuberculosis is definitely compensable. In the state of Illinois the new occupational disease disability compensation law went into effect on October 1, 1936. Dr. C. O. Sappington states that "during the first year of the operation of this law, 10.9% of disability claims filed were for pulmonary tuberculosis while silicosis claims were 15% of the total."[1]

The corporation that is looking toward the future with the best interests of its employees in mind certainly should be actively engaged in the problem of the control of tuberculosis. Many of our industrial institutions have already shown, by marked reduction of the incidence of pulmonary tuberculosis, just how this can be accomplished. Our own corporation has a very definite program concerning tuberculosis.

THE PROGRAM: 1. THE PRE-EMPLOYMENT PHYSICAL EXAMINATION. Every prospective employee is given a thorough physical examination. This is done with the intent of placing that individual in industry where he or she is best physically as well as mentally fitted. This examination is not done for the purpose of either passing or rejecting that person for employment. This pre-employment examination gives the examining physician the best possible opportunity to detect pulmonary tuberculosis.

Dr. Robinson Bosworth, President of the Illinois Tuberculosis Association, states:[2] "85% of adult pulmonary tuberculosis has its beginning in the age group 18 to 28. In the vast majority of cases there are no symptoms and no physical signs."

It is exactly this age group that concerns us most in our pre-employment physical examination, for it is during this age period that most employees first enter industry. We therefore feel that such an examination is not complete without an x-ray of the chest.

We believe, with Dr. Andrew R. Riddell, of the Industrial Hygiene Department, Ontario Department of Health, that the wholesale tuberculin testing in industry has many disadvantages. He states that[3] "the individuals must present themselves at least three times—there is considerable disruption of work—even after most careful explanation as to the meaning of the test, the employees who react positively are greatly disturbed."

Applicants in whom active pulmonary tuberculosis is discovered are sent to their family physician. Our roentgenogram is at his disposal, but must be returned to our files so that we can later compare the progress of the disease and determine at what future time those persons may be pronounced employable.

Applicants with arrested or quiescent tuberculosis are placed at work after being informed of their condition and instructed to return for periodic examinations. These examinations for new employees, in this classification, are conducted every three months.

It has been increasingly evident that our responsibility does not end there. We explain to the employee that while he now has an arrested tuberculosis, it was once active. We encourage him to have the members of his family examined by the family physician. We feel that not until then has industry wholly discharged its duty to the community.

2. PERIODIC EXAMINATIONS FOR OLD EMPLOYEES. These examinations are made at different times and for varied reasons:

(a) Upon returning to work after vacations.
(b) After absence caused by an illness.
(c) Re-employment following seasonal lay-off.
(d) Transfer from one type of work to another.
(e) Medical department requesting the examination for some definite reason.
(f) Volunteer requests by the employee for such an examination.

Little comment is necessary concerning these examinations except to state that every employee comes into our medical department for a general physical check up at least once each year.

Two types of periodic examinations deserve special attention. First, the medical department requesting the employee to appear for some specific reason. Each employee has his own physical record card. His visits to the medical department are recorded here. If it is noticed that frequent visits are being made for colds, bronchitis, loss of weight, feelings of fatigue, etc., he is requested to appear so that we may get at the underlying cause. These examinations are always accompanied by x-rays of the chest and if the disability is from early tuberculosis, we are able to detect it.

The other type of periodic examination is most gratifying to the medical man in industry — the physical check up requested by the employee himself. This is, indeed, a measure of the confidence that has been established between the medical department and the worker.

Cooperation with the family physician is of paramount importance. When some disability is uncovered and it is discussed with the employee's own physician, that employee realizes that the corporation is not attempting to deprive him of his job but is trying to keep him at work by improving his health. Again confidence is established, and that is the best foundation for a successful program to maintain a high standard of health within your organization.

One striking example of such a relationship is of unusual interest in regard to the tuberculosis problem. After the installation of excellent x-ray equipment in one of our plant hospitals, it was suggested to the employees that they take advantage of this opportunity to have their chests x-rayed. These were all old employees, some with service records of over 20 years. The response was amazing. Over 4600 employees requested the examination during the first 10 months.

All of these employees were working every day. They considered themselves in excellent health—so did the medical department as a matter of fact, as their previous physical examinations during the year had shown no disabilities. However, 12 cases of early active tuberculosis and 42 cases of arrested or quiescent tuberculosis were brought to light. The active cases are all under treatment —nine of them have been referred to sanatoria by the family physician. Active tuberculosis has also been found by the family physician in the households of those in the arrested groups.

3. Control of Tuberculosis Within the Plant. If there is to be real control of tuberculosis in industry, the activities of the industrial medical departments must not stop with examinations within the plant hospital.

Dr. G. T. Drolet[4] has shown conclusively that where there are bona fide cases of active tuberculosis the results of treatment, irrespective of where or how, are still far from satisfactory. In other words, "the hopeful sign is steady reduction in the *number* of cases and not what happens to those who actually develop the disease. Progress has come by prevention and not through treatment."[5]

We must take a page from the program of the plant safety engineer and again adopt "prevention" as our slogan.

As Dr. C. D. Selby has stated, the industrial physician is the health officer of the plant.[6] "It is his duty to locate, identify and determine the importance of all occupational and environmental sources of disease or health impairment and to see that they are corrected."

In relationship to tuberculosis he must know if "exposures" to the inhalation of dust particles or obnoxious gases and vapors are present within the plant. Also he must pay attention to overcrowding, proper lighting, ventilation, arranging rest periods for those engaged in strenuous or necessarily rapid operations, and have knowledge of the toxicity of materials handled.

Dr. Hamilton[7] has listed definite industrial poisons which are capable of irritating severely the bronchopulmonary system and activating a preexisting pulmonary tuberculosis — chlorine gas, ammonia, benzine, brass fumes, phosgene, nitric acid fumes, selenium and vanadium, to mention a few.

The danger of exposure to the inhalation of dust, especially silica dioxide (crystalline silica) is only too well known. It is not within the province of this paper to discuss silicosis. However, as Dr. Riddell[8] has stated, "Tuberculosis is the commonest and most important complication in deaths among silicotics. Therefore in any discussion of the control of tuberculosis in industry, the subject of silico-tuberculosis must have its place."

Dr. LeRoy Gardner[9] contends that "silicosis is the menace that it is because it specifically predisposes to tuberculosis. It is the latter which is responsible for disability, lost time, and, in many cases, death, and it is really tuberculosis against which we have to fight."

This statement has been recently challenged by Dr. George Ornstein.[10]

Whatever the conclusions may be in the future concerning the exact relationship of silicosis to tuberculosis, the industrial physician must continue his attempt to eliminate dust.

Dust counts should be made to locate the points of greatest hazard. Consultations should be held with the safety engineer as to the best type of control, whether (a) mechanical ventilation of the positive or supply type or local exhaust systems; (b) isolation or total enclosure methods, or (c) respiratory protection by respirators and positive pressure masks or helmets, are to be advised.

THE purpose of industry is manufacturing. Often the installation of adequate equipment is expensive. This adds to the cost of the manufactured article. It behooves the industrial physician to study his problem with care. Our experience has proved that when management is informed of the hazards that are present and shown the necessary steps toward their elimination whole-hearted cooperation is immediately forthcoming.

To Summarize: A plan to control tuberculosis in industry must start with pre-employment examination. The majority of employees first enter industry during the age period when adult pulmonary tuberculosis is most prevalent. X-ray of the chest is a requirement, if early cases are to be detected. When arrested or quiescent cases are discovered, we feel that it is industry's duty to the community to cooperate with the family physician in an attempt to uncover active cases in that employee's household.

Once the employee is at work, periodic examinations are the next requirement. Such an examination should be conducted at least annually. The employee quickly learns the personal value of these physical check ups. Confidence then established between the worker and the medical department goes far toward simplifying any plan for the control of tuberculosis in industry.

Lastly, the influence of the industrial medical department must extend to every department of the operating plant. Inspections must be made regularly. The industrial physician should be familiar with every possible "exposure" to health impairment. This is the final requirement of our program.

Our goal should be to make the employee's hours at work not only the safest from accident but also the freest from exposure to disease.

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X-Ray in Industry

M. William Clift, M.D., F.A.C.P.,
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Flint, Michigan

THE new attitude that has grown up between industrial physicians and the employees of this organization, stimulated by the consultant, has made it not only an interesting privilege but also a pleasure for an associate to be in contact with what we must feel are among the best ideals of the medical profession. Therefore, it seems to me that you might be interested in my experience of the past two years in the field of x-ray in industry.

That x-ray has had its definite function you all know, from the several years that industry has recognized its use. The contact of the roentgenologist with the industrial physician has been largely in the field of forensic medicine. With the new awakening of industry to the importance of preventive medicine has come a change in the qualifications of the roentgenologist and the physician, and a necessity for greater cooperation with and by the management of the organization. This has meant a study of the hazards of industry. That necessitates not only an intimate knowledge of those hazards but of those who may encounter them. Therefore, the roentgenologist must have a close contact with the factory physician, who in turn, must have contact with the individual employee and be conversant with the nature of his work.

Just how large a part the roentgenologist can contribute to this field of medicine depends upon two factors: *first,* the physical set-up of the department and, *second,* the cooperation received from the management.

The extent of the equipment naturally depends upon the size of the plant and the burden that will be imposed upon the medical department. However, there are certain minimum requirements that can not be neglected if efficient service is to be rendered. The equipment and arrangement of the department must be such as will produce the results most economically.

In the past two years the author has had the opportunity to organize and try out, what in his own mind is a model industrial x-ray department, this because of a sympathetic management and the helpful cooperation of a medical department which was attuned to the requirements of modern industrial medicine.

It is impossible to do adequate work without efficient equipment. And it has been thoroughly demonstrated that in larger factories x-ray work can be done most economically within the plant itself. To refer cases to the private roentgenologist is both expensive and lacks the cohesive efficiency that can only be obtained within the organization.

The result of two years' experience has demonstrated that the initial cost of the x-ray equipment is an extremely small factor in the economics of a medical department. With the most modern equipment and with a well regulated plan of operation the cost per case is hardly an incident in factory medicine. My experience in the organization with which I am connected has shown that the entire capital investment for the x-ray equipment has not only been liquidated but has also shown a dividend in less than two years. However, the greatest dividend has been in the salvage of individuals working in factories and by appreciating their physical needs, placing them back in industry in positions they can adequately fulfill.

In the time that we have had the opportunity to examine the employees, we have seen upwards of 6000 cases. We have detected cases of early tuberculosis, placed them under the proper conditions for their rehabilitation, and had the pleasure