The American Ceramic Society

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by each branch. During 1944 scientific investigations were undertaken in two principal directions: (1) the development of theoretical and practical methods of physical and chemical analysis of new alloys, the processing of complex multimetal ores, and the study of domestic mineral resources; and (2) investigations relative to the basic chemistry of complex compounds and the development of effective methods for the recovery of rare metals and their alloys. Of special interest to the ceramic industry are the studies undertaken by the Laboratory for Silicates and its reports on the chemical stability of glass and the diffusion of gases in molten glass. A.J.S.

Séailles-Dyckerhoff Alumina Process, Portlandzement Fabrik Dyckerhoff & Söhne at Amoneburg bei Biebrich. F. M. LEA. *BIOS Final Rept.*, 167, Item 22; PB 18,938, 7 pp. (Aug. 1945); abstracted in *Bibliog. Sci. Ind. Repts.*, 1 [22] 1341 (1946). Price photostat $1.00, microfilm 50¢.—This is a report of the process for extracting alumina from coal ashes, based on a discussion with personnel of the Dyckerhoff works and examination of some analytical records. Essentially, the process consists in burning an alumina-containing raw material with limestone; extracting the pulverized material with water by a countercurrent method; precipitating the alumina and lime from this solution by treatment with carbon dioxide, and then subsequently extracting the alumina from the mix of these two solids by treatment with soda. Initially, in the pilot-plant trials, the Séailles water extraction method was used, but it was later abandoned in favor of the alkali extraction method. Details of the process, analysis of the materials, and economic considerations are discussed. The residue from the alkali extraction process proved quite satisfactory for use in Portland cement manufacture.

Synthesis of Fluorine-Mica of the Phlogopite Group; Crystallochemical and Microscopic Investigations of Synthetic Phlogopites; Regular Intergrowth of Synthetic Phlogopite with Hydrous Mica. W. EITEL. *FIAT Final Repts.*, 747, 748, and 749; PB 20,530, 41 pp.; PB 20,531, 32 pp.; PB 20,532, 34 pp. (March 1946); abstracted in *Bibliog. Sci. Ind. Repts.*, 1 [18] 994 (1946). Price (each) photostat $3.00, microfilm 50¢.—This is a series of three reports on synthetic mica research by Eitel and his coworkers at the Kaiser Wilhelm Institute for Silicate Research at Berlin-Dahlem and Ostheim Rhoen, Germany. A process for the production of synthetic mica on a laboratory scale was developed. In PB 20,530, practical details involved in the synthesis are set forth. Potash-magnesia mica and barium mica were made in small crucibles. To produce well-oriented crystals, particular importance was placed on well-regulated temperature gradient in a vertical direction during the first of the cooling period and a magnetic field surrounding the crucible in a horizontal direction. In PB 20,531, the basic crystallographic theories are discussed with complete descriptions of the results of various melts in the phlogopite series. PB 20,532 gives the results of crystallographic studies of synthetic phlogopite, and the rules governing intergrowth of phlogopite and humite crystals are derived. Tables, diagrams, and explanatory photomicrographs.

Synthetic Sapphire and Spinel Production in Germany. M. H. BARNES. *FIAT Final Rept.*, 455; PB 17,545, 17 pp. (1945); abstracted in *Bibliog. Sci. Ind. Repts.*, 1 [20] 1204 (1946). Price photostat $2.00, microfilm 50¢.—Two plants in Germany produced synthetic sapphire and spinel boules during the war, the I. G. Farben plant at Bitterfeld and the Wiedes Karbid Werke at Freyung. Both plants employ the basic Verneuil process, the principles of which are known in the U. S. The details of German apparatus and process are revealed here for the first time. A process for hardening spinel bearings so that their performance approached that of sapphire and so that only one fourth as much diamond was needed for fabrication was developed.

Temperature Interconversion Tables and Melting Points of the Chemical Elements. *Nat. Bur. Standards Misc. Pub.*, M183, April 10, 1947 (supersedes *Misc. Pub.* M126). Price 5¢ from Supt. of Documents, Washington 25, D. C. S.M.L.

X-Rays in Practice. W. T. SPROULL. McGraw-Hill Book Co., Inc., New York, 1946. 615 pp. Price $4.00. Reviewed in *Mech. Eng.*, 69 [2] 165 (1947). F.G.H.

See the following additional abstracts

Sect. XII: Colloid chemistry of the clay mineral attapulgite.

XIV—General

Central Glass and Ceramic Research Institute. ANON. *Jour. Sci. Ind. Research* (India), 4 [7] 387–88 (1946).—The foundation of this Institute in Calcutta is the first of the five national laboratories to be established in India. Cf. *Ceram. Abs.*, 1947, July, p. 151f. M.HA.

Employing an engineer—hiring practices analyzed. JOINT ECONOMIC STATUS COMMITTEE. *Amer. Engr.*, 17 [4] 2, 12–13 (1947).—A preliminary report is given of a survey being made to answer questions which both the employer and the prospective engineering employee ask. The survey includes the type of engineers hired, how young engineers are recruited, how experienced engineers for specific openings are obtained, the most important factors taken into consideration in hiring an engineer, and how much newly employed engineers are paid. The median answer for the last question was found to be $207 per month in a range of approximately $175 to $250; however, the salary depends on the individual in 20% of the industries and upon prevailing wages or special factors in the other 80% of the industries polled. The glass industry was included in the list of those paying the highest wages for recent graduates. In general, the answers to other questions were based on too little data to be conclusive as yet; some trends, however, were indicated. L.R.M.

General business conditions. ANON. *National City Bank Monthly Letter* (June 1947).—The opinion that the peak of the postwar boom has been seen is now fairly general. Where recession has occurred, however, it is still of little weight, so far as the aggregates of production, income, or employment are concerned. The most significant changes that have occurred are in the price trend of basic commodities, the filling up of shortages of more and more consumers' goods, and buyers' resistance to out-of-line prices, including construction. The going will be harder for new or rapidly expanded concerns than it was during the war and the postwar boom. It will be harder for everyone who cannot meet competitive costs. The test of the situation in the coming months will be the state of employment and the output of goods and services to promote the general welfare. R.H.B.

Histology of asbestosis. L. NORO. *Acta Path. Microbiol. Scand.*, 23 [1] 53–59 (1946); abstracted in *Jour. Amer. Med. Assoc.*, 133 [9] 652 (1947). D.G.P.

How to tell your story to workers. ANON. *Modern Ind.*, 13 [5] 44–48 (1947).—The widening gulf between labor and management shows the need for better understanding. That gulf has led to Communism in some countries and to Socialism in others. Thus far it has led only to crippling strikes and generally reduced worker productivity in this country. Communications from management to workers, the smooth flow of information, facts, instructions, and educational material, is today's No. 1 industrial-relations problem. Methods of shaping employee opinion include the following mediums: (1) Supervisory word-of-mouth, (2) bulletin boards, (3) pay-envelope inserts, (4) news letters, (5) employee publications, (6) employee meetings, (7) public-address systems, (8) plant-city advertisements (9) radio, (10) employee handbook, (11) annual statement (12) labor-management activities, and (13) movies. R.H.B.

Influence of age on silicosis. E. MARTIN AND L. ROCHE *Presse méd.*, 54 [Jan. 5] 3 (1946); abstracted in *Jour. Ind. Hyg. Toxicol.*, 28 [6] 133–34 (1946). D.G.P.

Lamps and the spectrum. C. E. WEITZ. *Ohio State*

DEPARTMENT OF PATHOLOGICAL ANATOMY OF THE UNIVERSITY OF HELSINKI; HEAD: PROFESSOR ARNO SAXÉN

ON THE HISTOLOGY OF ASBESTOSIS

By *Leo Noro.*

(Received for publication October 2nd, 1945).

In the fall of 1943 two workers of an asbestos factory died under circumstances, which indicated that the cause of death was to be ascribed to their trade, in which for years they had to inhale asbestos dust. In the autopsy asbestosis was found to be the cause of death: *a lung disease caused by asbestos dust.*

When the workers of this factory were examined röntgenologically (*Wegelius*), the surprising result was attained that asbestosis was found in 65 % of the 167 workers examined.

The clinical picture of asbestosis based on observations made in Finland is explained more definitely in Nordisk Medicin 1946 (*Lavonius, Noro* and *Wegelius*).

In this paper the histological picture of asbestosis and its pathogenesis will be explained on the basis of my own observations and literature available in Finland.

Survey.

The clinical picture of asbestosis has been known only for a short time as *Murray*'s first publication on asbestosis dates back to the year 1899. In 1906 *Marchand* made the first autopsy of a person who died of asbestosis. But not till 1914 did *Fahr* and *Feige* explain the clinical picture thoroughly. In the 1930's research work on asbestosis got a good start in England, the United States, Germany, France, South-America, and Italy, and up to the year 1943 about 150 publications on asbestosis had appeared (*Lenke*). Up to the year 1939, however, observations had been published on fifteen autopsies only (*Wedler*), so that there is full reason to publish two of my own cases.

The Appearance, Use and Characteristics of Asbestosis.

Asbestos is a fibrous mineral, which is found in Siberia, South-America, Italy, and *Finland*, where the quarrying and refining of asbestos has been going on for more than ten years.

Asbestos is a poor conductor of heat and electricity so that it is used mainly for insulation purposes, among other things in fire-proof curtains (asbestos materials), in the making of fire-proof tiles (asbestos tiles), fire-proof paper (asbestos paper), and roofing shingles.

Asbestos has a fibrous structure, so that it can to some extent also be spun.

The Finnish asbestos as to its quality is amphibole asbestos.

Acids have no effect on it and it is poorly dissoluble. Its fibres are on the average one inch long. They are harder and more elastic than in the foreign asbestos in general. Because of this quality the Finnish asbestos dust is to be considered very dangerous.

The chemical consistency of Finnish asbestos is the following:

Silicic acid (SiO_2)	56,27 %
Aluminium oxide (Al_2O_3)	2,50 %
Ferro-oxide (FeO)	4,18 %
Calcium oxide (CaO)	0,25 %
Magnesium oxide (MgO)	31,44 %

Pathogenesis.

Asbestos dust is found everywhere in the air where asbestos is quarried or refined. The finest dust, invisible to the eye, gets into the lungs along with the inhaled air, mainly into their lower parts, where the circulation of air is largest. Only dust particles, the diameter of which is not more than 10 μ: s can penetrate into the vesicles of the lung.

In order to find out the quality of the asbestos dust in my cases I had the lung specimens examined in the following way.[1])

First the paraffin was separated from specimen through melting. After that the organic matter was dissolved with hydrogen peroxide and strong nitric acid and then the inorganic rest was examined.

When examining the rest microscopically it was noticed that it was composed of small particles which resembled knitting needles. *Mostly their size was about 9 μ or a little smaller.* The thickness could not be determined exactly with the instruments available, but it was always less than 1 μ However, some with the length of 45 μ were observed, but only one with the length of about 65 μ. Also some clusters of needles were seen whose length was from 30 to 90 μ.

The length of the asbestos needles found in the lungs naturally depends on the quality of the asbestos. According to *Wedler* the length of the asbestos needles usually varies from 25 to 150 μ., the thickness being 3 μ. Part of the needles may, however, be smaller, the length ranging from 2—6 μ and the thickness from 0,006—0,01 μ. According to *Beger* their length is 25—110, on the average 50 μ., and their thickness 0,5—1 μ; *Beintker* again gives the length as 150 μ and the thickness as 1—3 μ.

The needles of the Finnish asbestos then are noticeably smaller than the above-named qualities, with the exception of the kind with still smaller needles mentioned by *Wedler*.

[1]) This research work was performed in the Geological Department. I am very grateful to the Head of the Department, Professor *Aarne Laitakari* and to mag. phil. *Toini Mikkola* for the opportunity to make these examinations.

Like other strange objects the sharp asbestos needles and dust cause a reaction in the organism which is to be seen also in my own cases. Characteristic of this reaction are exudate cells and among other things, especially the appearance of giant cells containing strange particles to fagocyte strange substance. In Fig. 1 this kind of reaction is seen.

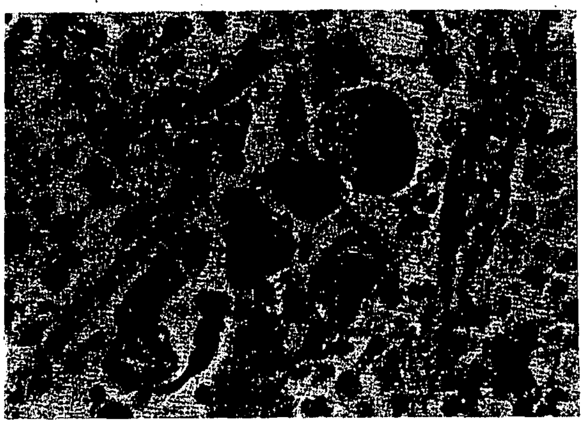

Fig. 1.
The asbestos needles have caused an exudate infiltration in the lung tissue, in which also a few giant cells are found.

The asbestos needles are however, only dissoluble with great difficulty, so that the fagocytose happens slowly, if it is at all successful. When the needles move in the lungs injuries most likely occur also in the alveolar epithelium, the result being hemorrhages and the formation of connective tissue. This again, together with the state of irritation caused by the foreign particles, gradually leads to the thickening of the epithelium, of a kind which is seen in Fig. 2. The picture is taken in polarized light.

Gradually the formation of connective tissue increases diffusively until a wide formation of connective tissue in the lungs has arisen, as seen in Fig. 3.

The changes begin and reach their largest extension in the hilus glands and the lower parts of the lungs, into which the dust penetrates most easily. Hence asbestosis is distinguished from silicosis essentially in that in the former necrose nests which resemble tubercles appear around the lymphatics under the influence of silicic acid, which in the latter there is a diffusive connective tissue formation in the foreground. In Fig. 4 a microscopic preparation of a silicose lung. When comparing it to Fig. 3 the distinct difference is apparent.

Asbestos bodies.

In a asbestos lung one can see here and there peculiar club-shaped, rod-shaped or bamboo-like bodies, *asbestos bodies*. They make a pretty *Berlin-blue* reaction of a kind bare asbestos needles do not make. Fig. 5 asbestos bodies are to be seen.

In the asbestos bodies the frame is constituted by an asbestos needle, around which there is a coating. This contains albumins and

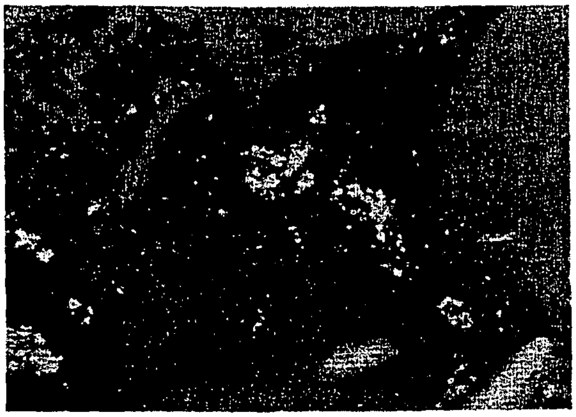

Fig. 2.
The epithelium of the alveoli has noticeably thickened.
(Picture taken in polarized light).

iron, which most likely originate from the hemoglobins freed from the hemorrhages in the surroundings.

The shape of the asbestos bodies can be most varying. The forms of the most usual ones are seen in Fig. 5.

Asbestos bodies disintegrate gradually in the tissues. Such a phase of distintegration is shown in Fig. 6.

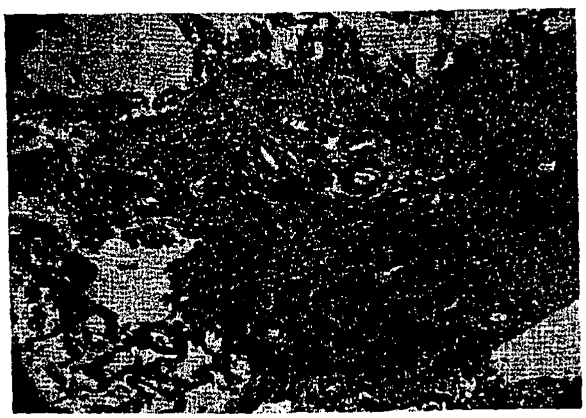

Fig. 3.
Diffusive interstitial connective tissue formation in the lungs.

Fig. 4.
Silicose lung.

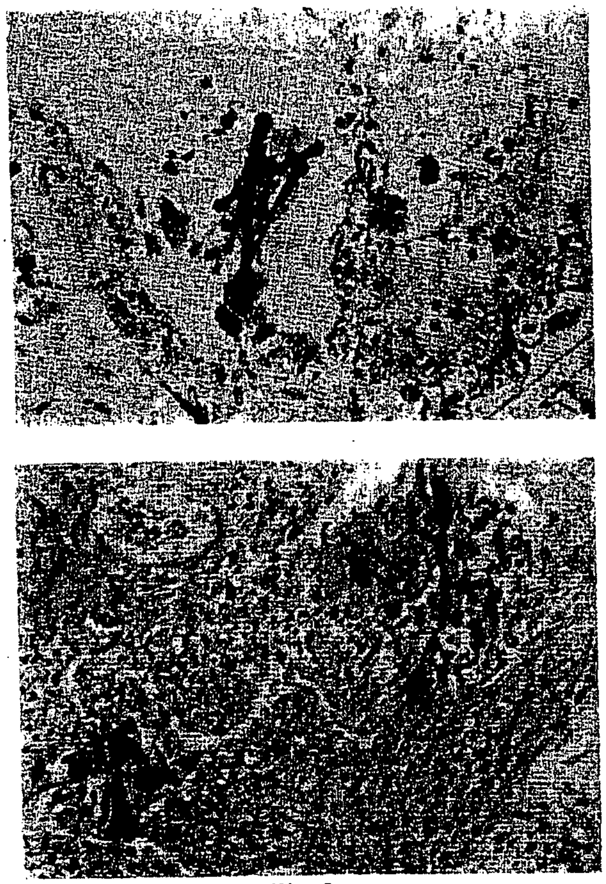

Fig. 5.
Asbestos bodies.

Which factor is more important in the pathogenesis of asbestos, the mechanical or chemical, is a question still debated.

The theory of the mechanical origin of disease is represented, among others, by the Swedish geologists *Sundius* and *Bygden* and the Italien *de Biasi.* They are of the opinion that the matter in question is a purely mechanical tissue lesion. The iron coating of the asbestos bodies has, accord-

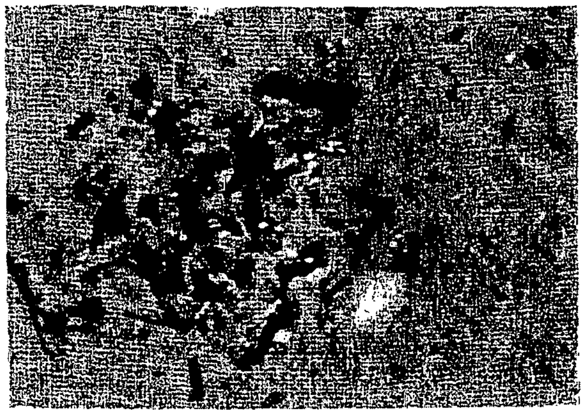

Fig. 6.
Disintegrating asbestos bodies.

ing to them, originated from the hemoglobin of the blood. Needles always cause small hemorrhages when the lungs stir. The other elements of the coating are mainly coagulated calloids, which, because of a surface tension, have got stuck on the needles. *Sundius* and *Bygden* justify their opinion by pointing out the rutile needles (TiO_2), which do not contain silicic acid, cause the same kind of formations in the tissue. Their opinion, then, is that an asbestos body is the result of a reaction in the tissue caused by a poorly dissoluble, foreign particle.

Beger represents the opposite point of view. He thinks the origin of the disease is a chemical process, in which the tissue injury characteristic of silicic acid is the most important. He is of the opinion that the lymph first detaches the metal ions from the asbestos needles, while the frame containing silicic acid remains. Only then does the actual chemical influence begin when the silicic acid dissolves. *Beger* explains the fact that asbestosis does not appear in all people in the following way: Depending on individual circumstances, mainly on the reaction of the reaction of the tissue, the dissolving of the silicic acid takes place with varying rapidity. If the dissolving is slow a large enough percentage of acid is not developed in the tissues to injure them. According to him a fibroid originates only when the asbestos bodies are dispersed, but not already when they are born. This fact would also speak for the chemical pathogenesis of the disease.

Both theories have their strong points. Personally, I am inclined to combine both theories in the following way:

The emphasis in the pathogenesis of the disease is to be laid on mechanical factors and on the reaction caused by foreign particles in the tissues. In Fig. 1 one can clearly see a reaction caused by asbestos needles, which may be compared to an inflammation. Besides this, the injuries of the tissue caused by the needles is to be taken into consideration, which, as in other parts of the body, will heal while forming connective tissue.

If as *Beger* claims, the chemical influense was the main factor, one would think that, when the asbestos bodies dissolve, a stronger reaction in the surroundings would arise than that seen e. g. in Fig. 6. There dissolving asbestos bodies are seen which have been photographed in polarized light. The reaction in the surroundings is not nearly so strong as in Fig. 1, in which to my mind we have to do with a mechanical irritation phase.

Under these circumstances I am inclined to think that in the pathogenesis of asbestosis the mechanical factors are the most important, although the chemical factors may have some significance in a later phase.

Summary.

The writer describes the histology and pathogenesis of asbestosis on the basis of facts derived from available sources and his own two cases.

After describing the characteristics of Finnish asbestos, amphibole asbestos, and the size of asbestos needles found in the lungs, the writer explains the histological picture of the disease. Characteristic of this is: A reaction caused by the needles in the tissue, which becomes manifest in exudate cell infiltration, accompanied by numerous giant cells containing foreign particles and an increase of diffusive, interstitial connective tissue and fibrosis.

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