Common Commodities and Industries

Asbestos

A. Leonard Summers

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PITMAN'S COMMON COMMODITIES AND INDUSTRIES

ASBESTOS

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THE WORLD'S MOST WONDERFUL MINERAL

AND OTHER FIREPROOF MATERIALS

BY

A. LEONARD SUMMERS

AUTHOR OF "ALL ABOUT ANTHRACITE: THE WORLD'S PREMIER COAL," ETC.

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FOREWORD

UNTIL the completion of this work, there existed no comprehensive book on the absorbing study of asbestos. Many years ago a book was issued abroad on the subject, but to-day, even if not out of print, this would in all probability be quite out of date.

The uses and scope of asbestos having now become universal, it has long been felt that a book thereon was much needed, so few people really understanding the subject; and the author (for many years closely associated with the industry), while avoiding as far as possible too dry and tiresome technicalities, has dealt with everything of real interest and utility in a concise and popular style to appeal to every class of reader.

The author's acknowledgments are due to Messrs. Bell's United Asbestos Co., Ltd.; Dick's Asbestos Co.; British Uralite Co., Ltd.; Vulcanite, Ltd.; and the Siluminite Insulator Co., Ltd., for the loan of their photographs appearing in the volume.

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ACL Doc 10006 · Page 9 of 131 asbestosclaims.law/library/10006/9

CONTENTS

PAGE

FOREWORD v

CHAPTER I

ASBESTOS—Its Modern History—Mining in Italy and Canada—Principal Sources—Its Composition and Properties—Chemical Analysis of the Mineral—Commercial Values—The Pioneers 1

CHAPTER II

Crude Asbestos—Processes of Manufacture Described—Cloth—Asbestos-Metallic Cloth—Patent Packings and Joints—"Eclipse," "Gladiator," and "Sirius" Packings—"Universal" Packing—Bricks—Armoured Sheets—Asbestos Soles and Spats—Theatre Curtains—Millboard—Non-conducting Compositions—"Viceroy" Coverings—World's Largest Boiler and Pipe-covering Contract—Saving of Fuel—Cold-pipe Covering—Instructions for Use—Asbestos Felt—Fireproof Paints—Engineering and Asbestos—Building Uses—Nature's Fireguard—Practical Tests—Decorations—Burlington Hotel Fire—Fireproof Cables—Uses in Electricity—Various Insulators—Asbestos Clothing—Domestic Appliances—Fireproof Solution—Portable Asbestos Cottage—Tiles, Bricks, etc.—World's Theatre Fires—London Fire Statistics—Bunker Fires and the Remedy 12

CHAPTER III

Miscellaneous Uses for Asbestos—Safety-lamp Washers—Lamp Wicks—Cold Insulation—"Asbestic"—China Clay—Cord and Twine—Asbestos-Leather—Automobile Tyres—Thread—Ropes—Rope-Ladders—Tubing—Gloves—Leggings—Aprons—Putty—Fuel—Filter Cloth—Waterproof Asbestos Cloth—Household Articles—Documents—Tapestries—Various Methods of Insulation 54

CHAPTER IV

COMPOSITE FIREPROOF MATERIALS

Uralite—Asbestone—Uacolite—Poilite—Decolite—Calbonite—Everite—Asbestilite—Vulcanite—Siluminite—Litholite—Reconstruction: Suggested Reforms—Concrete Houses—Possibilities of Concrete—Housing Essentials—Ventilation—Walls and Papers—Washing—Central Heating—Smoke Nuisance—The Remedy . . 62

INDEX 105

Asbestos and the asbestos industry; the world's most wonderful min… Published by AsbestosClaims.Law
ACL Doc 10006 · Page 10 of 131 asbestosclaims.law/library/10006/10

ILLUSTRATIONS

	PAGE
CRUDE ITALIAN ASBESTOS . . *Frontispiece*	
ROMAN NOBLE MAGICIAN	2
ITALIAN ASBESTOS—CRUDE STATE	13
CANADIAN ASBESTOS—CRUDE STATE . . .	14
ASBESTOS METALLIC CLOTH MANHOLE JOINT . .	16
"UNIVERSAL" PACKING	19
TWISTING "UNIVERSAL" PACKING.	21
PREPARING ASBESTOS COMPOSITION FOR BOILER COVERING	24
ASBESTOS PIPE-COVERINGS	28
ASBESTOS-PAINTED SHEDS	34
ASBESTOS CEILING PANEL	39
A FIREPROOF MAN	43
ASBESTOS FIRE-SCREEN	45
ASBESTOS FELT	46
ASBESTOS YARN	46
A HOUSE THAT WILL NOT BURN	48
URALITE FIREPROOF HOUSE	63
VULCANITE ROOF GARDEN	65
HUT OF ORDINARY CONSTRUCTION AFTER FIRE TEST .	67
HUT LINED WITH URALITE AFTER FIRE TEST . .	67
PAVILION CONSTRUCTED WITH URALITE AND ASBESTONE	70
BOILER HOUSE BUILT OF ASBESTONE . . .	71
EAVES AND TILES	72
FIRST COURSE OF EAVES	72
SECOND COURSE OF EAVES	73
FULL TILES	73
POILITE TILE	76
" "	78
ENTRANCE HALL OF DECOLITE MATERIAL . . .	83
BELFAST CORPORATION VULCANITE ROOF TANK . .	87
VULCANITE ROOF-GARDEN	89
SOME TYPES OF INSULATOR	94
SQUARE-FORMED INSULATOR	95
AN ITALIAN ASBESTOS MINE	103

Asbestos and the asbestos industry; the world's most wonderful min… Published by AsbestosClaims.Law
ACL Doc 10006 · Page 11 of 131 asbestosclaims.law/library/10006/11

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ASBESTOS

CHAPTER I

ASBESTOS—Its Modern History—Mining in Italy and Canada—Principal Sources—Its Composition and Properties—Chemical Analysis of the Mineral—Commercial Values—The Pioneers.

WHEN one comes to inquire into the qualities of this truly wonderful mineral—one of Nature's marvels—and its multitudinous uses of to-day, how surprising it appears that thousands of years have been allowed by civilization to elapse between the present time and the period when the ancients first made use of it, before finally giving serious attention to its immense possibilities!

Yet that is precisely the situation, for asbestos was practically unknown to the modern world less than a century ago; whilst commercially it has not been in vogue much over fifty years. However, the world, once thoroughly awakened to its merits, had rapidly made up for the past neglect by almost feverish activity in many directions, so that to-day this has become a very great and ever-growing universal industry of enormous importance, worked by influential companies with large financial resources in different parts of the world. Its uses, scientific and general, have become extensive in many spheres and new uses are constantly found for it. Ten years ago asbestos was declared to be, like electricity, only in its infancy, and possibly to-day it may have reached what might still be described as "early youth"; and, as its companion electricity—with which it is often closely allied—

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ACL Doc 10006 · Page 12 of 131 asbestosclaims.law/library/10006/12

asbestos undoubtedly has unlimited scope and possibilities for future developments.

The form in which asbestos was used by the ancients was usually as a cloth, of rather coarse texture (probably



FIG. 1

A ROMAN NOBLE "MAGICIAN"[1]

hand-woven), for a wrapping material of durable quality —such as that in which they buried distinguished personages. A specimen of this old-world fabric may possibly still be seen in the Vatican, Rome. In his thirteenth-century travels, Marco Polo refers to a fire-resisting material, which he believed to be made from

[1] Prominent hosts—including Charlemagne—sometimes entertained and mystified their guests by committing their table covers (asbestos) to the flames.

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ACL Doc 10006 · Page 13 of 131 asbestosclaims.law/library/10006/13

the skin of the Salamander—the little animal popularly supposed to be immune from fire—but which proved to be asbestos cloth. The word " Salamander " (signifying indestructible) has been adopted as a trade-mark for various articles in the asbestos trade.

Asbestos (from the Greek, meaning indestructible, unquenchable, eternal) has been found in almost all quarters of the globe, including Italy, Canada, the United States, Southern and Central America, China, Japan, Newfoundland, Australia, Spain, Portugal, Germany, Hungary, Russia, Central Africa, the Cape, and even as near home as in Wales ; and specimens from new districts frequently come to light, only to quickly retire to obscurity again, being of no value. The sole kinds hitherto found to be of any commercial value to the manufacturer are Italian, Canadian, Russian, and South African ; and of these their respective qualities are in the order named. The two former stand far superior to the others by reason of their most essential properties, infusibility, tensile strength, fineness and elasticity. The African asbestos is dark blue in colour, about the same length in fibre as Canadian, but less fire-resisting. While Italian asbestos (the best of all) contains nearly 80 per cent. silicate of magnesium and only about 3 per cent. oxide of iron, African asbestos has been found to contain only about 50 per cent. silica and quite 40 per cent. oxide of iron. Russian asbestos—from the Ural Mountains—is somewhat superior to this, but for many purposes is equally unsatisfactory, especially for engineering. Such kinds do not stand much heat without disintegrating and becoming rotten, due probably to the fact that some of the iron is in the form of a ferrous salt, which on exposure to air and heat oxidizes and alters the composition of the asbestos so that it quickly gets charred.

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ACL Doc 10006 · Page 14 of 131 asbestosclaims.law/library/10006/14

A new important field of asbestos is reported to exist in Western Spitsbergen, at Recherche Bay, on property owned by the Northern Exploration Company, Ltd., a British enterprise formed in 1910, but not working extensively until 1918. In Recherche Bay the Company's mineral deposits extend for upwards of seventeen miles, and are said to be very rich in coal and large deposits of asbestos. It is highly fibrous, pure amphibole asbestos, and all analyses have proved it to be of good quality. The locality possesses one of the most desirable natural harbours, well protected from the influences of the weather, and convenient for shipping; so we may in the near future be regarding the district as a fruitful source of supply.

Let us look into the modern history of Italian asbestos first, that being entitled to priority.

Experiments were made in Lombardy by two investigators, who discovered that a kind of cloth could be made from the mineral, for which enterprise they were honoured and encouraged by Napoleon I; but in consequence of the state of unrest throughout Europe, hardly any progress or development ensued for many years, and not until 1866 did anything really practical transpire. Then one Signor Albonico, in conjunction with a cultured and very shrewd Florentine cleric named Canon Del Corona, and a nobleman, the Marquis di Baviera, made experiments which resulted in the production of asbestos cloth and paper. These gentlemen had anticipated making bank notes, etc., for the Italian Government, but most unfortunately were frustrated in their negotiations by the outbreak of the Franco-German War.

Signor Albonico obtained concessions from some communes of the right to work the material on their properties, and having transferred his rights to Canon

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ACL Doc 10006 · Page 15 of 131 asbestosclaims.law/library/10006/15

Corona and the Marquis di Baviera, he became their agent until later the mines and rights were transferred to other parties.

The districts in which asbestos is found are some of the most beautiful in the Alpine region, an important one being the Susa Valley, approached from France through the Mont Cenis Tunnel. In the middle of this valley is obtained what is called " floss " asbestos fibre —very long, strong and silky fibre, as used in gas-stoves ; here also is found a white asbestos powder, used in the manufacture of asbestos paint, etc. The area from which these are extracted is about ten square miles, and work is carried on at altitudes of from 6,000 to 10,000 ft. above sea-level. The inhabitants who work the mines are of a hardy type and do not mind the low temperature ; but their task is necessarily of a dangerous nature owing to the liability of the locality to avalanches. A thrilling disaster of the kind occurred in April, 1904, near Turin, when an avalanche destroyed the huts occupied by miners and overwhelmed more than a hundred of the men. They reach their work by mule-paths part of the way and partly on foot, and from four to five hours are required for the journey from the road and railway on the plain. Work was first commenced here in 1876. The asbestos is brought down the mountain slope on a toboggan, which slides swiftly over the rocky surface ; and the miners are very skilful and quick in their work, two men being able to bring down about 8 or 10 cwt. of mineral in three hours.

Another important district is the Aosta Valley, beginning near Ivrea, about 40 miles north of Turin. From Ivrea to Chatillon, about 30 miles, the country is rich in asbestos properties.

Signor Antonio Ré, of Rome, was instrumental in discovering this province as a likely field of action.

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ACL Doc 10006 · Page 16 of 131 asbestosclaims.law/library/10006/16

In 1873, being acquainted with the activities of the Marquis di Baviera and Canon Corona, he looked well into the possibilities of asbestos in the Aosta Valley. He was already aware of its existence in the province, but doubts had been entertained of its quality, consequently nothing had been done in the matter. He therefore began to explore the locality, and, having become convinced that good quality asbestos existed in large quantities, he joined the Marquis and the priest, when work was begun in earnest.

The Aosta Valley is upwards of 75 miles long, and varies in width from 5 to 40 miles ; but it has not, it seems, yet been completely surveyed, so the full extent of the asbestos ground cannot be exactly defined. However, it is a very large area and has yielded an enormous supply of asbestos, the deposits being considered inexhaustible. The quality obtained here is known as " Grey Fibre," long, strong, and soapy to the touch, very similar to the kind found in another large district of Lombardy, the Valtelina.

The Valtelina area is reached from Turin, by rail, via Milan, Como and Colico. About two hours' journey by rail from Colico is Sondrio, the principal town of the district. Here the line follows the river Adda, an affluent of which, the Mallero, joins the Adda at Sondrio, giving the name Val Malenco to the valley in which, and others adjoining, are the asbestos mines.

This district, divided into five Communes, has asbestos-bearing ground covering an area of upwards of 25,000 acres, or nearly 40 square miles, and the population (over 5,000) is almost entirely engaged in asbestos mining. Some of the very richest veins of asbestos exist here, and the yield is prolific. A considerable portion of the district has yet to be explored, but the height above sea-level of the mines already opened is

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ACL Doc 10006 · Page 17 of 131 asbestosclaims.law/library/10006/17

from 3,000 to 7,500 ft. The climate is comparatively mild, notwithstanding the altitude, and work can be carried on throughout the year. From this locality was secured the extraordinary specimen of asbestos (weighing about 3½ cwt. and valued at over £500) which was exhibited in London a few years ago. It was considered the world's finest specimen.

At one time there was a prevalent opinion among experts that at a certain depth the veins of asbestos gradually lost themselves in the serpentine rock, but later experience has shown conclusively that if the direction of the vein be followed it will again be met ; while at greater depths the fibres have been found to be of superior quality and less indurated than those nearer the surface.

The work of mining here is done by means of shafts and galleries, dynamite being employed for blasting the rock.

Next, as regards Canadian asbestos, although the mineral was known to exist at several spots east of Quebec sixty years back, and specimens were exhibited in London during 1862, no serious attempts at mining occurred until the year 1878, when various plots were secured from the Government for that purpose. By 1884 several companies had obtained mining rights at Thetford and Coleraine, since which time they have steadily exported asbestos on a large scale, and the volume of business has become immense. The area of operations is, however, practically limited to Thetford and Black Lake, in which districts the rock containing good asbestos is a serpentine of a greyish-green colour, and covers a fair percentage of iron. The veins of asbestos vary in thickness from quite thin strips to about 4 in., and that from thicker veins is classed as "Grade No. 1" (valuable for spinning), whilst the

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ACL Doc 10006 · Page 18 of 131 asbestosclaims.law/library/10006/18

smaller veins and those holding impurities are classed "Nos. 2 and 3" respectively. The latter qualities are serviceable for making "millboards," boiler and pipe-coverings, etc.

The authorities of the Geological Survey Department of Canada and other authorities hold that the mineral asbestos proper—the Italian variety particularly—belongs to the hornblende group of minerals, while that which is found in Canada under the title of asbestos is not strictly asbestos proper, but a serpentine rock called chrysotile. This occurs principally in veins in portions of the great belt of serpentine rocks of the eastern townships of Quebec, Thetford, Ireland, Coleraine and Wolfetown. The credit of the discovery of this important area is said to be due to a French Canadian named Fecteau; but the first year of mining (1878) was a failure, the value of the mineral not being recognized; consequently the 50 odd tons extracted were only with difficulty disposed of on the market.

To-day, however, Canadian asbestos occupies a very prominent position in the world's supplies—80 per cent. of the total commercially used, in fact, is claimed for it.

In Canadian mining, owing to the more convenient nature of the ground, hand labour, necessitated in Italy, can be dispensed with, and steam derricks and drills are the leading features. When a block of asbestos-bearing rock has been displaced by blasting, the large piece is broken up, barren rock removed to "dumps," or waste heaps, and the useful part goes through the process of "cobbing," whereby any remaining rock or particles are removed, and the asbestos in its crude state is then ready for export to the manufacturer.

In the United States asbestos is not mined to any extent. An amphibole-asbestos is obtained from the

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ACL Doc 10006 · Page 19 of 131 asbestosclaims.law/library/10006/19

Sall Mountain, in Georgia, while the mineral has also been worked in the serpentine of Vermont.

The African asbestos mountains are situated in Griqualand West, Cape Colony, and yield a dark blue fibrous mineral, occurring in veins of slatey rock, associated very closely with jaspers and quartzites rich in magnetite and brownish iron-ore.

The following interesting table shows a chemical analysis of the two principal varieties of asbestos as compared with the South African variety—

	Italian Asbestos	Canadian Asbestos	S. African Asbestos.	
Magnesia	38	33	2	
Silica	42	41	50	
Oxide of Iron	3	5¾	40	
Potash	1	—	—	
Soda	1½	¾	—	
Alumina	2½	7	6	
Moisture evaporated at 100° C.	3	—	—	
Loss on heating to white heat	9	12½	—	
Loss on ignition	—	—	2	
	100	100	100	per cent.

Comparative table showing the proportions of production of asbestos from some of the world's principal sources of supply during a period of seven years—

Year.	Canada.	United States.	Russia.	South Africa.
1902.	29,000 tons.	912 tons.	4,507 tons.	41 tons.
1903.	31,000 ,,	805 ,,	5,624 ,,	276 ,,
1904.	35,000 ,,	1,343 ,,	7,502 ,,	373 ,,
1905.	48,000 ,,	2,820 ,,	7,266 ,,	454 ,,
1906.	55,000 ,,	1,538 ,,	9,201 ,,	473 ,,
1907.	60,000 ,,	592 ,,	9,500 ,,	548 ,,
1908.	68,000 ,,	849 ,,	10,000 ,,	1,605 ,,

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According to official statistics, the output from Canadian mines at the present time would probably be much more than double that for the year 1908.

In the crude or raw state, the commercial value of asbestos ranges in normal times from £10 to £70 per ton, according to quantity, quality, source and other conditions, of course; but some of the finest quality of Italian—known as "floss" fibre, already referred to—is much more expensive. Indeed, while the supply was available, it varied in price from 10s. 6d. to over 15s. per lb., which was fast becoming prohibitive, when the supply began to fail; and I believe that to-day the stock of this particular quality is completely exhausted.

Next to coal, asbestos is now undoubtedly the most important of the non-metallic mineral products of the world—and certainly one of the most wonderful. In Canada there are something like two dozen large quarries in operation, the major portion of which are controlled by the Amalgamated Asbestos Corporation, owning mills with a capacity of about 5,000 tons per day; and a population of 12,000 to 14,000 people is concerned in and dependent upon the asbestos industry of the district we have described.

Asbestos was first used in the United States in the year 1868 (a patent asbestos packing was introduced there a few years earlier, but did not get put on the market), in connection with the manufacture of roofing-felt and cement; but in England the mineral was brought to the notice of engineers by two Glasgow gentlemen, Messrs. H. R. Robson and Walter McLellan, who, in 1871, were enterprising and enthusiastic enough to form a company, called "The Patent Asbestos Manufacture Company, Limited," establishing works at Drummond Street, Glasgow. And about the same

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ACL Doc 10006 · Page 21 of 131 asbestosclaims.law/library/10006/21

period Canon Corona, the Marquis di Baviera, and Messrs. Furse Brothers, of Rome, combined in activities to secure properties and concessions to work asbestos from the Communal authorities in Italy, and when, a few years later, another company, called "The Italo-English Pure Asbestos Company," of London, was formed, they secured extensive rights and established a factory in Turin, and the industry began in earnest, stimulated by healthy and keen competition.

All these companies were amalgamated, in 1880, by the formation of "The United Asbestos Company, Limited," presided over by Sir James Allport, of the Midland Railway. To this powerful company's working and influence we owe the enormous development of the trade and its many departments and processes of manufacture. Extensive works were opened at Harefield, Middlesex, equipped with machinery and plant of the most complete character for the manufacture of practically all forms of asbestos goods as known to-day. These mills derive about 100 H.P. from three large water wheels, concentrating power from various local streams with a fall of 6 ft. With steam engines, they have a motive power upwards of 300 H.P. There is a coal-pit alongside the boilers, and all gas used is manufactured on the premises.

The company was amalgamated in 1910 with the well-known firm, Bell's Asbestos Co., and is now known as "Bell's United Asbestos Company, Limited," with branches and agencies throughout the civilized world, thus becoming the largest manufacturers in the whole industry.

CHAPTER II

CRUDE Asbestos—Processes of Manufacture Described—Cloth—Asbestos-Metallic Cloth—Patent Packings and Joints—"Eclipse," "Gladiator," and "Sirius" Packings—"Universal" Packing—Bricks—Armoured Sheets—Asbestos Soles and Spats—Theatre Curtains—Millboard—Non-conducting Compositions—"Viceroy" Coverings—World's Largest Boiler and Pipe-covering Contract—Saving of Fuel—Cold-pipe Covering—Instructions for Use—Asbestos Felt—Fireproof Paints—Engineering and Asbestos—Building Uses—Nature's Fire-guard—Practical Tests—Decorations—Burlington Hotel Fire—Fireproof Cables—Uses in Electricity—Various Insulators—Asbestos Clothing—Domestic Appliances—Fireproof Solution—Portable Asbestos Cottage—Tiles, Bricks, etc.—World's Theatre Fires—London Fire Statistics—Bunker Fires and the Remedy.

LOOKING at an ordinary lump of asbestos in its raw or natural state—a mere piece of stone, or rock, in most instances—one is amazed to find how little of its possibility is presented; and the fact is not easily grasped that such an awkward-looking mass can be spun into the finest, strongest thread and woven into cloth! It has truly been called a "physical paradox," being both fibrous and crystalline, elastic and brittle, and yet able to be carded and so converted as to be spun and woven like wool, flax, or silk. It would appear to possess the characteristics of mineral and vegetable, while being different from either; light and feathery as eiderdown, it is yet as dense and heavy as the rock it resembles. Older than anything in the animal or vegetable kingdoms, but so little affected by the influences of time that untold centuries, by which the hardest rocks have crumbled away, have had no appreciable effect upon the asbestos contained in them. The fiercest heat fails to consume it, nor acids affect the strength of its fibres,

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notwithstanding their delicacy—a strand of it can be spun to weigh less than an ounce to 100 yd. length, and fine cloth can be made from its fibres weighing



FIG. 2

ITALIAN ASBESTOS—CRUDE STATE

only a few ounces to the square yard! Its indestructible nature enables it to resist decay under almost every possible condition of heat or moisture, and its incombustiblity renders it absolutely immune from flames.

Crude asbestos is dealt with in several ways, being first of all sorted and opened. The solid blocks of fibre are crushed and opened by special machines which cannot destroy the quality of the fibre, and are then placed in shaking machines, where the long fibres become separated from the short and all rocky substances

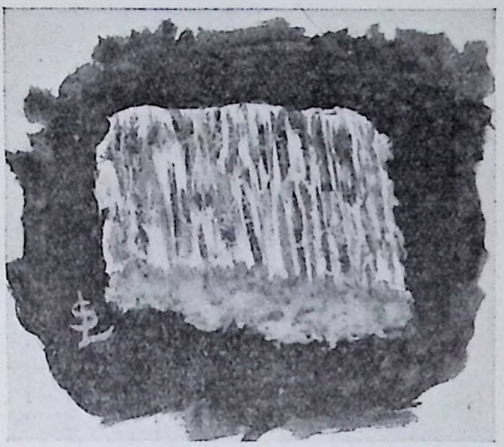


FIG. 3

CANADIAN ASBESTOS—CRUDE STATE

are removed. The long fibre is passed to the carding and condensing departments, the short going to the millboard, boiler-covering, etc., departments. "Millboard," it may here be explained, is like cardboard in appearance, but much tougher and stronger, and can be made in any thickness from $\frac{1}{64}$ in. upwards, being composed of layers compressed together.

As the long fibre comes from the condensers, in the

form of condensed thread but without any twist, it folds itself in cans placed to receive it, and thence passes to the spinning and doubling departments, where the process of twisting takes place. The thread then goes to the weaving and braiding departments, where delicate machines make it into cloth, tape and yarn for packings. The cloth next passes on to the india-rubber department, to be proofed with rubber, forming what are called (for use in engineering) asbestos and rubber-woven sheeting, tape, rings for jointing purposes, and rolled cloth and square block packings for glands. These cloths and packings are also made metallic (for greater strength) by combining woven wire therewith, which process proves very effectual for hydraulic work and is largely adopted by marine engineers.

In these days of high steam-pressures, it is of the utmost importance to marine engineers that they obtain jointing and packing materials of absolute reliability, and hence the introduction of a combination of asbestos and metallic wire. By the aid of ingenious machinery asbestos manufacturers are now able to enclose in the centre of each thread of asbestos warp and weft, a fine brass wire, thus greatly increasing the strength whilst completely protecting the wires by the asbestos. This material—known as " Victor " Metallic Cloth—can be made into tapes and all sizes and shapes of joints as well as into round or square packings, and is found highly satisfactory. So dense and close can joints be made from this material, that it is largely employed in hydraulic work, standing tests of pressure up to 3,500 lb. to the square inch.

Another important form of jointing is the patent " Salamander " joint, having two concentric rings made from asbestos-metallic cloth, sustained by a copper ring, the vertical wall in the centre of which forms a partition

between them, preventing all possibility of displacement by either steam or moisture. By these means, a *double* self-sustaining joint is made in place of the ordinary one.

Opinion is divided concerning the utility of india-rubber cores in gland packings. Provided that the



FIG. 4

ASBESTOS METALLIC CLOTH, RUBBER-PROOFED, MANHOLE JOINT

cores are properly made, and the rubber is of the proper quality, they are satisfactory enough ; metallic cores are preferable—but such must, of course, contain a degree of elasticity. They must not collapse under pressure. Two of the best packings of the kind, made with anti-friction metal, are Fisher's patent "Eclipse" and the "Gladiator" packings. These give excellent results in high-pressure triple expansion engines, maintaining a perfectly even and steam-tight surface against the rods, which they keep in a bright and smooth condition.

The "Gladiator" packing is claimed to be the most perfect combination of asbestos and soft metal ever

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ACL Doc 10006 · Page 27 of 131 asbestosclaims.law/library/10006/27

introduced. One user says: "I have been using 'Gladiator' packing for about seven years . . . I cannot find anything to equal it." Another user, referring to "Eclipse" packing, stated: "We have not yet found it necessary to replace this packing, put in nearly two years ago. We previously experienced considerable trouble in obtaining a reliable packing for our hammers, but the results obtained since the adoption of 'Eclipse' packing have given entire satisfaction."

A very successful packing for hydraulic purposes is Bailey's patent "Sirius" packing, containing an elongated core of vulcanized rubber, with concave sides and projecting edge, the core being protected by a covering of wire-woven asbestos. The patentee claims that the effect of this packing is that, when the gland nuts are screwed down, the core is compressed in a direction parallel to the rod, so that the concave sides become flattened and force the outer covering uniformly against the rod and the wall of the stuffing-box respectively, and that, owing to its shape and the direct pressure upon the elastic core in each turn of the packing, the pressure required to produce a tight joint with "Sirius" packing, and consequent friction, are reduced. Badly-worn or fluted rams can be packed drop-dry with this packing with the minimum of friction, and it retains its resilience under compression and follows the movement of the rod.

At one of the largest and most important pumping-stations in the Midlands "Sirius" packing was in almost constant day and night service for a period of about three years, if not longer.

One of the most convenient as well as generally efficient forms of packing, for high or low-pressure engines, pumps, winches, etc., is that called the "Universal" packing, manufactured by Dick's Asbestos

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Company. It consists of asbestos and anti-friction metal strands twisted together and well lubricated, making it singularly pliable and convertible to various uses. This, supplied on spools, ranges in size from ¼ in. to 1½ in. diameter, and is a particularly convenient and economical packing—a single spool serving for packing all the engines and pumps on a ship or in a factory, its size being quickly increased to required dimensions by the simple process of twisting the strands together, dispensing with the necessity for keeping a stock of different size packings. With this in reserve the engineer need lose no time through lack of a particular size of packing. It is particularly adapted for small auxiliary engines, and can be very well utilized in emergency (on a voyage at sea, for instance) for larger engines. There is practically no waste with it ; every ounce can be used up. Two kinds are manufactured, for steam or hydraulic work ; the steam is a black graphite colour, and the hydraulic is yellow.

" Universal " packing is improved by use, as it becomes tougher and stronger in actual working than it is when first placed in the stuffing-box. The hydraulic packing is made on the same principle as the steam packing, except that hemp is employed in the strands instead of asbestos, and it is impregnated with pure graphite and lubricating grease especially suitable for hydraulic work. This packing is being used extensively in all parts of the world, and by the British and many foreign governments. As supplied on the spools, it is in the form of a single strand, ¼ in. diameter, packed in boxes of 7 lb., 14 lb., and 28 lb. each. To prepare it for use in the gland, the strand is unwound from the spool, and cut into equal lengths, as long as the length of the packing which is requisite to fill the stuffing-box, allowing a little for the length taken up in the twisting.

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ACL Doc 10006 · Page 29 of 131 asbestosclaims.law/library/10006/29

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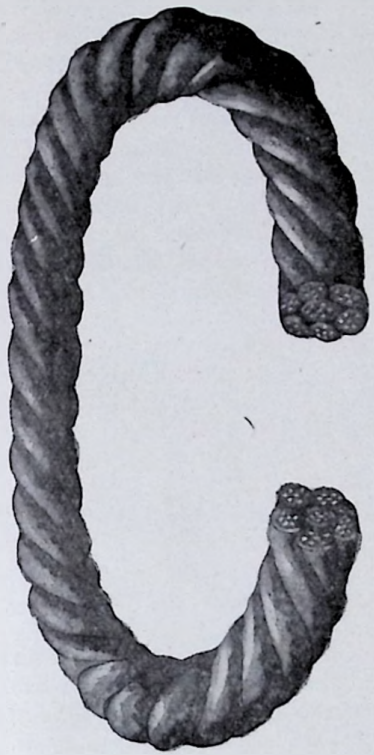


FIG. 5

"UNIVERSAL" PACKING

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As many pieces are cut as will make the packing the diameter required, and then it is laid together and twisted tightly by hand, as shown on page 21.

The strands being made up of special anti-friction metal and asbestos woven in a peculiar manner, and being extremely pliable, it will be found to stop in any position in which the strands are placed, without any "spring" to cause them to unwind. After twisting tightly, the packing is cut to length, made into rings, and put into the stuffing-box in the same way as an ordinary packing.

The following table (furnished by the makers) shows the precise number of strands which should be taken and twisted together to produce the various standard sizes—

Diam. of packing required.	*Number of Strands to be twisted together.*
¼ in.	1 strand.
7/16 "	2 strands.
½ "	3 "
5/8 "	4 "
¾ "	6 "
7/8 "	7 "
1 "	9 "
1¼ "	12 "
1½ "	14 "
1¾ "	18 "
1½ "	22 "

The weight of a single strand is approximately 1 oz. per foot, so that the weight of any of the sizes required will be the same number of ounces as there are strands.

If the size of the packing is slightly larger than wanted after it is twisted, it can be easily "squared up" with a hammer, being adaptable to any shape.

The strands being merely twisted together, and not tightly plaited, as in many packings, are freely acted on by the gland, and upon pressure being applied, they

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Fig. 6

TWISTING "UNIVERSAL" PACKING

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slide one over another, and close up on the piston rod, with comparatively less pressure from the gland. Although the packing so twisted together is not very hard or firm, each separate strand is of the exact firmness and consistency requisite to make a steam-tight fit against the piston rod, and is forced against the rod with less pressure than would be the case if the packing were tightly plaited instead of twisted.

The anti-friction metal is not merely embedded in the interior of the packing, but is woven throughout, the same as the fibrous portion, and comes into contact with the piston rod at different points all round its surface, so that the metal takes the greater part of the wear, making it practically a metal packing, with the advantages of the asbestos fibre and graphite mixture, which creates less friction than would either metal or asbestos alone.

This packing can be used in the stuffing-box in the form of a spiral instead of being cut into rings ; or the rings can be made so that the joint is broken and made more steam-tight.

Many purposes are found for this useful packing—even gauge-glass rings can be made of it in emergency.

Some other interesting specialities of Dick's Asbestos Company include asbestos bricks, asbestos armoured sheets, and asbestos soles for boots.

The bricks, made in two sizes, one of the same size as ordinary bricks, 9 in. × 4½ in. × 2¾ in., and the other 9 in. × 2 in. × 2½ in. These bricks are useful for many purposes, and are usually set with fireclay as mortar. They are made out of various non-conducting compositions, according to the purpose for which they are required—gas works using the largest quantities. They are not intended to be of sufficient strength to stand heavy weights, as in building construction, but only for use as heat insulators.

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ACL Doc 10006 · Page 33 of 131 asbestosclaims.law/library/10006/33

The armoured sheets are manufactured specially for use in front of glass furnaces, to protect the men from the great heat to which glass blowers are subjected. They are fitted with iron rings, and can be suspended from an iron rod, and easily moved along as desired. The centre filling is of cellular asbestos, strengthened with sheet-iron outside, forming a combination of heat insulation and great strength. They were designed specially in response to a demand from glass blowers, who find that by their adoption work is much facilitated, and that, suspended a few inches in front of the furnace, they prevent all radiation of heat.

Asbestos soles for boots are exceedingly tough, and are simply nailed to the bottom of ordinary soles, for use on hot floors where leather would char. The makers supply the shaped sole, or the material for cutting in sheets 40 in. × 40 in., as preferred.

Asbestos spats are also made, to protect the feet or furnacemen and others from the danger of falling molten metal, as sometimes the hot metal falls between the boot-laces. Fastened round the ankle by a leather strap, the bottoms of the trousers tuck inside them, lending quite an aristocratic appearance to the workman!

Asbestos-metallic cloth is also employed in the manufacture of fireproof curtains for theatres, and possesses great heat-resisting qualities and strength. One of these particular curtains (invented and constructed by the United Asbestos Company) saved the stage and its entire contents at the Queen's Theatre, Manchester, when the auditorium was completely devastated by fire in 1890, and although subjected to furnace heat, the curtain exhibited little or no traces of damage upon examination after the conflagration.

History is repeating itself in this connection, for the auditorium of the Kingston-on-Thames Empire Theatre

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ACL Doc 10006 · Page 34 of 131 asbestosclaims.law/library/10006/34

has just been totally destroyed by fire, while the fire-proof safety-curtain effectually barred the advance of the flames, saving the stage, dressing rooms, scenery and properties behind.

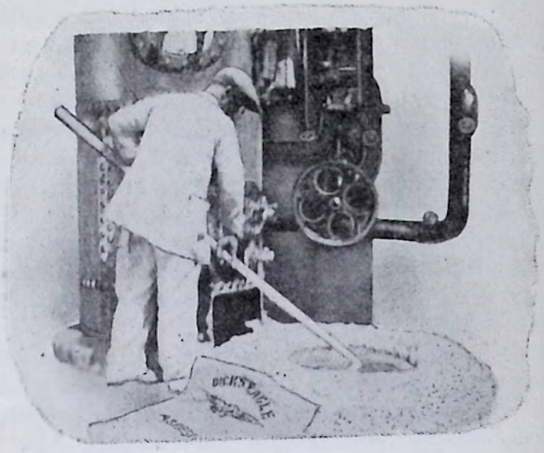


FIG. 7

PREPARING ASBESTOS COMPOSITION FOR COVERING A BOILER

Similar curtains have from time to time checked small outbreaks of fire at various theatres, so their utility is unquestionable.

Coming now to the manufacture of asbestos mill-board, we find that after certain preliminary treatment the fibre is run with water into the tanks of beating engines. Rotating beaters take up the fibre, opening and drawing it out, then passing it forward to be soaked for a period until it again returns to the beater. Suitable binding ingredients (about 5 per cent.) are then

mixed with the fibres and the pulp placed in the vats of millboard and paper machines, where it remains to be gradually drawn off. The water runs through a fine wire gauze on a revolving cylinder, leaving a thin coating of pulp behind. This is transferred to another rotating cylinder, where it accumulates until the desired thickness is attained. It is then cut and removed as sheets of millboard, usually 40 in. square.

To remove the moisture still in the millboard, the boards are placed between sheets of zinc and put under hydraulic pressure, and hung up in drying rooms. Finally they are again pressed and their edges trimmed.

The chemical composition of the asbestos is scarcely affected by these processes, and beyond the necessary binding material mentioned, no adulterant is added by the English manufacturers of repute ; but in the foreign-made article injurious admixtures are often discovered, which, of course, deteriorate the finished product very considerably.

With regard to the very short and powdery qualities of asbestos, these are used up, in conjunction with suitable ingredients, to make non-conducting composition for covering steam boilers, hot and cold water pipes, etc. ; and steam-power users throughout the world adopt this largely because of its retention of heat and consequent enormous saving of valuable fuel.

When asbestos non-conducting composition for covering steam boilers and pipes was first introduced, it was subjected to considerable criticism by those who desired to supersede it with other materials, but as time went on the manufacturers discovered that they were able, by carefully studying the essential ingredients for its binding and proper manipulation, to bring it to the highest state of efficiency, comparing most favourably with any other known material as a non-conductor of

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ACL Doc 10006 · Page 36 of 131 asbestosclaims.law/library/10006/36

heat, while its indestructible nature proved a decided advantage.

The Board of Trade rule that all steam pipes and boilers of marine engines be tested by hydraulic pressure to double the ordinary working pressure at intervals —lagging to be removed before testing—led to the introduction of removable boiler and pipe coverings, in the form of quilts, or mattresses, composed of asbestos cloth stuffed with non-conducting material, which, after many experiments, were practical and satisfactory, and weighed no more than $1\frac{1}{2}$ lb. to the square foot. Such could be quickly removed or replaced without trouble ; and the surfaces could either be painted or covered with sheets of zinc, according to particular requirements.

One distinct advantage of an asbestos composition is the important fact that *years of wear will not cause it to lose its nature ;* whereas compositions which contain animal or vegetable fibres, though extensively used and cheap, and good for certain temporary purposes, greatly deteriorate with time. But to be successful, a composition must not only be a good non-conductor ; it must have the right adhesive constituents, and it should set firm. It should be absolutely *neutral,* with no chemical effect on metal surfaces. The mere question of extra cost to steam-power users for efficient covering should never be allowed to mar the opportunity to secure fuel economy, etc., effected by a high-class covering. Yet it sometimes transpires after the erection of a plant and the boiler and pipe coverings are under consideration, a large percentage of the benefit of the first expenditure is lost by insufficient attention being devoted to this important question, a low-quality non-conducting composition being chosen for the apparent (and false) saving of a few pence per square foot ! In reality, the difference in cost involved by adopting

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ACL Doc 10006 · Page 37 of 131 asbestosclaims.law/library/10006/37

the best covering would only amount to a few pounds per 1,000 ft., hence this would quickly be recovered by the increased efficiency attained. And when it is remembered that with cheap, inferior compositions much greater thickness and weight are entailed, and the surface measurements of the finished work involve an increased cost, the anticipated "saving" is rather an illusion after all.

Good asbestos non-conducting compositions are supplied to the consumer perfectly dry, which again is important. Most of the low-grade coverings are supplied in a wet condition—containing as much as 50 to 70 per cent. of water, adding to the cost, carriage, etc., of the material whilst impoverishing its quality.

Asbestos non-conducting composition is manufactured in a number of forms, to suit different purposes and conditions, some almost pure asbestos, some with mixtures.

An asbesto-magnesia composition has been found to be satisfactory, as it combines toughness and durability with the lightness of magnesia, and the brittleness associated objectionably with magnesia is thus eliminated.

Asbesto-silicate composition is favoured for use on flues or other apparatus subjected to high internal temperatures, for the due protection of adjoining structures, as well as for heat conservation. It may be used alone or mixed with other compositions in suitable proportions.

There is a special hard-setting cold-pipe composition for use on vessels or pipes which cannot be sufficiently heated to ensure the proper drying of other compositions.

The two drawings I have made indicate the systems of pipe-covering usually adopted. Fig. 2 illustrates a pipe covered with flexible asbestos millboard, then with

a thick layer of hair-felt, whilst the whole is covered with oiled canvas—which may be painted any colour—rendering the coverings waterproof, durable, and of neat appearance. But a later and far superior covering

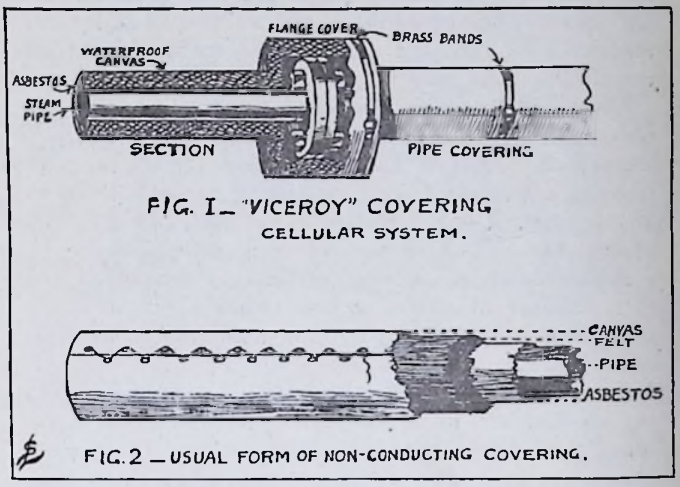


FIG. 8

ASBESTOS PIPE-COVERINGS

is shown in Fig. 1, in which the corrugated layers of asbestos form air-cells, and the waterproof canvas is more rapidly fastened by neat bands of brass, giving a distinctly smart finish to the work. Constructed on the scientific principle recommended by various experts, this covering obtains a maximum power of non-conductivity, and is considered the ideal covering in the trade. Professor Tyndall, in *Heat, A Mode of Motion*, says: "In the case of asbestos, the fibres are separated from

each other by spaces of air ; the motion has to pass from solid to air, and from air to solid. It is easy to see that the transmission of vibratory motion through the composite texture must be very imperfect."

This particular covering is called the " Viceroy," and was introduced by the United Asbestos Company, Ltd., London, several years ago. The company has carried out most of the important boiler and pipe covering jobs in this country, including that of the Northern Wood Haskinizing Company, Ltd., Newcastle-on-Tyne —the largest contract of the kind in the world, comprising an area of 17,000 sq. ft., using nearly 97 tons of asbestos composition, and 223 " Viceroy " flange covers and flange mattresses.

So great is the saving of fuel effected by the use of these asbestos boiler and pipe coverings, that it has been demonstrated that with coal costing (say) 9s. to 18s. a ton, a loss of from 4s. 4d. to 8s. 9d. is sustained in one day-and-night year *for every square foot of surface left uncovered.* The importance attached to protecting flanges is equally noteworthy : a *waste of nearly* 10 *cwt. of coal* a day-and-night year being sustained for *every square foot of surface thus left exposed !*

Rather different from the foregoing cellular covering is the patent " Viceroy " compound covering. This is an effective combination of two first-class coverings suitable for general use, but especially for large surfaces, such as boilers, tanks, separators, etc. The covering consists of an inner lining of asbestos wadding, attached to the outer cover of " Viceroy " cellular covering. The inner, soft lining adapts itself to any irregularities of surface, such as rivets and bolt-heads, and the outside cover forms a hard protection—which can be rendered waterproof, or painted any required colour, giving the whole a smart appearance and finish.

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ACL Doc 10006 · Page 40 of 131 asbestosclaims.law/library/10006/40

Its non-conductivity is great, the inner coating containing many air-cells, and it is made in thicknesses of from ½ in. to 2 in.

Another form of asbestos non-conducting covering, very popular because of its quick and easy application, is the plain rope lagging, made in diameters of from ½ in. to 1½ in., in 100-ft. lengths. Protected by an outer covering of waterproof canvas, this is suitable for use on ships, in confined spaces, also for the steam piping of temporary plants, as it can so easily be removed and used again on piping of any diameter. The canvas cover is fitted with eyelet hooks, and laced together with either waterproof twine or galvanized-iron wire, neatly finished off with a coat of special black varnish.

An excellent removable cold-pipe covering is composed of a combination of hair-felt and specially-prepared waterproof paper and canvas. This is effective against the accumulation of frost on the cold pipes of ammonia and other refrigerating plants. There are alternate layers of felt and special paper, encased in laced canvas, or canvas with brass or steel bands, as preferred.

A simple and very useful asbestos filling-in composition is made for the spaces around ovens, and between the inner and outer walls of gas-producing and other plant. It is used in its dry state and merely pressed into the spaces by any workman of ordinary intelligence.

In connection with the use of the various asbestos non-conducting compositions, the manufacturers deem it essential to issue special instructions, which should be carefully followed to obtain the best results, and, being important, these may be quoted here—

(1) Clean away all paint, oil, dust, or dirt from the surfaces of the parts to be covered.

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ACL Doc 10006 · Page 41 of 131 asbestosclaims.law/library/10006/41

(2) Mix the composition with water to about the same consistency as thick mortar, and rub over the hot surface with same. Next apply in small patches about 2 in. apart ; when these are dry and hard, apply the composition in layers of about ½ in. thick, each layer to be dry and hard before the next is put on. The last fine layer should be nicely levelled off with trowel and straight-edge before it has time to harden, and finished in this way to the required thickness.

(3) In covering the under surfaces of boilers, pipes, etc., it is best to rub the surfaces with the composition, holding it until the heat of the pipe draws the moisture, when small pieces of fibre will act as a key for the succeeding layers.

(4) We recommend a thickness of 1 in. to 2 in., or in some cases more, according to the steam pressures or temperatures of surfaces, and to the quality of the composition being used.

(5) When the vessels or pipes to be covered are subject to much vibration, fine galvanized binding wire, or wire netting, should be fixed around the covering at about two-thirds the thickness of the finished covering, the wire being covered over by the last layers of the covering.

(6) When the covered surfaces are exposed to the weather, two or three coats of special black varnish, or of suitable paint, should be applied with a brush, and renewed from time to time as required. Common tar is *not* suitable for this work, be it observed.

When using the higher qualities of composition, extra care must be exercised in applying in thin coats, and in ascertaining that *each coat is perfectly dry before the next is applied*, otherwise the composition will not harden properly. No paint or varnish must be applied before the composition is quite dry and hard.

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ACL Doc 10006 · Page 42 of 131 asbestosclaims.law/library/10006/42

In arriving at the proper estimation of advantages claimed for the use of asbestos non-conducting coverings, one needs to consider the total exposed surface of a steam installation of boilers, pipes, cylinders, etc. After calculating the heating surface, one reflects upon the size of boiler requisite to evaporate sufficient water to compensate for the steam condensation in the pipes, etc., due to the loss of heat from the exposed surfaces.

It is estimated that the water condensed in a range of bare steam pipes is about 1 lb. per square foot per hour, with a steam pressure of 160 lb. to the square inch, and an atmospheric temperature of 70° Fahrenheit. The loss of heat resulting in the condensation of 1 lb. of water corresponds to the combustion in ordinary circumstances of about $\frac{1}{8}$ lb. of coal to the square foot every hour. In, say, an electric-light station working day and night throughout the year, there are 8,736 working hours per annum, or 1,092 lb. of coal to the square foot per annum. Only supposing coal to cost 18s. a ton—it has, of course, been much higher for several years—this reveals a loss of 8s. 9d. the square foot of bare pipe surface per annum!

It is claimed for asbestos coverings that they pay for their cost in a short time by the saving of coal alone, apart from the saving of labour, pumping, and expense incurred by the extra boiler power necessitated, to say nothing of the probable damage to plant through water in the pipes.

And there is, of course, the not unimportant matter of healthier conditions in the engine-room, boiler-house, or workshop, tending to keep the employees in better condition. Where an intolerable temperature prevails, all doors, windows, etc., in the boiler or engine-houses are kept open, which not only exposes the staff to

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ACL Doc 10006 · Page 43 of 131 asbestosclaims.law/library/10006/43

colds, but results in increasing the condensation and loss of heat.

An asbestos felt, or wadding, is made in flexible sheets for boiler and pipe covering, etc., and heat-insulating purposes, also as a filling-in material between casings where compactness is essential. This, made in thicknesses of from $\frac{1}{4}$ in. to 2 in., may be used in conjunction with asbestos compositions for large surfaces. Sheets of felt are first applied to the surfaces to be treated and are securely fixed in position by wire netting or other suitable means. Two thin coats of asbestos composition are then applied, when the finished surface may, if required, be coated with one or two coats of waterproof varnish. The heat-insulating properties of this combination are particularly good, and, owing to the flexibility of the felt next to the expanding and contracting surfaces, there is no liability of the composition to crack.

Asbestos powder is also very extensively utilized in the manufacture of fireproof paints, which have from time to time been subjected to severe public tests and proved singularly effectual in resisting the flames. Perhaps the best test of the kind was that in which a wooden shed (see illustration) 12 ft. high by 12 ft. wide was erected, and one half (shown light in the illustration) painted with three coats of asbestos paint, leaving the other half (the dark portion) and the lean-to partitions on either side bare. The shed was afterwards half filled with shavings, over which two gallons of petroleum were poured, and then fired. The result was that every vestige of the bare wood was consumed in the flames, whilst the portion treated with the paint remained perfectly intact and uninjured.

Asbestos paints can be made in any colour, drying bright or dull, and their specific gravity is 25 per cent.

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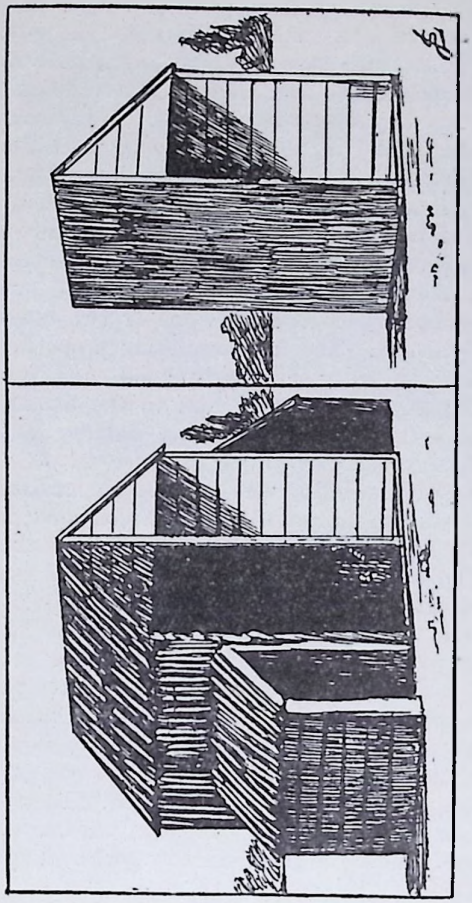


FIG. 9

ASBESTOS-PAINTED SHEDS

(see page 33)

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less than ordinary lead paints, owing to the lightness of the pigment employed ; and at the same time their covering capacity is much greater, three coats being equal to four of ordinary paint, thus making them strictly economical as well as advantageous to use.

Fireproof paints have been used on a number of exhibition and other large public buildings, including the British Museum, Crystal Palace, South Kensington Museums, the National Gallery, Houses of Parliament, and Hampton Court Palace ; and the late King Edward wisely adopted them at Buckingham Palace and Sandringham.

A special kind, called funnel paint, used by ship-builders, resists the action of sea-water as well as very great heat.

Asbestos paints were first patented and introduced in November, 1881, and are of two principal kinds ; one kind is specially suitable for rough woodwork, such as joists, rafters, beams, stairs, warehouses, etc., and the other is for material requiring superior finish and appearance. Many public experiments have been carried out to test their remarkable fire-resisting qualities, the first one being conducted by the Lord Mayor of London and a distinguished company at the Crystal Palace in January, 1882.

About 150 tons of such paint were used on that and the building of the Fisheries, Health, and Inventions Exhibitions of 1883–4–5–6. Many small fires occurred at these exhibitions, in one of which the contents of a stall were destroyed and the wooden floor burnt through ; but the wooden partitions against which the stall stood, as well as the roof—*both of which were covered with asbestos paint*—were quite uninjured.

One other kind is called asbestos-oil paint. This has both fire and acid resistance, but is not absolutely fireproof.

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ACL Doc 10006 · Page 46 of 131 asbestosclaims.law/library/10006/46

It is, of course, in the engineering and allied trades that most uses are found for asbestos at present—in the shape of numerous steam packings, jointings, rings, gaskets, tapes, washers, etc. ; and so effective has the material proved that scarcely an engineering workshop now exists without this accessory in some form or other, while to many it is absolutely indispensable, helpful as it is in numerous ways, and with new uses constantly being discovered for it.

But there are almost unlimited openings for its adoption in so many other spheres where the mineral can be advantageously introduced, if not to the public at large, in whose daily life it should, and undoubtedly will yet, form an important and essential factor. When one reads of appalling fire disasters, one marvels at the delay on the part of official bodies in seeking security while the real protection is already at hand in the shape of asbestos—Nature's own preventive from such calamities. Ignorance of the remedy may be the public's excuse for not adopting this natural fire-guard ; but no such excuse can hold good with governing corporations, who must surely be well aware of its great advantages and ought, therefore, to educate the people to a proper understanding of its capabilities and advocate its liberal use in domestic life. And with regard to our theatres and other public buildings, it should be *compulsory* for their owners or those responsible for the public safety to properly and fully afford protection from the spread of fire as much as possible by employing plenty of asbestos wall-panelling, partitions, door-linings, upholstery, curtains, etc. If this were done, an outbreak of fire could not spread with much speed (if any), nor to any considerable extent ; and the feeling of security arising from a common knowledge of these precautions, would ensure unanimous discipline and *calm* should

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ACL Doc 10006 · Page 47 of 131 asbestosclaims.law/library/10006/47

emergency happen, and the present-day prevailing terror and insane stampeding would become quite extinct, thus minimizing the risk of fatalities, and probably making the loss of life something of a rarity on such unfortunate occasions.

I have from time to time in the Press persistently and strongly urged a more universal and general adoption of asbestos, and I am persuaded that once public attention is directed seriously into this channel, and becomes better acquainted with the peculiar properties of the mineral and its innumerable uses, the desired result will quickly follow. The sooner the better, of course ; though I fear the day is distant yet, for people seem lamentably in the dark concerning the subject—a great portion of the public has never heard of asbestos, I believe, and I have actually been asked if it is a species of fish !

Illustrative of the importance of asbestos ceilings and wall-panellings in private houses, the following account of a New York fire is interesting and instructive—

" Through the use of asbestos ceilings in a model tenement house, thirteen families were able to escape from a fire that broke out to-day on the lower floor. The smoke blocked the front and rear doorways, and the tenants ran to the roof, where they remained until the firemen arrived. The fire was easily confined to the floor on which it originated *through the inability of the flames to burn the ceiling*, and the damage done was trifling. The use of asbestos in the construction of the house was an experimental measure, but its worth was so manifestly proved to-day that it has been suggested that the Municipality should pass an ordinance compelling all houses in the future to have similarly made ceilings."

With which expression of opinion the reader will doubtless agree.

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ACL Doc 10006 · Page 48 of 131 asbestosclaims.law/library/10006/48

Holkham Hall, the famous old Norfolk mansion, which enjoys a reputation for its fireproof construction, has never been insured, for the very good reason that *it will not burn!* Three times has fire broken out there, but on each occasion only superficial damage to the furniture has been done.

As a decoration asbestos has never been properly or fully recognized, but it deserves much more prominence than most other materials in this direction, for not only can very handsome ceilings, walls, etc., be manufactured from it, but such are distinctly economical by reason of their great durability and, of course, a sure protection from the risk of fire. Numerous outbreaks of fire in buildings so equipped have been promptly checked, and one particular instance conclusively demonstrated their efficacy. A fire occurred some years ago during the decoration of the Burlington Hotel and Restaurant, Dublin, with two hundred panels of these asbestos wall-panels. While the ceiling for the principal room was still on the premises of the decorators, their workshop accidentally caught fire and was completely destroyed; but next day was revealed the fact that, although everything else had been obliterated by the searching flames, and even the solid metal pillars had been melted, the asbestos ceiling remained quite uninjured, and it was shortly afterwards fixed up as intended at the Burlington Hotel.

Now, this was only part of the severe test which this remarkable ceiling was eventually destined to undergo, as about a year later a fire broke out in the Burlington itself, when the asbestos ceiling was again in the thick of it. The coating of paint with which it had been covered when put up was burnt entirely off, leaving the asbestos in its natural whiteness, except where blackened by smoke. The flames could not penetrate the ceiling

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ACL Doc 10006 · Page 49 of 131 asbestosclaims.law/library/10006/49

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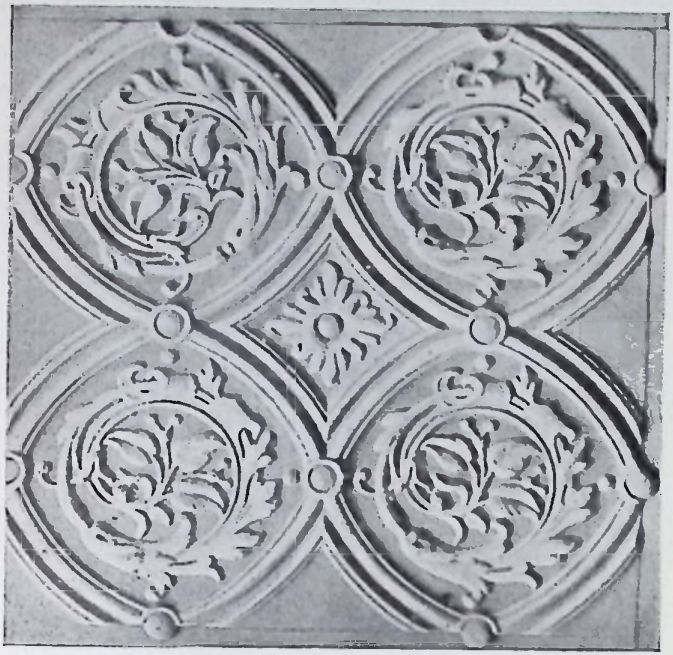


FIG. 10

AN ASBESTOS CEILING PANEL

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ACL Doc 10006 · Page 50 of 131 asbestosclaims.law/library/10006/50

into the room above, and only found their way upward through the staircase leading directly from the bar. Had the ceiling not been protected by this asbestos decoration, the fire would, of course, have rapidly passed through it and probably ignited the whole building. As it fortunately happened, however, the check thus given afforded ample time for the fire brigades to stop the threatening volumes of flame and for the inmates to escape unhurt.

A glance at the accompanying illustration of a specimen asbestos ceiling-panel suffices to satisfy the most fastidious that these can be made really artistic and in exquisite taste.

Similar fireproof panelling is now extensively used in shipbuilding—many have been adopted by the Royal Navy's battleships, as well as those of foreign navies—roofing and flooring to railway carriages, etc. The London Underground Railway, and Central London ("Tube") trains have for a long time been lined with such fireproof panels, which assurance the travelling public will doubtless be comforted to know, as the possibility of a fire on one of these crowded trains in a tunnel would be a terrible disaster indeed. Only a few years ago this danger was real, but to-day the wise precautions mentioned make the probability of any serious outbreak remote.

These artistic decorations (in great variety of design) were invented, patented, and first introduced by the United Asbestos Company, who may properly be called the pioneers of the whole asbestos industry.

Asbestos forms a principal part of the insulated magnet fireproof and waterproof cable for electrical purposes invented in America a short time back, by means of which fires such as occurred on the Paris Electric Railway and electrocution accidents through

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ACL Doc 10006 · Page 51 of 131 asbestosclaims.law/library/10006/51

overhead-tramway wires are rendered impossible. Under this system of insulation the method employed is to pass the wire through a solution of asbestos and other adhesive materials, when a covering is formed flexible as well as waterproof, and it will stand a red heat without the insulation breaking down.

An enterprising Englishman succeeded in going " one better " by making the whole cable vermin-proof (of much importance, as rats and other pests eat and destroy ordinary cables); but, owing to the characteristic British aversion to anything new and untried, this improvement was not encouraged and failed to find recognition in this country.

The uses for asbestos in connection with electrical engineering are usually in the form of paper, for dynamos; tubes, for electric-light leads ; putty and cement ; millboard (rigid), for switchboards, etc.; twine and thread, for covering wires ; fireproof paint, for protecting woodwork, troughs for leads, etc. ; and a special kind of glove, lined with india-rubber, is made for the use of electricians to prevent the possibility of shocks from " live " wires, etc.

It is possible to make a good insulating composition by adding very fine matter, preferably waste sand from glass works, or the fine slimes from the crushing and washing of ores, such as quartz slimes from gold quartz, to molten pitch, the mineral matter passing through a sieve of 130–150 wires to the linear inch. When the powder is stirred in with difficulty, ordinary field sand may be added, and mineral matter of ever-increasing size of grain stirred in until the mass contains 10 per cent. or less of pitch. This material can be cast into troughs for containing bare or covered conductors, or the material poured in round such conductors contained in troughs or pipes. Also it can be used to replace the

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ACL Doc 10006 · Page 52 of 131 asbestosclaims.law/library/10006/52

wood surrounding conductors. Admixtures of pitch, resins, tars and oils, thickened with this finely-powdered mineral, can be used for coating flexible conductors, a coating of any degree of hardness being obtained by regulating the temperature employed and the amount of mineral added. The layers of this insulation can be separated by layers of dry or impregnated fibrous or textile envelopes, or by metallic envelopes. These mixtures are prepared so as to flow readily and without contraction on cooling, and are suitable for filling joint boxes, or for coating fibrous or textile materials, and for waterproofing non-conducting wrapping materials.

Another method of non-conducting covering is in the form of tubular braiding, suitable especially for house wires, leading-in wire, telephone cords, etc. Two threads, or two bundles of more or less parallel threads, termed " fascicles," are woven into a long narrow strip of fabric, one of the fascicles forming the warp and the other fascicle forming the woof. The tape thus formed is cut into lengths and impregnated or treated with insulating and waterproofing materials in the usual way. Two or more of these tapes are passed together with the electric conductor through a cable-braiding machine, forming a tubular braided cover on the conductor.

For furnacemen and those occupied in glass-making and other dangerous trades where there is exposure to great heat, complete asbestos outfits are made, consisting of jacket, trousers, boots, gloves, helmet (or hood), aprons and face-masks with mica windows.

With such clothing, fire may be absolutely defied ; and I am surprised that a few garments of the kind are not kept in reserve at hotels and other public buildings for emergency use. They are not cumbersome, heavy, nor costly, so there is also no reason why the public generally should not keep them in readiness at home.

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ACL Doc 10006 · Page 53 of 131 asbestosclaims.law/library/10006/53

The " boots," or leggings, are perhaps rather clumsy in appearance ; but nobody could reasonably be critical of them if they served the purpose of enabling a person to walk safely through the flames. The whole outfit for a furnaceman, or fireman, would weigh from 10 to 12 lb., according to texture of cloth used ; and the cost is about equal to that of our ordinary suits of clothes.



FIG. 11

A FIREPROOF MAN !

There are numerous other articles made of asbestos especially for domestic purposes, quite simple as well as inexpensive, such as mats (for stoves, irons, etc.) ; ropes and rope ladders (for use as fire-escapes—most essential in every household) ; screens for fires ; putty, cement, and even soap (for cleaning utensils), etc. Yet how many private houses are equipped with these things ? Personally, I know of none where such necessities can be found—due primarily, as I stated elsewhere, to the prevailing ignorance of asbestos on the part of the public generally.

Very few houses utilize even such common necessaries as fire-guards, more especially in the poorer districts; hence we frequently read of children being burnt to death.

At the inquest on a little girl who met her death at Camden Town, London, entirely through the absence of a fire-guard, the St. Pancras coroner, Mr. Walter Schroder, on learning that a bit of live coal flew out of the grate on to the child's clothing, confirmed my contention that not half enough fire-guards were in use —especially in houses where there are children. Legislation should, I think, make it a criminal offence on the part of parents and guardians to neglect this precaution. The child's mother pleaded that she could not afford a fire-guard, but Mr. Schroder reminded her that capital fire-guards could be bought for 1s. or 1s. 6d.—lasting a lifetime with ordinary care. "To their absence is due many deaths," he said, and then added the startling official statement that "in 200 cases which have lately occurred in Central London, in which children have been fatally burnt, I find that *in only one instance was a fire-guard provided.*"

Surely such appalling statistics are a public scandal and warning, and their significance should stir the whole community into serious and immediate action.

The above incidents took place in 1904. How many more fatalities of the kind have happened since then, I wonder? The question of minimizing the risks of fire is of national importance, making it the duty of everyone to assist in the solution of the problem; it is in both senses a "burning" question! And when the remedy is offered us, as it is to-day, in the form of useful, ornamental and economical decorations for our homes, it is truly surprising if people much longer continue tolerating unnecessary danger or ignore the appeal of asbestos.

In reply to the objections of those who fear asbestos fire-guards might be cumbersome or unsightly, I need only refer to accompanying illustration of a particularly

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ACL Doc 10006 · Page 55 of 131 asbestosclaims.law/library/10006/55

useful one (designed by the writer), showing the combination of three articles in one, viz., fire-screen (asbestos), fire-irons-rest and flower-stand. The aim has been to produce a light, pleasing, and artistic effect.

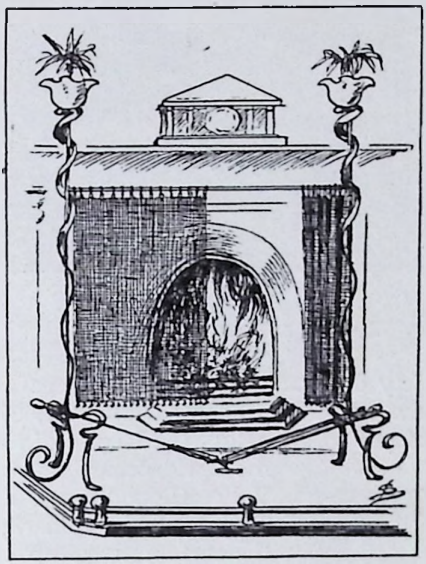


FIG. 12

ASBESTOS FIRE-SCREEN, FLOWER-STAND AND FIRE-IRONS REST

In the building trades asbestos figures largely for roofs, walls, ceilings, floors, etc., in the form of fire-proof and weather-proof cement, slates (enormous quantities of these are being employed), tiling, pipe-covering (effective protection from frost), as felt (for lining floors, walls, etc., to deaden sound and prevent

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ACL Doc 10006 · Page 56 of 131 asbestosclaims.law/library/10006/56

draughts), paints, asbestos "wood," wool, "leather," etc. Cloth is also used as a wall-lining or covering in some theatres, where official regulations require it, and in the production of theatrical scenery generally.



FIG. 13

ASBESTOS FELT

For safety drop-curtains for theatres, asbestos cloth has become universally adopted (about 1,000 of these are manufactured annually), the largest of the kind in the world being that at the New York Hippodrome, I believe. They are extraordinarily durable, the curtain fixed up at Terry's Theatre, London, over 40 years ago being still intact to-day.



FIG. 14

ASBESTOS YARN

It is also possible now to fire-proof tapestry, curtains, upholstery, etc., by treating them with an asbestos solution. The management of the London Alhambra a few years ago had the whole of their stage properties used in the ballets so treated—and even the ballet girls' costumes were fire-proofed! Whilst experimenting, the

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ACL Doc 10006 · Page 57 of 131 asbestosclaims.law/library/10006/57

shavings of treated timber were found to be quite immune, proving the liquid's penetrating power. At the request of some of the audience, one of the "sky borders" placed for the evening's performance was lowered into a row of naked gas-jets, without suffering the least damage.

One satisfactory feature was the fact that the cost of the treatment only equalled about 5 per cent. of the cost of the entire production—probably all covered by a substantial reduction in the insurance premium.

The ex-Kaiser possesses (or formerly possessed) a portable asbestos cottage, in which he resided when taking part in military manoeuvres. It contained a reception room, the ex-Kaiser's bedroom, and bedrooms for the staff, as well as a bathroom. It had double walls, hot air circulating between. The cottage required only three hours to erect. A pumping and filtering engine on wheels enabled water to be laid on with constant hot or cold supplies.

Over 30,000 tons of asbestos paper are used in building construction alone yearly, and with a proper regard for life-saving on the part of municipal authorities and governments, this output would total hundreds of thousands of tons per annum.

Flooring tiles of asbestos are preferable to others in many ways. They are impervious to heat and water, and their elasticity is equal to that of wood. They have the hardness of cement, greater durability than asphalt, are light in weight, and a non-conductor of sound; also they do not crack or bend, and show greater resistance to wear than stone.

Asbestos bricks have been subjected to many stringent tests and shown remarkable results. One side of a 9-in. partition was submitted for an hour to a temperature of 2,050° Fahrenheit. The material was not the least

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ACL Doc 10006 · Page 58 of 131 asbestosclaims.law/library/10006/58

affected, while the temperature on the other side of the partition never reached sufficient heat to ignite a match held against it!

I should like to see asbestos employed in the construction of *every* building throughout the Kingdom, be it theatre, museum, asylum, or private residence.

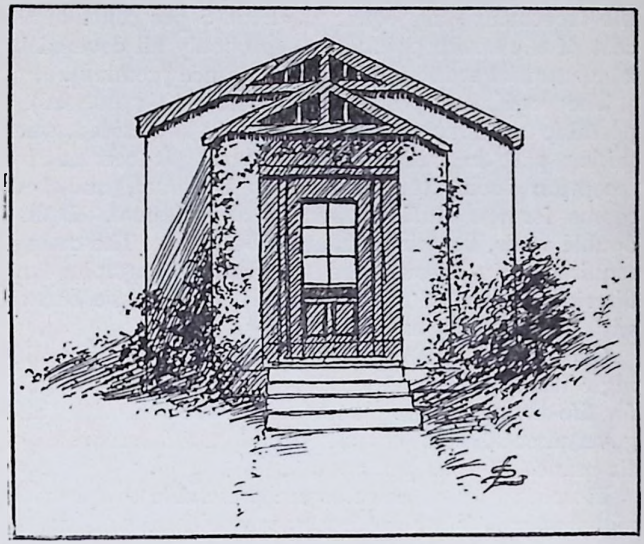


FIG. 15

A HOUSE THAT WILL NOT BURN

A portable cottage, containing reception-room, bedrooms, and bathroom. Built entirely of asbestos, with double walls, hot-air circulating between. Only requires three hours to erect, and one hour to take down for transportation

Or, failing that, on the plea of insufficient means among the middle and poorer classes, asbestos fireproof paint should certainly supersede ordinary paint in the interior decoration of houses, and it should be

made compulsory for either landlords or tenants to adopt such.

I append an instructive statistical table of the world's fires at theatres during a period of about 12 years, which should be ample evidence of the great risks we run ; and I venture to assert that, had each of the buildings in question been adequately fireproof in construction, not only would their loss and damage have been diminished by at least 75 per cent., but 95 per cent.—if not the whole—of the lives would have been saved ! Stampede, of course, accounts for the greatest mortality in such disasters ; in theatres that *would not burn*, there would be a sense of security and consequently *no stampede*—

Theatres.	*Dates.*	*Lives Lost.*
Theatre des Arts, Rouen	April 25, 1876	8
Chinese Theatre, San Francisco	Oct. 30, 1876	19
Circus Theatre, Madrid	Nov. 13, 1876	2
Mrs. Conway's Theatre, Brooklyn	Dec. 5, 1876	283
Kronstadt Theatre	Jan. 9, 1881	8
Opera House, Nice	Mar. 23, 1881	150
Ring Strase Theatre, Vienna (iron curtain not let down)	Dec. 8, 1881	794
Briggs's Theatre, Moscow	Jan. 7, 1881	300
Temporary Theatre, Dervis	June 24, 1883	50
Theatre Govi Sanuki, Japan	Aug. 28, 1883	75
Tinnevelly, India	July 28, 1886	100
Temple Theatre, Philadelphia	Dec. 27, 1886	2
Opéra-Comique, Paris (official report)	May 25, 1887	77
Exeter Theatre	Sept. 5, 1887	188
Grand Theatre, Islington (uncertain)	Jan. 1888	—
Bolton Theatre ,,	Jan. 1888	—
Varieties, Madrid ,,	Jan. 1888	—
Theatre Royal, Blyth ,,	Feb. 1888	—
Union Square Theatre, New York ,,	Feb. 1888	—
Music Hall, Leith ,,	Mar. 1888	—
Oporto Theatre	Mar. 1888	160
	Appalling Total	2,216

As these warning lines are being penned, the newspapers are recording yet another terrible disaster, due to a wild panic at a cinema theatre fire at Valence,

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ACL Doc 10006 · Page 60 of 131 asbestosclaims.law/library/10006/60

during the Joan of Arc celebrations, 1st June, 1919. A cinematograph performance was given as part of the festival in the hall of St. Madeleine at 4.30 in the afternoon, and was attended by 4,000 spectators. Fire broke out in the operator's box, when the huge audience was seized with panic, resulting in a large number of casualties, including about eighty dead, fifty-three of whom were children and twenty-one women. All died of suffocation, etc., through being trampled under foot ; no casualty was reported as directly caused by the fire itself.

The *Daily Telegraph*, of 10th January, 1912, published a very interesting record of London fires during the year 1911 (which year is said to have broken all previous records), showing that there were no fewer than 4,450 outbreaks of fire in the Metropolis, involving the loss of 120 lives, to say nothing of a very large number of injured persons. Many of these fires were, of course, only small affairs, and some on commons and open spaces ; but think of the enormous damage to property the majority must have entailed. Moreover, the immense, and constantly-increasing, public expense with regard to fire-brigades is considerable, including the cost of keeping appliances up to date in the way of expensive motor fire-engines, etc. The personnel of the fire brigades, too, is ever growing, whereas, by minimizing risks as I have endeavoured to show, all this ought to be gradually decreasing. In 1878 the personnel of the London fire brigades consisted of 420 officers and men. In 1912 it had grown to 1,380 officers and men, while to-day the figures must be even higher.

The question of preventing the frequent serious outbreaks of fire in the bunkers of ocean liners was raised some years ago, when the subject of the best means caused some controversy, asbestos at that time not

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ACL Doc 10006 · Page 61 of 131 asbestosclaims.law/library/10006/61

being regarded favourably by many. Professor V. B. Lewes read a paper before the British Association, at Cardiff, on the " Spontaneous Ignition of Coal," expresing the opinion that bunker fires were solely due to the rise of temperature through the bunker bulkheads being too close to the hot-air upcast shafts from the boilers and furnaces, and suggesting as a remedy the construction of a thin water jacket between the smoke shaft and the bunkers. The company assembled were in general agreement with these views, but a few months later the matter was discussed in the columns of *Engineering* by practical experts, clearly showing that far better results, economically and practically, were to be obtained by covering the uptakes, funnels, and bunkers with asbestos. The asbestos lagging on the uptakes occupied no more space than that usually required for air casings or baffle plates ; and being applied directly to the funnel, of course, kept the heat *in* the funnel, preventing it from reaching the bunkers, etc., where it is a danger.

One writer, criticizing Professor Lewes's proposal, commented thus : " If it is true that Professor Lewes suggested fitting water jackets to protect steamers' bunkers in order to prevent the coal from catching fire, it clearly shows that he has not had the experience which is required to deal with this very important and dangerous risk. It is not stated where he would fit the water jackets, but I presume, owing to the very irregular form of the uptakes, and the enormous expense and difficulty there would be in fitting water jackets round them, that the jackets would have to be fitted to the bunkers themselves. Unless the water jackets are applied direct to the funnel and uptake, the heat would not be confined, and the inconvenience of the heat would not be removed. In most steamers there certainly would not be room to fit water jackets independently

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ACL Doc 10006 · Page 62 of 131 asbestosclaims.law/library/10006/62

of the bunker plates. If the bunker plates were not used to form part of the jackets, there would have to be an additional thickness of plating, incurring additional weight. If the bunker plates were used to form part of the jackets, they would have to be made watertight, and the first time the bunkers were filled the joints would be started and the water would leak out, because, unless the bunker plating were increased considerably in thickness, or even closely stayed, it would never stand the violent shocks to which it is subjected when coaling. It is not stated what water it is proposed to use for this purpose ; if salt, the jackets would soon be filled up solid ; if fresh, then evaporators, etc., would be required to supply it. Any experienced man could see at a glance that water jackets are impracticable. . . . The heat from the boilers, and particularly the uptake and funnel on the one side of the bunker plates and the dampness of the coal on the other, lead to very rapid corrosion of the bunker plates. All experienced marine engineers know that unless these parts are preserved by frequent cleaning and coating they corrode very rapidly ; to add a water jacket would be increasing the mischief enormously. Any reasonable steps which can be taken to reduce the rate of corrosion and the present necessary amount of chipping and coating of the bunker plates must be an advantage. Lagging the uptake and the funnel with asbestos must prevent a large quantity of the heat from getting at the bunkers, and consequently tend to reduce the rate of corrosion ; this I consider the best method of dealing with the difficulty, and I have obtained very good results from it.

" The chief engineer of one of the steamers under my care frequently reported that his bunkers had been on fire, and though the fires were comparatively small, a

considerable amount of coal was wasted, and I had to make costly repairs. Owing to the donkey boiler being close to the main funnel, the heat of the latter rendered it almost impossible to clean the former at the proper time, viz., at sea, consequently I had the uptake and funnel lagged with asbestos, and up to the present have received very satisfactory reports from the chief engineer. He states that no further fires have occurred, and that there is a great difference in the temperature, so much so that the captain has remarked the absence of the intense heat which previously escaped from the ventilators over the boilers, and the chief engineer also reports that the donkey boiler can now be cleaned without inconvenience. I think there is now a comparatively small chance of further trouble, and I expect there will be a reduction in the rate of deterioration of the bunker plates opposite these parts."

This was a pretty good case for asbestos, as well as effectively disposing of the water-jacket theory.

The whole discussion was finally dealt with by the general manager of The United Asbestos Company, in a paper which he read at a meeting of the Institute of Marine Engineers, when he was able to refer to the successful use of asbestos supplied to the Admiralty and the mercantile navy for bunkers from time to time; and in consequence of its extended adoption, I believe bunker fires are considerably fewer than hitherto. It is an important matter, of course, and, apart from the damage resulting from such fires, there is the difficulty of having to combat the fire while going at full speed—admitted to have often been accomplished at sea without the passengers on board the steamer having any knowledge of what was happening!

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ACL Doc 10006 · Page 64 of 131 asbestosclaims.law/library/10006/64

CHAPTER III

MISCELLANEOUS Uses for Asbestos—Safety-lamp Washers—Lamp Wicks—Cold Insulation—"Asbestic"—China Clay—Cord and Twine—Asbestos-Leather—Automobile Tyres—Thread—Ropes—Rope-Ladders—Tubing—Gloves—Leggings—Aprons—Putty—Fuel—Filter Cloth—Waterproof Asbestos Cloth—Household Articles—Documents—Tapestries—Various Methods of Insulation.

As previously explained, constant experiments are being made with asbestos and new uses frequently discovered for this wonderful mineral. It is employed for filtering water, oils, acids, and wines; and I have heard of its being utilized, in the form of cloth, for the purification of the atmosphere!

Large quantities of asbestos washers are used in miners' safety-lamps, and these have to be of the very best quality material, for any defective material might result in explosions and great loss of life.

A lamp-wick, composed principally of asbestos, has been used, but by many is not considered satisfactory by reason of its interference with the proper flow of oil by capillary attraction.

A good fire-extinguisher, or cover for smothering fires, applicable also as a garment for protecting the person, or as a rug, bed-cover, or carpet, consists of an asbestos fabric, nearly or quite airproof, with an eyelet or suspending ring in one corner.

Asbestos cloth is being largely employed in the automobile industry; also for large mangles in hotels and steam laundries, as the constant dampness has no effect on it.

For cold insulation and for covering brine and ammonia pipes, in connection with refrigerating plants,

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ACL Doc 10006 · Page 65 of 131 asbestosclaims.law/library/10006/65

asbestos is excellent ; while asbestos mattresses are found indispensable to locomotive engines in protecting them from loss of heat and excessive fuel consumption. Its use for the lining of brake bands and blocks for hoisting engines and gravity incline drums is acknowledged superior to any other brake lining in existence.

The stove and range industry utilizes immense quantities of asbestos millboard, for lining oven-doors, washers, etc.

What is known in the trade as " Asbestic " is really the residue or refuse of the mines, a kind of fibrous sand, which, mixed with 10 per cent. of caustic lime, makes an efficient fireproof wall plaster, for either inside or outside work. It has a marked sound-deadening effect, making it particularly suitable for many purposes.

China clay is much used in conjunction with the powdery forms of asbestos to manufacture a number of the cheaper articles of domestic use, where high quality of material is not essential.

A strong, hard cord or twine is made from good quality fibre, for use in suspending metals, retorts, and crucibles in contact with fire ; also for use in chemical, glass and printing works.

There is also a splendid imitation leather made from asbestos, closely resembling leather in appearance and characteristics, but waterproof and fireproof. For certain purposes this is tougher than and preferable to the real article. Known in the trade as " Dellerite " (as made by Deller's Asbestos Co.), and " Bestorite " (as made by Dick's Asbestos Co.), this is a combination of pure asbestos fibre and vulcanized rubber, in the course of manufacture subjected to enormous pressure. The exact mixture of materials and processes of manufacture are known only to the makers, of course, and vary accordingly. It is usually red in colour, but can

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ACL Doc 10006 · Page 66 of 131 asbestosclaims.law/library/10006/66

be made almost any required colour. The material forms excellent joints for steam (wet or superheat), water pressure, ammonia, oil motor and all internal combustion engines.

A new automobile tyre has been introduced consisting of rubber with insertions of asbestos cloth, in place of the usual duck or canvas, with an outside covering of asbestos, forming a durable and practically non-puncturable tyre.

As a steam packing, asbestos is admittedly the ideal material for either high or low-pressure, resisting heat without charring, expansion, or contraction due to changing temperatures, unaffected by continual exposure to moisture or oils, and proof against rapid deterioration by friction or the most severe service.

Numerous special uses for asbestos, either by itself or in conjunction with other suitable materials, are included among the following manufactures, employed daily in various trades—

An extra fine asbestos thread, hard spun and very strong ; suitable for sewing materials exposed to heat, acids, etc. It is usually supplied in 1 lb. balls, like balls of ordinary twine.

A strong fire and acid-resisting cord, in 1 lb. balls, made in diameters of $\frac{1}{16}$ in. to $\frac{3}{8}$ in.

Powerful asbestos ropes, fitted with hooks and swivels, for fire-escapes, etc. These are made $\frac{3}{4}$ in. diameter (weighing $4\frac{3}{4}$ oz. per foot) and 1 in. diameter (weighing $5\frac{3}{4}$ oz. per foot), and possess the remarkable tensile strength of 2,000 and 3,000 lb. respectively.

Asbestos rope-ladders, for escape from burning buildings.

Asbestos woven tape, for acid-tank joints, etc. Made in widths from $\frac{1}{2}$ in. upwards, and in any thickness from $\frac{1}{32}$ in.

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ACL Doc 10006 · Page 67 of 131 asbestosclaims.law/library/10006/67

Asbestos woven tubing, specially adapted for covering rollers in printing works, and to resist the action of acids. These tapes and tubings are usually only manufactured from the best qualities of asbestos—Italian and Canadian.

Asbestos gloves, for furnacemen, etc., knitted, either with fingers and thumb, with thumb only (called "bags"), or as gauntlets 24 in. long, with or without thumb.

Asbestos knitted leggings, about 28 in. long, with flaps to overlap the front of boots.

Asbestos cloth aprons, for furnacemen, puddlers, and others, with covering for the chest, shoulder and body straps.

Asbestos "carded" fibre, for making gaskets.

Asbestos putty, for use in lieu of red lead, etc. Quite fireproof.

Asbestos cement, for protecting conductors in electric-light installations, and in chemical works, and for retort and other joints.

Asbestos fuel for gas-stoves—the familiar egg-shaped perforated fireballs, consisting largely of china clay.

The long, silky, Italian fibre (known as "floss" fibre) for gas fires.

Asbestos building felt, or sheathing, made from asbestos fibre, and used as a lining for floors, partitions, etc. Usually supplied in 80 lb. rolls, 30 in. in width.

Asbestos millboard tubes, for electric-light leads, etc.

Asbestos filter cloth. This is adopted largely for household and main supply water filters, its peculiar qualities enabling it to withstand the action of alkalies and acids; consequently, it is very extensively employed for filtration everywhere. When fouled, it can be very easily cleansed, either by boiling water or steam. It is also adaptable to various other uses, such as fire-screens, furnacemen's aprons, leggings, firemen's

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ACL Doc 10006 · Page 68 of 131 asbestosclaims.law/library/10006/68

clothing, gloves, etc. Usually made in widths of 25 in., 36 in., and 40 in.

Asbestos fireproof and waterproof cloth—known as "F. W." cloth. This is extensively used for tents, shop and machinery coverings, etc., and is readily recognized by its light green colour. It is rendered water and weather-proof by a special process, and ensures safety in camps or other places where there may be proximity to naked lights, sparks, etc. Carmen, motorists, etc., find it a splendid protection against rough weather.

In the domestic household the mineral, in various forms, can be used for table-covers, stove-mats, table-mats, flat-iron holders, rugs, gas-logs, and fibre for grates. Trinket-boxes, deed-boxes, in fact any box in which one keeps valuables should certainly be made of asbestos, as the fire fiend often proves a worse enemy than the enterprising burglar. Made of extra stout, hard asbestos millboard, and coated with asbestos fireproof paint or enamel, affording opportunity for artistic treatment, one would possess handsome miniature fireproof safe deposits of real service in emergency.

And there is no reason why ladies should not indulge in the pleasing pastime of painting and ornamenting their own fancy boxes, book-cases, desks, etc., with fireproof paints. It would then in time become such a fascinating hobby—almost a habit—to decorate our belongings in the manner suggested that we should soon have a sense of security in the knowledge that our things throughout the house were non-inflammable.

In view of the high premiums charged by the insurance companies on valuable art collections, it should particularly interest connoisseurs and collectors to know that they could obtain a substantial rebate by the more liberal use of asbestos to protect their treasures—and

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ACL Doc 10006 · Page 69 of 131 asbestosclaims.law/library/10006/69

at the same time have the personal satisfaction of feeling secure against the ravages of fire. Asbestos millboard alone is, of course, scarcely strong enough to make into large boxes, but serves admirably for *lining* the inside of a box (metal, for preference); and such may be confidently relied upon to protect their contents several hours in a conflagration. A piece of asbestos millboard even $\frac{1}{16}$ of an inch thick will resist the flames effectually for over two hours, and thicker sheets much longer in proportion. A good-sized tin box lined with asbestos and shelved or divisioned can be bought for a few shillings, so that he who hesitates deserves to be lost.

Numerous outbreaks of fire are caused by the fusing of electric-light wires—usually ignition occurs just above the glass bulb. It cannot be too generally known that an important and ingenious little asbestos and metal clasp preventor is made and sold by Messrs. Veritys, Limited (the patentees), at a low price, and thousands of this contrivance are now adopted in offices, shops, etc.

Some other domestic uses for asbestos include curtains, screens, iron-holders, knitting yarns, aprons, mittens, torches, fire-lighters, stove polishers, and even baking powder!

For the preservation of public and other important legal documents, asbestos paper is admirably suited, and can be made with a fairly good surface for writing upon; but, unfortunately, up to the present we have not discovered a fireproof *ink* with which to meet the occasion. In case of fire, such records would be obliterated, leaving us nothing but the bleached, blank paper to gaze upon!

Valuable tapestries in our national galleries ought certainly to be rendered fireproof by treatment with the

liquid asbestos solution referred to elsewhere, and I am surprised if this precaution has not been taken ; and our future artists in tapestry should employ fine asbestos thread in their work—it can be dyed in various colours like ordinary thread, and would endure the test of time far better than existing works of this kind appear to have done.

Yarns, fabrics, or garments, etc., may be made fireproof by treating with an inorganic salt of ammonia ; and the excess of the solution is removed by wringing, when the fabric is dried. Cotton, linen, jute, wool, or silk may be similarly treated with equal results, and the fireproofing solution may be added to sizing or finishing solutions.

An excellent fireproof composition, specially suited for use in the construction of safes, fireproof rooms and buildings, consists of asbestos, blast-furnace dust, and Portland cement mixed with water and moulded into shape ; and it is applicable to compound safes composed of nesting-cases, etc., and can be so applied as to leave strata between the cases. This material is stated to be totally unaffected by thermite.

Another capital method of insulating " live " wires is to coat with tape, or canvas, which is subsequently cut into strips or tapes, with a layer of moistened borax, in which is afterwards embedded a layer of mica scales. A second tape or canvas is placed over the borax and mica. After drying, the tapes are ready for use. Other flexible mineral material and fixing mineral material may be used instead of mica and borax.

A fireproof cement for repairing retorts and crucibles, and similar purposes, consists of magnetite, china clay, barytes, sodium silicate, water and borax, the usual proportions being 25 parts of magnetite and 75 of the remainder, which may consist of 200 cwt. of china clay,

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ACL Doc 10006 · Page 71 of 131 asbestosclaims.law/library/10006/71

100 cwt. of barytes, 40 gallons of sodium silicate (100° Tw.), 24 gallons of water, and 28 lb. of borax.

An efficient compound for fireproofing wood and similar cellular materials is said to consist of a mixture of solutions of sodium silicate, chloride, and hydrate, in about the proportions of 4 parts sodium silicate, 40° to 50° Bé., one part of sodium hydrate 26° Bé. The resulting solution is reduced to about 20° Bé. by the addition of water, and, when a denser solution is required, more sodium silicate is added to this latter solution.

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CHAPTER IV

COMPOSITE FIREPROOF MATERIALS

URALITE—Asbestone—Uacolite—Poilite—Decolite—Calbonite—Everite — Asbestilite — Vulcanite — Siluminite — Litholite —Reconstruction: Suggested Reforms—Concrete Houses—Possibilities of Concrete—Housing Essentials—Ventilation —Walls and Papers—Washing—Central Heating—Smoke Nuisance—The Remedy.

CLOSELY allied to the asbestos trade are a number of synthetic fireproof materials of excellent qualities and special merits for various purposes, and some of these, manufactured by well-known British firms, have served and are serving important functions and becoming famous in all parts of the world. Prominent among these materials well worthy of description in a work of this kind are "Uralite," "Poilite," "Decolite," "Asbestone," "Siluminite," "Vulcanite," "Litholite," and "Everite." It is a singular circumstance that they mostly terminate in "ite" or "lite," which caused *Punch* to facetiously observe that the word "Uralite," for instance, was peculiar for a fireproof substance.

URALITE.—This material is manufactured by the British Uralite Company, Ltd., from asbestos fibre and mineral glue by a patented process, and supplied in two qualities—hard and soft. It is made in sheets up to 6 ft. × 3 ft., and in three colours, white, grey, and red, in thicknesses from $\frac{7}{64}$ in. to $\frac{1}{2}$ in. Its uses are numerous, primarily for roofing, ceilings, walls and partitions in all classes of buildings, including chemical factories, explosive works, foundries, breweries, collieries, hospitals, electrical works, malt kilns, laundries, railway carriages, etc. As a fire-resisting and weather-proof material it

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ACL Doc 10006 · Page 73 of 131 asbestosclaims.law/library/10006/73

has won renown during many years' practical trial; and it is a good non-conductor of heat or electricity, and unaffected by gases and acid fumes. For building purposes it is also convenient, and can be readily fixed to timber or steel framing. A notable public building

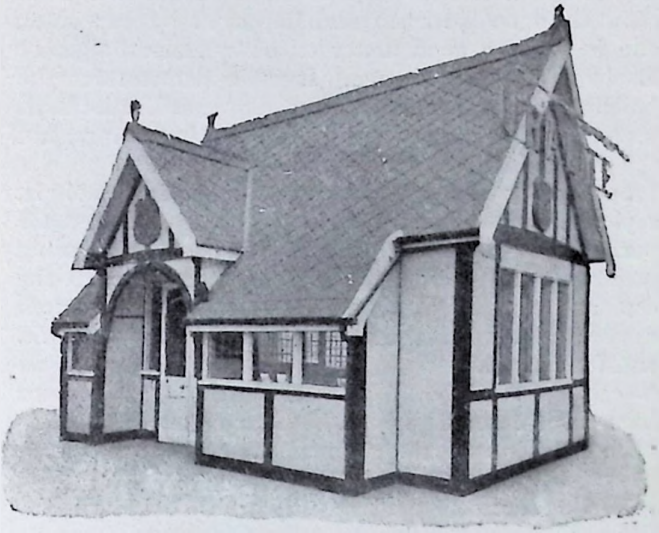


FIG. 16

"URALITE" FIREPROOF HOUSE

of Uralite is the Pier Pavilion, Great Yarmouth, erected several years ago by the company. This, accommodating 2,000 persons in the auditorium, was erected complete within eight weeks. It has a smart, light, pleasing appearance, yet its strength and durability withstand the rough weather to which it is exposed by its position jutting well out into the North Sea.

As Uralite does not expand by heat nor contract with cold, it is not affected by climatic variations nor changes of temperature within or without, consequently is not liable to warp, shrink, or crack. Its weight is about equal to one-fifth the weight of iron. So far from deteriorating through severe weather conditions, it is claimed to be hardened and improved by exposure ; and it forms a good motor or boiler-house lining, or insulator for cold storage. It is in demand for the building of seaside and other bungalows, as Uralite walls keep the rooms warm in winter and cool in summer, and the whole absolutely waterproof.

Such walls are particularly desirable in hospitals, asylums, sanatoriums, etc., as they may be fired for purification—the most effectual method of cleansing possible. And their erection also dispenses with the cost and work of laths and plaster. Uralite is often used as a protective covering for existing woodwork, and for floors and walls round stoves, flues, etc. ; and it can be veneered, papered, painted, varnished, or scoured, if desired. It can be fixed either by glue, or nailed without splitting ; and sawn, planed, or rubbed down with glasspaper.

Uralite is used extensively by the Admiralty, War Office, Office of Works, and other Government departments, as well as by many British railway, brewery and mining companies, in the erection of plant. It is exceedingly hard, as the writer discovered on testing samples. Repeated heavy blows with a hammer failed to break or even dent it.

The material has been adopted in many important breweries and maltings ; indeed for the latter it is far more suitable than plaster, which so quickly deteriorates and peels off—falling directly into and contaminating the malt. Uralite, on the other hand, is practically

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indestructible, as well as proof against sulphur fumes, and needing no repairs, its maintenance ensures considerable economy. Uralite ceilings are said to outlast the building itself.

Being very easily fixed, tough, fire and waterproof,

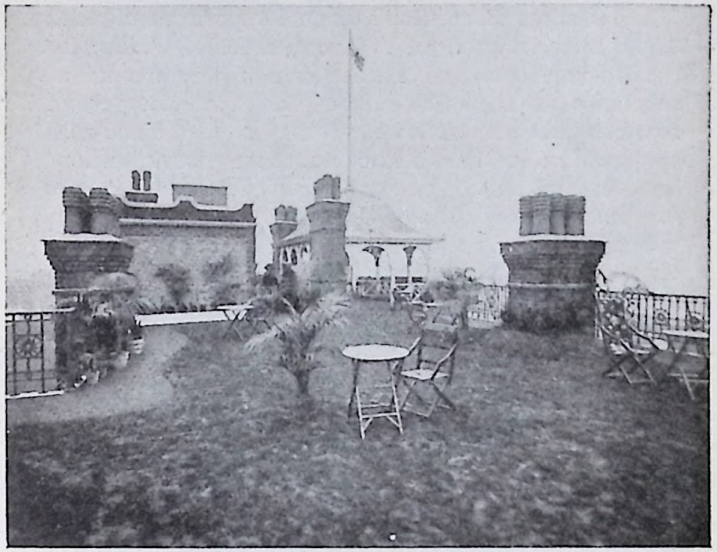


FIG. 17

A VULCANITE ROOF GARDEN

and of quite light weight (about 1 lb. per square foot), makes Uralite a desirable roofing material, as letters from some users testify. The Engineer of the Metropolitan Railway writes: "The Uralite covering to roof of engine shed, which was laid two years ago, has, up to the present time, given satisfaction as a rainproof cover, and it also appears to resist the sulphur fumes."

The proprietor of an iron foundry: "I had the Uralite roof you erected for us thoroughly examined, and it has every appearance of being a very durable job. As you know, it is placed under very severe conditions, being exposed to acids, smoke, and the varying temperature of a foundry."

The Madras Boat Club's annual report mentioned: "The material used for the roof, namely, Uralite for the dressing-room, and another form of the same patent substance for the other houses, has stood the test of *monsoon* most satisfactorily. It may be mentioned that our serangs did the whole of the roofing work without outside assistance, and that the *economy in fire insurance alone is close on 4½ per cent. on the outlay.*"

The Engineer and Manager of the Liverpool Overhead Railway: "I have severely tested Uralite, and found its fire and heat-resisting properties to be very satisfactory, and I intend to make still further use of it in this Company's trains, as I think, to be absolutely safe, the whole of the underside should be covered with Uralite."

Messrs. Parnall & Sons, Ltd., Bristol: "You will be interested in knowing that we had a fire in our packing department. We had taken the precaution of lining this department with Uralite, and thus prevented the fire from spreading beyond the room where it started, and only trifling damage resulted. Had it not been for the Uralite, it is almost certain that the whole of our narrow Wine Street premises would have been burnt out and the damage would have run into thousands of pounds."

Messrs. W. & C. Pantin, Upper Thames St., London: "We are pleased to say that the fire did not affect that part of the basement which is protected by Uralite, and that the machinery and goods stored there were not injured by the fire nor by the heat."

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ACL Doc 10006 · Page 77 of 131 asbestosclaims.law/library/10006/77

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ACL Doc 10006 · Page 78 of 131

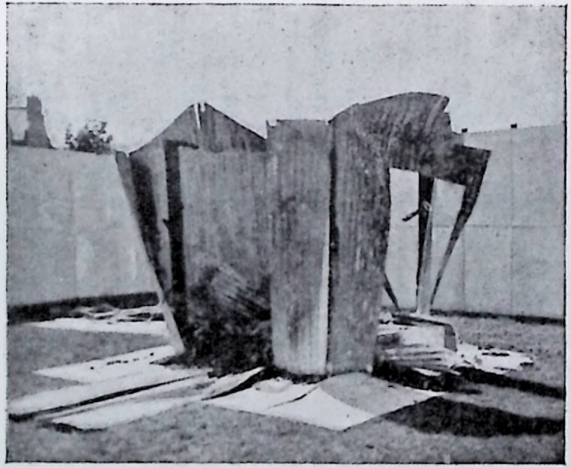


FIG. 18

HUT OF ORDINARY CONSTRUCTION

(AFTER FIRE TEST)

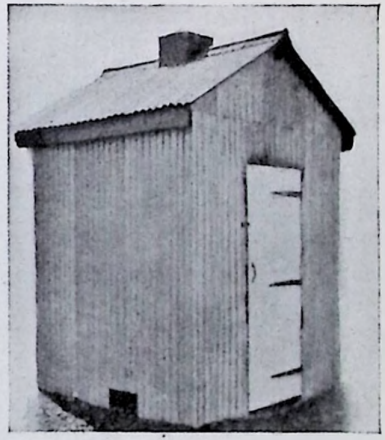


FIG. 18A

HUT LINED WITH "URALITE"

(AFTER FIRE TEST)

Result of a fire test on Uralite, carried out at the Fountain Hospital, Tooting, London, S.W., before representatives of the Metropolitan Asylums Board. As the illustration (Fig. 18A) shows, the hut protected by its lining of Uralite remained intact and quite unaffected by the fire. Beyond discolouration by smoke above the door, there is nothing to suggest that the test had been made.

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Uralite is used by the Great Northern and City Electric Railway for lining chambers containing the switch gear on the trains, as well as to line the undersides of the carriages, to guard against the spread of possible fire.

Fireproof doors are a Uralite speciality, made in three different styles, viz., "Warehouse," built up of two thicknesses of wood (cross-grained) with one thickness of Uralite between, and both faces and all edges covered with two thicknesses of Uralite; "Uralite Armoured," similar in construction to the ordinary armoured door, but with the important addition of a layer of Uralite between the wood foundation and the steel sheeting; and "Uralite Ordinary," of similar construction to the ordinary panelled wood door, but with a double thickness of Uralite forming the panels, and extending throughout the whole area of the door, the edges also being protected.

In this connection it is interesting to record particulars of a fire test conducted by the British Fire Prevention Committee with an executive of distinguished architects, surveyors, and engineers, on a Uralite "Warehouse" door. An extract from the official report reads: "In 40 minutes a spurt of flame appeared on the north side at the joint between door and frame, about the centre of the height. It was about 8 in. long, and lasted for a short time and then ceased. At the conclusion of the test, viz., 90 minutes, the door and frame remained in position, and *the external surface was not damaged;* the door was slightly buckled."

OBSERVATIONS DURING TEST.

2.45 p.m. The gas was lighted.
3. 0 ,, Slight vapour or smoke coming through the joint between the door and frame about top bolt.

3.5 p.m. Cracking noise coming from door.
3.25 ,, A flash of flame appeared on the north side at the joint between the door and frame, about the centre of the height; it was about 8 in. long and lasted a few seconds and then ceased.
3.45 ,, Large quantities of vapour or smoke coming through joint almost all around the door.
4.15 ,, The gas was shut off and water applied on the outside of the door.
4.18 ,, Water applied on the inside of door. Test closed.

OBSERVATIONS AFTER TEST.

The door was buckled $\frac{3}{4}$ in. outwards between the bolts, and slightly less than that between the hinges. *The outer thickness of Uralite was not damaged.*

TEMPERATURES DURING TEST.

P.m.	*Degrees Fah.*	*P.m.*	*Degrees Fah.*
2.48	500	3.50	1,580
3.0	880	3.55	1,620
3.10	1,040	4.0	1,620
3.25	1,360	4.5	1,720
3.40	1,530	4.10	1,780

"ASBESTONE."—This material, known in the trade as asbestos slate, is another speciality manufactured by the British Uralite Co. It is both fireproof and waterproof, very hard, durable, easily fixed, and economical. The makers claim for it successful comparison with ordinary slates and tiles, or even corrugated iron, for roof covering and with plaster as an internal lining. Unaffected by frost or heat, it suits cold or hot climates equally well, and once erected it does not require renewing, painting, or any other attention. "Asbestone" is about half the weight of slates, and it can be manufactured in three colours—light grey, slate-colour, and red. As tiles it is cut into sizes of 9 in. × 9 in., 12 in. × 12 in., 16 in. × 16 in., 18 in. × 18 in., and 24 in. × 24 in., $\frac{3}{16}$ in. thick. In sheets it is made up to 6 ft. × 3 ft., from $\frac{5}{32}$ in. to 1 in. thick.

Asbestone is an excellent non-conductor of sound, and

practically indestructible so far as the weather is concerned. It is quickly fixed to either wood or metal framework, and, unlike plaster, is quite dry at the start, enabling papering or painting to be done without loss of time, and, being perfectly smooth on its surface, the filling in of cracks and other imperfections common to plaster ceilings is obviated.

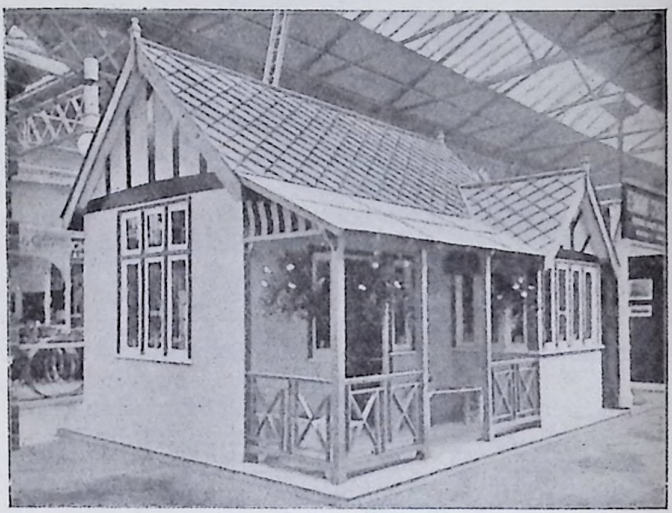


FIG. 19

PAVILION CONSTRUCTED WITH "URALITE" AND "ASBESTONE"

Its light weight has the advantage of rendering massive superstructures unnecessary, hence a very appreciable saving is effected in certain buildings. There is also an absence of the usual loss by breakages in transport and fixing entailed with ordinary slates, often a

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ACL Doc 10006 · Page 81 of 131 asbestosclaims.law/library/10006/81

considerable and vexatious item. A building erected in a very important position at Southampton was roofed with Asbestone, and although exposed to storm and rain during the process, not a single sheet was out of place.

The method of fixing Asbestone is simple. Roofs may be covered with either tiles or sheets, the former presenting a neater appearance on small roofs, while the

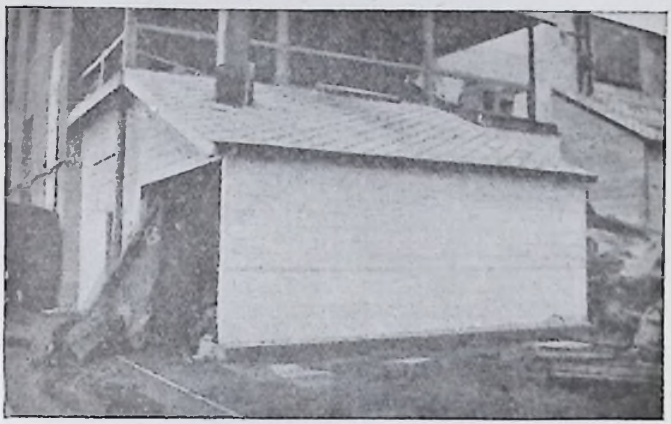


FIG. 20

A BOILER HOUSE BUILT OF "ASBESTONE"

latter are more suitable for large roofs of factories, engine-sheds, etc.

The tiles may be laid either on boards or battens. If the latter, the battens should be arranged at 10-in. centres for 18-in. tiles, and at 8½-in. centres for 16-in. tiles.

Fig. 21 represents the three shapes of tiles usually adopted, A and B being the eaves tiles and C the full tile.

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The roof is started by nailing on the eaves tiles A, arranged as in Fig. 22, allowing as much overhang as may be desired.

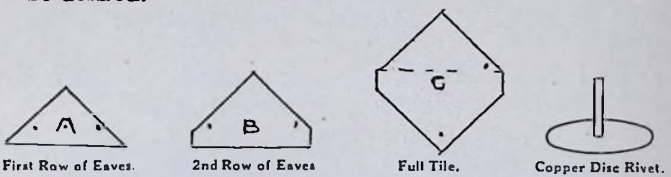


FIG. 21

THREE SHAPES OF TILES

Then proceed with the double eaves tiles B, as in Fig. 23, slipping one of the copper storm rivets in at D head downwards and shank upwards.

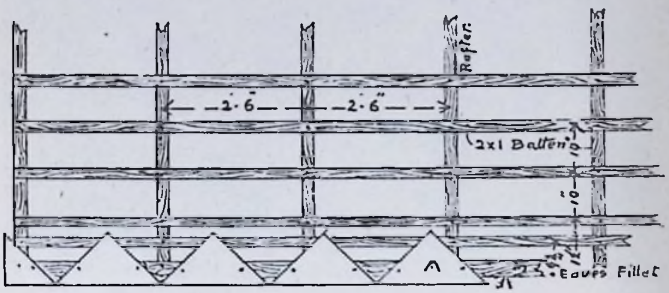


FIG. 22

SHOWING FIRST COURSE OF EAVES

Next proceed with the whole tiles C (Fig. 24), passing the shank of the rivet through the hole in the point of the tile, nailing to the battens, and bending the shank over, slipping a fresh rivet in between each two tiles as they are fixed.

Diagonal tiles are fixed on steel angle battens by the

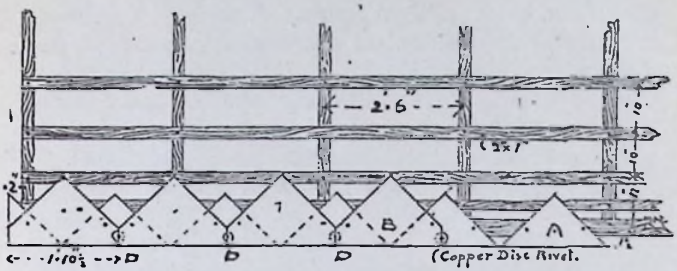


FIG. 23

SHOWING SECOND COURSE OF EAVES

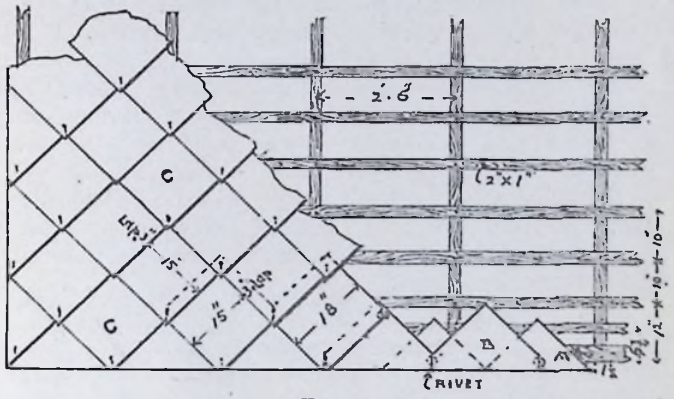


FIG. 24

SHOWING FULL TILES

same method, the sole difference being that instead of the two nails being driven into a wooden batten or board, soft lead or copper nails are used, and bent round the angle batten.

For external work the weather-board method of fixing Asbestone is found convenient and advantageous. The

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ACL Doc 10006 · Page 84 of 131 asbestosclaims.law/library/10006/84

sheets can be supplied in lengths up to 6 ft., 1 ft. wide, and these can be nailed to the studding in exactly the same way as weather-boards, using a lap of 1½ to 2 in. This is found to give perfectly weather-proof walls, besides having a neat appearance.

For partitions, the studding should be placed at 18-in. or 24-in. centres, and should be of equal thickness, in order to insure an even surface. A support should be fixed where the sheets butt, to nail the sheets to. The sheets should be nailed with either sherardized or copper nails, which should be driven about ⅜ in. or ½ in. from the edge, and about 6 in. to 8 in. apart. The joints of the sheets should be stopped with any of the usual hard-water paint stoppings, and rubbed down smooth and dry. If the sheets are required to be painted or distempered, it is advisable to give them a first coat of any of the usual priming preparations, or a coat of boiled linseed oil—or silicate of soda. If the latter is used, the strength should be about 20° B.

For ceilings, the sheets must be nailed to the joists with sherardized or copper nails. The joists must be made flush to secure a level surface, and the sheets butted together.

COMPARATIVE TABLE OF WEIGHTS OF "ASBESTONE" AND ORDINARY SLATES AND TILES.

(Per square of 100 ft., allowing for laps, etc., but not for fixing.

	Cwt.	*qr.*	*lb.*
Welsh Slates	5	1	–
Brossley Tiles	14	–	–
3/16 in. Asbestone Sheets, 6 ft. × 3 ft.	1	3	–
1/4 in. Asbestone Tiles, 18 in. × 18 in.	1	3	20
3/16 in. Asbestone Slates, 20 in. × 20 in.	3	1	–

Several important asbestos composition materials, including "Poilite," "Decolite," and "Uacolite," are manufactured by Bell's United Asbestos Co., Ltd. "UACOLITE" is quite similar in appearance and

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ACL Doc 10006 · Page 85 of 131 asbestosclaims.law/library/10006/85

substance to "Uralite"; indeed its composition does not differ sufficiently to need description, and I think it is used for precisely similar purposes.

"POILITE" marks a new era in building construction and fire prevention. At Harefield, Middlesex, where it is made, a matured stock of millions of square feet, in standard sizes and colours, are kept in readiness to meet the immense demand for it; and for several years its makers have been awarded the British War Office, Admiralty, and other Government contracts. It is composed of best quality Portland cement reinforced with asbestos fibre, in such proportions as to obtain strength equal to ten times that of the British Standard Portland Cement. Made in three colours (red, blue, and grey), as tiles or sheeting, the standard size for the former being $15\frac{3}{4}$ in. × $15\frac{3}{4}$ in., and for the latter 4 ft. × 4 ft.; 6 ft. × 4 ft., and 8 ft. × 4 ft., from $\frac{5}{32}$ in. thick upwards. A special form of compressed sheet, 4 ft. square, is also made, this being smooth on both sides, and especially suitable for exposed positions and where extra strength is necessary, or for electrical purposes, switchboards, etc., and these can be drilled and tapped with a coarse thread. Such are absolutely fire and weather resisting, and unaffected by damp, rot, or vermin.

The method adopted in fixing "Poilite" tiles to boarded or battened roofs is—

To form eaves course, cut a whole tile where shown in illustration (Fig. 25), so as to produce "E 6" and "Ex," according to the lap required. This can best be done by scoring with a chisel and breaking off as in the case of glass. "Ex" forms the first under-eaves course, and should be nailed to the eaves board or first batten with two copper nails, allowing for a 2-in. overhang as shown, right along the eaves course.

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ACL Doc 10006 · Page 86 of 131 asbestosclaims.law/library/10006/86

Next, lay upper half "E 6" flush on top of "Ex" tile breaking bond, placing copper disc rivet in centre of Ex tile and nail E 6 tile home. Butt next E 6 tile

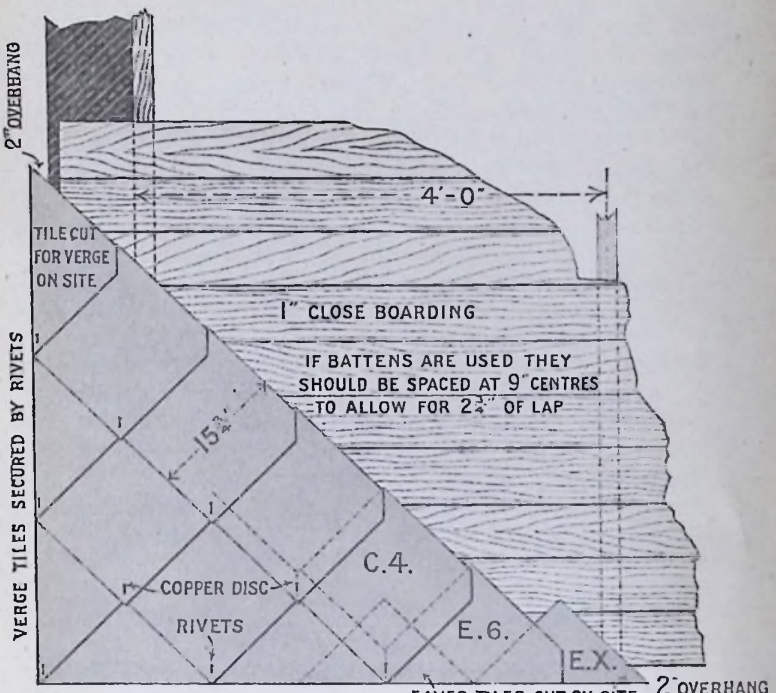


FIG. 25

POILITE TILE

against shank of rivet and complete this second course along the whole length of eave.

Commence again at left-hand corner by placing "C 4" tile suitably cut to fit gable or verge line, allowing for

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ACL Doc 10006 · Page 87 of 131 asbestosclaims.law/library/10006/87

2-in. overhang at verge. Place rivet midway between under chamfered end, and fasten down with a nail at right-hand end of tile. Butt next full-sized tile closely against verge tile, threading rivet at eave through tip of tile, to produce the required lap. Place rivet again midway under right-hand chamfer and fix with nail on each side and complete course along the entire length of roof.

The amount of overhang of the tip of the C 4 standard tile will depend upon the lap given, of course. When fixed to a 3½-in. lap, it can be supplied with the lower point cut off if desired, but when required for a 4-in. lap the tip must always be cut off.

The "F 5" pattern tile, illustrated in Fig. 26, is cut and holed for a 2¾-in. lap only.

Tilting fillets, if used, should not exceed ⅜ in. in thickness.

Tiles must be cut to suit verge and fixed with a 2-in. overhang. Verge tiles must always be fixed with a rivet at the bottom, in order to secure them to the tiles below. They should only be nailed well up under the lap at the top, or there will be a leakage through the nail hole. Complete by nailing wood fillet to barge board closely to underside of tiles, or alternately finish with a neat cement fillet.

Nail tilting fillet on boards 6 in. wide from the centre of valley, dress sheet lead well over same, and cut tiles so as to allow 2-in. overhang at tilting fillet.

Roofs in exposed positions, or of low pitch, should be close boarded and felted.

The number of 15¾ in. standard tiles required per 100 ft. square with 2¾-in. lap is 85; with 3-in. lap, 89; 3½-in. lap, 97; 4-in. lap, 106. A hundred square feet of "Poilite" roofing weighs approximately 270 lb. Copper or galvanized nails and rivets should be used.

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ACL Doc 10006 · Page 88 of 131 asbestosclaims.law/library/10006/88

Poilite tiles are also manufactured in the Roman style, size 4 ft. × 1 ft. $10\frac{1}{2}$ in.—or about $15\frac{1}{2}$ tiles to cover 100 sq. ft. of roof area, allowing for 4 in. of lap. With these tiles, felt is unnecessary except under extreme

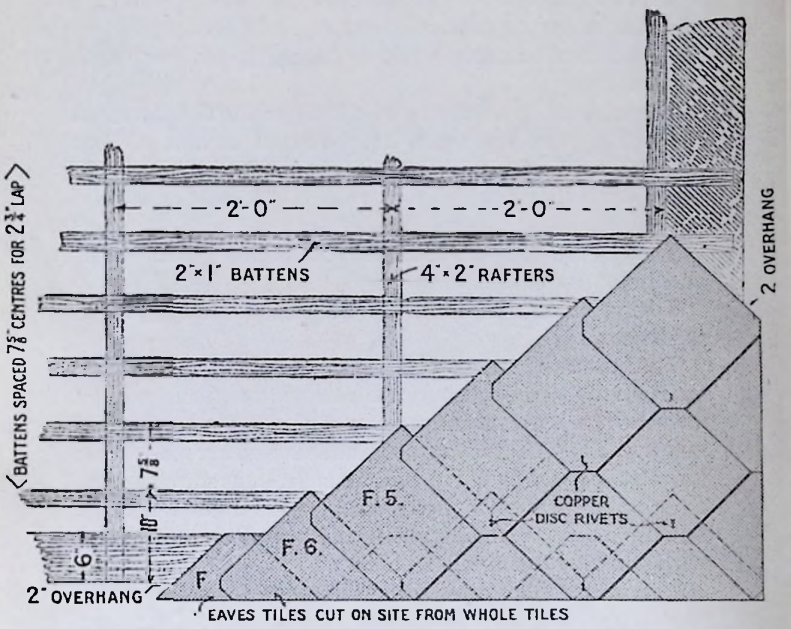


FIG. 26.

POILITE TILE

(see page 77)

conditions, or on roofs under 30° pitch. They may also be glazed by the use of sherardized clips and bolts, constituting an improved alternative to the ordinary roof lights. Skilled labour is not necessary for fixing, and only a few minutes are occupied in fitting a pane

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ACL Doc 10006 · Page 89 of 131 asbestosclaims.law/library/10006/89

of glass at any part of the roof, without cutting the tiles. In the event of the glass being broken, it can be removed and replaced quickly without the disturbance of any lead work or the use of putty.

Poilite building sheets for internal partitions or outside walls are fixed thus—

Standards or studs should be of equal thickness and spaced at 16-in. or 24-in. centres. Between these vertical supports, cross-pieces are fixed to receive the horizontal joints of the sheets. Sheets measuring 8 ft. × 4 ft. × $\frac{3}{10}$ in. thick and upwards are most suitable for these purposes.

For lining ceilings, sheets 4 ft. × 4 ft. × $\frac{5}{32}$ in. thick are recommended, being more easily handled.

The edges of the sheets must be closely butted and secured to the studding with $1\frac{1}{4}$-in. 13 B.W.G. galvanized flat-headed nails, at intervals of about 6 in. and $\frac{3}{8}$ in. from the edges of the sheets. Care should be exercised that the heads of the nails are flush with the sheet's surface. All joints where the sheets butt must be made on a support. Where sound-proof partitions are required, the space between the sheets should be filled with either slag wool or sawdust.

Joints may be filled, stopped, and rubbed down with a slow-setting plaster ; or joints for interior work may be covered with $\frac{1}{2}$-in. wooden fillets, and for outside work, cover strips of Poilite material $2\frac{3}{4}$ in. wide are provided.

To render the horizontal joints absolutely watertight, soakers formed of the thinnest sheet zinc, $1\frac{1}{2}$ in. wide, should be used.

Poilite sheets may be distempered or whitewashed, and treated in a similar manner to ordinary cement plaster work ; they may be painted, grained, or varnished, if a suitable priming is used.

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ACL Doc 10006 · Page 90 of 131 asbestosclaims.law/library/10006/90

The fireproof qualities of " Poilite " are recorded in the following extract from *The Architect*, 6th February, 1914—

" Our Newcastle contemporaries recorded the particulars of an outbreak of fire at a confectionery works at Blyth on 19th January. These works were in two portions. The old building, in which fireproof materials had not been employed, was completely gutted. The new building adjoining, and communicating with the other by two large openings made for the purpose of loading and unloading of wagons, had been recently erected, and all the ceilings of this had been formed by nailing ' Poilite ' sheets only $\frac{5}{32}$ in. thick direct to the wood joists, nothing whatever of a fireproof nature being present between the sheets and the wood flooring above.

" The fire extended with great fierceness through the openings to the ground floor of the new buildings and completely destroyed the contents. All the published accounts show that the fire was confined to the ground floor of the new building entirely by the presence of ' Poilite ' on the ceiling. This is confirmed by Captain Naisbitt, Chief of the Council Fire Brigade, who writes as follows—

> ' Had the ceiling of the ground floor in the large new building not been lined with these sheets, I am firmly of opinion that, in spite of our efforts, nothing could have saved the whole of this building from being involved. I consider that the facts cannot be too widely known in the interests of property owners generally.' "

" DECOLITE," the asbestos composition fire-resisting flooring, is considered to be one of the best of its class

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ACL Doc 10006 · Page 91 of 131 asbestosclaims.law/library/10006/91

on the market. Awarded the gold medal at the Franco-British Exhibition, its makers claim that its toughness, hard-wearing quality, warmth, and elasticity to the tread, make it a considerable improvement on composition floorings often called patent or jointless floorings. It has been in use many years, under a multitude of conditions, and has satisfactorily stood its trials.

This material is made in three colours—red, brown, and buff—and has a covering capacity as follows—

2 lb. of composition (dry) will cover 1 sq. ft. $\frac{1}{8}$ in. thick.
4 „ „ „ „ „ 1 „ 1 „ „

When finished and dry the material weighs—

$\frac{1}{8}$ in. thick approximately $3\frac{1}{2}$ lb. per sq. ft.
1 „ „ „ 7 „ „ „

"Decolite" is laid in a plastic condition, and sets within twenty-four hours. It is not brittle, and adheres firmly to iron, steel, wood, concrete (not screeded), brick or other hard, dry and clean surfaces. It has a non-slipping surface—though it will take a high polish, if desired,—is hygienic, has a pleasing appearance, and is easy and comfortable to the tread. For these reasons, it is very suitable for hospitals and public buildings, schools, or kitchens, wine cellars, laboratories, bath-rooms, etc.; indeed it has been laid with success on the floors of electric-railway cars, in Pullman cars, observation cars, lavatories, etc., of railways at home and abroad. Enjoying freedom from cracking, too, is an advantage it possesses.

At a works' time office, on a very old wooden floor, an experimental flooring of "Decolite" was laid, subjected to the heavy wear and tear of a large number of workmen for over five years, and at the end of that time showed no undue signs of wear, cracking, or other defects.

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ACL Doc 10006 · Page 92 of 131 asbestosclaims.law/library/10006/92

The material is usually laid $\frac{1}{2}$ in. thick, on hard cement concrete, with a rough level surface ; or $\frac{5}{8}$ in. thick or more on wooden floors, and $\frac{1}{4}$ in. to $\frac{3}{8}$ in. thick on walls direct to brickwork, woodwork, or fireproof partitions. Its quality is the same throughout, no cheap underlayer being employed. As flooring it will take a screw thread, thus being useful for theatres, tram and rail cars, where chairs are required to be screwed to the floor.

A special floor polish is recommended as a top dressing to obtain a dull polish, though any other polish may be used ; but its own preparation gives it the desirable non-slipping surface. It is cleaned and polished in the same way as wooden floors.

While comparing favourably in all respects with wood block flooring, Decolite has the advantage of standing wet or heat without swelling or buckling ; and as it contains no joints in which dirt can accumulate, it is far cleaner and easier to repair than wood block flooring. Its impervious nature also causes it to dry quicker after washing. Moreover, it is not subject to dry-rot as are wood floors. It may be formed into covings and borders, and applied to walls to form a dado, either direct to brickwork or to two-to-one sand and cement screeding. Laid on old wooden floors, it well replaces linoleum, obviating the necessity of planing, besides lasting so much longer ; it will also obviate the renewal of old wooden floors. In repairing surfaces with this material a floor is strengthened at the same time.

Any ordinary workman can manipulate Decolite and quickly repair a floor, which is of importance in cases of damage frequently occurring in factories and workshops.

Essential points to remember in connection with the use of Decolite are given on page 84.

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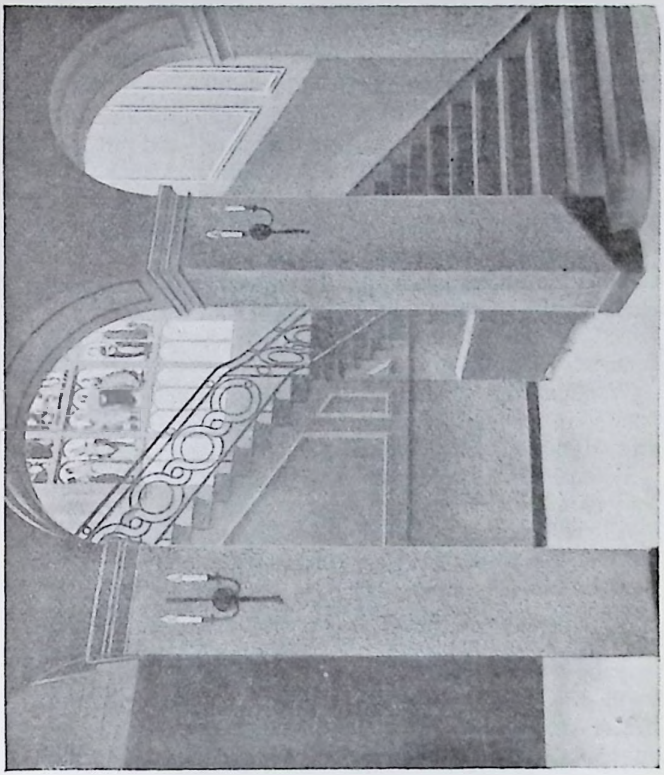


FIG. 27
AN ENTRANCE HALL OF "DECOLITE" FLOORS, PILLARS AND DADOS

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Being very strong and quick setting, it should only be laid on hard, dry and tough foundations, such as concrete, brick, stone, or wood. It must be protected from wet and must not be washed until thoroughly set and hard—about fourteen days after being laid. It must not be laid on soft or friable surfaces.

The concrete foundation should consist of one part Portland cement (not lime), one part sand, and not more than three parts of clean ballast, clinker, clean sifted coke breeze, granite, etc., the aggregate to pass through a $\frac{3}{4}$-in. mesh.

The surface should not be screeded or floated, but should this be necessary, good material must be used—three parts sand to one part Portland cement, well keyed to the concrete and left with a fairly rough surface.

Wooden floors should be first thoroughly cleaned, and open joints covered or plugged to form a solid foundation, all rotten parts being removed.

When laid on cement or other surfaces worn smooth, they should be chipped to form a key for the Decolite.

All surfaces to be treated must be *quite free from dirt*, for the Decolite to adhere firmly. Concrete surfaces must be free from lime, plaster, or builders' refuse before applying the material.

For a highly-polished floor, beeswax and turpentine may be used sparingly on Decolite after it is dry and hard.

The makers of Decolite also supply an excellent imitation marble material called "Calbonite." It is made in sheets, for dados, bathrooms, etc., and is cheaper than marble or tiles, and is easily fixed to brickwork or woodwork, or can be cut and drilled like wood.

"Everite."—This is claimed by its manufacturers, the British Everite and Asbestilite Works, Ltd., to be

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ACL Doc 10006 · Page 95 of 131 asbestosclaims.law/library/10006/95

an ideal building material, and not only equal to the strain of long, hard service, but that it will outlast the purposes for which it has been utilized. "Not for an age—but for all time," is the ambitious phrase the firm have attached to their product, and it certainly has an attractive ring about it, as well as a flavour of the classics.

"Everite" and "Asbestilite" roofing tiles and sheets are composed of materials claimed to be proof against fire, water, frost, snow, wind, acids, gases, and corrosion; also that they do not break, crack, warp, flake, or disintegrate; are non-conducting, perfect insulators; withstand extreme vibration; are non-absorbent and immune from condensation; free from expansion or contraction, and permanently defy all atmospheric influences.

Such qualifications are ample, and in "Everite" and "ASBESTILITE" (a composition of asbestos and Portland cement), a strong and durable material for its sphere, is doubtless established. The writer cannot speak from personal experience of the material, but it appears to have been in great demand during the war by the British and allied Governments, fully occupying the makers to the fullest capacity of their large works.

A particularly good feature of Everite—supplied in grey, slate blue, and terra-cotta red—is the corrugation of sheets, in sizes from 3 ft. to 10 ft., 30 in. wide, $\frac{1}{4}$ in. thick, corrugations 3 in. pitch, weighing approximately $2\frac{1}{4}$ lb. per square foot. For covering semicircular or "Belfast" roofs (supplied to any radius from 1 ft. greater than the actual length of sheet to be curved) these are said to possess all the advantages and none of the disadvantages of corrugated iron sheeting, which Everite is rapidly superseding. Its immunity from breakage and atmospheric effects makes it a most satisfactory roofing for all purposes, as well as an

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ACL Doc 10006 · Page 96 of 131 asbestosclaims.law/library/10006/96

economical one. There are no upkeep expenses, and it will not decay, while it is light and expeditious in erection.

" Asbestilite " building sheets, in thicknesses of from $\frac{1}{4}$ in. to $\frac{3}{4}$ in., are fireproof, sound-proof, rot-proof, and non-absorbent ; they lie perfectly flat, with perfect joints, and may be painted, distempered, enamelled, or papered immediately after fixing—which can be accomplished with ordinary carpenter's tools. For the lining of walls, partitions, ceilings, etc., the material should be very effective.

The material is made into roofing tiles $15\frac{3}{4}$ in. $\times$ $15\frac{3}{4}$ in., cut and holed ready for laying to a $2\frac{3}{4}$-in., $3\frac{3}{4}$-in., or 4-in. lap. Ridge tiles, 16 in. long, are also supplied for use in conjunction with the other tiles.

A sample of the material, kindly submitted to me by the makers, gave a very favourable impression of its strength and other qualities. It has a breaking weight of 180 lb. per square foot, and a crushing weight of 4,000 lb. per square foot.

VULCANITE.—Enormous quantities of this roofing material are in use, something over twenty million super feet, and its peculiar fire-resisting qualities are well known. It has experienced some severe tests, including those of the British Fire Prevention Committee as far back as 1902, and successfully withstood them all.

Impervious to water, snow, atmosphere, and unaffected by any climate, it has been adopted in all parts of the Kingdom, on many of the most important public buildings, hospitals, factories, warehouses, breweries, mills, hotels, theatres, etc., and is generally utilized for covering flat roofs, of either concrete or wood construction. These roofs have distinct advantages over all others, inasmuch as their surfaces can be made into gardens, playgrounds, tanks for water storage, drying grounds,

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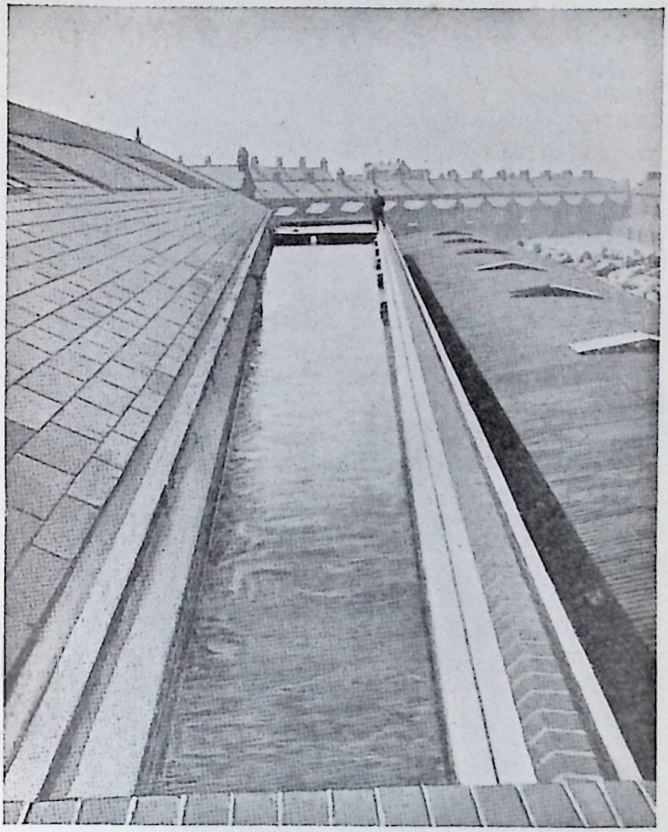


FIG. 28

BELFAST CORPORATION'S VULCANITE ROOF TANK

(Some of these roof tanks hold 100 tons of water)

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ACL Doc 10006 · Page 98 of 131 asbestosclaims.law/library/10006/98

promenades, etc. ; and they are not liable to damage by gales or storms.

As will be seen from the accompanying photograph, kindly lent by Messrs. Vulcanite, Ltd., quite charming roof-gardens are some of the pleasant possibilities of vulcanite roofs.

Vulcanite displaces asphalt, copper, lead, or zinc as roofing, and its application to timber or concrete construction offers no difficulty. When completed, it forms one flat surface, without seam or joint, requiring no drips or rolls ; and it is absolutely waterproof and dust-proof.

The principal advantages are that the roof is arranged in an almost horizontal position, thus reducing the area to the least possible extent, affording much saving in outlay for timber and wages ; complicated and costly frameworks and high gabled walls are dispensed with. The boarding may also be used as a ceiling, giving good rooms immediately below the roof, the temperature of such rooms being more even in summer and winter than that under other roofs—an important consideration in sleeping apartments.

It is also claimed that Vulcanite, being a bituminous, horn-like, elastic substance, while retaining its elasticity permanently, becomes in course of time of a metallic hardness. In case of fire these roofs are easily reached, giving firemen better facilities for extinguishing fires in the vicinity.

Although the material by itself will burn in a fire, as applied to wood construction it is covered with a 2-in. layer of gravel, to meet the requirements of the authorities, and this acts as a satisfactory preventive. Recently a serious fire occurred at Ruskin House, Rochester Row, Westminster, which was roofed with Vulcanite—measuring about 475 yd. super. All the roof joists and boarding remained in position unbroken,

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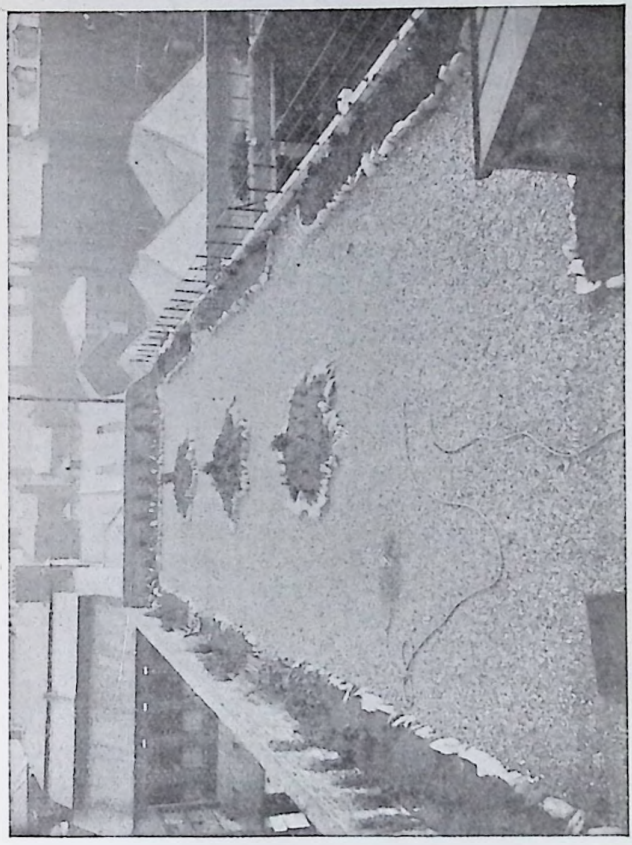


FIG. 29

A VULCANITE ROOF-GARDEN

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owing to the Vulcanite covering; but all other woodwork was badly burnt.

The British Fire Prevention Committee's test was carried out on an ordinary slated roof, in the presence of London District Surveyors and officials of various public bodies. Fire (at temperatures ranging from 800° to 1,650° Fah.) was applied to the roof from the inside for one hour's duration. The slated roof was entirely consumed, while the Vulcanite roof remained intact, and afterwards withstood being jumped upon.

At a house at Homerton which was completely gutted by fire, nothing was left standing after the fire had burnt itself out but the walls and Vulcanite roof. After the house was rebuilt, it contained the same Vulcanite roof, which needed no repairs whatever!

On 12th January, 1900, an appeal was heard in the Queen's Bench Division, before Mr. Justice Grantham and Mr. Justice Channell, from the Hendon Urban District Council, in a case stated by the Justices of Edgware. The question was whether Vulcanite roofing was incombustible within the meaning of the bye-law, following the terms of the Building Act. The case was stated in connection with a judgment given by the Edgware Petty Sessions on 17th May, 1899, following a summons issued by the District Council against Mr. W. Martin, builder, of Cricklewood, N.W., for using patent Vulcanite roofing on his buildings in Hendon, which the said Council contended was not within the bye-laws, in so far that "all buildings should be externally covered with slates, metal, or other incombustible material."

The Justices, after hearing weighty evidence from eminent architects, fire-insurance surveyors, fire-brigade officers and others, showing that the patent Vulcanite roofing was more fire-resisting than slates, metal, etc.,

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ACL Doc 10006 · Page 101 of 131 asbestosclaims.law/library/10006/101

dismissed the summons with costs, whereupon they stated a case for appeal.

At the hearing of the appeal in the Queen's Bench Division, their Lordships listened to exhaustive arguments of counsel for the District Council, but Mr. Justice Grantham, without calling on Mr. M'Call, Q.C., who appeared for Mr. Martin, held that the Vulcanite roofing was in accordance with the bye-laws, and Mr. Justice Channell concurred. Judgment was therefore issued against the Hendon District Council with costs.

The preparations for covering a roof with this material vary according to the roof to be treated.

With a concrete roof, if the concrete is of coke breeze, a sound surface must be provided, but it need not be floated ; but where ballast or other concrete of large aggregate is used, all unevenness must first be levelled off with cement and sand. If the Vulcanite is to be covered with 2 in. of gravel proper, gravel kerbs must be provided at outlets or eaves, etc.

When a garden roof is required, 2 in. of loamy gravel is the best finish, or cement concrete. Tiles set in cement, tarred macadam, asphalt, or other surfaces can be used.

If the roof will not be used, except for occasional light traffic, in cleaning windows, etc., a sanded and varnished surface can be used ; but when frequent or heavy traffic is anticipated, a small stone-embedded surface is recommended.

For covering a wooden roof, the boarding should be 1 in. thick, nailed to wooden joists, the nails driven well home and the edges even. The surface must be a plain one without drips or rolls ; and there should be a fall of 1 ft. in 40 ft. to carry off rain water. A wood triangular fillet $4\frac{1}{2}$ in. $\times$ 3 in. is placed along the parapet or other walls, skylights, chimney stacks, roof entrances.

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ACL Doc 10006 · Page 102 of 131 asbestosclaims.law/library/10006/102

etc. The boarding is flush with facia when draining to eaves gutter, but where there is no eaves gutter, rain water is carried through the parapet wall by lead or zinc outlets, or into a metal gutter inside the parapet. Where wooden newels occur, the bottom rail must be quite 6 in. in the clear from flat.

All gutters, other than eaves gutters, should be 4 in. deep at the shallow end.

The Vulcanite must be covered with $\frac{3}{4}$ in. loamy sand and $1\frac{1}{2}$ in. of shingle. Breeze or cement concrete may be used instead of sand and shingle, if preferred.

Where the underside of joists is lath and plastered, two or three air-bricks should be used between the joists, the intervening joists to have $\frac{1}{2}$-in. holes through them for ventilation.

When verandah floors of wood construction are covered with Vulcanite, concrete tiles set in cement, or other similar covering, is frequently used in place of the half-inch of loamy gravel.

"SILUMINITE."—This is a new British insulating material possessing qualities and characteristics different from others of the kind, and having very high electrical resistance—and it is in the electrical industry where it is most used. It is black, rather like ebony to look at, hard and tough; and can be turned, drilled, tapped, screwed, filed, or polished. It can be moulded into shape for all sorts of useful articles, has great strength, and may be heated to considerably above 600° Fahrenheit without losing its shape, and is impervious to moisture.

Quantities of this material are daily used on the leading railways, by various Government departments, and many electrical undertakings. Its electrical resistance, as tested by the National Physical Laboratory, is between 10,000 and 13,000 volts per mm. Before leaving

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ACL Doc 10006 · Page 103 of 131 asbestosclaims.law/library/10006/103

the works it is subjected to a temperature of 600° Fahrenheit, so there is not much fear of its shape changing through contact with heat.

It is supplied in the form of rods, sheets, tubes, rings, cups, handles, etc., which will withstand the action of alkalis and hot transformer oil.

"Siluminite" replaces porcelain and glass for insulating purposes, possessing about six times their mechanical strength.

The sheets are supplied in any size up to 30 in. × 40 in., from $\frac{1}{8}$ in. thick upwards; and the approximate weight of 1 sq. ft. $\frac{1}{4}$ in. thick is 2·4 lb.

The *Electrical Review*, of 4th May, 1917, says—

"The essential qualities of a perfect insulating material are high electrical resistance, high dielectric strength, high tensile and compression strength, immunity from attack by acids, alkalis and oils; that it shall be easy to mould and to machine, and able to withstand exposure to high and low temperatures; that it shall be non-hygroscopic and waterproof, and that it shall be cheap. There are numerous varieties of insulators which possess some or other of these qualities, but none which answer to them all. Perhaps it would be too much to expect that perfection should be attained in this world, but it is right to aim at the ideal and strive to attain it. We therefore accord a hearty welcome to a new insulating material introduced by the Siluminite Insulator Co., Ltd., of The Green, Southall, which possesses a remarkably large proportion of the qualities above scheduled. We have been favoured with some samples of Siluminite in the forms of rod, sheet, tube, and moulded insulators, and have subjected them to such mechanical tests as are at our disposal. . . . It is not softened by heat, and is not brittle. Immersion in oil or caustic alkali, or boiling water, leaves

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No. 2

No. 3

No. 1

FIG. 30

SOME TYPES OF INSULATOR

it unchanged, and it is non-hygroscopic. . . . Its structure is homogeneous and dense. . . . The substances with which it will directly compete are porcelain, glass, mica, fibre, ebonite, wood, slate, marble, and moulded compounds. While Siluminite possesses most of the qualities of these materials, it excels in respect of its mechanical strength. . . . Perhaps, however, the

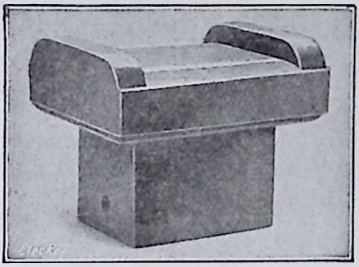


FIG. 31

most convincing demonstration of the strength of Siluminite is its use for rail insulators *without the aid of the usual iron cap*. We illustrate herewith examples of their application on the Metropolitan District Railway, where they have been subjected to severe practical tests, and have been on the track since June, 1916. The larger insulator weighs 8 lb., and is designed for use without the usual malleable cast-iron clip to hold the positive conductor rail; the smaller insulator is also designed to dispense entirely with the metal clip, and the negative conductor rail is simply laid in the seating on the top of the insulator. Figs. 1 and 2 show the top and base of the former, and Fig. 3 the latter type of insulator. An anchor insulator is also made for railway work.

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"In addition to the properties before mentioned, Siluminite is found to withstand the effects of lengthened exposure to an atmosphere highly charged with ozone, and orders are in hand for sheets of dielectric for the ozonisers of an underground electric railway ventilating system."

Metal parts can be insulated by compressing Siluminite on to them in any desired shape, thereby obviating the cementing or screwing process so often necessary.

"LITHOLITE."—This is another well-known and good insulating composition (manufactured by Messrs. Litholite, Ltd., Hackney), somewhat similar to the foregoing. It is moulded in steel dies to practically any desired shape, for use as electrical insulators, such as handles, motor terminals, fuse holders, and the like.

RECONSTRUCTION: SUGGESTED REFORMS.

It is to be sincerely hoped that in the great work of reconstruction now before the world, architects, builders, and particularly municipal and town-planning authorities, will give serious attention to these various excellent materials available, and most suitable for the building of sound, healthy, weatherproof and fireproof homes, which would not only be more substantial and durable than most of the trumpery "villas" of cheap materials inflicted upon us in our suburbs of recent years—with unseasoned woodwork, warped windows and doors that do not close properly, leaky roofs constantly worrying owners and tenants, etc.—but far less expensive. In normal times the British Uralite Company (to name but one firm) could erect really good houses of the kind suggested after the style of some of those at Letchworth Garden City, for the modest sum of £180; and such would compare favourably in accommodation and convenience with the ordinary house costing £400 or more,

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ACL Doc 10006 · Page 107 of 131 asbestosclaims.law/library/10006/107

built of the troublesome and defective materials complained of. And they have the additional advantage of rapid construction—a big consideration to-day when a house famine exists everywhere.

And there is also the concrete house—much favoured in America for years, although only recently tried in this slothful England of ours, always loth to depart from old ways for new, however advantageous.

By way of experiment, concrete cottages have been built at Merthyr, Barrow, and York ; and in Ireland (Enniskillen) a cottage of this description was erected at as low a cost as £88 !

The Crittall Manufacturing Company exhibited concrete cottages at Braintree, Essex, with the commendable substitution of steelwork for window-frames in place of wood frames.

It is calculated that a good middle-class residence can be built of concrete at a cost below £400. The York cottages cost much less than this ; and Mr. Edison, the famous American inventor, has declared it quite possible to erect nine-roomed houses of the kind at £200 each.

Apart from other advantages, concrete houses are built much more rapidly than houses of brick or stone. That energetic and enthusiastic reformer, Mr. N. Pemberton Billing, M.P., is now erecting experimental model houses in Hertfordshire on this principle, one of which will be a type appealing to the business man, and another will conform to the requirements of municipal authorities. Concrete slabs of special design are employed, and the method of construction is new. They will be of the most modern and approved type internally, while outwardly they will be of artistic Elizabethan design.

Roof troubles will be obviated ; the use of slates,

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ACL Doc 10006 · Page 108 of 131 asbestosclaims.law/library/10006/108

tiles, rain-water gutters, drain pipes, and timber is entirely dispensed with ; no brickwork is employed in the construction of either walls or foundations, and it is claimed that such a building is produced 150 per cent. stronger than one brick-built. The process of building is so rapid that the first house is calculated to be an established fact in something like two months, at a cost 30 per cent. below the usual.

In reply to a recent question in the House of Commons, it was stated that houses of a simple type are being built in concrete as an experiment at a cost of about 8¾d. per cubic ft., against about 1s. 1d. per cubic ft. for brick houses.

A new concrete block-moulding machine, called the "Australia," was recently operated before experts at Australia House, London. Solid concrete blocks, 24 in. × 12 in. × 3 in., were moulded at the remarkable rate of one per minute. The inventor claims that a building constructed of these will be reduced in cost by at least one-half as compared with bricks, and could be erected in one-fourth the time.

Professor W. R. Lethaby gave some useful hints on household decoration at the "Model Homes" Exhibition held at Westminster. He advised the use of as much white paint as possible in the interior arrangements, being more cheerful and light than any other. "The more white you have inside the house the better, especially in London, for it counteracts gloom and makes for cheerfulness and good spirits," he said.

The Professor also rightly condemned as "pawnshop furnishing" the collection of spurious antiques in the home. People should stop grouping about the second-hand shops, and, instead, encourage the living makers of good furniture. "Beware of the accumulation of too many household gods. Rooms, like gardens, can

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ACL Doc 10006 · Page 109 of 131 asbestosclaims.law/library/10006/109

only be kept in order by continual weeding," he added.

There can be no doubt that the craze for antiques, " old masters " (a large percentage of which is absolute rubbish), etc., has in recent times been carried to excess—as modern artists have found to their cost. It is high time we had the courage to condemn this unhealthy snobbish convention, dismiss the alleged old " masters " as dead and done with, and honestly give the living their fair chance. An American art critic visiting England a short time ago confessed his horror at the worthless stuff passing for pictures in our national galleries and museums, stored up religiously generation after generation and regarded as " priceless treasures " when they should be burnt on the scrap heap!

At the Brighton Guild of Applied Arts exhibition, recently held at Brighton, the Mayor condemned the prevailing ugliness of our homes. " We do not apply our art teaching sufficiently in our daily lives. We English are the most inartistic nation on the face of the earth," he declared. " In our homes our furniture, decorations, pictures and ornaments are all hideously ugly. Everything wants burning." In the model village which the Brighton Corporation proposes erecting, they intend not only that the houses shall be homes "fit for heroes to live in," but artistic inside and out.

Mr. S. B. Caulfield, F.R.I.B.A., is another advocate of light colouring for walls, pointing out that its use entails a saving of light astonishing in itself.

The possibilities of concrete and similar materials are not generally realized, nor fully understood as they should be. For instance, even the furniture can be made of it; one firm has already turned out, by a secret process, concrete chairs, tables, desks, and other domestic articles in very good imitation of polished oak.

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ACL Doc 10006 · Page 110 of 131 asbestosclaims.law/library/10006/110

And quite recently the interesting announcement appeared in the Press that motor-cars will shortly be made almost entirely of concrete, with hardly any woodwork. The concrete in question will be rather different from the usual kind—light but strong, and including waste materials, such as slag, clinkers, sawdust, etc., and coated with a special metal solution. And as the various parts, chasis, wheels, etc., will be standardized and stamped out, these cars will be produced at an exceptionally low price, of course.

Adverting to the housing question, there are one or two essential reforms of vital importance which I would emphasize and strongly advocate those responsible to adopt—

(1) All houses, whether private residences or public buildings, should by law be constructed of fireproof materials so far as possible, to reduce the chances of destruction by fire to an absolute minimum.

(2) All windows should be made to either open inwards or be otherwise constructed as to permit of cleaning from the inside, thus doing away with the inconvenience and risk of outside cleaning, working on ladders, etc. Several good methods have been introduced and are well known, so no excuse exists for continuing in the old clumsy way.

(3) That absurdity and eyesore, the "Venetian" blind should be abolished from all windows in this country, where the absence of sunshine (except on rare and infrequent occasions) makes such a farce as well as a nuisance.

(4) Ventilation should receive more consistent attention than hitherto. To properly ventilate a room, the top of a window, or the ventilating chamber, should *not be less than three or four inches from the ceiling.* Most rooms in this country, either through stupid convention,

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or ignorance of builders, contain windows whose opening at the top is invariably twelve or eighteen inches from the ceiling, thereby continually harbouring a large volume of foul air which never has a chance of escaping.

(5) All walls should be either tiled, painted, or distempered, to permit of washing. Wall-papers ought to be strictly forbidden, unless capable of being washed clean.

Wall papers, with their irritating (and unnatural) floral designs, are not only a bore to look upon, but a constant menace to the health. Speaking at a recent meeting of the Psycho-Therapeutic Society, Dr. H. Anderson, of Denmark, stated that many people medically treated for "nerves" were really suffering from arsenic poisoning, caused by unknowingly absorbing the poison from wall papers!

Some places abroad—notably Sweden—are far in advance of us in this respect. At regular intervals householders move their furniture into the middle of the room, cover it with a tarpaulin, and thoroughly wash down the walls with a hose! A small gutter in one corner of the room, connected with a pipe in the outer wall, carries off the water to the drain. Their walls are distempered in light and beautiful colourings, which are quite permanent—and, like most hygienic and improved materials, these are supplied from America.

(6) Central heating, modern approved grates and stoves—burning only *anthracite*, the smokeless coal—should without further delay be compulsory, if we are ever to have clean and healthy homes. Such have been in general use for generations on the Continent and in the United States of America, and found not only labour-saving and healthy, but economical of fuel and heat. The old-fashioned, wasteful grates, burning unwholesome bituminous coal, throwing out constant volumes of injurious soot and smoke, will certainly not do any

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longer. I have frequently pointed out in the Press the evils arising from this great plague, the smoke-fiend, and have no hesitation in asserting that its noxious influence has deteriorated the physique of the race, until to-day we have become a " Grade 3 " nation !

Speaking at the British Scientific Products Exhibition on 11th July, 1919, Professor W. A. Bone, who has given very careful attention to the question of fuel economy, warned his audience against accepting the advice of the gas undertakings to fit the new houses to be erected as " all-gas " houses, and the similar advice of the electricity undertakings to fit them throughout for the use of electricity. He said that personally he would not use gas for the continual heating of rooms, not only on the ground of expense, but also from consideration of health. Professor Bone is rightly of opinion that the solution of the domestic problem will be found in the use of *a smokeless fuel for heating purposes*, and electricity for lighting purposes.

Sir William B. Richmond recently wrote in *The Times :* " We are most of us doing all in our power to save coal and therefrom are suffering from cold and discomfort. In the meantime, factories, steamers on the river, and traction engines in the streets are belching out tons of coal per diem. The effect of this waste of fuel is to produce the darkest and most smoky winter in my memory. Who is responsible for this waste ? The excuse of its perpetrators will be, ' We cannot help it.' *We know by now that it can be helped.* Then why, in the name of justice and common sense, is not the waste and nuisance arrested ? "

The answer is : Our indifferent authorities are to blame. They must wake up, and make the use of smokeless fuel *compulsory* here, as it is in America and elsewhere.

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INDEX

Aprons, Furnacemen's, 42
African Asbestos, Characteristics, 3
—— ——, Analysis, 9
Aosta Valley, 5
Amalgamated Asbestos Corporation, 10
Anthracite, 101
Armoured Sheeting, 23
" Asbestic," 55
" Asbestilite," 85
" Asbestone," 69
Asbestos, Analyses, 3
——, ——, (African), 9
——, ——, (Canadian), 9
——, ——, (Italian), 9
——, Mining in Canada, 8
——, —— Italy, 5
——, Miscellaneous Uses, 54
——, Modern History of, 4
——, Russian, 3
——, Sources of Supply, 3
—— Veins, thicknesses of, 7
——, World's Largest Specimen, 7
——, World's Output, 9

Bell's United Asbestos Company, Ltd., 11, 75
Black Lake, 7
Boiler Coverings, 25
—— ——, " Viceroy " 29
—— ——, World's Largest Contract, 29
Boots (Asbestos), 42
Bricks, 22, 47
British Everite and Asbestilite Works, 84
British Fire Prevention Committee, 68, 86, 90
British Uralite Company, Ltd., 62, 69
Building Materials (Asbestos), 45, 62–98
Bunker Fires, 51
Burlington Hotel Fire, 38

" Calbonite," 84
Canadian Asbestos, 3
—— ——, Mining, 8
Cape Colony, 9
Ceilings, 37, 62, 80
——, Burlington Hotel, 38
Cement, 45, 57, 60
Chemical Analysis, African Asbestos, 9
—— ——, Canadian Asbestos, 9
—— ——, Italian Asbestos, 9
China Clay, 57, 60
Cloth, 2, 15
——, Asbestos-Metallic, 15, 23
——, Fireproof and Waterproof, 58
Clothing (Asbestos), 42
Commercial Values, 10
Composite Fireproof Materials, 62
Concrete Houses, 97–98
Cord, 55
Cottage, Portable Asbestos, 47
Crude Asbestos, Prices, 10
—— ——, Treatment, 14
Crystal Palace Experiments, 35
Curtains, Theatre, 23, 46

" Decolite," 80
Decorations, Asbestos, 38
Dick's Asbestos Company, 17, 22
Districts, Mining, 4–9
Domestic Uses of Asbestos, 43, 59

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ACL Doc 10006 · Page 115 of 131 asbestosclaims.law/library/10006/115

"Eclipse" Packing, 16
Electricity, Asbestos in, 41
Engineering, Asbestos in, 36
"Everite," 84

Felt, 33, 57
Fibre, Carded, 57
——, "Floss," 5, 10, 57
——, Grey, 6
Filter Cloth, 57
Fireproof Tapestry, etc., 60
Fire-guards, 43, 45
Fires, Bunker, 51
——, London, 50
——, World's Theatre, 49
Flatiron Holders, 59
Flooring, 80–84
Fuel (Asbestos), 57
Funnel Paint, 35
Fuse Preventors, 59
Furnacemen's Aprons, etc., 42

Geological Survey of Canada, 8
"Gladiator" Packing, 16
Gloves (Asbestos), 42, 57
Grey Fibre, 6
Griqualand, 9

Helmets, 42
Hendon Council *v.* Vulcanite, Ltd., 90
Holkham Hall, 38

Insulating Compositions, 27, 41, 42, 60
Insulation for Cables, 41
Italian Asbestos, Analysis, 9
—— ——, Mining, 5
—— ——, Largest Specimen, 7

Joints, Steam, 15
——, "Salamander," 15

Kingston Theatre Fire, 23

Ladders (Asbestos), 43, 56
Lagging, 30
Lamp-wicks, 54
Leather (Asbestos), 55
Leggings, 43, 57
Liquid, Fireproof, 46
Litholite, 96
Lombardy, 4
London Fires, 50

Madras Club, Report, 66
Mattresses, 55
Millboard, Manufacture of, 14, 24
—— Tubing, 57
Mining Disasters, 5
Mining Districts—
Aosta Valley, 5
Griqualand, 9
Lombardy, 4
Quebec, 7
Sondrio, 6
Susa Valley, 5
Thetford, 7
Valtelina, 6
Mining Methods, Canadian, 8
—— ——, Italian, 5
—— Population, Italian, 6

New York Fire, 37
Non-conducting Composition, Instructions for Using, 30
Northern Exploration Company, Ltd., 4

Oil Paint (Asbestos), 35
Output, World's, 9
Oxide of Iron, 3, 9

Packings, Various, 16–22
Paint, Fire Test, 33
——, Fireproof Qualities of, 33
——, Funnel, 35
——, Asbestos-Oil, 35
Panelling, 37, 40, 79, 80
Paper (Asbestos), 47
"Physical Paradox," 12
Pier Pavilion, Great Yarmouth, 63

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ACL Doc 10006 · Page 116 of 131 asbestosclaims.law/library/10006/116

Pipe Coverings, 25–32
" Poilite," 74
Poison in Wallpapers, 101
Powder (Asbestos), 33
Practical Tests, 33, 35, 38, 65, 68
Public Documents, 59
Putty (Asbestos), 43, 57

QUEBEC, 7
Queen's Theatre, Manchester, 23

RAIL Insulators (" Suliminite "), 92
Reconstruction, Reforms, 96–102
Roof Gardens, 86
—— Tanks, 86
Roofing, 65–80; 85–92
Rome, Vatican, 2
Rope, 43, 56
—— Lagging, 30
Russian Asbestos, 3

" SALAMANDER " Joints, 15
Sheeting, Asbestos Armoured, 23
" Siluminite," 92–96
Siluminite Insulator Co., Ltd., 93
" Sirius " Packing, 17
Slates (Asbestos), 45
Soap (Asbestos), 43
Soles (Boot), 23
Solutions, Fireproof, 46
Sondrio, 6
South African Asbestos, 3
Spats, 23
Spinning, 15
Spitsbergen, 4
Susa Valley, 5

TABLE Covers, 58
Tape, 15, 57
Tapestry, 60
Terry s Theatre, 46
Theatre Curtains, 23, 46
—— Fires, World's, 49
Thetford, 7
Thread, 15, 56
Tiling, 47, 69–80
Trinket Boxes, 59
Tubing, 58
Turin Disaster, 5
Tyres (Asbestos), 56

" UACOLITE," 75
Underground Railway, 40
" Universal " Packing, 17
" Uralite," 62
Ural Mountains, 3

VALTELINA, 6
Vatican (Rome), 2
" Viceroy " Pipe-Covering, 29
" Victor " Metallic Cloth, 15
Vulcanite, 86–92
Vulcanite, Ltd., 88

WALL-PAPERS, Poison in, 101
Waterproof Cloth, 58
Washers, 54
Weaving, 15
Wool (Asbestos), 46
Wood, Fireproofing, 63
Woven Tubing, 57
World's Asbestos Output, 9
—— Theatre Fires, 49

YARN, 46, 60

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