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THE ASBESTOS TEXTILE INDUSTRY IN GERMANY

Report prepared by

FIELD INFORMATION AGENCY, TECHNICAL
UNITED STATES GROUP CONTROL COUNCIL
FOR GERMANY

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BRITISH INTELLIGENCE OBJECTIVES SUB-COMMITTEE

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THE ASBESTOS TEXTILE INDUSTRY IN GERMANY

BY

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JOINT INTELLIGENCE OBJECTIVES AGENCY

FIELD INFORMATION AGENCY, TECHNICAL.

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I. Purpose and Scope of the Investigation.

The purpose of this investigation was to inquire into the wartime operations of asbestos textile plants in Germany and to determine the state of technical knowledge prevailing in the industry during the war and up to the present time. It was also an objective of the investigation to ascertain the extent to which substitute materials were developed and used in place of asbestos fiber, and insofar as possible, to study the nature and uses of end products manufactured from asbestos textiles.

Because of the known scarcity of asbestos fiber in Germany during the war years, and the knowledge that substitute materials, such as fibrous glass and mineral wool were used extensively in place of asbestos fiber in many products, this investigation included not only a survey of asbestos textile plants but also a study of plants in Germany engaged in the manufacture of fibrous glass and fibrous glass textile materials which ultimately found outlet through asbestos textile plants.

This report covers information obtained from visits to the following plants in Germany:

Frankfurt Asbestwerke - Niederrad Plant - Frankfurt a/M
Frankfurt Asbestwerke - Bornheim Plant - Frankfurt a/M
Danco Wetzel & Company - Dortmund
Gerresheim Glashuttenwerke - Dusseldorf
Pahlsche Gummie und Asbestwerke - Dusseldorf
Hardt Pororny & Company - Dahlhausen-Wupper
Hans Limperg - Schwelm
Oscar Gossler, Glasgespinstfabrik - Bergedorf - Hamburg
Asbest und Gummiwerke - Martin Merkel - Harburg - Hamburg
Deutsche Kap Asbestwerke - Bergedorf - Hamburg
Norddeutsche Asbest und Gummiwerke - Wandsbek - Hamburg
Glas-Wolle - Kom.Gas. W.Schuller & Co., Coburg
Frankfurter Asbestwerke - Walldorf
Gerresheim Gashuttenwerke - Ettlingen
Deutsche Asbestwerke, Reinhold, Georgi and Co. - Mannheim
Mitteldeutsche Asbestfabrik, Franz Fichtler - Niedernhausen/Taunus.

It is believed that the above list includes all important asbestos textile plants in Germany excepting only plants located in the Russian Occupation Zone where investigations were not permitted and certain small manufacturers

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of braided asbestos packings, asbestos gaskets etc. The list includes all of the basic manufacturing plants producing fibrous glass materials in Germany.

As a general rule, relatively few machines were observed in operation. At the time of this investigation the asbestos textile industry in Germany is estimated to be operating at only 25% of the plant capacity available for operation. Primary reason for curtailed operations is the lack of raw material, but almost as important is the effect of war damage. Few plants observed are intact; most have had some damage by bombing or artillery fire. Where equipment is intact, it may not be running due to damage to other processing equipment. Lack of fuel and shortage of factory labor are also important factors in curtailment of operations.

Certain additional information on the manufacturing units listed above will be found in the Appendix following this report.

II. General Discussion.

1. Observations on Asbestos Textile Manufacture.

In the preparing, carding, spinning, and weaving of asbestos textiles in Germany, all production machinery equipment and methods are conventional and well known to the asbestos textile industry in the United States.

Most of the preparing, spinning, and weaving equipment observed in asbestos plants in Germany is very old, inefficient, and in relatively poor condition. Some of the carding machinery is modern and probably capable of performance equal to late model asbestos carding machines in the United States, although such performance is not achieved in Germany.

Machine output in German asbestos plants is generally much lower than corresponding American machine output, and the products much coarser and very low in quality by comparison. Low production and inferior quality is largely due to lack of good quality and uniform raw material, but even if high grade asbestos spinning fiber were available to the German industry, it does not appear likely that they could have produced asbestos textiles equal in quality and machine output to that of the American industry.

Asbestos textile plants in Germany are poorly organized generally in respect of plant layout and the orderly flow of material in process. Factory buildings are very old.

A decided absence of technical work and experimental development was noted. Most of the asbestos textile manufacturers in Germany have little, if any, technical control over production. Simple control tests, such as asbestos content determinations of asbestos yarn and textiles, are made only infrequently and then usually by outside testing laboratories or technical organizations.

Asbestos textiles in Germany are not standardized by grade and asbestos content, as is the case in the United States. Almost all asbestos textiles contain from 20% to 30% cotton. There is very little production in grades containing over 80% asbestos. Ordinarily, no guarantee is made as to the asbestos content in the sale of asbestos textiles.

In spite of high cost and acute shortages of asbestos fiber in Germany, nothing appears to have been done to find better methods of preparing and opening the fiber to achieve maximum fiber utilization. Preparing and opening methods and equipment are decidedly ordinary. No new developments were observed in control of asbestos dust. Progress in this field is considerably behind American development in design of equipment and in the variety and originality of methods of dust control.

In the manufacture of finished products from asbestos textiles, nothing new or unusual was observed. Asbestos braided and fabric packings and gasketing materials are made in considerable volume by unconventional methods with a great deal of hand work. The quality of these products, as a general rule, is quite low.

There has been no development and apparently little interest in producing high temperature lubricants for asbestos packings. Lubricants consist chiefly of tallow and ordinary cylinder oil. In frictioning and coating compositions for textiles for gasketing purposes, poor grade rubber substitutes are principally used and usually applied to the fabric by hand labor. There has been no development within the German industry in application of plastic fire-proof and oil-proof coatings to asbestos textile materials. Developments of this kind which are more or

less common in the American industry seem to be entirely outside the scope of interest and activity of the German plants.

Thermal insulating products such as fabric jacketed insulating pads for boilers, turbines and locomotive insulation and braided insulations for spiral wrapping of pipes are commonly used in Germany, but are in no way unusual in character and are inferior in quality as compared with corresponding American products.

No new methods, machines, or labor saving devices were observed. There has been little incentive for maximum and effective utilisation of labor, as slave labor and forced labor have been common in the asbestos industry as in all other German industry.

In Germany the asbestos textile industry has not broadened and extended the use and scope of asbestos products as has been the case in the United States. Rather the range of asbestos textile products in Germany is distinctly limited and confined to very conventional usages.

2. Asbestos Textile Production Equipment.

The following data relating to processing equipment is intended to be a composite summary of the nature of equipment and methods observed in all of the asbestos plants covered by this investigation:

(a) Preparing, Opening and Mixing Operations. Methods and machines for preparing asbestos fiber mixes prior to carding seem to be rather uniformly standardized throughout the German industry. Preliminary crushing (if any) is done solely with chaser mills (Kellergang) of conventional type. Disintergrators or attrition mills were not seen. Opening of asbestos fiber is done in all plants with the Vertical Opener, passing the stock through the machine once or twice as may be required. Proportioning asbestos fiber with cotton or Zellwolle (staple rayon fiber which is generally used instead of cotton - apparently with good results) is accomplished by floor batching, manually building up the batch in successive layers. No mechanical proportioning equipment was observed. Actual mixing of batches is done through use of ordinary mixing pickers. The most common machine for this purpose in Germany is the Fearnaught type of picker (Krempel Wolf)

(b)Carding Operations.The carding machinery observed was not unusual, but in many plants investigated, the carding machines were the most modern and best equipment. 60" carding machines are definitely the standard in the industry even in older machines. About 75% of all cards seen in asbestos plants were Gessner make, the balance made by Hartman. All carding machines were equipped with tape condensers. No ring doffers are used.

Some Gessner cards built as late as 1943 were examined. These machines were single units equipped with double doffers. The main cylinder is 60" by 49" and the main doffer (lower doffer) is 28" in diameter. The upper or secondary doffer is 19" in diameter. Two laps are doffed separately and carried by separate feed aprons into the tape condensor section. On these machines the speed of the main cylinder was approximately 100 R.P.M., the speed of the lower doffer 4 to 6 R.P.M., and the upper doffer 8 to 9 R.P.M. approximately.

Card clothing varied considerably with different plants. Very coarse to fairly fine clothing was observed with no particular relation to the type of stock being run. The range of card clothing numbers being reported is from No.10 to No.26.

At the plant of Norddeutsche Asbestwerke, Hamburg, Gessner cards of the type described above were set up in a rather unusual manner so as to produce asbestos yarn from very short asbestos. Zellwolle fiber without asbestos was run through the card so that a very thin lap came off of each of the two doffers. Between the two doffers at the front of the card was a small feed box arrangement from which very short asbestos fiber was uniformly dropped on the lower lap of Zellwolle leaving a layer of short asbestos sandwiched between the two layers of the carded Zellwolle lap as it entered the tape condensor section. By this arrangement the asbestos fiber did not pass through the card at all - only the Zellwolle was carded. The asbestos fiber did not enter the operation until the stock reached the tape condenser. The operation appeared to be of questionable control and the sliver emerging from the tape condensors looked to be about 50% Zellwolle although it was reported to be about 80% asbestos and 20% Zellwolle.

In general in carding asbestos mixes the rate of production as reported is quite low. Typical production is 55 pounds per hour on 2.5 cut yarn, 33 pounds per hour on 8 cut, and 22 to 26 pounds per hour on 10 cut yarn.

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Waste droppings under the card were reported as ranging from 30% to 50% depending on the stock used.

Carding machines in most plants are set over pits ranging from two feet to eight feet in depth and running the full length of the card. The waste under the card is accumulated in the pit and periodically shoveled out.

(c) Spinning Operations. All spinning of asbestos yarn is done on ring spinners for finer yarns and on flyers for coarse yarns. Since the bulk of the production is and has been on coarse yarn, the flyer is most extensively used. No mule spinning was observed in Germany. All spinning is done from single ends of sliver in the individual cheese. Spinning from multiple ends on jack spools was not observed.

There seemed to be in nearly every plant an excessive amount of spinning equipment in relation to the number of carding machines. This is indicative of very low production per machine in spinning operations.

(d) Weaving Operations. Weaving equipment in the German asbestos industry is particularly antiquated. Top rate of production on cloth 1 meter wide (39") is about 60 picks per minute. A common type of cloth seen throughout the industry had about 6 to 7 picks per inch and 13 to 15 warp ends per inch, usually made of 3 or 5 cut yarn. This type of fabric is commonly used for gasket cloth, gloves, and clothing, high pressure packing insulation lagging, and other purposes. All brake lining tape looms are single space looms.

(e) Dust Control Equipment. All plants had either cyclone collectors or cloth stocking-type collectors. No cloth screen-section collectors were observed and no wet systems. The equipment that was examined seemed to be well designed and reasonably effective but in no way unusual. Oil or processing agents for control of dust are not used.

3. Scarcity of Asbestos Fiber. It became obvious from the very beginning of this investigation that the scarcity of asbestos fiber in Germany has been and is extremely acute, and that such stocks of asbestos that were available during the war consisted chiefly of odd lots of material of widely assorted grades and varieties captured or seized in all parts of German occupied Europe during the early years of the war.

As a typical example of this situation, the record of all purchases of "asbestos spinning fiber" for the Bornheim plant of Frankfurter Asbestwerke, Frankfurt a.M. from July 1941 until the middle of 1943 (shortly before the plant was completely destroyed by bombing) is reproduced below.

7/21/41	Rhodesian C. & G.2.	3146 Kilograms
7/16/41	Beaver 4 T.	14974 "
7/28/41	Rhodesian C. & C.2.	10516 "
4/15/42	Rhodesian VRA 3	6038 "
4/13/42	Amosite M-1	2397 "
5/ 9/42	Arizona Crude 2	1003 "
5/27/42	Johnsons 1A Extra	2492 "
5/27/42	Johnsons 2AR 3T	7801 "
4/ 4/42	Rhodesian C. & C.3.	13047 "
4/23/42	Vimy H-4T	16500 "
7/ 7/42	Blue asbestos DKS	9675 "
7/ 7/42	Blue asbestos MX	9963 "
9/ 9/42	Bells AA 3F	4599 "
12/16/42	Rhodesian C. & G.2.	5230 "
1/ 9/43	Johnsons 2 AR	5079 "
2/28/43	Blue asbestos S	1714 "
3/12/43	Canadian BH fiber	8695 "
5/26/43	Italian AVM/AC/S	10000 "
5/29/43	Canadian 4T	10091 "

Much of this material was obviously not suited for spinning purposes, but it had to be used in the manufacture of asbestos textiles without regard to cost of production, high waste losses, or lack of uniformity of quality because no other asbestos fiber was obtainable.

At the present time no asbestos textile plant in Germany, as far as this investigation could reveal, has any stock of asbestos except very limited quantities of fiber of variable and miscellaneous character as described above.

A scarcity of raw material such as this could produce only one result, that is, the extensive development and use of substitute materials.

4. Substitutes for Asbestos.

(a) Fibrous Glass Materials. On various occasions in the past several years rumors have circulated in the asbestos industry in the United States to the effect that Germany had developed a "synthetic" asbestos fiber, and was therefore no longer dependent on sources outside of Germany for her requirements of asbestos.

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Because of such reports a good deal of attention was given to this subject during this investigation and many inquiries were made in an effort to find some basis for such rumors. As a result of these investigations, a conclusion is reached that the "synthetic" asbestos reported in Germany is a form of fibrous glass that is produced by what is known as the Schuller process. Since 1939 fibrous glass made by this process in Germany has had a very extensive use throughout the asbestos textile industry as a substitute for asbestos fiber, chiefly because it can be carded and spun into yarn on conventional textile equipment, and also because the cost of Schuller process glass fiber is reasonably close to the cost of asbestos in Germany and much lower in cost than glass fibers made by various other processes in Germany.

The production of a fibrous glass material capable of being carded and spun into yarns and the development of efficient carding and spinning techniques for this fiber are the only technical achievements observed in the German industry that have not been duplicated in the United States.

The first impression of Schuller process fibrous glass, gained in this investigation, was that it might have significance and possibilities of use in the United States as an asbestos substitute. However, as the investigation progressed and additional information was accumulated, it became apparent that the economic and technical value of the Schuller glass fiber, and the carding and spinning of it, is extremely doubtful, at least for development as a substitute for asbestos in the United States.

While the Schuller process glass fiber has been extensively substituted for asbestos fiber in Germany for the past 7 years, it has two fundamental limitations which, while not important in Germany, would be highly important in the United States. These objections are: (1) that Schuller process glass fiber as made in Germany is inferior to asbestos fiber in heat resistance and is limited in application to a maximum temperature of 650°F., (2) that while Schuller glass fiber appears to cost only a little more than asbestos fiber in Germany, this is due to the fact that asbestos itself is very expensive in Germany in relation to domestic items, and for this reason, the Schuller process fiber in the United States would probably be far too expensive to compete directly with asbestos.

Throughout Germany every asbestos plant visited is familiar with Schuller process glass fiber, the asbestos industry having been the sole outlet for this material. The opinion of all persons interviewed on the subject is that the Schuller glass fiber has been an effective substitute for asbestos, and without it the industry could not have operated, but all were unanimous in stating that were asbestos fiber available, it would be the preferred material. The opinions were equally unanimous with reference to the fact that the Schuller glass fiber is limited in usage to service temperatures below 600° to 650°F. At higher temperatures the glass fiber begins to sinter and loses its fibrous character. It was also reported that the storage characteristic of Schuller glass fiber is not particularly good under conditions of dampness, owing to its relatively high alkali content.

Werner Schuller, owner and director of the Schuller Company in Coburg, Bavaria, and the inventor of the Schuller process, was questioned at great length with reference to the temperature limitations of the glass fiber. Mr. Schuller seemed to be a very competent glass technologist and was fully aware of the higher heat resistance of asbestos fiber. It was obvious that he had studied the subject and had made many attempts to increase the heat resistance of his fiber; however, he appeared to feel certain that it was not possible to alter this characteristic in any practical way. The problem lies in the fact that by his process he has not been able to reach sufficiently high melting temperatures to avoid the use of low melting soda glass. The composition that he uses contains 20% alkali. Extremely high temperature melting, necessary when soda glass is not used, is difficult by the Schuller process because the glass, at point of melting, is not in contact with any refractory, platinum, or other material. Rather there is an air gap between the glass itself and the source of heat. This air gap causes a lowering of the melting temperature.

The Schuller process consists of drawing individual and continuous glass fibers from a battery of thin (4 mm) glass rods. A production unit, which is quite simple in design, has either 80 or 100 glass rods approximately 1 meter in length supported in a vertical position and driven downward at a very slow but uniformly controlled speed through a melting zone heated electrically or with gas. From the lower end of each rod which is maintained in the melting zone continuously at temperature of 1100° to 1200°C., a thin fiber (approximately 8 to 10 microns in

diameter) is drawn and rapidly accumulated on a drum, 1 meter in diameter, revolving at 800 R.P.M. The rate of production for a unit of 100 rods is approximately 5 to 6 pounds per hour. During the war period Schuller continuously operated about 25 units of this kind.

The Schuller glass textile fiber is processed into yarn by carding and spinning in several different plants in Germany. The most important of these is the Hardt Pocorny Company, at Dahlhausen-Wupper, who are primarily engaged in producing woolen yarns. However, since 1939 Hardt Pocorny have taken about 75% of the output of glass fiber of the Schuller plant, and they have in turn disposed of their entire output of finished glass fiber yarn in the asbestos textile industry where it has been substituted directly for asbestos yarn.

The methods of processing the glass fiber into yarn as developed by Hardt Pocorny are simple and effective, and since no similar work has been done in the United States, the details of the operations are recorded here.

The glass fiber is received from the Schuller Company in skeins or bundles about 10 feet long. The skeins are run lengthwise through a simple chopping machine cutting the fibers uniformly to a staple length of about 4 inches (10 cm).

The four-inch staple fiber is then passed through a Hartman picker (Krempel Wolf) which appeared to be identical in design to the Fearnaught picker made in the United States by Curtis and Marble Company. The picker is operated at only 160 R.P.M. and the fiber passed through only once. About 4% of light mineral oil is added to the fiber at the picker to aid in subsequent processing. On leaving the picker the fiber is ready for carding.

At Hardt Pocorny 30 Gessner and Hartman single woolen cards are set up to card glass fiber. The cards are all 60" by 40" size and of simple design. Card clothing is fairly fine and reported as No.26. The speed of the main cylinder was reported as 90 to 100 R.P.M. but could not be verified. The speed of the doffer was only 5 to 6 R.P.M. by actual check.

No feed box or mechanical feeding device is used behind the card, rather the feed of the stock into the card is controlled by hand weighing and spreading 100 grams of fiber at a time over a marked area on a horizontal feed

apron behind the card. One female operator tending the front of the card also takes care of weighing and spreading the fiber on the back apron. This seems crude, but the results were effective and flow of stock to the card was uniform.

At the front of the card the doffer is split and two strands of carded glass fiber roving or sliver are drawn from the doffer, each strand passing through a revolving funnel putting a slight twist in the strand and feeding it into a stock can.

The rate of carding production is approximately 3 kilograms of roving or sliver per hour per machine (approximately 6 to 7 lbs per hour)

The waste losses under the card are practically negligible. The total loss from raw fiber to finished yarn is reported as only 6% to 7%; that is, for 100 kilos of raw glass fiber used 93 to 94 kilos of finished yarn is produced.

The operation is clean, free from dust, and relatively free from difficulty with brashness or "itch" from the glass fiber, although this problem is present to some extent.

From the carding machine the glass sliver is taken to a horizontal drafting machine and drafted about 5 to 1 depending on size of finished yarn desired. It was reported that various sizes of yarn have been produced in a range equivalent to 4 cut to 25 cut asbestos yar; however about 80% of the production has always been on metric No. 1.6 approximately equal to 8 cut asbestos yarn. After drafting, the sliver is spun on a Flyer, reported to operate at 1500 R.P.M.

The cost of Schuller glass fiber and finished glass fiber yarn, as compared with asbestos fiber and finished asbestos yarn, is as follows:-

Schuller glass fiber	1.05	marks	per lb.
Schuller glass fiber yarn (Hardt Pocorny)	2.50	"	" "
Asbestos spinning fiber - 3F	.80	"	" "
Asbestos finished yarn	1.80	"	" "

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Asbestos fiber is a very costly commodity in Germany in relation to wages, living costs, and other items in the domestic economy. This is because asbestos is an imported raw material, and its cost reflects the world price which has no relation to German domestic values. An example of this is the fact that a pound of asbestos spinning fiber in Germany has a value approximately equal to the value of an hour of male factory labor (0.8 to 1.0 marks per hour) whereas in the United States a pound of asbestos spinning fiber has a value only about one-tenth that of one hour of male factory labor.

Because of the very high cost of asbestos fiber in Germany, the cost of Schuller glass fiber does not seem to be seriously out of line competitively, but it is likely that Schuller process fiber, produced in America, would have a cost several times that of asbestos and probably some place near the cost level of fibrous glass textile materials now available in the United States.

The Schuller process does not seem to have possibilities of radically lowering the manufacturing cost of glass textile fibers if the process were to be used in the United States.

In the event of a critical shortage of asbestos textile fiber were to develop in the United States, it is probable that glass textile fibers now available in America would have better possibilities in substituting for asbestos because of their higher heat resistance than Schuller glass fiber. Further, it is probable the existing forms of American glass fiber, measuring 10 microns or less, are capable of being carded and spun in the same manner as Schuller process glass in Germany. However, there has been no serious attempt to develop such carding and spinning techniques in America for purpose of replacing asbestos, because there has been no practical reason for doing so, in view of the availability and the relatively low cost of asbestos.

In addition to the Schuller process, glass textile fibers are produced in Germany by the same processes developed and used in the United States by the Owens Corning Fiberglass Corporation. These processes came into use in Germany, prior to the war, through patent licensing arrangements between Owens Corning and the Gerresheim Glasshuttenwerke-Dusseldorf. Textile fibers of glass made by the Owens processes in Germany have, however, been confined in usage chiefly to electrical insulating

materials because the cost of Owens process fibrous glass textiles in Germany has been very high, considerably in excess of the cost of Schuller process glass textile fibers.

Two other processes for producing fibrous glass materials are used in Germany. These are the Gossler process and the Hager process, both of which were observed in operation in the plant of Oskar Gossler, Glasgespinstfabrik-Hamburg. However, both of these processes are devoted solely to production of glass wool for insulating purposes, the fiber diameters being too coarse (20-30 microns) for textile purposes. Considering that glass insulating wool as produced by the Owens process in the United States and Germany is a very low cost material, the Gossler and Hager processes did not appear to be productive enough to be able to compete very effectively in the insulating wool field.

(b) Iron Slag Wool. In one plant (Denco Watzell-Dortmund) the carding and spinning of iron slag wool as a substitute for asbestos was observed. The slag wool yarn is a coarse material produced primarily for weaving into brake lining tapes, and also used to a limited extent for packing yarn and gasket fabrics. The size of the slag wool yarn is confined to Metric sizes No. 1 and 1.6 corresponding to 5 cut and 8 cut yarn approximately.

The slag wool stock is mixed with 20% Zellwolle waste. Mixing is accomplished in an ordinary mixing picker prior to carding.

The carding of this stock is done on single 60" Gessner cards using tape condensors. Rate of production on Metric No.1 and No.1.6 yarn was reported to be approximately 30 lbs. per hour per carding machine. Considering the size of the yarn produced, this is a very low machine production. Losses under the card were reported to be approximately 40%. The slag wool is spun on Flyers with a strand of zinc wire, and because it runs so poorly it is necessary to have two girls tend one side of a flyer consisting of 72 to 90 spindles.

The cost of the slag wool as a raw material is only 0.6 marks per kilogram as compared with the cost of 3R asbestos spinning fiber (when available) of 1.5 marks per kilogram. However, when allowing for the excessive waste losses, low machine production, and inferior quality of the finished yarn, the substitution of slag wool for asbestos fiber for textile purposes does not seem to be economically desirable.

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The slag wool used in this operation is a brown, long-fibered wool, rather soft and relatively free of shot. It appears to be similar to American slag wool, although it probably is a carefully selected material in order to obtain the longest fiber and minimum shot content.

It seems extremely unlikely that the use of slag wool for textile purposes is capable of being developed to any appreciable extent as a substitute for asbestos.

(c) Peat Fiber. In the plant of Norddeutsche Asbest und Gummiwerke Hamburg, the use of peat fiber in carding and spinning operations as a substitute for asbestos was observed. The peat fiber is blended with 15% Zellwolle waste and is processed through mixing pickers, vertical openers, carding and spinning machines in the same manner as asbestos is worked. Peat fiber yarn is very coarse and irregular and its uses are confined to brake lining and some packing and gasketing materials.

The locality around Hannover, Bremen, and Hamburg produces the particularly fibrous variety of peat used in this plant. The cost of the peat fiber is 30 to 60 pfennigs per kilo. However, the material cannot possibly have any real value as an asbestos substitute since peat is normally used as a fuel and is destroyed by heat above 225°F.

III. Conclusions.

This investigation of the asbestos textile industry in Germany was undertaken with the conviction that the investigation could hardly fail to reveal some positive development in the German industry or some technological achievement in the processing of asbestos textiles that would be of interest and value to the industry in the United States.

An earnest and diligent search throughout the German industry however, has failed to uncover such developments.

It is the conclusive opinion of this investigator after seeing the present state of the asbestos textile industry in Germany, and allowing for what it probably was at the peak of its operating efficiency prior to intensive bombing, that the industry in Germany is and has been very far behind the asbestos textile industry in the United States. This is true in respect of quality and variety of products manufactured, in scientific and technological

development, in machine output, in effective utilization of labor, in the development of new and better processing equipment, and in the initiative of management.

It is only in the field of substitute materials that the German asbestos textile industry has shown any progress or accomplishment not duplicated in the United States. Due to the scarcity and high cost of asbestos in Germany, there has been a very great incentive for the development of asbestos substitutes, and the circumstances have made possible the use of substitutes that otherwise could not be economically justified. It has been concluded, however, that the German substitutes for asbestos, while of technical interest, are not, in their present stage of development, of particular value as asbestos substitutes in the United States where asbestos fiber is available at relatively low cost.

The German asbestos textile industry was never large as compared with the industry in the United States, and at least 50% or more of the production capacity of the German industry has been destroyed. At its present size, the capacity of the entire asbestos textile industry in Germany could be equalled by the ouput of any one of several asbestos textile plants in the United States.

APPENDIX.

Plants Visited.

1. Frankfurter Asbestwerke - Frankfurt a/M

3 plants Niederrad Plant (South suburb of Frankfurt)
Bornheim Plant (North section of Frankfurt)
Walldorf Plant (10 miles Southwest of Frankfurt)

Dates of Investigations: Niederrad - October 13 and 26, 1945
Bornheim - October 13, 1945
Walldorf - October 26, 1945

Interviewed: Paul Kind - Owner and Director
Franz Weber - Secretary & Purchasing Agent
Gottfried Kohns - Chief Engineer
G. Schmidt - Superintendent

This company is reported to be the oldest manufacturer of asbestos products in Europe having started business in 1890. Prior to October 1943 the company operated only two plants, the Bornheim plant being a complete asbestos textile and Niederrad plant being devoted to manufacture of asbestos packings and gaskets of all types, millboard, high pressure compressed sheet and other miscellaneous asbestos products.

The Bornheim plant was bombed On October 5, 1943 and completely destroyed. No attempt has been made to rebuild the plant. A visit to the site of this plant revealed nothing but a huge pile of rubble, the wreckage of a large three storey building including approximately 160 pieces of asbestos textile equipment none of which was salvaged. Following the destruction of the Bornheim plant, a few looms and spinning frames were assembled and installed in an old building at Walldorf, a small town near Frankfurt. To whatever extent asbestos and fibrous glass yarns could be purchased during the war, weaving operations were carried on at Walldorf to supply textiles for gasket and packing manufacture at the Niederrad plant.

The Niederrad plant, where the offices of the Company, are located was also bombed and about 60% destroyed in March 1944. Part of the plant is now being rebuilt. At present, operations, under permit of the Military Government, consist of a very limited production of braided

asbestos and fibrous glass packings, sheet packing and gaskets, and millboard.

2. Vereinigte Asbestwerke.
Danco Wetzell and Co. - Dortmund.

Location: Kanalstrasse (Northwest section of Dortmund near dock area)

Date of Investigation; October 13, 1945.

Interviewed: Fritz Theobald - Manager
Heinrich Wachter - Assistant Manager

This company is fairly large in relation to other asbestos textile plants in Germany and is quite well known. The company has been in business many years and was founded by the father of the present manager, Mr. Theobold.

Prior to 1939 about 535 persons were employed in the plant in three shifts. During the war part of the textile equipment was transferred to a location near Dresden and operated there as a separate plant to avoid bomb damage. The wartime force of employees at Dortmund was about 350. Currently about 150 workers are employed in manufacture of woven brake lining made from slag wool yarn, asbestos yarn, cloth, packing, gloves, fibrous glass electrical tapes, molded clutch facings, tailored insulation pads of mattresses, braided insulating tapes for pipe wrapping, high pressure sheet packing and molded packing rings.

This represents about as broad a line of asbestos products as was found in any plant in Germany. None of the products were impressive in appearance or method of manufacture. Nothing was observed that was in any way an improvement over corresponding products or methods in America. At present production on all of the items is relatively limited and depends primarily on availability of raw materials for each of the items of manufacture.

Stocks of asbestos in the plant are very low. At the time of this investigation they had about 40 tons of asbestos spinning fibers of widely assorted grades and varieties including Canadian, Rhodesian, Russian and Italian fibers, and they also had a stock of about 30 tons of a variety of short fibers suitable only for millboard and compressed sheet packing.

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During the war Danco Wetzell produced millboard in addition to products now being manufactured. The millboard department, however, was badly damaged by bombing, and the usable equipment salvaged from this department has been requisitioned by the Military Government for transfer to Saxony in the Russian occupation zone.

These people do not know what has happened to the textile machinery that they transferred to Dresden and operated there during the war. This equipment consisted of 5 carding machines and necessary preparing, spinning, twisting, and spooling equipment. Since it was located in what is now the Russian Zone they have no access to the equipment.

Essential asbestos textile equipment in the Dortmund plant consists of one chaser mill, 2 vertical openers, 4 mixing pickers, 4 double and 4 single Gessner cards, numerous ring spinning frames and flyers, 15 to 18 single space brake lining looms, 6 cloth looms, 5 light tape looms for fibrous glass electrical tapes, miscellaneous braiders and twisters for packing. None of this equipment was unusual and most of it is very old.

Records of raw material costs in this plant were examined and the following typical costs noted.

Canadian Asbestos - Crude No.1 (1944)	- 8.0 marks per kilogram
Canadian 3R Spinning Fiber 1945	- 1.5 marks per kilogram
Rhodesian C & G 2 (1944)	- 1.7 marks per kilogram
Fibrous glass yarn (Schuller process - Hardt Pocprny)	- 5.3 marks per kilogram
Iron slag wool (for spinning purposes)	- 0.6 marks per kilogram

The Dortmund Area is generally very heavily damaged by bombing. This plant however was hit in only two sections. The offices of the company were destroyed in 1943 and the millboard department of the plant was hit early in 1944. Total damage to the plant represents only approximately 20% of total floor space.

At the time of this investigation, Mr.Theobold, the manager of Danco Wetzell Company, had just been ordered by the Military Government to sever his connection with the company because of his former Nazi party affiliations.

3. Gerresheim Glashuttenwerke - Dusseldorf.

2 plants Dusseldorf Plant - Gerresheim section of Dusseldorf
Ettlingen Plant - Ettlingen - Baden.

Dates of Investigation: Dusseldorf - October 16, 1945
Ettlingen - October 30, 1945

Interviewed: Dr. DeRuyter - Managing Director at Dusseldorf
Rudolf Utz - Asst. Mamager - Ettlingen.

The Dusseldorf plant is reported to be the largest glass manufacturing plant in Continental Europe, and is equipped to manufacture window glass, glass bottles and containers, glass blocks, and fibrous glass. Fibrous glass textile materials in this plant are manufactured solely by the Owens processes used in the United States, both staple fiber and continuous fiber textile materials being produced.

Production of staple fiber by the Owens process in Germany has been very limited due to the fact that Schuller process glass fiber, which is lower in cost in Germany, has apparently taken over most of the applications where coarser sizes of fibrous glass yarns can be used.

The use of Owens Process continuous filament glass yarns has been confined to electrical insulation applications.

Due to bomb damage at the Dusseldorf plant in 1943, some continuous and staple fibrous glass equipment was moved to Ettlingen near Karlsruhe. The Ettlingen plant was visited and production of continuous glass fiber material observed. The methods used appeared to be identical to those employed in the United States, however, efficiency of the operations seemed very low, probably accounting for the high cost of Owens process continuous fiber textile materials in Germany. Staple fiber operations were not running at the Ettlingen plant due to lack of fuel.

4. Pahlsche Gummi und Asbestwerke - Dusseldorf.

Location: Roth (suburb of Dusseldorf)

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Date of Investigation: October 15, 1945

Interviewed: Dr. Henrich Pahl - Plant Manager
Dr. Alfauss - Technical Director.

This plant does not produce asbestos textile products of any kind, but rather is engaged in manufacture of mechanical rubber goods, conveyor belting and rubber hose.

It has been reported, however, that this company had some knowledge of developments of "synthetic" asbestos fiber. Questioning on this subject revealed only the fact that some of the technical personnel at Pahlsche had participated in experiments on the production of fibrous glass and mineral wool materials, and that no commercial development had resulted from these experiments.

5. Hardt Pocorny Company - Dahlhausen - Wupper.

Location: Dahlhausen - Wupper (small town near Wuppertal)

Date of investigation: October 16, 1945.

Interviewed: Walter Ruggeberg - Manager
Albert Lotz - Engineer

This plant was of interest only because they are the largest intermediate processors of Schuller Process glass fiber through carding and spinning operations, details of which are described in the main part of this report.

6. Hans Limperg - Schwelm.

Location: Schwelm - small town near Elberfeld

Date of Investigation: October 16, 1945.

This is a very small plant engaged in a limited production of woven electrical tapes from Owens process continuous glass yarn produced by Gerresheim. Weaving equipment is very old, and product inferior to comparable American electrical tapes.

7. Oskar Gossler, Glasgespinstfabrik - Hamburg.

Location: Kampchanseestrasse 71 Bergedorf - Hamburg

Date of Investigation: October 18, 1945.

Interviewed: Dr. Wilhelm Esser - Managing Director

This plant is engaged in the manufacture of glass fiber insulating materials by processes of their own development. The glass fibers produced in this plant are relatively coarse and have no applications as textile materials. Fabricated products consist solely of stitched glass wool blankets and glass wool turbine and boiler lagging, tailored in form of pads with asbestos fabric jackets. Purpose of the asbestos jacket is to provide protection against high temperatures as the glass wool insulating material inside the pad has temperature limit of about 600°F.

8. Deutsche Kap Asbestwerke - Hamburg.

Location: Kampchauseestrasse 8 Bergedorf - Hamburg.

Date of Investigation: October 19, 1945.

Interviewed: Dr. Wilhelm Esser - Managing Director
Karl Fornkeller - Plant Engineer

This company and Oskar Gossler Glasgespinstfabrik, located on the same street in Bergedorf, are both under the same management and both are controlled by Gerresheim Glasshuttenwerke - Dusseldorf.

The plant of Deutsche Asbest is a representative asbestos textile mill producing a full line of asbestos products including yarn, cloth, packings, gaskets, gloves and clothing, insulating pads and specialties. The essential textile equipment in this plant consists of one chaser mill, 3 mixing pickers, 2 vertical openers, 5 single and 3 double sets of Gessner cards, an assortment of ring spinners in ring sizes from 3" to 5" and considerable number of flyers. Weaving equipment consisted of approximately 40 tape and cloth looms of various types all from 20 to 40 years old.

Sizes of yarn reported to be made in this plant range from 2.5 cut to 25 cut. However, yarns finer than 12 cut are made only when very good quality asbestos fiber is available. At the time of this investigation nothing finer than 6 cut yarn was observed in any of the processing operations.

Asbestos mixes used in this plant are typical of mix formulas observed in other plants throughout Germany.

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Asbestos Mix for Ordinary Cloth and Packings.
(Commercial Grade).

40% Italian Spinning Fiber (Short)
25% Russian Spinning Fiber (Short)
15% Yarn Waste
20% Zellwolle waste

This mix is used to manufacture metric No.1.6 yarn (8 cut). Droppings under the card are reported to be 40% - 45% with this stock.

Asbestos Mix for High Temperature Cloth and Packing.
(High Quality)

10% C & G No.2.
30% Italian Spinning Fiber (Long)
40% Russian Spinning Fiber (Long)
13% Yarn waste
7% Zellewolle

This mix is carded in yarn sizes ranging 5 to 10 cut with losses under the card reported as 30% - 35%.

This mix represents the best quality stock observed in Germany and is considerably higher in quality than most asbestos mixes used throughout the industry.

Nothing of unusual nature in either equipment or methods was observed in this plant. Fibrous glass yarn is used as a substitute for asbestos yarn in many of the products. On questioning these people as to the relative merits of asbestos fiber and German fibrous glass, they confirmed previous opinions of other asbestos textile manufacturers that asbestos, if available, was the more desirable material, for reason of better handling and processing characteristics, and also because of the greater heat resistance of asbestos.

9. Asbest und Gummiwerk - Martin Merkel K.G. - Hamburg

Location: Sanitasstrasse 17 Harburg - Hamburg.

Date of Investigation: October 19, 1945.

Interviewed: Martin Merkel, Owner - Director

This company is a relatively small concern established in 1899 by the father of the present owner. They have

for years specialized in asbestos packing and gasketing materials.

Formerly they operated an asbestos textile department for manufacture of asbestos yarn and cloth for packing fabrication. However, about 75% of their plant including the entire textile department was destroyed in June 1944 by American bomber raids on nearby oil refineries in Wilhelmsburg. The textile plant has not been rebuilt.

Merkel was able to supply considerable information about the asbestos textile industry in Germany, having been associated with various asbestos trade groups in Germany before the war, and with the Reichstelle in Berlin during the war. The Reichstelle was the government agency in Berlin (corresponding to the War Production Board) that controlled war industry and allocated raw materials. Merkel has a wide acquaintance in the German industry and some knowledge of the American and Canadian industry having travelled in both countries prior to 1939.

10. Norddeutsche Asbest und Gummiwerk - Hamburg

Location: Wendemuthstrasse 8 - 14 Wandsbek - Hamburg.

Interviewed: Herman Trenkner - Manager

This is a small plant producing asbestos yarn and cloth, packings and gaskets; also peat fiber yarn, cloth, and brake lining tape.

Quality of products in this plant was particularly poor.

Textile equipment consists of 1 chaser mill, 1 Fearnaught picker, 1 vertical opener, 6 Gessner single cards, 8 Flyers and a number of ring spinning frames - also 16 miscellaneous cloth and tape looms.

Except for three of the carding machines which were built by Gessner in 1943 (described in main part of this report) and which are very fine machines, nothing of value was seen in this plant.

This company before the war was connected financially with the J.W.Roberts Co., Ltd., of Leeds, England and was the licensee in Germany for the Roberts process of spraying insulating materials.

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11. Glas Wolle Kom, Ges W.Schuller & Co. - Coburg.

Location: Coburg - Bavaria (north of Bamberg)

Date of investigation:

Interviewed: Werner Schuller - Owner and Director.

This company was considered important in this investigation because it is the producer of the Schuller process glass textile fiber which has been used extensively in Germany as a substitute for asbestos. Details of the Schuller process and discussion of various aspects of the use of Schuller glass textile fibers are covered in the main part of this report.

12. Deutsche Asbestwerke, Reinhold, Georgi and Co. - Mannheim.

Location: Schwetzingerstrasse - Mannheim.

Date of Investigation: October 31, 1945.

A visit was made to this plant only to find that it had been completely destroyed by bombing. The buildings and machinery are a total loss. There was no personnel at this location to interview.

The main plant of this company formerly one of the largest in Germany was located in Berlin, but no attempt was made to visit the Berlin plant as information was obtained that it had been partially destroyed and that salvageable equipment had been removed by the Russians.

13. Mitteldeutsche Asbestfabrik - Niedornhausen.

Location: Niedernhausen - Taunes (near Frankfurt)

Date of Investigation: November 3, 1945.

Interviewed: Moritz Schepping - Owner - Director.

This small asbestos plant was established in 1894 and the present owner has been associated with the company from the beginning of its operations, a total of 51 years.

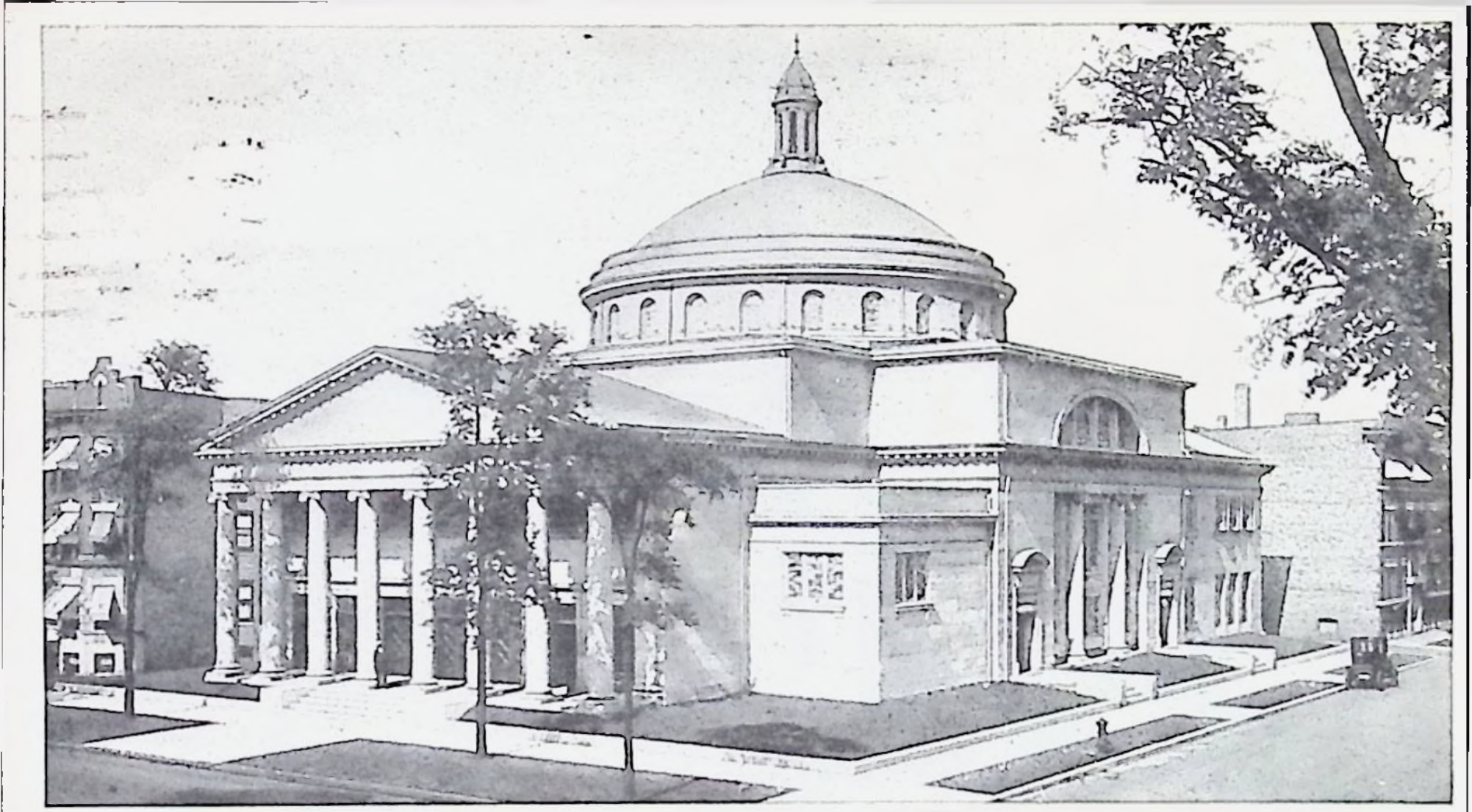
Asbestos yarn and cloth are manufactured, as well as packings, gaskets, gloves and clothing.

Equipment consists of 1 vertical opener, 3 Gessner cards, numerous flyers but no ring spinners, 6 cloth looms and an assortment of braiders.

The textile equipment was not operating due to lack of workers and lack of raw materials, but in spite of its small size this plant appeared to be one of the most orderly and best organized observed in Germany. The quality of asbestos textile materials observed in various stages of processing appeared fairly good, although as is common throughout Germany, all cloth packing and gasketing material is based on coarse yarn sizes on the order of 5 cut to 8 cut.

Although the plant was located on the outskirts of a very small rural town, it had suffered bomb damage, the millboard department having been destroyed.

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