FILE NAME: Industrial Hygiene Foundation (IHF)

DATE: 1944 Mar

DOC#: IHF080

DOCUMENT DESCRIPTION: Excerpts - Report of Industrial Hygiene made For Raybestos-Manhattan with Cover Letter

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

4400 FIFTH AVENUE

PITTSBURGH, PA. (13)
April 18, 1944.

Mr. O. H. Cilley, Asst. Gen. Mgr.,
U. S. Asbestos Division
Raybestos Manhattan, Inc.,
Manheim, Pa.

Dear Mr. Cilley:

Enclosed is the report giving the results of the Foundation's recent studies at your Manheim operations which are a part of your continuing dust control program. Additional copies of the report are provided for your associates. The statement covering the work is enclosed.

Please note that the Foundation arranged for examination of dust samples by the electron microscope. This, because of circumstances involved, was somewhat time-taking.

After the report has been examined we anticipate that you or your associates may have some questions. If so we invite you to correspond with Mr. W.C.L. Hemeon direct. After the recommendations have been carried forward we will expect to continue the study and we will appreciate your advices when the time is opportune.

We are enclosing a copy of the Foundation's bulletin on Measurement of Air Flow in Industrial Ventilation which Mr. Hemeon promised to Mr. Joyce.

The excellent assistance and cooperation which was given Mr. Hemeon was of great assistance in the conduct of this work.

Very truly yours,

John F. McMahon
Managing Director

JFM:D
encls.

FOR THE CONSERVATION OF EMPLOYEE HEALTH IN INDUSTRY

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.
4400 FIFTH AVENUE
PITTSBURGH, PA.

REPORT OF INDUSTRIAL HYGIENE SURVEY

MADE FOR

United States Asbestos Division
of
Raybestos-Manhattan, Inc.

Manheim, Pennsylvania

March 14,15,16 and 17, 1944

FIELD WORK BY W. C. L. Hemeon
Ventilation Engineer
LABORATORY WORK BY Francis R. Holden Ph.D.,
Industrial Hygienist

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

BY John [illegible]
MANAGING DIRECTOR

April 18, 1944

R.M. 3870-A [illegible]

Industrial Ventilation Survey

of the

United States Asbestos Division

of Raybestos-Manhattan, Inc.

Manheim, Pennsylvania

March 14,15,16 and 17, 1944.

SUMMARY

This is a report of a study undertaken to locate the most important sources of dust and to develop additional dust control measures at the Manheim plant of U. S. Asbestos Division of Raybestos-Manhattan, Inc. Sixteen dust counts were made in various departments. These samples indicate that conditions in the Picker House are not satisfactory but dustiness in the Carding, Spinning and Twisting Departments is less than 5 million particles per cubic foot. Recommendations are made that can lead to a reduction of dustiness in the Picker House as well as in the Carding Department. It is believed that while the card room is under considerable negative pressure the consequent starvation of the exhaust equipment is probably not in itself sufficient to account for any marked reduction in control of dust.

The results of dust counts are given in Table I.

INDUSTRIAL HYGIENE FOUNDATION OF AMERICA, INC.

Industrial ventilation survey of the U.S. Asbestos Div. of Raybestos-Manhattan, Inc., Manheim, Pa., March 14, 15, 16, 17,1944.

TABLE I

Dust Counts

Sample No.	Date	Time	Location and Operation	Particles per cu. ft.
			Picker House	
24	3/14/44	1:50-2:01 P	At Pan Crushers, to nearly simulate operator's exposure	8.7 million
27	3/14/44	1:35-1:45 P	Floor Batching - Exposures of 2 workers outside booth - Finished about 1:42	1.7 million
21	3/14/44	2:16-2:27 P	Operation of Pan Crushers for Amosite-Time represented complete cycle of operation. (1/2 hour daily)	38.0 million
19	3/14/44	4:22-4:33 P	Batch feeding vertical opener. Exposure of operator within booth	9.9 million
ESP 10	3/17/44	9:50-10:42A	52 minute sample at central point of room for "general air." near vertical opener	5.6 million
			Carding	
23	3/14/44	2:59-3:10 P	General air walking about various carding machines in Breaker Card Room	4.0 million
26	3/14/44	3:17-3:27 P	Beside point of discharge from condenser to box in Breaker Card Room	3.8 million
1	3/15/44	10:54-11:09A	At roving end of 4 finish cards, #1, 2,7,8. General air - Exposure of 2 attendants	4.3 million
2	3/15/44	11:15-11:25A	Along central aisle-way, at camel-back ends of cards	4.8 million
ESP 11	3/17/44	10:49-11:49A	Between finisher cards, #15,16,21,22. All windows of carding and spinning room open wide to simulate summer conditions	2.8 million
			Spinning and Winding	
3	3/15/44	11:48-11:58A	At mule spinner, while following operator, to simulate his exposure	4.8 million
4	3/15/44	1:10-1:20 P	At Universal winders, 2nd floor, adjoining cards - following operator (no exhaust)	3.0 million
5	3/15/44	1:36-1:46 P	At Foster Winders. Average of all aisle-ways	3.6 million
6	3/15/44	1:50-2:00 P	At Twisters. Average of all aisle-ways	4.0 million
7	3/15/44	2:19-2:29 P	At L-frames on 2nd floor. Average along aisle-ways	3.6 million
8	3/15/44	2:45-2:55 P	At L-frames on 1st floor. Average along aisle-ways	2.0 million

Note: All samples with Midget Impinger except those marked ESP (Electrostatic Precipitator.)

DUST CONTROL IN THE PICKER HOUSE

Operation of the pan crushers results in excessively high concentrations of dust as shown by Sample 24 (8.7 million). It is recommended that the system originally designed, which contemplated keeping the doors of the enclosure closed most of the time, be supplanted by the following arrangement:

Exhaust from each pan crusher hood a sufficient volume of air to create a velocity of 200 feet per minute through one of the two working openings whose dimensions should be reduced to 2½ feet wide by 2½ feet high. it is suggested that inasmuch as the two openings would never be necessary at any one time, doorway covers be provided that are interconnected so that when one is opened the other will close. The covers might be hinged and their closure motions connected by cable and pulley or they could be slidable vertically and similarly interconnected. In any case a snug fit is unnecessary and should be avoided for ease in manipulation. This plan will call for a total exhaust capacity of 5000 c.f.m. for the four crushers.

Batching

The dust counts of Samples 27 and 19 indicate that the two workers stationed outside the booth are not exposed to important dust concentrations but that the man who feeds the vertical opener within the booth is exposed to concentrations of about 10 million particles during the actual batching by the two men outside. His average exposure, of course, is less than this because of the intermittent nature of the operation.

It is recommended that consideration be given to the erection of a "batching bed" comprising a long narrow bin, located in the position where the pile is now made on the floor. This bin would be enclosed and exhausted and have as an important element, a side facing the opener that may be removed or shifted by raising when the batched material is ready for feeding to the machine. Further study will be given to this at the time of the next visit. The arrangement is illustrated diagrammatically in Figure 1.

Tandem Vertical Opener

This unit was not in regular operation at the time of the study but it was apparent from a brief, specially arranged operation that considerable dust leaks from the cast iron cover located adjacent to the condenser. It should be possible to correct this without the application of exhaust, either by replacing the cover or by providing an adequate gasket.

The giant cutter, Johnson's grader, waste machine and willow were not in operation at the time of our studies.

DUST CONTROL IN CARDING

Studies of uncontrolled dust sources around the carding machines disclosed the following:

Feed Rolls

An appreciable amount of dust originates at the feed roll of many of the finisher cards, which can best be observed with an intense light beam. Some machines are equipped with curved trays or baffles under this roll which are effective in minimizing dust at this point. Observations on this point, made on somewhat less than half of the machines, are as follows:

Card No.	Observation
1	OK
2	Fair (but needs front to complete enclosure)
3	OK
4	Dusty
5	OK
8	Dusty
11	Dusty
12	OK
19	Dusty
20	OK
21	OK
22	OK

It is recommended that such baffles be installed on all finisher cards not now equipped. This point was discussed particularly with the card room foreman.

Wiper Roll and Rub Apron

Another dust source is at the junction of the wiper roll and the doffer. A partial check of machines was made with the conclusion that an appreciable amount of dust occurs at this point in the case of the following finisher cards:

Numbers 3, 4, 9, 10, 17, 18, 23, 24.

It was noted also that some dust originates from the rub aprons and since these are adjacent to the wiper rolls it may, for purposes of control, be considered the same source of dust.

It is recommended for the top set of rolls that a removable cover be provided clear over the upper set of rub aprons thus, in effect, extending the present exhausted enclosure and rendering this dust source subject to the influence of the present exhaust. It may also be advisable to remove one stave at the lower end of the existing enclosure immediately over the doffer roll to facilitate air flow through the supplementary enclosure.

For the lower rub apron and wiper it is recommended that some experimental work bedone on a hood as suggested below. We illustrate in Figure 2 an exhaust hood or slot which is designed to be placed immediately adjacent to the wiper roll at the point where it joins the rub apron. In the design illustrated an attempt has been made to reduce the width of the hood to the smallest possible dimension in order to avoid interference with proper functioning of the machine. In this preliminary design we provide for:

(a) an air flow of 75 c.f.m. per foot of length,

(b) a face velocity of 2000 feet per minute (to aid in effecting good distribution along the length of each slot section, and

(c) elimination of excessive cross sectional area in the transition section in order to maintain adequate velocities for the transport of material.

A partial compromise has been incorporated in the design to avoid a too complicated hood but it is believed that the lower velocities at the largest section of the transition will not seriously interfere with its proper function.

Not shown on the diagram are necessary pieces at the ends which will extend to the side frames and serve to support the unit in position. It would be advisable to have a quickly detachable connection with the branch duct that will lead to the exhaust main overhead.

Reserve Exhaust Capacity

The following observations indicate that there is adequate exhaust capacity for the supplementary exhaust hoods described above.

The capacity of the exhaust system indicates an average of 700-800 c.f.m. per cylinder. Some individual measurements of air flows in different branches were made by means of static suction measurements and with the dampers in the position that had been set by the operators of the carding department. They indicate what was considered adequate by the operating personnel as judged visually. As may be seen from the results in the following table they vary quite widely.

Industrial Ventilation survey of the U. S. Asbestos Div. of Raybestos-Manhattan, Inc., Manheim, Pa., March 14,15,16,17, 1944.

Air Flows Through Individual Card Hoods

(Taking Damper Adjustment as Found)

Unit	Static suction	Air Flow
#1 Finisher	1.9 inches	920 c.f.m.
#2 Finisher	1.0 "	670 "
#2 Breaker	0.6 "	515 "
#3 Breaker	0.8 "	590 "
#3 Finisher	0.4 "	420 "
#4 Breaker	0.2 "	210 "
#5 Breaker	0.6 "	510 "
#5 Finisher	1.6 "	840 "
#31 Breaker	1.4 "	790 "

It is particularly significant that even in the case of #3 Finisher and #4 Breaker no escaping dust could be detected at any point. This indicates that there is considerable reserve capacity.

AIR EXHAUST AND SUPPLY IN VARIOUS DEPARTMENTS

Picker House

With all doors and windows closed, as is the case in winter, the Picker House was found to be under a negative pressure of 1/2" water column. While this is likely to starve at least some of the exhaust equipment we believe the dust sources enumerated above are of much greater importance than this factor and should receive prior attention. A tabulation of existing exhaust capacity from this department is given in the table below and is based principally on the measurements made by Mr. Bertelet and Mr. Gilpin.

Exhaust Capacity in Picker House

Unit	Capacity
Old Shaker Screen	2500 c.f.m.
Cotton Machine	2900 C.f.m.
Willow and Tandem Vertical Opener	6000 c.f.m.
New P. & S. Grader, through condenser over shaker screen	3400 c.f.m.
New shaker screen, through condenser in card room	2900 c.f.m.
C.O.B.	2400 c.f.m.
15" Pipe to Breaker card system, from pan crushers, etc. (estimated)	2500 c.f.m.
Total	22600 c.f.m.

Unbalance in Card and Spinning Department

The measurement of air flow from the carding exhaust systems together with other data obtained from Mr. Bertelet is tabulated below to indicate the total volume of air exhausted from the room.

Cards 1-12	18,000 c.f.m.
Cards 13-24	17,000 c.f.m.
L-frames (older system)	13,000 c.f.m.
L-frames (newer system - estimated)	13,000 c.f.m.
Total	58,000 c.f.m.

The available data for the breaker card room are as follows:

Right half (double fan)	6,500 c.f.m.
Left half (double fan)	7,900 c.f.m.
	14,500 c.f.m.
From Picker House (estimated)	2,500 c.f.m.
Net from breaker room	12,000 c.f.m.

Some air is supplied to this floor from the first floor Carrier system but there is a deficit for the carding and spinning department of about 32,000 c.f.m.

There is, however, an air supply unit in this department with a capacity of 36,000 c.f.m. which is operating at present as a heater only and requires modification (brought out by Mr. Bertelet) to permit it to handle outdoor air directly. The necessary changes should be effected.

The same is true of the breaker room where a unit with a capacity of 18,000 c.f.m. requires modification to permit it to supply properly tempered outdoor air to the room.

Effect on Dust Control

Pitot tube measurements were made on one of the main pipes with the windows open and with windows closed. In the former case the velocity was 3100 feet per minute and in the latter case 2970 feet per minute, a ratio of 1.05 indicating a 5% increase in air flow. These measurements are not considered exact.

The characteristic curve of the fan (American Blower Company, steel plate fan, #80, at 662 r.p.m.) is shown as Figure 3 and as may be seen from the analysis indicated thereon, an increase in air flow of 10 to 15% may be expected by reducing the resistance by 0.4 inches. One would hardly expect material difference in the operation of the exhaust system with such a small percentage increase in air flow.

Dust sample ESP 11 shows a concentration, with all windows wide open, of 2.8 million particles, as against concentrations of over 4 million (for example, sample #1) taken two days earlier. If this comparison is to be considered representative it must be due to the additional general ventilation caused by natural air currents through the open windows. That is, in warm weather, with all windows open, a volume of general ventilation in addition to that caused by operation of the exhaust system will be obtained and must affect the dust situation favorably. This would not, however, indicate marked improvement in winter by providing just the proper volume of make up air.

Such unbalanced conditions are always likely to cause discomfort because of drafts that occur in the peripheral areas of the room, so it is recommended that correction be made.

TWISTING DEPARTMENT

No conclusions were reached with regard to improved dust control in this department but data on the exhaust capacity and volume of air supplied by the Carrier system is reported below. With the assistance of Mr. Bertelet and Mr. Gilpin we made 64 readings of linear velocity at the face of the pre-heater, whose area is 81 sq.ft., and concluded that under conditions then prevailing the system was delivering 60,000 c.f.m.

A capacity of the various exhaust systems has been estimated by Mr. Bertelet as follows:

Foster Winders	
East Fan	3300 c.f.m.
West Fan	3330 c.f.m.
Twisting Machines	
North Fan	11000 c.f.m.
South Fan	11000 c.f.m.
Cop Winders	5000 c.f.m.
Total	33600 c.f.m.

RECAPITULATION -- AIR EXHAUST AND SUPPLY

	Total Exhaust c.f.m.	Potential Supply c.f.m.	Source
Picker House	22,600		
Breaker Card Room	12,000	17,800	Existing Carrier Unit, modified
Carding and Spinning Room	58,000	36,000	Existing Carrier Unit, modified
		26,400	Overflow from Twisting Department
Twisting Department	33,600	33,600	Required portion from available supply of 60,000 from main Carrier system

It appears from the tabulation above that there are available means for supplying all requirements except that for the Picker House. It is believed that this may be cared for by air cleaning units to permit recirculation from some of the systems handling small amounts of dust. (See following section.)

AIR FILTRATION

An effective dust collector which will produce clean air i.e., one with a dust content of less than 1/4 million particles per cubic foot, would have valuable applications. It could serve to reduce the unbalance between air exhaust and air supply by drawing air from the dust house for recirculation and also would permit direct recirculation from some of the exhaust systems that handle relatively small amounts of dust such as those for the L-frames and for the winders and twisters. We have in mind particularly the indicated deficit of about 25,000 c.f.m. for the Picker House.

Recirculation of air from dust collector systems where the dust is inherently hazardous to health is generally frowned on and we are among those who usually discourage the practice. This is because of the difficulty of maintaining such equipment so as to assure the purity of the air returned. However, it is not often that there are economic incentives as great as in the present case. We believe an exception is warranted here and recommend certain preliminary experimentation which will lead to an adequate system that will overcome the objections usually encountered.

It is recommended for this purpose that a small unit be constructed for connection to the dust house or to a system serving Foster winders or L-frames so that tests including dust counts in the effluent air can be conducted. The unit illustrated has bags 6" in diameter and about 7' long providing a cloth area of approximately 10 sq. ft. per tube. This unit can be made with as many tubes as desired. We show six for a total of 60 sq. ft., and whose capacity may be anywhere from 100 c.f.m. to 600 c.f.m., depending upon the application. It is contemplated that the cloth will be plugged with some inert dust preliminary to actual use, for example limestone dust, until its preliminary resistance is 0.1 to 0.2 inches at a filtration velocity of 1 f.p.m. This will probably require about 1/2 ounce of dust per sq. ft. of cloth area.

The design is illustrative only. It may be advisable to increase the size to fit an available blower. Further, to avoid the inconvenience of finding a source of supply for the small quantities of filter cloth required it is suggested that bags be ordered from a manufacturer of such collectors, in which case the metal collars and other pertinent dimensions of the housing would be changed to accommodate the bags. Either of the following is suggested:

C. F. Berg Company
East Dedham Street
Boston, Mass.

Parsons Engineering Company
3589 East 82nd Street
Cleveland, Ohio.

SUMMARY OF RECOMMENDATIONS

Picker House

1. Modify exhaust for pan crusher hoods, providing 1250 c.f.m. per hood and interconnected hinged doors. ✓

2. Repair cast iron cover on Saco-Lowell vertical opener where dust leakage occurs. ✓

3. Consider the installation of a batching bed enclosure, with movable side and air exhaust in volume to create face velocity of 100 f.p.m. (See page 4 and figure 1.) ✓

Carding Machines

4. Install curved trays under the feed rolls of the finisher cards requiring them. (See page 5.)

5. Construct experimental removable cover for one or two finish cards for dust from upper wiper roll and rub apron. (See page 6.)

6. Construct experimental slot-hood for lower wiper roll and rub apron. Provide connection to exhaust system at a convenient location for testing and another for attachment to one or two selected machines. (See pages 6 and 7 and figure 2.)

Air Filtration

7. Construct a model filter dust collector for efficiency tests with arrangements for connection to dust house for one test and to spinning and twisting exhaust system for another. (See page 14 and figure 4.) ✓

It would be advisable to complete most of the above prior to our next visit, especially Nos. 1, 4, 5, 6.

ELECTRON MICROSCOPE EXAMINATION OF DUST

It was felt that an examination of the air-borne dust by the electron microscope would throw some additional light on the fundamental problem of asbestosis even though we draw no definite conclusions therefrom. One school of thought maintains that the pulmonary condition results from a mechanical action of asbestos fibers on lung tissue, yet the dust seen in counting is almost all non-fibrous.

Through the courtesy of the research laboratories of the Aluminum Company of America, which is a member of Industrial Hygiene Foundation, electron microphotographs of air-borne dust have been obtained and are appended hereto. The dust was collected with the electric precipitator in the carding room.

Two questions were propounded by us to the laboratory, as follows:

1. Are the cubical (non-fibrous) particles that are seen in the light microscope used for counting actually composed of unbroken bundles of fiber as in the parent rock? (Particles of this shape comprise over 95% of those seen and counted.)

2. Is there a large quantity of fibers whose length is several microns but which are invisible by the light field set-up because their diameter is below the limit of resolution?

The report included the following:

"The dust was found to contain many fibrous particles as well as non-fibrous particles as shown in Fig. 1. At the magnification used for this micrograph (5000X), however, the non-fibrous particles may appear to predominate. This is not the case and no doubt results from the small size of the fibers as examination at high magnification shows that much of the material is present as small fibers as shown in Fig. 2. The fibers were found to range in length from a fraction of a micron up to a few microns with an average length of about 1 micron. The thickness of the small fibers ranged from 0.01 micron to 0.05 micron (100-500 Angstrom units) with the average closer to the lower limit.

"The nature of the non-fibrous particles probably is as suspected - that is, they consist of bundles of fibers which have not been broken apart. This is evident from a few of the particles in Fig. 1 and particularly from the particle in Fig. 3. Several fibers protruding from the end of the large bundle are shown in the latter micrograph."

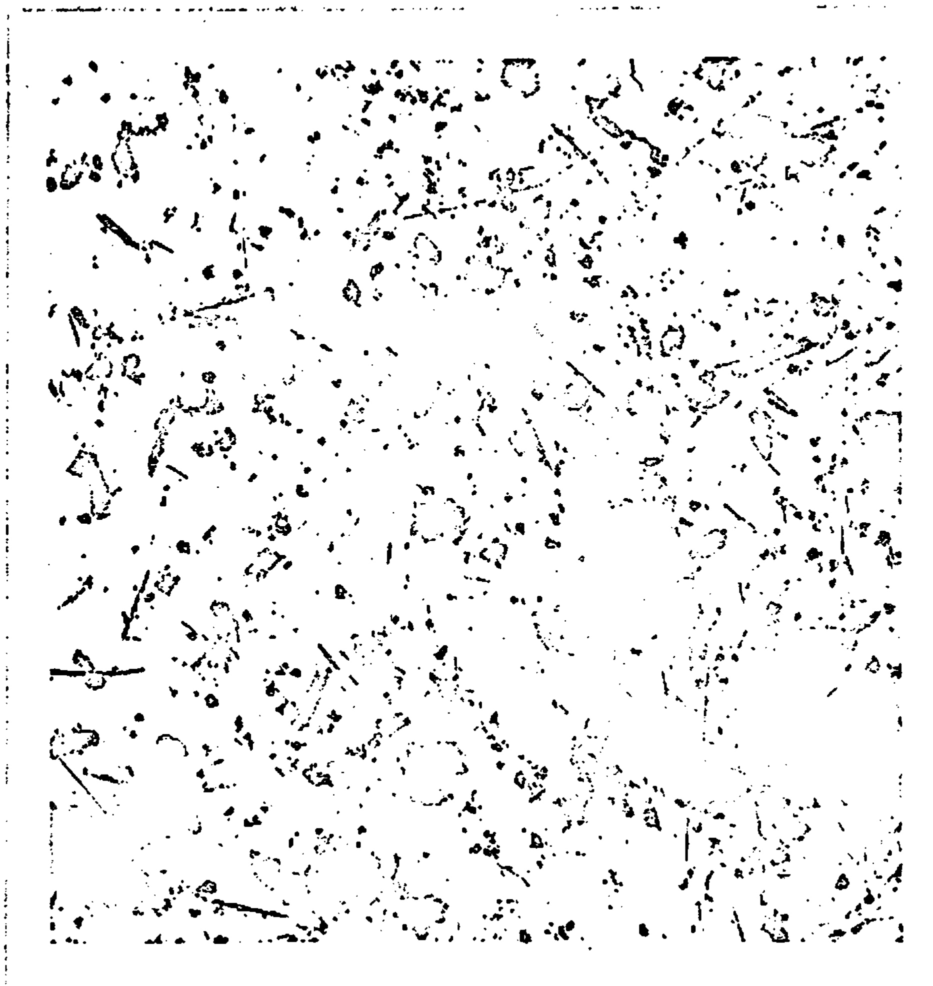

Fig. 1 Plate 2780 5000X

Appearance of air-borne asbestos dust at a low magnification showing both the non-fibrous and the fibrous particles.

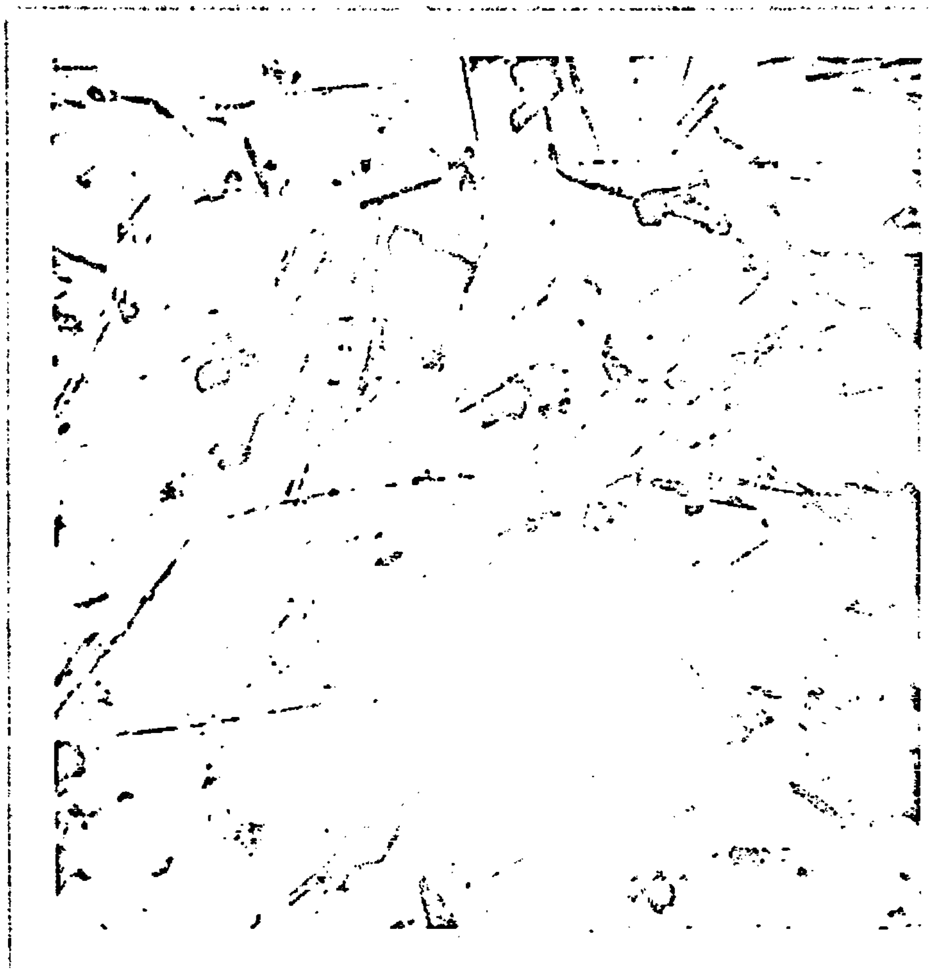

Fig. 2 Plate 874A 25,000X

Appearance of the fine fibers at a high magnification.

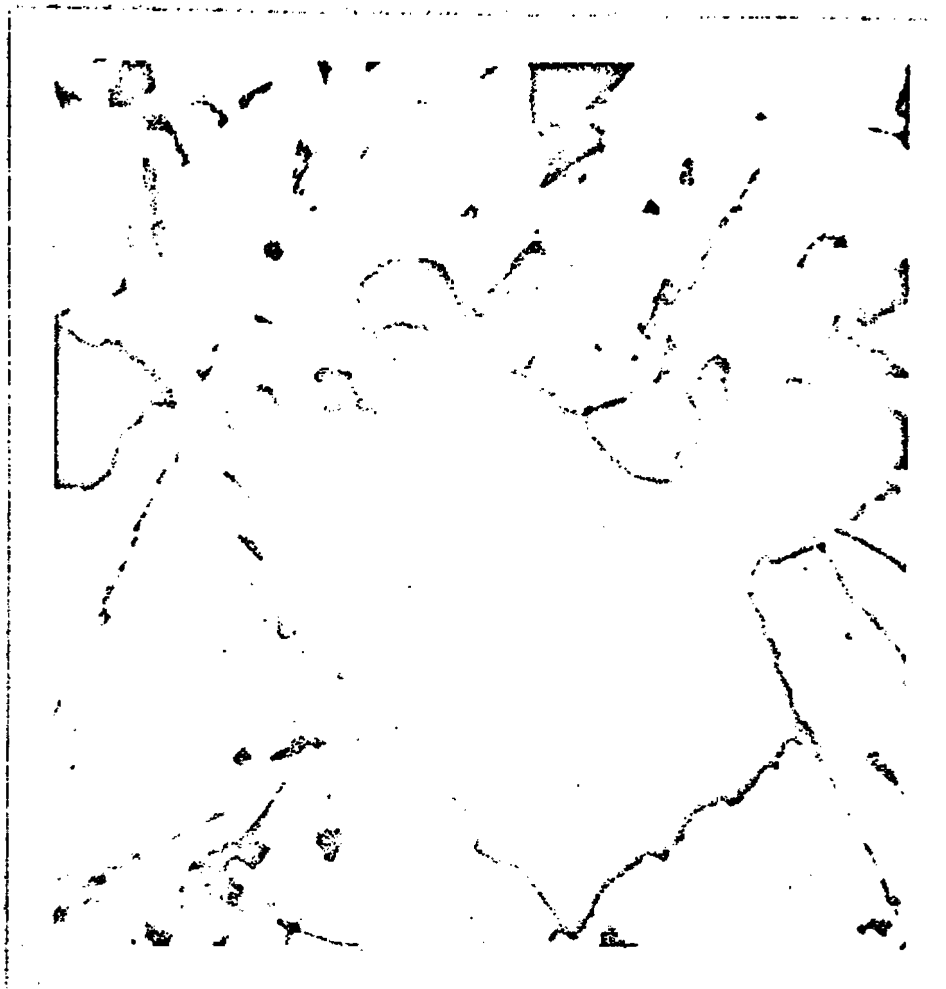

Fig. 8 Plate 278A 35,000X

Nature of a large non-fibrous particle which appears to be composed of a bundle of fibers as evident by the irregular nature of the one end surface.