

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
FOOD AND DRUG ADMINISTRATION

TO : Dr. Robert M. Schaffner, Director
Office of Technology (BF-400)

DATE: July 31, 1973

RMP
7/31/73

FROM : Dr. Alfred Weissler, Acting Director
Division of Color Technology (BF-430)

SUBJECT: Summary and Comments on Prof. Lewin's Analytical Results for Asbestos in Talc

1. The purposes of this memorandum are to present a summary of the analytical results for asbestos in Cosmetic talcum-type powders obtained by Prof. Seymour Z. Lewin of New York University in his role of consultant to FDA; to compare his results with those obtained by other laboratories on some of the same samples; and to make some comments on the general question of suitable techniques for the analysis of asbestos in talc.

2. I asked Dr. Lewin in December 1971 to undertake asbestos analyses in 100 samples of cosmetic powders; the scope was expanded on two subsequent occasions, to include a total of 195 samples. I chose Dr. Lewin for this work because he is an internationally-recognized expert on mineralogical chemistry and because he is a member of the academic community and therefore likely to be impartial in a confrontation between industry and government. Furthermore, his competence had previously been recognized by industry (by virtue of their own use of him as a consultant) which appeared to confer a desirable immunity against possible industry attacks on the validity of the results.

3. Dr. Lewin's findings are shown in Table I; the key to the identities of the numbered samples is given in Table IV. Please note also the explanatory comments in Dr. Lewin's memo of July 10, 1973, which is an Attachment to Table I. No varieties of asbestos other than chrysotile (a serpentine) or tremolite (an amphibole) were found by Dr. Lewin in the 195 samples which he examined. As shown in Table I, Dr. Lewin found definite indications of chrysotile in 17 of the samples (many of these also had tremolite) and definite indications of tremolite but not chrysotile in an additional 18 of the samples. These results were obtained primarily by means of X-Ray diffraction, supplemented in some cases by optical microscopy and other techniques. However, Dr. Lewin points out on page 2, paragraph 1 of the Table I Attachment that the chrysotile he has identified in commercial products shows several significant differences from "classical" chrysotile: in the location of its X-Ray diffraction peaks, in its appearance under the microscope, in its reactivity toward dilute acid, and in its behavior with respect to differential thermal analysis.

4. In Table II, I have compared Dr. Lewin's results for tremolite with those obtained for some of the same samples at FDA (by means of optical microscopy) and at the Pfizer Minerals, Pigments, and Metals Division (by means of X-Ray diffraction). This comparison, which was undertaken in order to obtain additional information on the samples, shows good semi-quantitative agreement among the three laboratories. Whatever quantitative differences exist in the amounts of tremolite found can be understood readily on the basis of such factors as (a) preferred orientation of plates and fibers in the packing of the X-Ray diffraction sample, and (b) inhomogeneities in sample composition, caused for example by air elutriation within the container when it is shaken.

5. In Table III, I have compared Dr. Lewin's results for chrysotile with those obtained for some of the same samples by four other laboratories; the additional two laboratories included in this part of the study are Columbia Scientific Industries of Austin, Texas (who sell the Stone apparatus for differential thermal analysis) and the Health Protection Branch of the Department of National Health and Welfare of the Canadian government in Ottawa. The agreement of results from different laboratories is much less satisfactory for chrysotile than that discussed above for tremolite. For example, samples 89 and 163 were found by Dr. Lewin to contain 5% and 10% of chrysotile, respectively, but chrysotile was not found in these samples by the other laboratories. Also, a preliminary finding of chrysotile in a sample of Johnson and Johnson Shower to Shower Body Powder has been disputed by the company, which claimed that their own analyses by several different techniques fail to show the presence of chrysotile. The explanation for these differences is attributable largely to Dr. Lewin's inclusion in the term "chrysotile" of mineral species which show significant differences from classical chrysotile, as discussed in paragraph 3 above.

6. The difficulties involved in analyzing talc and other samples for small amounts of asbestos have been pointed out by many investigators. It is not surprising that the results of different laboratories disagree sometimes, especially in the presence of transitional or altered mineralogical species. Moreover, with regard to the two varieties of asbestos of concern here, it is unfortunate that the one which is a clear inhalation hazard to man, namely chrysotile, poses an intrinsically more difficult analytical problem than the other, tremolite, which has not yet been shown to present a biological hazard. This is due in part to the less prominent X-ray diffraction peaks of chrysotile and to the fact that the fibers are often too small to be seen in the optical microscope.

7. In connection with a proposed new regulation on the safety of cosmetic talcum powders, we face the problem of specifying an analytical test for asbestos which must be satisfied by the powders if they are not to be considered adulterated. On the basis of information available at present, I recommend consideration of the following procedure. The powders shall be examined first by X-ray diffraction, which has a sensitivity of the order of 1% for chrysotile and somewhat greater sensitivity

for tremolite. If either species is found, confirmation that the species is present in fiber form is to be obtained by optical microscopy and electron microscopy. This is necessary because tremolite is known to occur in a non-fibrous form, and the X-ray diffraction pattern of chrysotile is the same as that of antigorite, a non-fibrous form of the same mineral. The sample is considered adulterated if the presence of fibrous tremolite or chrysotile is shown by the above procedure. An alternative procedure, based solely on optical microscopy (which is a less expensive and more widely available technique) might be proposed. However, the difficulty with optical microscopy alone is that it may completely miss the presence of chrysotile if the fibers are submicroscopic, which may well be the case in finely-milled talc; X-ray diffraction is not subject to this source of error.

A handwritten signature in dark ink, appearing to read "Alfred Weissler". The signature is fluid and cursive, with the first name being more prominent.

Alfred Weissler, Ph.D.

Enclosures

TABLE I

FINAL REPORT

X-RAY POWDER DIFFRACTION ANALYSES OF COMMERCIAL COSMETIC POWDERS

<u>Sample</u>	<u>Talc</u>	<u>Chlorite</u>	<u>Phlogo- pite</u>	<u>a- Quartz</u>	<u>Dolo- mite</u>	<u>Calcite</u>	<u>Trem- olite</u>	<u>Chryso- tile</u>	<u>Other Species</u>
1	70%	3%	7%	n.d.	n.d.	n.d.	n.d.	n.d.	
2	100%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	
3	99%	n.d.	1%	n.d.	n.d.	n.d.	n.d.	n.d.	
4	100%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	
5	95%	2%	3%	n.d.	n.d.	n.d.	n.d.	n.d.	
6	80%	2%	5%	n.d.	n.d.	n.d.	n.d.	n.d.	CaUndecyl.
7	86%	7%	2%	3%	2%	n.d.	n.d.	?	
8	95%	2%	3%	n.d.	n.d.	n.d.	n.d.	n.d.	
9	89%	7%	2%	2%	n.d.	n.d.	n.d.	n.d.	
10	93%	3%	2%	2%	n.d.	n.d.	n.d.	n.d.	
11	90%	2%	2%	4%	2%	n.d.	n.d.	n.d.	
12	100%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	
13	60%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	ZnUndecyl.
14	31%	50%	2%	10%	7%	n.d.	n.d.	n.d.	
15	100%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	
16	--	--	--	--	--	--	--	--	Kaolin, Starch
17	60%	30%	4%	n.d.	6%	n.d.	n.d.	n.d.	
18	90%	4%	2%	2%	2%	n.d.	n.d.	n.d.	
19	97%	1%	2%	n.d.	n.d.	n.d.	n.d.	n.d.	
20	35%	60%	1%	4%	n.d.	n.d.	n.d.	n.d.	
21	67%	25%	2%	3%	3%	n.d.	n.d.	n.d.	
22	59%	35%	1%	n.d.	5%	n.d.	n.d.	n.d.	
23	42%	50%	2%	3%	3%	n.d.	n.d.	?	
24	94%	1%	2%	3%	n.d.	n.d.	n.d.	n.d.	
25	95%	2%	3%	n.d.	n.d.	n.d.	n.d.	?	
26	95%	1%	4%	n.d.	n.d.	n.d.	n.d.	?	
27	78%	n.d.	2%	n.d.	20%	n.d.	n.d.	n.d.	
28	ca. 20%	1%	n.d.	n.d.	n.d.	10%	n.d.	n.d.	Kaolin, Mica
29	ca. 94%	n.d.	2%	n.d.	2%	n.d.	n.d.	n.d.	Kaolin
30	97%	1%	2%	n.d.	n.d.	n.d.	n.d.	n.d.	
31	47%	50%	2%	3%	8%	n.d.	n.d.	n.d.	
32	80%	7%	3%	2%	8%	n.d.	n.d.	n.d.	

<u>Sample</u>	<u>Talc</u>	<u>Chlorite</u>	<u>Phlogo- pite</u>	<u>α- Quartz</u>	<u>Dolo- mite</u>	<u>Calcite</u>	<u>Trem- olite</u>	<u>Chryso- tyle</u>	<u>Other Species</u>
33	55%	40%	2%	n.d.	3%	n.d.	n.d.	n.d.	
34	78%	7%	4%	3%	8%	n.d.	n.d.	n.d.	
35	78%	5%	2%	10%	5%	n.d.	n.d.	n.d.	
36	ca. 81%	4%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	Mica
37	38%	50%	5%	n.d.	7%	n.d.	n.d.	n.d.	
38	87%	5%	4%	2%	2%	n.d.	n.d.	n.d.	
39	94%	3%	n.d.	3%	n.d.	n.d.	n.d.	n.d.	
40	67%	25%	n.d.	3%	5%	n.d.	n.d.	n.d.	
41	33%	8%	2%	2%	5%	n.d.	n.d.	n.d.	
42	89%	6%	n.d.	n.d.	3%	2%	n.d.	n.d.	
43	97%	n.d.	n.d.	3%	n.d.	n.d.	n.d.	n.d.	
44	--	--	--	--	--	--	--	--	ZnO, Kaolin
45	66%	30%	n.d.	n.d.	4%	n.d.	n.d.	n.d.	
46	48%	40%	n.d.	5%	7%	n.d.	n.d.	n.d.	
47	98%	n.d.	n.d.	n.d.	n.d.	2%	n.d.	n.d.	
48	88%	4%	2%	2%	4%	n.d.	n.d.	n.d.	
49	100%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	
50	95%	5%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	
51	100%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	
52	87%	8%	2%	3%	n.d.	n.d.	n.d.	n.d.	
53	90%	4%	2%	2%	2%	n.d.	n.d.	n.d.	
54	ca. 87%	3%	4%	n.d.	4%	n.d.	n.d.	?	
55	80%	15%	n.d.	5%	n.d.	n.d.	n.d.	n.d.	
56	90%	7%	n.d.	3%	n.d.	n.d.	n.d.	n.d.	
57	80%	15%	n.d.	n.d.	5%	n.d.	n.d.	n.d.	
58	96%	n.d.	n.d.	4%	n.d.	n.d.	n.d.	n.d.	
59	ca. 90%	n.d.	n.d.	3%	n.d.	n.d.	n.d.	n.d.	Storch
60	ca. 60%	30%	n.d.	n.d.	7%	2%	n.d.	n.d.	ZnStear.
61	38%	40%	n.d.	4%	18%	n.d.	n.d.	n.d.	
62	85%	2%	n.d.	3%	n.d.	10%	n.d.	n.d.	
63	87%	2%	2%	4%	n.d.	n.d.	5%	n.d.	
64	ca. 80%	5%	3%	2%	3%	n.d.	n.d.	n.d.	ZnStear.
65	ca. 78%	15%	n.d.	n.d.	4%	n.d.	n.d.	n.d.	ZnStear.
66	84%	5%	3%	3%	3%	n.d.	n.d.	2%	
67	78%	15%	n.d.	n.d.	5%	n.d.	2%	n.d.	
68	80%	15%	n.d.	n.d.	5%	n.d.	n.d.	n.d.	
69	97%	1%	n.d.	n.d.	n.d.	2%	n.d.	n.d.	

<u>Sample</u>	<u>Talc</u>	<u>Chlorite</u>	<u>Phlogopite</u>	<u>α-Quartz</u>	<u>Dolomite</u>	<u>Calcite</u>	<u>Tremolite</u>	<u>Chrysotile</u>	<u>Other Species</u>
70	28%	60%	n.d.	5%	7%	n.d.	n.d.	n.d.	
71	85%	10%	n.d.	2%	n.d.	n.d.	3%	n.d.	
72	86%	5%	3%	4%	n.d.	2%	n.d.	n.d.	
73	ca. 80%	10%	n.d.	3%	5%	n.d.	n.d.	n.d.	ZnStear.
74	90%	n.d.	n.d.	n.d.	5%	5%	n.d.	n.d.	
75	75%	5%	n.d.	n.d.	15%	5%	n.d.	n.d.	
76	75%	n.d.	5%	5%	10%	n.d.	5%	n.d.	
77	91%	n.d.	4%	2%	n.d.	n.d.	3%	n.d.	
78	85%	2%	1%	4%	3%	n.d.	5%	n.d.	
79	81%	5%	4%	n.d.	2%	8%	n.d.	n.d.	
80	ca. 50%	40%	n.d.	8%	n.d.	n.d.	n.d.	?	
81	ca. 80%	7%	1%	6%	4%	n.d.	n.d.	?	
82	ca. 78%	12%	2%	4%	3%	n.d.	n.d.	?	
83	ca. 84%	6%	5%	n.d.	4%	n.d.	n.d.	?	
84	ca. 92%	4%	n.d.	n.d.	3%	n.d.	n.d.	?	
85	ca. 86%	5%	n.d.	n.d.	8%	n.d.	n.d.	?	
86	85%	4%	2%	4%	4%	n.d.	n.d.	?	
87	ca. 30%	50%	n.d.	4%	12%	3%	n.d.	?	
88	61%	n.d.	n.d.	5%	25%	n.d.	4%	5%	
89	68%	1%	3%	8%	10%	n.d.	5%	5%	
90	55%	n.d.	3%	7%	25%	2%	3%	5%	
91	ca. 50%	1%	n.d.	n.d.	3%	5%	n.d.	5%	Mica
92	64%	n.d.	n.d.	6%	20%	n.d.	5%	5%	
93	55%	1%	4%	6%	25%	n.d.	5%	4%	
94	ca. 46%	4%	3%	6%	35%	n.d.	4%	?	
95	86%	n.d.	n.d.	5%	4%	n.d.	2%	3%	
96	28%	n.d.	3%	6%	45%	n.d.	8%	10%	
97	31%	1%	1%	5%	35%	n.d.	12%	15%	
98	ca. 40%	n.d.	3%	n.d.	6%	2%	n.d.	n.d.	Kaolin, Mica
99	ca. 40%	n.d.	3%	n.d.	6%	2%	n.d.	n.d.	Kaolin, Mica
100	ca. 80	10%	4%	n.d.	2%	n.d.	n.d.	n.d.	ZnStear.
101	63%	8%	3%	7%	4%	n.d.	15%	n.d.	
102	63%	2%	n.d.	3%	15%	n.d.	10%	7%	
103	93%	3%	n.d.	n.d.	4%	n.d.	n.d.	n.d.	
104	91%	3%	1%	2%	3%	n.d.	n.d.	n.d.	

<u>Sample</u>	<u>Talc</u>	<u>Chlorite</u>	<u>Phlogo- pites</u>	<u>Quartz</u>	<u>Dolo- mite</u>	<u>Calcite</u>	<u>Trem- olite</u>	<u>Chryso- tile</u>	<u>Other Species</u>
105	92%	3%	1%	2%	2%	n.d.	n.d.	n.d.	
106	91%	3%	1%	3%	2%	n.d.	n.d.	n.d.	
107	87%	5%	2%	n.d.	6%	n.d.	n.d.	n.d.	
108	81%	10%	2%	2%	3%	n.d.	2%	n.d.	
109	74%	15%	3%	3%	3%	n.d.	2%	?	Kaolin
110	99%	n.d.	1%	n.d.	n.d.	n.d.	n.d.	n.d.	
111	42%	40%	2%	n.d.	15%	n.d.	1%	n.d.	
112	ca. 60%	n.d.	n.d.	4%	n.d.	10%	n.d.	n.d.	Salicylic A., Boric
113	75%	15%	n.d.	3%	7%	n.d.	n.d.	n.d.	
114	53%	40%	n.d.	3%	4%	n.d.	n.d.	n.d.	
115	53%	40%	n.d.	3%	4%	n.d.	n.d.	n.d.	
116	53%	40%	n.d.	3%	4%	n.d.	n.d.	n.d.	
117	42%	35%	n.d.	15%	4%	2%	n.d.	?	
118	53%	40%	n.d.	3%	4%	n.d.	n.d.	n.d.	
119	49%	40%	n.d.	6%	5%	n.d.	n.d.	n.d.	
120	46%	40%	n.d.	8%	4%	n.d.	n.d.	?	
121	87%	8%	2%	n.d.	3%	n.d.	n.d.	n.d.	
122	56%	35%	n.d.	5%	4%	n.d.	n.d.	?	
123	51%	40%	n.d.	3%	4%	n.d.	n.d.	?	
124	54%	40%	n.d.	3%	3%	n.d.	n.d.	?	
125	55%	40%	n.d.	2%	3%	n.d.	n.d.	?	
126	75%	10%	3%	4%	8%	n.d.	n.d.	n.d.	
127	85%	n.d.	n.d.	4%	n.d.	n.d.	n.d.	n.d.	Boric Acid
128	60%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	CaUndecyl.
129	97%	n.d.	n.d.	n.d.	3%	n.d.	n.d.	n.d.	
130	ca. 88%	7%	n.d.	2%	3%	n.d.	trace	trace	
131	ca. 92	3%	3%	n.d.	2%	n.d.	trace	n.d.	
132	95%	3%	2%	n.d.	n.d.	n.d.	n.d.	n.d.	
133	94%	2%	4%	n.d.	n.d.	n.d.	n.d.	n.d.	
134	93%	3%	2%	n.d.	2%	n.d.	n.d.	n.d.	
135	93%	2%	3%	n.d.	2%	n.d.	n.d.	n.d.	
136	89%	4%	3%	2%	2%	n.d.	n.d.	n.d.	
137	91%	4%	n.d.	3%	2%	n.d.	n.d.	n.d.	
138	85%	7%	3%	2%	3%	n.d.	n.d.	n.d.	
139	ca. 85%	n.d.	n.d.	2%	n.d.	n.d.	n.d.	n.d.	ZnStear. MgCO ₃
140	ca. 85%	n.d.	n.d.	2%	1%	n.d.	n.d.	n.d.	ZnStear. MgCO ₃

<u>Sample</u>	<u>Talc</u>	<u>Chlorite</u>	<u>Phlogopite</u>	<u>Quartz</u>	<u>Dolomite</u>	<u>Calcite</u>	<u>Tremolite</u>	<u>Chrysotile</u>	<u>Other Species</u>
141	80%	n.d.	n.d.	2%	1%	n.d.	n.d.	n.d.	ZnStear, MgCO ₃
142	79%	7%	5%	4%	5%	n.d.	n.d.	n.d.	
143	55%	2%	n.d.	3%	25%	n.d.	5%	10%	
144	ca.70%	10%	n.d.	6%	n.d.	n.d.	5%	?	ZnStear. Kaolin
145	ca.70%	3%	n.d.	n.d.	3%	n.d.	n.d.	2%	ZnStear. Kaolin, ZnO
146	ca.85%	n.d.	n.d.	4%	n.d.	5%	n.d.	n.d.	ZnStear.
147	ca.85%	n.d.	n.d.	n.d.	n.d.	5%	n.d.	n.d.	Kaolin
148	ca.45%	40%	n.d.	n.d.	8%	n.d.	2%	n.d.	ZnStear.
149	ca.50%	10%	n.d.	10%	12%	n.d.	8%	?	Kaolin
150	80%	2%	n.d.	5%	n.d.	5%	n.d.	n.d.	Kaolin
151	63%	25%	n.d.	2%	10%	n.d.	n.d.	n.d.	
152	ca.70%	2%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	Pyrophyllite
153	ca.80%	2%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	ZnO, Boric Acid
154	ca.70%	10%	4%	4%	2%	n.d.	2%	n.d.	ZnO
155	ca.84%	10%	n.d.	4%	2%	n.d.	n.d.	?	
156	79%	10%	n.d.	6%	3%	n.d.	2%	n.d.	
157	63%	2%	n.d.	3%	18%	n.d.	6%	8%	
158	78%	7%	n.d.	3%	2%	10%	n.d.	n.d.	
159	ca.74%	10%	2%	n.d.	4%	10%	n.d.	?	
160	60%	25%	n.d.	n.d.	4%	10%	n.d.	trace	
161	59%	25%	n.d.	2%	4%	10%	n.d.	n.d.	
162	58%	25%	n.d.	2%	5%	10%	n.d.	n.d.	
163	55%	2%	n.d.	3%	20%	n.d.	10%	10%	
164	92%	3%	2%	n.d.	2%	n.d.	n.d.	1%	
165	92%	5%	n.d.	n.d.	2%	n.d.	n.d.	?	
166	ca.50%	40%	n.d.	2%	8%	n.d.	n.d.	?	
167	76%	10%	n.d.	n.d.	12%	n.d.	2%	n.d.	
168	==	==	==	==	==	==	==	==	Gypsum
169	==	==	==	==	==	ca.80%	==	==	
170	52%	n.d.	n.d.	5%	25%	n.d.	n.d.	8%	
171	70%	10%	n.d.	5%	15%	n.d.	n.d.	n.d.	
172	43%	50%	n.d.	n.d.	5%	n.d.	2%	n.d.	
173	ca.99%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	?	
174	ca.60%	1%	2%	15%	n.d.	n.d.	n.d.	n.d.	Kaolin, Mica

<u>Sample</u>	<u>Talc</u>	<u>Chlorite</u>	<u>Phlogo- pite</u>	<u>Quartz</u>	<u>Dolo- mite</u>	<u>Calcite</u>	<u>Trem- olite</u>	<u>Chryso- tile</u>	<u>Other Species</u>
175	ca. 86%	3%	n.d.	10%	n.d.	n.d.	n.d.	?	
176	ca. 79%	3%	2%	15%	n.d.	n.d.	n.d.	?	
177	84%	10%	4%	2%	n.d.	n.d.	n.d.	n.d.	
178	ca. 50%	20%	2%	5%	4%	n.d.	n.d.	?	Kaolin
179	97%	n.d.	n.d.	3%	n.d.	n.d.	n.d.	n.d.	
180	88%	n.d.	n.d.	n.d.	12%	n.d.	n.d.	n.d.	
181	ca. 70%	n.d.	n.d.	n.d.	n.d.	10%	n.d.	n.d.	Kaolin
182	ca. 40%	25%	15%	n.d.	n.d.	n.d.	n.d.	?	ZnO
183	ca. 76%	10%	n.d.	n.d.	2%	10%	1%	?	
184	93%	2%	n.d.	2%	n.d.	n.d.	3%	n.d.	
185	ca. 50%	8%	n.d.	n.d.	n.d.	25%	n.d.	n.d.	ZnO
186	ca. 50%	5%	n.d.	n.d.	n.d.	25%	n.d.	?	ZnO
187	ca. 85%	5%	n.d.	2%	n.d.	5%	2%	n.d.	
188	70%	15%	2%	3%	4%	5%	1%	?	
189	72%	12%	n.d.	3%	2%	5%	1%	n.d.	
190	ca. 82%	12%	2%	n.d.	3%	n.d.	n.d.	?	
191	96%	2%	n.d.	n.d.	2%	n.d.	n.d.	n.d.	
192	100%	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	
193	ca. 93%	2%	n.d.	2%	2%	n.d.	n.d.	?	ZnStear.
194	ca. 94%	2%	n.d.	n.d.	3%	3%	n.d.	?	
195	97%	n.d.	n.d.	n.d.	3%	n.d.	n.d.	n.d.	