Sunderland, who was the first to draw attention to the occurrence of this peculiar type of cataract in glass-blowers.

It may be of interest to mention here that Mr. Robinson expressed the opinion that the case of "puddlers' cataract" shown was more typical of the condition than were those shown by himself, and which had occurred in glass-blowers.

A second case of this kind was published by the writer in Vol. XIV of the *Ophthalmoscope*, and since then other cases have been observed at the Wolverhampton Eye Infirmary.

On the whole, there seems to be little or no doubt but that the type of cataract known as glass-workers' cataract can occur in occupations other than that of glass-blowing, one being that of "puddling."

Inasmuch as the glass-blower is entitled to compensation under the Workmen's Compensation Act, it would be fitting that the puddler should be placed in the same category, and it is hoped that before long this will be done.

THE PREVALENCE OF LENTICULAR OPACITIES IN THE EYES OF TINPLATE MILLMEN

BY

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LLANELLY.

DURING the early months of 1920, I was interested in the number of cataract cases occurring in tinplate and sheet millmen, which I came across in the course of my practice. The early clinical manifestations of the disease in these men seemed to me similar to those in some cases of bottlemaker's cataract, which I had had the opportunity of seeing at Sunderland Eye Infirmary. In the course of the enquiries which I began to make I found that there was a prevalent belief among the workers themselves that cataract was very rife in their midst, and certain different conditions at the work were assigned as a cause. In order to satisfy myself, I visited some of the works, and the following is a description, as I saw it, of a tinplate mill in operation.

Nature of the Work

The millmen work in three shifts of eight hours each. Each mill has a personnel of four men, named respectively the furnace-man or heater, the doubler, the rollerman, and the behinder or catcher. Steel bars are heated red-hot in a coal fire furnace which is attended to by the furnacemen. (The weight of the bars varies; in tinplate mills in this locality they average about 23lbs.; in sheet

mills they are much heavier.) The furnaceman manipulates the bars with long tongs, and when red-hot, he takes out a bar and hands it to the rollerman, the latter using shorter tongs, runs it through the heavy rolls to the catcher who lifts it over rolls again to the rollerman. This process is repeated a few times until the bar is a certain thinness. By this time the bar has lost most of its red glow and the rollerman hands it back to the furnaceman to be replaced in the furnace. When again red-hot the furnaceman hands it once more to the rollerman, who this time passes it through the fine highly polished rolls several times to the catcher, and in a few seconds it is rolled out into a thin plate. It is then handed to the doubler who doubles the still red-hot plate and replaces it in the furnace. This process goes on till the plate has been doubled eight times and now forms sixteen sheets.

The work is unusually heavy and the heat is very great, so much so that a person unaccustomed to the work could not stand in the centre of a mill for longer than about five minutes without feeling somewhat overcome. My hands and face felt scorched at the end of such an experience. The men perspire very freely and drink a lot in consequence, in most cases beer or tea.

The men first enter the mill at the age of about 18 as behinders or catchers. At the end of about two or three years they advance another stage and become furnacemen. As vacancies occur most of the men get promotion to doubling after five years at the furnace, and most of these again after a further five years become rollers, whose occupation is not only very heavy but needs practical skill to ensure the plates being the necessary width and thickness. All the men in the mill are exposed to infra-red rays from the red-hot tin plates. The furnaceman and doubler are, in addition, exposed to the infra-red rays given off by the furnace. In the tinplate mills the ultra-violet rays are negligible. During the manipulation of the red-hot tinplate its distance from the eye of the workman varies from two to five feet. Each man in manipulating his tongs prefers as a rule to hold one particular hand in front, and he is very often not square on to the work, so that at times the eye corresponding to the hand in front is more exposed to the heat rays.

Nature of Investigations

I determined to investigate the matter more fully, and by arrangement with Mr. John Hughes, the Executive Member of the Iron and Steel Trades Confederation for Llanelli, I was enabled to examine all the men of two shifts at the X works. The examination was carried out during working hours, and the men were withdrawn in batches from the mills and were examined in a darkened office on the premises by means of the ophthalmoscope and an oil lamp. Of necessity, no mydriatic was used, and note

was made of any opacity in the lens which could be detected. I found that about 40 per cent. of men of 35 years of age and over had opacities of various types. Two types of opacity predominated, one being the dense round posterior cortical, and the other a striated cortical wedge-shaped opacity, apex upwards, growing in the lower cortex or downwards and slightly inwards.

The Iron and Steel Trades Confederation shortly afterwards requested me to examine their members in as many works as possible. I suggested that the examination should be carried out in the same manner as at the X works, and they made the necessary arrangements through their officials. I visited altogether twelve works, and the results of my examination are given in Tables II and III. In my own practice during the past thirteen months, I have seen 96 cases, details of which will be found in Table I.

For the preparation of Table II, 424 men were examined in shifts. Of these, 70 were under the age of 35 years, and amongst them I found one case only of lenticular opacity. In the later works visited, I examined men of 35 years of age and over only, or men who had been 15 years or over in the mill. Out of 354 men of 35 years of age and over examined, 144 were found to have lenticular opacities. Of these, five were definitely complicated, making 139 cases available for statistics or 39 per cent. The age distribution of these cases is shown in Table III.

The length of time a man has been at work in the mill given in the above tables needs some qualification. Many of the men entered the mills as boys, but until they reached the age of 18 or 20 it is unlikely that they would have been engaged in the work which exposed them to the heat rays. The impression given me by a survey of all the cases is that a man does not develop a lenticular opacity before he has been at work in the mill 15 years. I have made notes in many of the cases of the lengths of time the men have spent at the various jobs in the mill, and I cannot find that one class of work is more predisposing than another.

Character of Opacity

If we analyse the types of opacity found in the 209 cases, in Tables I and II, we find that the typical wedge-shaped striated cortical opacity below, with its apex upwards and growing into the posterior cortex, predominates and occurs alone in 105 cases. Dense round posterior cortical opacity, similar to that supposed to be typical of bottlemakers' cataract, occurred in 26 cases. The two above-mentioned types were found associated in 20 cases. Nuclear opacity alone was found in 4 cases. Dense posterior cortical opacity associated with nuclear opacity was found in 2 cases. In one case, it was possible to differentiate dense posterior cortical, nuclear, cortical striae below as well as anterior cortical and

TABLE I.—TABLE SHOWING PARTICULARS OF CASES EXAMINED IN THE COURSE OF PRACTICE.

No.	Age.	Occupation.	No. of Years in Mills.	Hand Forward	Remarks.
1	60	Roller ...	...	...	Cat. removed in left eye 12 years ago. L.E. old iridocyclitis. Atrophic pupillary membrane
2	69	Roller ...	...	...	R.E. cat. ext. 3 years ago. L.E. mature cat.
3x	66	Roller ...	...	...	Typ. post. cort. R.E. L.E. cat. ext. 3 years ago
4x	68	Doubler	34	...	Right ant. and post. cort. cat. R.E. striae nasal side. Vision 6/60. Hyp. astig. 150°. L.E. normal
5x	60	Roller...	...	...	Mature cort. cat. L.E. Signs of increase of tension
6	56	Late Roller	...	...	R.E. cort. cat. almost mature L.E. old burn 26 years ago
7	65	Roller ...	21	...	Typ. post. cort. cat. both eyes
8	70	Late Roller	...	...	R.E. and L.E. cat. extractions
9	54	Roller ...	32	R	R.E. cat. mature 6 years duration. L.E. normal
10x	58	Roller ...	20	...	"Y" shaped post cort. in both eyes. Vision 6/24 both eyes
11x	62	Roller ...	20	L	L.E. post. cort. cat.
12	52	Roller ...	...	...	Post. cort. cobweb pattern both eyes more marked L.E. Retinitis pigmentosa
13x	60	Roller ...	40	R	R.E. typ. post. cort. 8 years duration
14	64	Roller ...	30	...	Post cort. dotted opacities in disc form, more marked L.E.
15	66	Roller ...	...	L	Almost mature cat. L.E. R.E. slight cort. striae
16	55	Roller ...	38	...	R.E. post. cort. typ. Peripheral striae all round. 3 years since noticed sight failing. L.E. normal. Vision R.E. 6/60
17x	50	Roller ...	33	R	Post. cort. dot with less dense opacity more anterior R.E.
18	69	Roller ...	Over 30	...	Cort. striae both eyes
19	55	Roller ...	...	L	Mature cat. L.E. Advanced cort. cat. R.E.
20x	59	Roller ...	30	L	Cort. striae downwards both eyes more marked L.E. Fine vitreous opacities. Vision 6/12 both eyes
21x	55	Roller ...	32	L	Slight cat. L.E. Cort. striae
22x	66	Furnaceman	28	R	R.E. Cat. ext. 1 year ago L.E. typ. post. cort. with post striae below
23x	58	Roller ...	36	R	Post. cort. both eyes, R.E. more advanced and nucleus cloudy
24	60	Roller ...	40	...	Mature cat. L.E. almost mature R.E.

TABLE I.—*continued.*

No.	Age.	Occupation.	No. of Years in Mills.	Hand Forward.	Remarks.
25	56	Roller ...	Over 20	L	Typ. small post. cort. L.E.
26	68	Roller ...	38	L	L.E. typ. post., small post. cort. dot R.E.
27x	47	Roller ...	28	R	Mature cat. R.E. L.E. clear
28x	50	Roller ...	29	L	Typ. post. cort. with peripheral striae R.E. post. cort. typ. not so advanced L.E.
29	46	Roller ...	...	L	Nuclear opacity L.E.
30x	58	Roller ...	40	L	Post. cort. cat. L.E. diffuse with striae. Less marked ditto R.E. Anterior cort. L. and R.
31	67	Late Roller	38	L	Diffuse post. cort. cat. L.E.
32	62	Late Roller	...	L	Mature cat. L.E. R.E. normal
33x	61	Roller ...	38	R	R.E. cat. mature. L.E. cort. striae running from below to post. cortex
34	56	Roller ...	38	L	Cort. striae below reaching towards post cortex in both eyes more marked L.E.
35	67	Late Roller	20	...	Mature cat. both eyes
36	70	Roller ...	48	L	L.E. reg. star-shaped post. cort. cat. Slight ditto R.E.
37	58	Late Roller	40	...	Cat. nigra R.E. L.E. normal
38	64	Late Roller	48	L	Cat. ext. 12 years ago L.E. R.E. normal
39x	60	Old Roller	43	R	Typ. post. cort. both eyes. R.E. more advanced
40	64	Doublet	...	...	Cat. ext. R.E. Almost mature L.E.
41	64	Late Roller	40	L	Typ. post. cort. cat. both eyes. L.E. more advanced
42	75	Roller ...	50	L	Mature cat. R.E. Cort. senile L.E.
43	52	Roller ...	36	R	Fully developed cat. R.E. Post. cort. cobweb appearance L.E.
44	74	Furnaceman	Over 40	...	Cort. striae both eyes growing below and in nasal side towards post. pole. L.E. more advanced
45	58	Roller ...	44	L	L.E. cat. ext. 1913. R.E. cat. ext. 1916. L.E. went first
46x	58	Roller ...	40	R	Vision R.E. 6/12. L.E. 6/9. Typ. post. cort. cat. R.E. cort. striae below and to nasal side. L.E. cort. striae below growing towards post. pole
47x.	50	Roller ...	32	L	Vision R.E. 6/9. Vision L.E. 6/12 minus. L.E. typ. post. cort. R.E. small dot post. cortex

48	58	Late Roller	38	R	R.E. cat. ext. 13 years ago. L.E. cat. ext. 10 years ago
49x	55	Roller ...	30	L	Post. cort. cat., typical both eyes equally affected
50x	51	Roller ...	32	L	Ant. cort. cat. small dot in post. cortex L.E. R.E. normal. Vitreous opacities
51	53	Late Furnaceman	20	L	L.E. cat. ext. year ago. R.E. cat. mature L.E. began to fail 4 years ago R.E. about 2 years ago
52x	36	Roller ...	17	R	Blotchy opacity both eyes probably congenital. Vitreous opacities
53x	58	Roller ...	37	L	R.E. cat. ext. 2 years ago L.E. mature. Both eyes went together
54x	61	Late Roller	40	L	Mature cat. L.E. sight failing last 10 years. R.E. slight striae anterior cortex below
55x	67	Late Roller	27	...	Commencing cort. cat. below and sides, both eyes probably senile
56x	35	Roller ...	15	R	Cort. striae below R.E. L.E. normal
57	55	Roller ...	35	L	Cort. striae below, both eyes equally developed
58	60	Roller ...	44	L	Mature cat. L.E. and R.E. cort. striae below growing into post. cortex
59x	51	Doubler	32	L	Slight cort. striae below, both eyes
60	69	Late Roller	45	R	Post. cort. R.E. and cort. striae below less marked ditto L.E.
61	67	Roller ...	...	...	Cat. ext. R.E. 4 years ago. L.E. mature
62	59	Late Roller	38	...	L.E. cat. almost mature
63x	65	Roller ...	36	L	Both eyes cat. extracted
64	56	Roller ...	36	L	Cort. striae below growing towards post. cortex both eyes L.E. more marked
65x	44	Doubler	...	...	Cort. striae below both eyes, L.E. more marked
66	61	Late Roller	35	...	L.E. old penetrating wound membranous cat. R.E. cort. striae below growing towards post. cortex
67	63	Late Roller	44	R	Post. cort. cat. both eyes with cort. striae below on nasal side in both eyes. More marked R.E.
68	54	Furnaceman	30	L	Cort. striae below R.E. L.E. normal
69x	39	Roller ...	20	L	Cort. striae below growing to post. cort. more marked L.E.
70	50	Doubler	30	L	Cort. striae below both eyes, more marked L.E.
71	64	Furnaceman	32	L	L.E. typ. post. cort. cat. below and anteriorly R.E. striae below and anter. less marked in R.E.
72	81	Late Roller	40	L	Mature cat. both eyes. L.E. went 15 to 20 years ago
73x	50	Furnaceman	36	L	Post. cort. diffuse both eyes. More marked L.E.
74x	63	Roller ...	45	L	L.E. cat. ext. 2 years ago. R.E. almost mature
75	65	Late Doubler	40	L	L.E. post. cort. diffuse cort. striae below growing towards post. cortex. R.E. dots in post. cortex. Cort. striae below less marked in R.E.
76	43	Roller ...	16	...	Slight striae below, both eyes
77	60	Late Roller	31	L	Cort. striae below and inwards, both eyes. More marked L.E.
78	56	Furnaceman	34	L	Sight failing for past 8 to 10 years. Typ. post. cort. cat. Cort. striae below growing towards post. cortex, equal in both eyes
79x	57	Late Roller	22	L	Cort. cat. below growing post., both eyes and slight anterior R.E. Vision R. and L. 5/6
80	55	Late Doubler	20	L	Slight cort. striae down and nasal L.E. R.E. clear
81	69	Late Roller	20	L	Cort. striae below growing towards post. pole equal in both eyes

TABLE I.—*continued.*

No.	Age.	Occupation.	No. of Years in Mills.	Hand Forward.	Remarks.
82	60	Roller ...	36	...	Slight striae both eyes equal
83	56	Furnaceman ...	20	...	Mature cat. R.E. typ. post. cort. both
84	41	Roller ...	20	L	Cobweb striae slight down and in L.E.
85	55	Late Roller ...	30	R	Cort. striae below growing up to dots at post. pole R.E. Cort. striae below less marked L.E.
86	53	Late Roller ...	35	L	Typical post. cort. R. and L. L.E. most marked
87	57	Late Roller ...	25	R	Post. cort. cat. diffuse cort. striae below and nasal side R.E. cort. striae below and nasal side L.E. slight
88	65	Late Roller ...	40	...	Cat. ext. R.E. 2 years ago. L.E. mature
89	59	Late Doubler ...	33	L	L.E. almost mature. R.E. cort. striae below dots at post. pole
90	79	Late Furnaceman ...	...	...	Nuclear haze both eyes
91	47	Roller ...	...	L	Cort. striae below L.E. slight
92	67	Furnaceman ...	21	R	R.E. cat. ext. 2 years ago sight failing for last 12 years; L.E. cort. striae below growing towards ant. and post. cortex
93	60	Late Furnaceman ...	28	L	Cat. cort. striae downwards and growing up post. and anterior both eyes, L.E. more marked
94	54	Roller ...	36	L	Mature cat. L.E. cort. striae below going towards post. cortex
95	80	Late Roller ...	...	...	Mature cat. L.E. R.E. optic atrophy probably senile cat.
96	50	...	...	L	Cort. striae below L.E. R.E. normal

NOTE.—All marked X should also appear on the list of those examined at the Works

TABLE II.—TABLE SHOWING PARTICULARS OF CASES EXAMINED AT THE WORKS.

No.	Age.	Occupation.	No. of Years in Mills.	Hand Forward.	Remarks.
97	63	Roller ...	45	R	Post. cort. cat. and striae below both eyes
98	60	Roller ...	42	R	Cort. striae both eyes growing towards post. cortex
99	57	Furnaceman	30	L	Cort. striae below both eyes
100	54	Roller ...	34	L	Cort. striae growing towards post. cortex both eyes, more marked L.E.
101	56	Roller ...	36	L	Cort. striae below both eyes more marked L.E.
102	60	Roller ...	40	L	Cort. striae below L.E.
103	62	Roller ...	26	L	Cort. striae below and in post. cortex L.E.
104	65	Roller ...	47	R	Mature cat. R.E. Extraction 4 years ago L.E.
105	52	Roller ...	35	R	Mature cat. R.E. Cort. striae below spreading to post. cortex L.E.
106	56	Roller ...	40	L	Cort. striae below R.E. Old penetrating wound L.E.
107	49	Roller ...	36	L	Post. cort. cat. both eyes more marked L.E.
108	50	Roller ...	36	L	Mature cat. L.E. Cort. striae below R.E. spreading to post. cort.
109	49	Roller ...	32	R	Post. cort. cat. both eyes, more marked R.E.
110	65	Doubler	36	L	Mature cat. L.E. post. cort. below and in post. cortex R.E.
111	41	Roller ...	25	R	Mature cat. R.E. L.E. clear. No history of injury
112	38	Roller ...	20	L	Cort. striae below L.E.
113	43	Roller ...	25	R	Cort. striae below R. and L. equally developed spreading to post. cortex
114	57	Roller ...	37	L	Cort. striae below and in post. cortex both eyes, more marked L.E.
115	53	Late Roller	36	L	Cort. striae below spreading to post. cortex both eyes, more marked L.E.
116	48	Roller ...	32	R	Cort. striae below spreading to post. cortex both eyes, more marked R.E.
117	40	Roller ...	20	L	Cort. striae below R.E. L.E. clear
118	54	Roller ...	30	L	Cort. striae downwards spreading to post. cortex R.E. L.E. slight ditto
119	36	Furnaceman	17	L	Cort. striae both eyes spreading to post. cortex
120	34	Furnaceman	14	L	Cort. striae down and in R.E., cat. spreading to post. cortex slightly in L.E.
121	57	Late Roller	32	L	Typ. post. cort. cat. R.E. Cort. striae below and spreading to post. cortex and anteriorly both eyes

TABLE II—continued.

No.	Age	Occupation.	No. of Years in Mills.	Hand Forward.	Remarks.
122	60	Late Roller	31	L	Cort. striae below and inwards spreading to post. cortex, more marked L.E.
123	61	Late Roller	36	L	Typ. post. cort. cat. in both eyes, more marked L.E.
124	66	Late Roller	47	R	Cort. striae below spreading to post. cortex R.E.
125	62	Late Roller	40	L	Cort. striae down, spreading to post. cortex both eyes. More marked L.E. Slight dot post. cortex both eyes
126	46	Roller	30	L	Cort. striae below and in, spreading to post. cortex L.E.
127	54	Roller	36	R	Typ. post. cort. cat. R.E. Cort. striae down both eyes spreading to post. cortex
128	47	Roller	30	L	Slight cort. striae down and inwards L.E.
129	46	Doubler	20	L	Cort. striae down and in R.E.
130	50	Doubler	30	L	Cort. striae down and in both eyes
131	36	Doubler	12	L	Cort. striae down and in post. cort. R.E. L.E. clear
132	38	Late Roller	14	L	Typ. post. cort. cat. both eyes. More marked L.E.
133	43	...	20	L	Cort. striae down and in L.E. R.E. clear
134	52	...	30	L	Cort. striae down and posteriorly L.E. R.E. clear
135	56	...	40	L	Cort. striae down and in and posteriorly both eyes more marked L.E.
136	53	...	34	L	Cort. striae down and in and posteriorly L.E. R.E. clear
137	51	Doubler	33	R	Cort. striae externally L.E.
138	38	Furnaceman	18	R	Cort. striae downwards more marked R.E. Growing posteriorly
139	44	Furnaceman	24	L	Typ. post. cort. cat. R.E.
140	56	Roller	38	L	Cort. striae both eyes downwards growing post. More marked L.E.
141	59	Roller	40	L	Nuclear cloudiness both eyes
142	61	Late Roller	38	L	Cort. striae down both eyes. More marked L.E.
143	60	Late Roller	40	L	R.E. cataract ext. 12 months ago. L.E. typ. post. cort. cat
144	40	Doubler	22	L	Cort. striae down both eyes
145	61	Late Roller	38	L	Almost mature cat. both eyes
146	52	Doubler	32	R	Typ. post. cort. cat. R.E. Cort. striae down and post. both eyes

147	Late Roller	...	28	L	Cort. striae down L.E. growing post. R.E. clear
148	Roller ...	...	36	L	Typ. cort. striae both eyes more marked L.E. Nuclear haze L.E.
149	Roller ...	...	34	L	Cort. striae down R.E. growing post. and anteriorly
150	Roller ...	...	38	L	Cort. striae down both eyes. More marked L.E.
151	Roller ...	...	41	L	Cort. striae down L.E. R.E. clear
152	Roller ...	...	26	L	Cort. striae down R.E.
153	Roller ...	...	24	L	Cort. striae both eyes growing post., more marked L.E.
154	Late Roller	...	34	L	Cort. striae down both eyes growing post. more marked L.E.
155	Roller ...	...	44	R	Almost mature cat. R.E.
156	Roller ...	...	40	R	Cort. striae down and in growing post R.E.
157	Roller ...	...	38	L	Cort. striae growing post. L.E.
158	Roller ...	...	30	L	Typ. slight post. cort. cat. both eyes. Slightly larger L.E.
159	Roller ...	...	26	L	Lamellar type cat. both eyes
160	Roller ...	...	10	L	Cort. striae externally R.E.
161	Roller ...	...	23	L	Cort. striae down both eyes
162	Furnaceman	...	20	R	Typ. post. cort. cat. R.E. Cort. striae down and post. both eyes
163	Roller ...	...	30	L	Cort. striae down and in L.E. growing post
164	Furnaceman	...	18	L	Cort. striae down and in L.E. growing post R.E.
165	Doubler	...	15	L	Cort. striae down and upwards and inwards
166	Roller ...	...	30	L	Blotchy opacities down both eyes
167	Roller ...	...	26	L	Cort. striae down R.E.
168	Roller ...	...	40	R	Cort. striae down and in growing post. L. and R. more marked R.E.
169	Roller ...	...	26	L	Cort. striae down and in growing post. Both eyes more marked L.E.
170	Doubler	...	34	...	Cort. striae down and in R.E.
171	Roller ...	...	34	...	Cort. striae down both eyes
172	Roller ...	...	25	...	Cort. striae down both eyes more marked L.E. Growing posteriorly
173	Roller ...	...	25	...	Cort. striae down both eyes more marked L.E. Growing posteriorly
174	Roller ...	...	40	...	Cort. striae down both eyes more marked L.E. Growing posteriorly
175	Roller ...	...	40	...	Cort. striae down R.E. Growing posteriorly
176	Roller ...	...	30	...	Cort. striae down both eyes. Growing posteriorly
177	Roller ...	...	40	...	Cort. striae down both eyes more marked L.E. Growing posteriorly
178	Roller ...	...	46	...	Cort. striae down both eyes more marked L.E. Growing posteriorly
179	Doubler	...	34	...	Cort. striae below growing post. R.E.
180	Roller ...	...	36	...	Cort. striae down both eyes and in post. cortex more marked L.E.
181	Roller ...	...	25	...	Cort. striae down both eyes more marked L.E. growing posteriorly
182	Roller ...	...	30	...	Cort. striae down both eyes more marked L.E.
183	Roller ...	...	24	...	Typ. post. cort. cat. both eyes
184	Late Roller	...	32	...	Cort. striae down both eyes growing post. More marked L.E.
185	Roller ...	...	24	...	Cort. striae down both eyes

TABLE II—continued.

No.	Age.	Occupation.	No. of Years in Mills.	Hand Forward.	Remarks.
186	50	Doubler	28	...	Single dots post. cort. both eyes
187	64	Late Roller	40	...	Cat. ext. both eyes 10 years ago
188	49	Doubler	28	L	Post. cort. dot L.E.
189	58	Roller ...	36	L	Cat. ext. both eyes
190	54	Roller ...	30	...	Cat. almost mature both eyes
191	53	Roller ...	33	L	Cat. R.E. ext. 1 year ago. L.E. typ. post. cort.
192	51	Furnaceman	30	R	R.E. single streak posterior
193	63	Roller ...	38	...	Nuclear cloudiness both lens more marked L.E.
194	48	Furnaceman	33	L	Cat. R.E. ext. 12 years ago. L.E. 6 years ago
195	52	Roller ...	28	...	Slight typ. post. cort. both eyes
196	48	Doubler	32	...	Post. cort. cat. both eyes and cort. striae down and in both eyes
197	43	Furnaceman	20	...	Cort. striae down and in both eyes and post.
198	59	Roller ...	...	...	Nuclear opacities both eyes. Eccentric post. cort. dot R.E. Central typ. post. cort. cat. L.E.
199	51	Roller ...	36	...	Slight cort. striae anteriorly and below both eyes
200	55	Roller ...	30	L	Post. cort. striae down and in R.E. Slight ditto L.E.
202	55	Doubler	30	L	Cort. striae down and in growing post. and anteriorly more marked L.E.
203	53	Roller...	30	L	Cort. striae below both eyes. More marked L.E.
204	45	Roller ...	20	L	Cort. striae below both eyes. More marked L.E.
205	55	Roller ...	40	L	Cort. striae down growing anter. and post. L.E.
206	58	Roller ...	38	L	Cort. striae below growing anter. and post. both eyes more marked R.E.
207	63	Roller ...	48	R	Cort. striae down post. and below both eyes, more marked L.E.
208	55	Roller ...	40	L	Cort. striae externally L.E.
209	54	Roller ...	40	R	Cort. striae down and in growing post. L.E.
209	55	Roller ...	42	L	Cort. striae downwards and growing post R.E.
					Cort. striae down and growing post. L.E.

capsular opacities. In 31 cases the cataract had been extracted or was so advanced that it was impossible to say what the initial type was. In 13 cases the types were miscellaneous, and in 7 cases the opacities were complicated by other disease. The types were evenly distributed over the various ages. In 112 cases where the hand forward on the tongs was recorded, the eye first affected corresponded to the hand forward. In 17 cases the converse obtained.

During 1920 I operated on twenty-two tinplate millmen for cataract and in the majority of cases the cortex was soft, and in the older men, corneal collapse and slow re-formation of the anterior chamber were common. The sight after operation as a rule is satisfactory.

Questioning the patients regarding the duration of the cataract is not very satisfactory, but an intelligent construction put upon

TABLE III.—AGE DISTRIBUTION OF CASES EXAMINED AT WORKS

Age.	35-40	41-45	46-50	51-55	56-60	61 & over
Number of men examined ...	74	67	65	61	53	29
Number of men found to be suffering from lenticular opacities	13	12	22	38	34	20
Percentage of ditto ditto ...	17.5%	18%	34%	62%	64%	69%

answers to leading questions will give us some idea, and my impression from this source is that the cataract is very slow in growth. In some early cases that I have had the opportunity of re-examining after an interval of six to nine months, I have been able to detect little appreciable advance in the opacity. I have come to the conclusion that in the early stages, at any rate, the cataract is very slow-growing and may exist for a number of years without any interference with the visual acuity necessary to the man's occupation. The work calls for a fair but not exact visual acuity, and owing to the fact that one eye as a rule is in a more advanced state of cataract than the other, many men can keep at work up to the day they enter hospital for operation.

Confirmatory Evidence

In November, 1920, I communicated my views to Dr. T. M. Legge and Mr. J. Herbert Parsons, who brought them to the notice of the Glass Workers' Cataract Committee of the Royal Society. On February 23rd, as a result of this communication, a Sub-Committee

of the Glass Workers' Cataract Committee of the Royal Society, consisting of Mr. J. Herbert Parsons, Dr. T. M. Legge and Dr. J. C. Bridge visited Llanelly in order to see some of my cases, and if possible to obtain confirmatory evidence. They saw 120 cases and will no doubt publish a separate report.

Comparative Incidence

We have now got the clinical facts before us and it is necessary to come to some conclusions if possible.

In the first place, can we establish the fact that cataract is more prevalent among tinplate millmen than among persons of a similar age engaged in other occupations? I have no direct evidence to offer at present on the incidence of cataract amongst persons engaged in other occupations, but I hope later to be able to get statistics. Legge, in the course of his investigations into Bottlemakers' Cataract produced figures drawn mainly from the "Hearts of Oak Benefit Society," which show that 3 per cent. of the superannuated, disabled members, and members placed on reduced sick allowance of the average age of 56 suffer from cataract or probable cataract. He further quotes from Norris and Oliver that the percentage at various clinics for all ages is from 5 to 10 per cent. (One observer, Schoen, gives a percentage as high as 18.4.) We cannot regard the clientèle of an eye clinic as being representative of the eye conditions of a normal population and many juvenile types would be included. At any rate, from such evidence as we have of the normal incidence, it is apparent that the incidence amongst tinplate millmen, as shown by my figures, is abnormally high.

Incipient Types

In the second place, can we establish a definite type or types of incipient opacity as being common among tinplate millmen or as being in any way pathognomonic of what we may now call Tinplate Millmen's Cataract?

Since attention was first drawn to the prevalence of cataract amongst bottlemakers in this country by the publication by Robinson in 1903 of Dalglish's and his own experiences in the Sunderland Eye Infirmary, most observers have described the posterior cortical type as being pathognomonic, notwithstanding the fact that they all in their notes of cases recorded the existence of other incipient types, either existing alone or in combination with the posterior cortical type. It is possible that too much attention has been focussed upon this type and that observers have not given the consideration they might have to other types. Robinson in his description of the typical incipient posterior cortical opacity describes it as being irregularly disc-shaped in outline and of cob-webby

texture. I have seen a few cases of this nature amongst tinplate workers, but the majority of the incipient posterior corticals I have seen have appeared by transmitted light as distinctly black dots, or at a later stage round or irregularly round black discs which are almost always central, so that my experience agrees more with Legge, who describes the opacity as being like a blot of ink. This type of opacity is not confined to bottlemakers and tinplate workers, but is occasionally to be seen in old people as a senile type. I have seen two or three cases in women. It cannot, therefore, be regarded as the preserve of the bottlemakers and the tinplate millmen. My own records of tinplate millmen and the records of observers of the bottlemakers' cataract show that the posterior cortical type often exists in combination with cortical striae and presumably the cause (whether it be ultra-violet rays or heat rays) of the one is also the cause of the other.

There is another type of incipient cataract which I have found more common in tinplate millmen than the posterior cortical variety, and that is a broom-like opacity in the lower cortex, with the striae very crowded together until at the base they form often a conglomerate mass. This opacity is usually wedge-shaped with apex upwards, and it grows as a rule in the posterior cortex towards the posterior pole, and occasionally into the anterior cortex. The base is either directly downwards, or downwards and inwards, and the striae rarely spread externally. The apex is often very blunt or rounded. This form rarely spreads externally and above until the lower half of the lens is well involved. This opacity is seen occasionally amongst cases of senile cataract, but not nearly so frequently found in combination with the posterior cortical type, and my own feeling is that in tinplate millmen, at any rate, we have two pathognomonic types.

Aetiological and Pathological Theories

We now come to the question of causal agents. The majority of ophthalmologists in this country regarded the infra-red rays as being the probable cause in the production of bottlemakers' cataract. More recently experiments have been carried out in America by Burge and others who seek to place the blame at the door of the ultra-violet rays. These experiments have been done mainly *in vitro* or upon frogs and fish. The nature of the experiments was that of acute, rather than chronic, exposure to concentrated ultra-violet rays in no way comparable to the conditions under which trade cataracts are supposed to be produced. Although interesting, they help us very little in the aetiology of the diseases under review. It has always been advanced against the heat rays theory that there was no record of cataract amongst workers in the iron industries who were exposed to red-hot iron and steel, and this was the weak

link in the chain of evidence. I think that the statistics which I have given above, if they can be borne out by others, will supply a fresh and very strong link in that chain. In the tinplate mill the men are exposed to practically no ultra-violet rays, but they are exposed constantly to excessive amounts of infra-red rays.

Hartridge and Hill have shown that the iris absorbs practically all the infra-red rays between $\lambda 5,000$ and $\lambda 13,000$ and that radiations of greater wave length are absorbed by the cornea and aqueous. The curve for the lens shows absorption to the extent of 10 per cent. to 30 per cent. of the heat rays between $\lambda 11,000$ and $\lambda 13,500$. We do not know exactly in what manner the heat radiations cause cataract, and I plead this as an excuse for advancing certain possibilities which might form a basis of research. It is reasonable to assume that the lens itself in a tinplate millman is constantly absorbing considerable quantities of infra-red rays, and that these cause acceleration of its metabolism, probably an over-rapid growth of the lens fibres at first, and finally exhaustion of this process at the time when it is most necessary, namely, when sclerosis and shrinking of the nucleus begins. It is probable also that the lower portion of the eye receives more direct rays owing to the position of the head (bent forward slightly) and the screwing together of the lids. This would result in shading of the upper and outer part of the cornea and expose the inner and lower portion. Possibly, however, the most potent factor in the probable production of cataract by heat rays is the enormous absorption by the aqueous, the iris, and ciliary body. Here the enemy is attacking the headquarters of the eye's physiological life. The intestine and kidney of the eye, so to speak, are subject to chronic irritation which must result in an alteration in the secretory endothelium, in the secretions entering the eye, and in the selective mechanism of the excretory endothelium. The eye might now be likened to a man with an impaired digestion and a granular kidney, and it is probable that excess of salts, proteins, and end products of the eye's metabolism are retained. The lens depends upon the ciliary body through the vitreous, the aqueous, and the suspensory ligament with Petit's canal for its nourishment, which takes place mainly by diosmosis it is supposed; if this be the case the increase in the dissolved constituents of the aqueous would materially alter the normal metabolism of the lens. The nature of this alteration is obscure, but it is probable that degenerative changes occur more quickly in the innermost fibres which shrink and lose their nucleus, and the lens being of epithelial origin they become cornified and form the outer layers of the nucleus. By this time the growing epithelial cells have been overworked and cannot keep pace with the demand for production of new fibres to fill up the space produced by the shrinking of the older fibres, and fissures occur between the fibres of the cortex.

These fissures become filled by fluid, and secondary degeneration occurs in the fibres surrounding. It is just possible that some of the heat absorbed by the iris and ciliary body, especially in the lower part, may be conducted along the zonule and the aqueous of the posterior chamber to the lens capsule, and may so damage the epithelial layer as to allow filtration through it of minute amounts of aqueous. Fuchs states that slight filtration occurs through the endothelium on the posterior corneal surface when it is the seat of inflammation or deposition of inflammatory products. This would account, therefore, for the opacity starting in some cases in the lower segment of the lens. The nutrition of the vitreous, being dependent on the ciliary body, no doubt also suffers. It is probably subject to sclerosis of its limiting membrane and trabeculae, and possibly to a slight shrinking in volume. The limiting membrane of the vitreous is firmly attached to the posterior capsule of the lens, especially in the region of the posterior pole. We have now two bodies on either side of the posterior pole of the lens, each with a tendency to almost imperceptible shrinking. It might be possible for a slight detachment of the posterior capsule of the lens to occur at the posterior pole, and for fluid to collect beneath the capsule. Next to the equator, the greatest shrinking of the lens would occur at this point, and in the cases where the posterior cortical variety occurs I would advance this series of events as a possible cause. This does not exhaust all the possibilities. We have no exact knowledge of the lymph channels of the vitreous; the existence of a lymph channel in the position of the embryological hyaloid vessel is debated, but should it exist, it is not improbable that it forms a further channel of communication for exchange of nourishment and waste products between the lens and ciliary body *via* the vitreous. Research along these lines might throw some light on the production of the posterior cortical opacity.

Question of Scheduling of the Disease

There is no doubt in my mind that many cases of cataract amongst tinplate and sheet millmen are caused by occupational conditions. I think also that it is possible for an ophthalmologist to make out in the early stages of the disease certain peculiarities which distinguish it more or less from other types of cataract. It is my opinion, therefore, that the time has come when it is necessary to consider the advisability of adding this condition to the list of diseases scheduled under the Workmen's Compensation Act for which compensation could be claimed.

Prevention

Admitting that it is a trade disease, is it possible to avoid it? The wearing of suitably prepared triplex standardized goggles would keep

back the heat rays from entering the eye. The atmosphere of the mills, unfortunately, is very dusty and the men perspire freely. To prevent the collection of moisture and dust on the goggles it would be necessary to treat the glass with some preparation similar to that used on the gas masks in France. This, of course, should not be sticky or greasy. I am making a few practical experiments with one of these preparations at present. The framework should be light with plenty of air space between frame and face, and not metallic, as a metal frame gets very hot and gives rise to the popular opinion among the men that goggles draw the heat to the eye. There is another difficulty in the use of goggles: the workers themselves object to wearing them, but I have seen a few old men in the tinplate mills wearing glasses after cataract extraction which were both heavy and devoid of any anti-moisture collecting preparation. Much, I think, could be done to overcome the men's prejudice by suitable propaganda. In the tinplate mills I do not think it is possible to suggest any other reasonable form of prevention.

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A SERIES OF CASES OF "GLASSBLOWERS' CATARACT" OCCURRING IN CHAINMAKERS

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DURING the last few years I have collected notes of about twenty-five cases of cataract in men and women engaged in chainmaking, all of whom presented in one eye or both a posterior polar and cortical opacity of a type closely resembling that described as occurring in glassblowers.

The centre of the chain trade in this country is located at Cradley Heath and the surrounding Black Country. The district is some square miles in extent, and there are several thousands of people engaged in the trade.

Chain is made by hand, the work being a specialized type of