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H. WYNFORD BARROW,
Municipal Secretary.

19th July 1890.

REPORT

ON THE

SANITATION OF BOMBAY.

BY

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APPENDIX.

STATEMENT SHOWING THE LEVELS OF THE TIDE as observed hourly on the
8th March, 1890, near the B.B. and O.L. Railway Iron Bridge over
Bandora Creek.

Hours of Day.	Reduced Levels of the Surface of Water.	Remarks.
6½ A.M.	82·85	Observation taken at 6½ in morning.
7 "	82·74	" " 7 "
8 "	82·60	" " 8 "
9 "	82·43	" " 9 "
10 "	82·33	Tide commenced at 10 "
11 "	82·67	Observation taken at 11 "
12 "	83·08	" " 12 "
1 P.M.	83·50	" " 1 P.M.
2 "	83·85	Tide commenced to subside at 2 P.M.
3 "	83·45	Observations taken at 3 P.M.

HOURLY OBSERVATIONS OF TIDE taken on 8th March, 1890, at Wellington
Pier from 6 A.M. to 6.10 P.M.

Hours.	Reduced Levels of Surface of Water.	Remarks.
6 A.M.	75·20	
7 "	75·53	
8 "	76·62	
9 "	78·62	
10 "	81·62	
11 "	84·12	
12 "	85·62	
1 P.M.	85·70	
2 "	84·12	
3 "	81·45	
4 "	78·28	
5 "	75·86	
6.10 "	74·86	

STATEMENT showing the Average Time the Tides in Bombay Harbour were below the given Levels in the Months of June, July, and August 1889.

Levels.	Average Time.
88	12·41
86	12·86
84	11·16
82	8·26
80	5·90
78	3·39
77	2·29
76	1·84
74	0·81

STATEMENT showing the Time the Tides in Bombay Harbour were below the given Levels in the Months of June, July, and August 1889.

Date.	Levels.								
	88	86	84	82	80	78	77	76	74
1889.	hours	hours	hours	hours	hours	hours	hours	hours	hours
June 1	12·41	12·41	9·60	6·92	4·84	1·35	Nil	Nil	Nil
" 2	12·41	12·41	10·98	8·64	6·91	5·10	3·97	2·74	"
	12·41	12·41	12·41	6·79	4·35	Nil	Nil	Nil	"
" 3	12·41	12·41	12·41	8·45	6·57	4·42	3·19	1·50	"
	12·41	12·41	12·41	6·95	3·81	Nil	Nil	Nil	"
" 4	12·41	12·41	12·41	8·75	6·69	4·27	2·54	"	"
	12·41	12·41	12·41	7·31	4·12	Nil	Nil	"	"
" 5	12·41	12·41	12·41	6·92	6·18	2·79	"	"	"
	12·41	12·41	12·41	6·79	Nil	Nil	"	"	"
" 6	12·41	12·41	12·41	7·94	4·85	"	"	"	"
	12·41	12·41	12·41	8·12	4·09	"	"	"	"
" 7	12·41	12·41	12·41	7·87	4·31	"	"	"	"
	12·41	12·41	12·41	8·39	5·39	"	..	..	"
" 8	12·41	12·41	12·41	8·05	4·45	"	Nil	Nil	"
	12·41	12·41	12·41	8·91	6·31	3·80	"	"	"

STATEMENT—continued.

Data.	Levels.								
	88	86	84	82	80	78	77	76	74
1889.	hours	hours	hours	hours	hours	hours	hours	hours	hours
June 9	12·41	12·41	12·41	7·40	4·32	1·48	1·89	Nil	Nil
	12·41	12·41	11·20	8·61	6·78	4·97	Nil	"	"
" 10	12·41	12·41	9·78	7·22	5·10	2·02	4·01	2·82	"
	12·41	12·41	10·25	8·32	6·88	..	Nil	Nil	"
" 11	12·41	12·41	8·80	6·75	5·07	5·40	4·61	3·76	1·21
	12·41	12·41	..	..	..	2·75	Nil	Nil	Nil
" 12	12·41	12·41	9·79	8·22	6·89	5·54	4·03	4·31	2·69
	12·41	12·41	8·32	6·71	5·08	3·09	1·41	Nil	Nil
" 13	12·41	12·41	9·51	8·34	7·12	6·04	5·45	4·72	3·22
	12·41	12·41	8·06	7·12	5·15	3·38	2·15	Nil	Nil
" 14	12·41	..	9·51	8·21	7·08	6·02	5·47	4·89	3·61
	..	..	7·21	6·58	5·27	3·61	2·55	Nil	Nil
" 15	12·41	12·41	9·50	8·22	..	6·03	5·51	4·92	3·58
	12·41	12·41	8·02	6·60	5·23	3·72	2·72	Nil	Nil
" 16	12·41	12·41	9·50	8·17	7·02	5·93	5·35	4·72	3·25
	12·41	12·41	8·38	6·75	5·21	3·59	2·60	Nil	Nil
" 17	12·41	12·41	9·82	8·22	6·98	5·69	5·00	4·21	2·45
	12·41	12·41	9·09	7·08	5·55	3·89	2·78	Nil	Nil
" 18	12·41	12·41	10·46	8·50	7·03	5·50	4·69	3·65	"
	12·41	12·41	12·41	7·85	5·92	3·97	2·54	Nil	"
" 19	12·41	12·41	12·41	8·62	6·98	4·89	3·72	1·82	"
	12·41	12·41	12·41	9·06	6·70	4·37	2·72	Nil	"
" 20	12·41	12·41	12·41	8·78	6·88	3·60	1·21	"	"
	12·41	12·41	12·41	9·85	7·29	4·60	2·82	"	"
" 21	12·41	12·41	12·41	8·80	5·65	1·55	Nil	"	"
	12·41	12·41	12·41	10·05	7·35	4·51	2·75	"	"
" 22	12·41	12·41	12·41	7·82	4·51	Nil	Nil	"	"
	12·41	12·41	12·41	10·00	7·25	4·79	3·47	"	"
" 23	12·41	12·41	12·41	7·65	4·65	Nil	Nil	"	"

STATEMENT—continued.

Date.	Levels.								
	88	86	84	82	80	78	77	76	74
1889.	hours	hours	hours	hours	hours	hours	hours	hours	hours
June 24	12·41	12·41	12·41	9·60	7·09	4·82	8·57	1·62	Nil
	12·41	12·41	12·41	7·35	4·28	Nil	Nil	Nil	"
" 25	12·41	12·41	12·41	9·27	7·08	5·10	4·05	2·58	"
	12·41	12·41	12·41	7·58	4·75	Nil	Nil	Nil	"
" 26	12·41	12·41	12·41	8·85	6·93	5·05	4·03	2·86	"
	12·41	12·41	12·41	7·45	4·81	Nil	Nil	Nil	"
" 27	12·41	12·41	12·41	8·87	7·02	5·25	4·29	3·32	"
	12·41	12·41	12·41	7·32	5·05	0·40	Nil	Nil	"
" 28	12·41	12·41	12·41	8·68	7·09	5·45	4·55	3·58	"
	12·41	12·41	12·41	7·15	5·15	1·25	Nil	Nil	"
" 29	12·41	12·41	12·41	8·59	7·02	5·45	4·58	3·53	"
	12·41	12·41	12·41	7·11	5·00	2·50	Nil	Nil	"
" 30	..	..	12·41	8·61	7·08	5·51	4·60	3·62	"
	12·41	12·41	12·41	6·97	5·02	2·41	Nil	Nil	"
July 1	12·41	12·41	12·41	8·67	6·93	5·30	No mark	3·29	"
	12·41	12·41	9·35	6·93	5·09	2·40	Nil	Nil	"
" 2	12·41	12·41	11·20	8·61	6·90	5·07	4·02	2·72	"
	12·41	12·41	12·41	7·02	5·00	2·19	Nil	Nil	"
" 3	12·41	12·41	12·41	8·45	6·62	4·62	3·39	1·90	"
	12·41	12·41	12·41	7·48	5·38	2·58	Nil	Nil	"
" 4	12·41	12·41	12·41	8·65	6·54	4·19	2·68	"	"
	12·41	12·41	12·41	7·52	5·65	2·80	Nil	"	"
" 5	12·41	12·41	12·41	8·77	6·43	3·48	1·11	"	"
	12·41	12·41	12·41	9·05	6·20	3·25	Nil	"	"
" 6	12·41	12·41	12·41	8·62	5·72	1·76	"	"	"
	12·41	12·41	12·41	9·15	6·54	3·78	1·85	"	"
" 7	12·41	12·41	12·41	7·84	4·74	Nil	Nil	"	"
	12·41	12·41	12·41	9·08	6·84	4·65	3·30	0·90	"
" 8	12·41	12·41	12·41	7·53	4·71	Nil	Nil	Nil	..
	12·41	12·41	12·41	9·12	7·22	5·31	4·38	3·27	Nil

STATEMENT—continued.

Date.	Levels.								
	88	86	84	82	80	78	77	76	74
1889.	hours	hours	hours	hours	hours	hours	hours	hours	hours
July 9	12.41	12.41	12.41	7.01	4.60	Nil	Nil	Nil	Nil
	12.41	12.41	12.41	8.89	7.12	5.62	4.85	3.92	1.49
" 10	12.41	12.41	9.05	6.82	4.70	0.83	Nil	Nil	Nil
	12.41	12.41	..	..	..	..	4.96	4.25	2.41
" 11	12.41	12.41	10.11	8.48	7.11	5.73	Nil	Nil	Nil
	12.41	12.41	8.44	6.38	4.62	1.30	5.00	..	..
" 12	12.41	12.41	9.58	8.08	6.92	5.63	0.97	4.37	2.75
	12.41	12.41	7.85	6.29	4.85	2.97	..	Nil	Nil
" 13	12.41	..	9.19	8.04	6.84	5.73	5.23	4.51	3.02
	12.41	9.91	9.85	6.36	5.08	3.70	2.05	Nil	Nil
" 14	12.41	11.18	9.10	7.89	6.82	5.78	5.19	4.63	3.20
	..	9.74	7.85	6.69	5.39	3.89	2.87	0.94	Nil
" 15	12.41	10.97	9.00	7.80	6.75	5.63	{ 5.11 3.12 4.85 }	4.43	2.80
	12.41	12.41	8.25	6.91	5.59	4.02	3.25	1.72	Nil
" 16	12.41	12.41	12.41	12.41	5.75	4.25	3.25	1.90	"
	12.41	12.41	8.75	7.15	6.80	5.54	4.85	No mark	"
" 17	12.41	12.41	12.41	7.90	6.60	5.3	4.11	3.10	"
	12.41	12.41	9.20	7.50	5.90	4.12	3.02	3.78	"
" 18	12.41	12.41	10.20	7.80	6.00	3.80	2.38	Nil	"
	12.41	12.41	12.41	8.20	6.17	3.90	2.25	"	"
" 19	12.41	12.41	12.41	7.73	5.37	1.22	Nil	"	"
	12.41	12.41	12.41	9.12	7.00	4.30	1.32	"	"
" 20	12.41	12.41	12.41	8.30	4.77	Nil	Nil	"	"
	12.41	12.41	12.41	9.93	7.22	4.15	"	"	"
" 21	12.41	12.41	12.41	8.03	3.85	Nil	"	"	"
	12.41	12.41	12.41	11.00	7.55	4.47	2.12	"	"
" 22	12.41	12.41	12.41	7.45	3.18	Nil	Nil	"	"
	12.41	12.41	12.41	10.85	7.60	4.67	2.82	"	"

STATEMENT—continued.

Date.	Levels.								
	88	86	84	82	80	78	77	76	74
1889.	hours	hours	hours	hours	hours	hours	hours	hours	hours
July 23	12·41	12·41	12·41	8·70	3·40	Nil	Nil	Nil	Nil
" 23	12·41	12·41	12·41	10·65	7·30	4·85	..	"	"
" 24	12·41	12·41	12·41	8·55	4·00	Nil	3·37	"	"
" 24	12·41	12·41	12·41	9·83	7·12	"	Nil	"	"
" 25	12·41	12·41	12·41	..	..	5·00	3·69	2·18	"
" 25	12·41	12·41	12·41	7·89	5·19	Nil	Nil	Nil	"
" 26	12·41	12·41	12·41	9·09	7·15	5·21	4·19	2·89	"
" 26	12·41	12·41	12·41	7·62	5·15	Nil	Nil	Nil	"
" 27	12·41	12·41	12·41	8·81	7·05	5·21	4·31	3·30	"
" 27	12·41	12·41	12·41	7·23	5·12	2·02	Nil	Nil	"
" 28	12·41	12·41	9·55	8·61	6·97	5·40	4·55	3·84	0·85
" 28	12·41	12·41	..	7·15	5·27	2·90	Nil	Nil	Nil
" 29	12·41	12·41	10·31	8·35	6·91	5·42	4·63	3·69	0·32
" 29	12·41	12·41	9·22	7·10	5·40	3·32	1·55	Nil	Nil
" 30	..	..	10·15	8·30	6·76	5·22	4·47	3·51	0·79
" 30	12·41	12·41	9·08	7·12	5·52	3·55	2·10	Nil	Nil
" 31	12·41	12·41	10·25	8·32	6·72	5·19	4·22	3·25	"
" 31	12·41	12·41	9·38	7·29	5·70	3·85	2·70	Nil	"
August 1	12·41	12·41	10·30	8·35	6·65	4·95	4·06	2·80	"
" 1	12·41	12·41	9·80	7·30	5·93	4·23	2·78	0·61	"
" 2	12·41	12·41	10·24	8·22	6·44	4·44	3·24	1·50	"
" 2	12·41	12·41	12·41	7·90	6·22	4·33	3·26	1·48	"
" 3	12·41	12·41	12·41	8·04	6·06	3·34	1·32	Nil	"
" 3	12·41	12·41	12·41	8·20	6·40	4·42	3·15	0·72	"
" 4	12·41	12·41	12·41	7·96	5·28	0·84	Nil	Nil	"
" 4	12·41	12·41	12·41	9·14	7·02	4·82	3·60	1·36	"
" 5	12·41	12·41	12·41	8·08	4·68	Nil	Nil	Nil	"
" 5	12·41	12·41	12·41	9·84	7·51	5·18	3·25	1·92	"
" 6	12·41	12·41	12·41	7·60	3·96	Nil	Nil	Nil	"
" 6	12·41	12·41	12·41	10·00	7·58	5·40	4·32	3·02	"

STATEMENT—continued.

Date.	Levels.								
	88	86	84	82	80	78	77	76	74
1889.	hours	hours	hours	hours	hours	hours	hours	hours	hours
August 7	12·41	12·41	12·41	7·56	4·21	Nil	Nil	Nil	Nil
	12·41	12·41	12·41	7·66	7·56	5·80	4·89	"	"
	12·41	12·41	12·41	7·12	4·79	Nil	Nil	3·90	"
" 8	12·41	12·41							
	12·41	12·41	12·41	8·80	7·30	5·82	5·05	4·24	1·78
" 9	12·41	12·41	9·04	6·84	5·10	2·87	0·72	Nil	Nil
	12·41	12·41	10·06	8·40	7·06	5·86	5·21	4·52	2·90
" 10	12·41	12·41	8·50	7·00	5·56	3·96	2·94	0·94	Nil
	12·41	12·41	9·56	8·10	7·00	5·90	5·29	4·70	3·14
" 11	12·41	12·41	8·26	6·86	5·55	4·20	3·35	2·18	Nil
	12·41	12·41	8·92	7·70	6·67	5·61	5·10	4·35	3·10
" 12	..	..	8·43	7·05	5·90	4·60	3·87	3·05	Nil
	12·41	12·41	9·10	7·90	6·81	5·60	4·97	4·41	2·81
" 13	12·41	12·41	8·60	7·30	6·09	4·80	4·07	3·25	Nil
	12·41	12·41	7·05	7·60	6·45	5·20	4·52	3·70	1·70
" 14	12·41	12·41	8·86	7·50	6·20	4·77	3·78	3·05	Nil
	12·41	12·41	9·16	7·60	6·18	4·60	3·60	2·40	"
" 15	12·41	12·41	9·65	7·98	6·50	4·87	3·72	2·55	"
	12·41	12·41	9·70	7·75	6·18	3·88	2·08	Nil	"
" 16	12·41	12·41	12·41	..	..	5·05	3·75	1·80	"
	..	..	..	8·72	6·98	..	Nil	Nil	"
" 17	12·41	12·41	12·41	8·24	5·82	1·98	2·23	"	"
	12·41	12·41	12·41	9·75	7·56	5·13	Nil	"	"
" 18	12·41	12·41	12·41	8·25	4·89	Nil	"	"	"
	12·41	12·41	12·41	10·50	7·65	3·80	"	"	"
" 19	12·41	12·41	12·41	9·00	Nil	Nil	"	"	"
	12·41	12·41	12·41	11·97	7·82	3·20	"	"	"
" 20	12·41	12·41	12·41	..	Nil	Nil	"	"	"
	12·41	12·41	12·41	12·41	7·85	3·35	..	"	"
" 21	12·41	12·41	12·41	12·41	3·12	Nil	Nil	"	"
	12·41	12·41	12·41	12·41	7·61	4·40	"	"	"

STATEMENT—continued.

Date.	Levels.								
	88	86	84	82	80	78	77	76	74
1889.	hours	hours	hours	hours	hours	hours	hours	hours	hours
Aug. 22	12·41	12·41	12·41	12·41	4·01	Nil	2·15	Nil	Nil
" 23	12·41	12·41	12·41	12·41	6·88	4·41	Nil		
	12·41	12·41	12·41	12·41	..	..	2·88	Nil	Nil
" 24	12·41	12·41	12·41	7·82	4·54	Nil	Nil	"	"
	12·41	12·41	12·41	8·92	6·64	4·57	3·40	1·56	"
" 25	12·41	12·41	12·41	7·25	4·98	0·40	Nil	Nil	"
	12·41	12·41	9·75	8·38	6·65	4·87	3·87	2·83	"
" 26	12·41	12·41	..	7·25	5·30	2·69	Nil	Nil	"
	12·41	12·41	10·35	8·28	6·70	5·10	4·21	3·15	"
" 27	12·41	12·41	9·08	7·10	5·44	3·59	2·45	Nil	"
	12·41	12·41	9·98	8·12	6·69	5·22	4·44	3·51	0·83
" 28	..	..	8·92	7·18	5·70	4·13	3·20	2·04	Nil
	12·41	12·41	9·49	7·85	6·48	5·12	4·38	3·50	1·12
" 29	12·41	12·41	8·75	7·31	5·91	4·49	3·68	2·73	Nil
	12·41	12·41	9·32	7·80	6·45	5·05	4·28	3·32	"
" 30	12·41	12·41	9·08	7·59	6·21	4·84	4·05	3·12	"
	12·41	12·41	9·38	7·78	6·39	4·89	4·06	2·93	"
" 31	12·41	12·41	9·45	7·84	6·55	5·05	4·31	3·35	"
	12·41	12·41	9·60	7·85	6·38	4·59	3·45	2·01	"
	12·41	12·41	10·98	8·36	6·95	5·40	4·60	3·59	"

STATEMENT SHOWING THE VARIOUS DRAINAGE AREAS OF BOMBAY.

Area in Acres.	Description of Locality.
110	East side of Malabar Hill, drained into sea.
294	West " " " "
337	West side of Khambala Hill, drained into sea.
251	West side of Warli Hill " "
2,308	District drained by Warli Channel.
525	West portion of Mahim, drained into Mahim Bay.
1,321	District drained by Dharavi Channel.
151	North side of Dharavi Road, drained into Mahim River.
185	District drained by Sion Channel.
3,029	West side of Sewri and Sion Roads, drained into sea.
668	West side of Mazagon Road, drained into sea.
200	East side of Mazagon, eventually draining towards flats.
784	Additional area, draining into the storm-water reservoir.
928	Flats drained into open main drain channel.
256	Gowalia Tank and Khambala Hill, draining towards the open main drain channel.
736	District drained by Parel and Bellasis Road drain, and finally falling into old main drain.
336	Khetwadi district, finally draining into old main drain channel.
103	District drained by Charni Road drain.
60	" " Sonapore drain.
52	" " Marine Lines drain.
163	Esplanade, draining into sea.
265	Elphinstone Reclamation, drained by Carnac Bunder outfall.
144	Mody Bay district, drained into sea.
79	Frere Road, drained by Mandvi outfall.
273	Fort district, drained by Mint Road outfall.
61	Dock and Custom House portion of Fort, drained into sea.
257	Colaba (western district), drained into sea.
208	" eastern " " "
147	Portion west of Queen's Road, falling into sea.
14,231	

STATEMENT showing Areas of the different Districts and total Areas drained by different Ovoid Sewers, and the Populations served by them, together with the Size of the Sewers and their Gradients.

Ovoid Sewer.	District.	Acres.	Population (as per Census of 1881).	Total.	Discharging Capacity, 2/3rds full. Cube Feet per Minute.	Size of Sewer.
Mint Road to Shek Memn Street.	Esplanade	214	4,429	40,772	707	2 6 x 3 0
	Fort South	131	3,515			
	Fort North	133	33,828			
	Total ..	478				
Carnac Road. Sewer from Frere Road to Shek Memn Street.	Umankhari	8	4,164	96,313	752	2 6 x 3 9
	Dongri ..	285	33,290			
	Esplanade	201	4,159			
	Mandvi ..	164	42,351			
	Chakla ..	17	12,349			
Total ..	675					
Shek Memn Street to Kavasji Patel Tank.	Chackla ..	19	13,802	220,334	796	2 8 x 4 0
	Market ..	79	43,609			
	Dhobi Taloo	23	9,155			
	Fanaswadi	20	3,715			
	Bhuleswar	18	9,145			
	Girgam ..	12	2,450			
	Esplanade	18	373			
	Mint Road Sewer ..	478	41,772			
	Carnac Road Sewer ..	675	96,313			
	Total ..	1,342				
Kavasji Patel Tank to Khetwadi 10th Lane.	Kombhar- wada ..	19	14,452			
	Khetwadi ..	97	16,796			
	Carried over	116	31,248			

STATEMENT—continued.

Ovoid Sewer.	District.	Acres.	Population (as per Census of 1881).	Total.	Discharging Capacity, 2/3rds full, Cuba Feet per Minute.	Size of Sewer.
	Brought over	116	31,248			ft. in. ft. in.
	Girgam ..	12	2,450			
	Sewer from Shek Memn Street to K a v a s j i Patel Tank	1,342	220,334			
	Total ..	1,470		254,032	1,304	3 4 × 5 0
Queen's Road ..	Dhobi Taloo	76	30,254			
	Fanaswadi	105	19,503			
	Market ..	10	5,521			
	Girgam ..	100	20,419			
	Khetwadi ..	61	10,562			
	Chopati ..	103	10,184			
	Walkeahwar	10	210			
	Eaplanade	137	2,835			
	Total ..	602		99,488	704	2 6 × 3 9
Khetwadi 10th Lane to Grant Road.	Khetwadi ..	12	2,078			
	K a v a s j i Patel Tank to Khet- wadi 10th Lane ..)	1,470	254,032			
	Queen's Road	602	99,488			
	Total ..	2,084		355,598		
Kamatipura ..	Tardoo ..	13	1,156			
	Kamatipura	55	23,713			
	Total ..	68		24,869	749	2 6 × 3 9

STATEMENT—continued.

Ovoid Sewer.	District.	Acres.	Population (as per Census of 1881).	Total.	Discharging Capacity, 2/3rds full, Cube Feet per Minute.	Size of Sewer.
						ft. in. ft. in.
Grant Road to Clerk Road.	Bhuleshwar	57	28,961			
	Chakla ..	15	10,896			
	Chopati ..	8	791			
	Milkeswar	4	84			
	Tardeo ..	215	19,125			
	Umarkhari	97	50,492			
	Mahalaxmi	152	8,058			
	Byculla ..	4	111			
	Khanbhawadi	27	20,538			
	Kamatipura	11	4,742			
	Khara Taloo	41	28,691			
	1st Nagpada	29	9,372			
	2nd Nagpada	34	15,922			
Total ..		724	192,783		2,567	4 8 x 7 0
Kamatipura ..	Kamatipura	68	24,869			
Khetwadi 10th Lane to Grant Road.	Khetwadi 10th Lane to Grant Road ..	2,084	355,598			
	Total ..	2,876		573,250		
Ripon Road ..	Byculla ..	260	..	7,186	740	2 6 x 3 9
Clerk Road ..	Tarwadi ..	318	9,654			
	Byculla ..	180	4,974			
	Warli ..	71	702			
	Ripon Road	260	7,186			
Total ..	829			22,516	740	2 6 x 3 9
Clerk Road to Pumping-station.	Grant Road to Clerk Road ..	2,876	573,250			
	Clerk Road	829	22,516			
	Total ..	3,705		595,766	3,328	5 4 x 8 0

MEMORANDUM BY SURGEON-MAJOR WEIB, MEDICAL
OFFICER OF HEALTH.

The nuisance felt during the monsoon from the flats was more serious than for many years. The nuisance was caused by a deposit of sludge across the reservoir.

A. Interrupting the current of sewage.

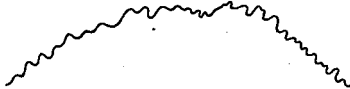
B. Polluting the water.

I wrote two reports on the causes of the offensive smells. Before giving these reports, I may mention that the deposit in some of the sewers in the Fort, as in the Church Gate and Marine Street sewers, was exceptionally small. In the Marine Street sewer there was practically none.

Popularly the nuisance from the Flats was ascribed to sewer emanations, but the nuisance was not due to the sewers, nor to any nuisance caused within the sewers. It was due to the deposit in the reservoir and its effects.

REPORT DATED 18TH OCTOBER, 1889.

"I have the honour to submit the result of observations I made this morning. A little after six, one of the sluice gates at Clerk Road was opened, and I followed the sewage from the sluice gates to the Vellard, Mahalaxmi; the stream of sewage on entering the reservoir set towards the Vellard, and was preceded by a wave or border of charcoal and sewage matters some two feet broad, having a wavy outline, as"



The rate of motion was, on an average, 45 feet in one minute and twenty seconds as I timed it. I followed the sewage till the current arrived at the Vellard. It now extended in an irregular line from the Vellard east, across the reservoir, having the greatest surface north as follows, the apex being towards the Vellard.

"In about two hours, the surface of the water of the reservoir, as far as I could see, was covered with sewage, i. e., in a few words the reservoir was more or less converted into a sewage pond. The set towards the

Vellard explains the offensive smell which you have observed on Khambala Hill. With a set towards the Vellard, the roads on either side of the



Khambala Hill act as funnels, and attract the foul vapours towards the hill. The Acting Executive Engineer, Mr. Smith, attributes the set of the sewage to the deposit on the east of the reservoir. The removal of this deposit has been under your consideration."

Report dated 6th November, 1889.

"The liquid sewage in the open main drain gave 20 parts per million of free ammoniacal products, and the water from the south-east side of the reservoir, 14; while the water from near the outlet near Love Grove yielded 17. These have been the results of my examinations. The quality of the water in the open drains on the Flats varies very much; those communicating during the rains with the open drain or with the drainage of dwellings are sewage tainted.

"I may offer an opinion on the nuisance from the reservoir during this year, and the cause of the nuisance being more observed than in the last year. In my opinion the cause is due to the deposit in the reservoir.

"The deposit—

"A.—Obstructs the circulation of the water.

"B.—Retards the diffusion of the sewage.

"C.—Causes a current of sewage to the Vellard.

"D.—Exposes a greater surface of sewage to the atmosphere.

"E.—And, therefore, brings the sewage the distance between the east of the reservoir and Mahalaxmi, so much nearer to Khambala and Malabar Hills.

"I forward in a bottle of sewage a sample of the odours which have been observed from the direction of the Flats."

It must be recollected that the new sewer system is tried as no other

system in the world is tried. There is discharging daily in faecal mass some 340 (three hundred and forty) tons of night-soil into the sewers. And why is this done? Because the harbour outfall, the ancient way of discharge, was closed by Government, and because the interests of the city have been sacrificed to the interests of the harbour. Both Mr. Walton and I objected strongly to the discharge of night-soil in mass from the Carnac Bunder night-soil depot into the sewers.

The following is one of my reports:—

“I believe the discharge of the night-soil brought to the Carnac Bunder Night-soil Depot into the new sewer in the Esplanade Cross Road within a limited period of about six hours would be attended with danger. I am further doubtful whether any practicable system of flushing would prevent portions of the mass of night-soil that would be poured into the sewer adhering to the sewer and blocking the sewer subsequently. Night-soil is most tenacious. The circulation for some hours through the city of an immense current of night-soil is attended undoubtedly with danger; although the danger is less in proportion to the freshness of the organic fluids and particles. The danger is very much greater than the danger that would attend the admission of the same quantity in divided portions and at divided points.

“I do not think the emptying of night-soil into the drains at junction of drains and sweepers' gullies is practicable; it would create a most serious nuisance, a nuisance that would be protested against. I believe it is impracticable.”

MEMORANDUM OF TEMPERATURE OF SEWAGE IN MAIN SEWERS ON
1st February, 1890. Taken by Mr. Baldwin Latham.

Locality.	Tempera- ture.	Time.	Remarks.
Temperature in shade at Pump- ing Station, Love Grove .. }	69·8	7.30	In shade.
Shred-lifter chamber	75·7	7.30	Sewage.
" " "	75·7	7.35	"
From pumping-station	75·5	7.50	Manhole No. 5.
" " "	74·9	8.10	" No. 2.
In Clerk Road manhole	75·2	8.15	
" " "	74·2	8.15	On ovoid sewer, east manhole No. 1.
North side of the Bellasis } Bridge }	75·4	8.45	At pipe depot man- hole.
Air Temperature	74·6	8.45	In shade.
In Gilder Street main sewer ..	76·5	9.10	
" " old sewer ..	73·5	9.10	On old manhole.
Bapty Road main sewer	76·8	9.20	On storm water
" old sewer	73·7	9.20	manhole.
Falkland Road	76·2	9.30	Manhole No. 1.
10th Khetwadi Lane, north side	76·2	9.40	In manhole.
" " " south side	76·0	9.45	" "
Khetwadi Back Road	74·8	9.45	On Queen's Road sewer.
Khetwadi Back Road, opposite } the 9th lane }	77·0	9.45	On main sewer.
Khetwadi Back Road	73·8	9.50	Fresh water from main pipe.
Air Temperature	75·7	9.50	In shade.
15th Khetwadi Lane	73·5	10.04	Fresh water from main pipe.

NOTES taken on 3rd February, 1890. (Temperature taken by Mr. Baldwin Latham.)

Locality.	Temperature.	Time.	Remarks.
At Pumping Station, } Love Grove }	75·7	A.M. 7.45	{ Sewage, ahred-lifter chamber.
Air Temperature }	69·4	7.45	
Water for Condensers ..	89·6	7.55	In shade.
Water from Condensers	105·3	7.55	In cooling tank.
" " "	107·2	"	{ In channel between tank and engine house.
" " "	109·6	"	
" " "	106·7	"	

MEMORANDUM OF STATE OF SEWERS in Bombay, taken under Executive Engineer's instructions.

Location.	Depth of Sewage.	Depth of Silt.	Total Depth of Sewage and Silt.	Remarks.
<i>Hornby Road and Town Hall Sewer, January 17, 1890.</i>	ft. in.	ft. in.	ft. in.	
North Corner School of Art ..	1 1	0 7½	1 8½	
Manhole	1 0	0 9½	1 9½	
Manhole	1 0	0 8	1 8	
North end of Victoria Terminus	0 9½	0 8	1 5½	
North of Novelty Theatre ..	0 9	0 8½	1 5½	
Entrances to platform, Victoria Terminus }	0 9	0 6	1 3	
Dome of Victoria Terminus ..	0 11½	0 4½	1 4	
Opposite Post Office door, but little to east }	0 9½	0 7	1 4½	
Tanks for road watering, European General Hospital ..	0 9	0 6	1 3	
Goa Street	0 8	1 1½	1 9½	
North of corner Mint Road and Frere Road }	0 7	1 0½	1 7½	
Agiari Street	0 11½	0 10½	1 10	

MEMORANDUM OF STATE OF SEWERS—*continued.*

Location	Depth of Sewage.	Depth of Silt.	Total Depth of Sewage and Silt.	Remarks.
<i>Hornby Road, &c.—continued.</i>				
	ft. in.	ft. in.	ft. in.	
Ballard Road	0 5	1 4	1 9	
Mint, north circle manhole . .	0 6	1 3½	1 9½	
18-in. pipe manhole	1 1½	0 6½	1 8	
Penstock manhole on old drain	..	1 9		
<i>Queen's Road Sewer, January 18, 1890.</i>				
Khetwadi, 10th Lane	2 7	1 10	4 5	
„ 11th Lane	2 2	2 2	4 4	
„ 13th Lane	2 5	1 11	4 4	
Charni Road, corner	2 7	1 10	4 5	
Khetwadi, main road	3 9½	0 7	4 4½	
Naserwanji Parakh's house . .	2 4½	1 9	4 1½	
Girgam Back Road	3 3½	1 1	4 4½	
North of Eye Hospital	2 5	1 11	4 4	
Girgam Road	3 1	1 4	4 5	
North of mill	2 10	1 6	4 4	
Charni Road and Queen's Road	2 8	2 0	4 8	
Centre of Bhoras Sanatorium	3 3½	1 2½	4 6	
Thakodwar Road	3 8	1 9	5 5	
Mahomedan Burial Ground . .	4 3½	1 6½	5 10	
Chandanwadi Latrine	3 2	1 10	5 0	
Next N. of Marine L. Road . .	4 1½	0 2½	4 4	
Corner Wellington Street . .	4 0	Nil.	4 0	
Hospital Lane	3 0	„	3 0	
Dr. Crimmin's bungalow (Capt. Parker)	2 4	„	2 4	
Side road (southernmoet) . .	1 1	„	1 1	
W. F. Melvin . . . . .	..	..	0 4	
Church Gate Street (195 feet)	..	..	0 1½	

MEMORANDUM OF STATE OF SEWERS—*continued.*

Location.	Depth of Sewage.	Depth of Silt.	Total Depth of Sewage and Silt.	Remarks.
<i>Clerk Road Sewer, January 20, 1890.</i>				
Head manhole	1 1	0 9	1 10	
2nd from manhole west . .	0 3½	1 1½	1 5	
De Lisle Road	1 2	0 5	1 7	
Centre of Hay Stack's Ground	0 4	1 2	1 6	
New Culvert	0 7	1 1	1 8	
Arthur Road, 9-inch pipe . .	0 4	1 10	2 2	
Level crossings B. B. & C. I. Ry.	1 1	1 8	2 9	
Opposite Grand Stand . . .	1 10	1 9	3 7	
Last on Clerk Road sewer . .	3 0	1 10	4 10	
<i>Main Sewer, January 20, 1890.</i>				
Clerk Road Bridge	3 3	3 3	6 6	
1st north of bell-mouth junction	3 0	4 3	7 3	
South bund running east . .	3 3	4 1	7 4	
3rd manhole north of ditto . .	3 6	3 6	7 0	
6th " "	3 6	3 11	7 5	
Next manhole south of middle bund running east	4 2	3 3	7 5	
Next manhole north of preceding	7 9	0 9	8 6	
" " "	6 8	1 8	8 4	
Intermediate	7 0	1 6	8 6	
1st manhole south of north bund running east	7 4	0 9	8 1	
3rd manhole from shred-lifter sump	5 2	2 11	8 1	
2nd " " "	5 0	3 1	8 1	
1st " " "	7 4	0 8	8 0	
Shred-lifter sump, sunk 12 in.	8 8	Nil.	8 8	

MEMORANDUM OF STATE OF SEWERS—*continued.*

Location.	Depth of Sewage.	Depth of Silt.	Total Depth of Sewage and Silt.	Remarks.
<i>Ripon Road Sewer, January 20, 1890.</i>				
	ft. in.	ft. in.	ft. in.	
Head manhole	0 8	0 7	1 3	
2nd "	0 9½	0 8½	1 6	
4th "	1 3	0 4	1 7	
6th "	1 7	0 5	2 0	
8th "	1 4	1 0	2 4	
10th "	1 6	1 0	2 6	
Sankli Street	1 1	1 4	2 5	
2nd manhole north	1 3½	0 9½	2 1	
4th " "	1 6½	0 7½	2 2	
Agripada open drain	1 0	0 9	1 9	
" connection manhole	1 4	0 8	2 0	
Indian Manufacturing Com- pany's Mill	0 4	1 3	1 7	
Ripon Mill (centre)	0 3½	1 4½	1 8	
South part of Hindustan Mill	0 5½	1 4½	1 10	
2nd manhole from Jacob's Circle	0 6	1 5	1 11	
Clerk Road sewer (west aisle of fountain)	1 8½	0 7½	2 4	

MEMORANDUM OF DEPTHS OF SEWAGE taken on the Morning of the
24th January, 1890, under Executive Engineer's instructions.

Locality.	Depth of Silt.	Depth of Sewage above Silt.	Total Depth of Silt and Sewage.	Remarks.
Kamatipura Centre Street (old brick sewer), opposite 12th Kamatipura Street	Not taken separately.	Very little.	ft. in. 1 6	
Kamatipura Centre Street (old brick sewer), opposite 10th Kamatipura Street	"	"	1 6	
Kursetji Sukhlaji Street, at 7th Kamatipura Street	ft. in. 0 4½	ft. in. 0 7	0 11½	
Bapty Road (next manhole west of Kursetji Street) (storm-water drain)	0 5	0 8	1 1	
Bapty Road (ovoid sewer), at Kamatipura Centre Road	2 0	0 5	2 5	
Bapty Road (ovoid sewer), at Trimback Parashram Street	2 7	0 8	2 10	
Bapty Road (ovoid sewer), at Kamatipura Bazaar Street	2 2	0 9	2 11	
Bapty Road (storm-water drain), at Kamatipura Bazaar Road	1 8	1 4	3 0	
Bapty Road (old main drain), at Stable Street	0 11	0 7	1 6	
Kursetji Sukhlaji Street (south end, near latrines)	0 10	1 2	2 0	
Grant Road (manhole between Sukhlaji Street and Falkland Road)	1 9	1 7	3 4	
New main ovoid sewer at junction of Falkland Road and 10 Khetwadi Road	2 1	4 1	6 2	} Mr. Baker's men were removing silt at the time of these observations at these places.
Next manhole on Falkland Road	3 5	2 10	6 3	
Manhole on Falkland Road, near Bapty Mills	3 3	3 1	6 4	
Falkland Road, at junction of Bapty Road	0 1	6 1	6 2	

SEWAGE PUMPING ENGINES AT LOVE GROVE.—COUNTER READINGS.

Date.	Engine No. 1.		Engine No. 2.		Engine No. 3.		Engine No. 4.		Total Strokes.
	Counters.	Strokes.	Counters.	Strokes.	Counters.	Strokes.	Counters.	Strokes.	
1889.									
May 18	651952	..	637838	..	..	..	674126		
" 19	681321	29369	684533	46695	..	..	685445	11819	87383
" 20	694180	12859	706352	21819	..	..	712095	26650	61328
" 21	725968	81788	730000	23646	..	..	726652	14557	69993
" 22	753832	27864	750012	20012	..	..	740821	14169	62045
" 23	768336	14504	772105	22093	..	..	761968	21147	57744
" 24	790703	22367	790008	17903	..	..	784186	22218	62488
" 25	790704	000001	820057	30049	..	..	748416		
" 26	816845	26141	850000	29943	..	..	807218	58802	114886
" 27	843996	27091	871390	21390	..	..	827529	20311	68792
" 28	853863	9927	907063	35673	..	..	845668	18139	63739
" 29	876498	22635	918978	11915	..	..	881751	36083	70633
" 30	902763	26265	947867	28889	..	..	893240	11489	66643
" 31	910665	7902	970909	23042	..	..	915368	22128	53072
June 1	934182	23517	436	29527	..	..	918345	2977	56021
" 2	953397	19215	25356	24920	..	..	941246	22901	67136
" 3	975198	21801	36958	11602	..	..	968719	27473	60876
" 4	000248	25050	69855	32897	..	..	968720	1	57948
" 5	005478	5170	100050	30195	..	..	969723	1003	36368
" 6	070020	64542	125958	25908	..	..	996515	26792	117242
" 7	100120	80100	141010	15052	..	..	22352	25837	70989
" 8	116515	16395	172092	31082	..	..	56567	34215	81692
" 9	146168	29653	193870	21278	..	..	81025	24458	75389
" 10	161911	15743	225522	32152	..	..	106586	25561	73456
" 11	199021	37110	243492	17970	..	..	138445	31859	86939
" 12	223586	24565	274039	30547	..	..	139493	1048	56160
" 13	238781	15195	302422	28383	..	..	164782	25289	68867
" 14	272424	33643	321926	19504	..	..	192960	28178	81325
" 15	301905	28881	355740	33814	..	..	214606	21646	84341
" 16	338350	37045	389286	33466	..	..	215140	0534	71045
" 17	366656	27706	418606	29820	..	..	232879	17739	74765

COUNTER READINGS—continued.

Date.	Engine No. 1.		Engine No. 2.		Engine No. 3.		Engine No. 4.		Total Strokes.
	Counters.	Strokes.	Counters.	Strokes.	Counters.	Strokes.	Counters.	Strokes.	
1889.									
June 18	899845	83189	430623	12017	..	..	270142	37263	82469
" 19	420880	39035	448037	17414	..	..	302420	32278	88727
" 20	450840	29960	476239	28206	..	..	307569	5149	63315
" 21	450841	00001	501968	25729	..	..	344933	37364	63094
" 22	475960	25119	515808	13840	..	..	374940	30007	68966
" 23	508469	32509	549115	33307	..	..	374932		
" 24	544958	36489	563298	14183	..	..	398042	23110	73782
" 25	564526	19568	573700	10402	..	..	423390	25348	55318
" 26	574642	10116	583700	10000	..	..	454838	31448	51564
" 27	593675	19033	585764	2064	..	..	458742	3904	25001
" 28	621230	27555	586290	526	..	..	460588	1846	29927
" 29	656884	35654	615788	29498	..	..	470590	10002	75154
" 30	658133	01249	634220	18432	..	..	475580	4990	24671
July 1	..	..	668350	34130	..	..	511320	35740	69870
" 2	..	..	685064	16714	828230	..	542152	30832	
" 3	681670	23537	..	..	852520	24290	551627	9475	57302
" 4	714680	33010	710023	24959	863713	9193	553164	1537	67999
" 5	733547	18867	738498	28465	..	..	570124	16960	64292
" 6	736802	3255	760623	22135	..	..	589963	19839	45229
" 7	765215	28413	787701	17078	..	..	..	..	45491
" 8	791721	26506	817954	30253	..	..	..	..	56759
" 9	805121	13400	..	..	..	..	620442	30479	43879
" 10	812024	6903	..	..	885690	21977	621682	1240	30120
" 11	813104	1080	842508	24554	900456	14766	622404	722	41122
" 12	..	..	851828	9320	925110	24654	660038	37634	71608
" 13	..	..	875212	23384	950568	25458	670704	10666	59508
" 14	826496	13392	..	..	982415	31847	662211		
" 15	831626	5130	901491	26279	1379	18964	702316	40095	90468
" 16	885946	54320	922701	21210	..	..	718491	16175	91705
" 17	885346	..	951457	28756	..	..	..
" 18	909940	24594	958165	6708	..	..	746232	27741	59043

COUNTER READINGS—continued.

Date.	Engine No. 1.		Engine No. 2.		Engine No. 3.		Engine No. 4.		Total Strokes.
	Counters.	Strokes.	Counters.	Strokes.	Counters.	Strokes.	Counters.	Strokes.	
1889.									
July 19	925762	15822	967698	9533	..	..	769544	23312	48667
" 20	947872	22110	998843	31145	..	..	..	..	53255
" 21	969845	21973	031468	32625	..	..	..	..	54598
" 22	992909	23064	059248	27780	..	..	774046	4502	55346
" 23	18604	25695	61174	1926	..	..	806865	32319	59940
" 24	43013	24409	88715	7541	..	..	830794	24369	56319
" 25	68007	24994	122015	33300	..	..	851496	20762	79056
" 26	..	..	157807	35792	..	..	880785	29289	65081
" 27	75577	7570	194045	36238	..	..	909280	28495	72303
" 28	111572	35995	202572	8527	..	..	937710	28430	72952
" 29	150025	38453	210923	8351	..	..	966026	23316	75120
" 30	185085	35060	242650	31727	..	..	..	..	66787
" 31	221068	35983	275022	32372	..	..	..	..	68355
Aug. 1	231308	10240	306615	31593	..	..	993705	27679	69512
" 2	..	..	333182	26567	10210	8831	28230	28525	63923
" 3	..	..	353700	20518	40740	30530	52622	24392	75440
" 4	..	..	369704	16004	69978	29238	87178	34556	79798
" 5	248363	17055	..	..	97984	23006	122267	35089	80150
" 6	258846	10483	387905	18201	124855	26871	141544	19277	74832
" 7	293515	34669	416103	28198	150440	25585	..	..	88425
" 8	327890	34375	450415	34312	..	..	161382	19838	88525
" 9	355730	27840	472906	22491	..	..	182254	20872	71203
" 10	390680	34950	..	..	..	..	212830	30576	65526
" 11	424480	33800	501030	28124	..	..	218055	5225	67149
" 12	454081	29601	530935	29905	..	..	224118	6063	65569
" 13	477081	23050	564002	33067	..	..	229430	5312	61429
" 14	500071	23040	599432	35430	..	..	..	..	58470
" 15	503327	3256	635155	35723	..	..	253718	24233	63262
" 16	531223	27896	671360	36205	..	..	..	..	64101
" 17	566630	35407	686157	14797	..	..	276880	23167	50204
" 18	602374	35744	721179	35022	..	..	286950	10070	80836

COUNTER READINGS—continued.

Date.	Engine No. 1.		Engine No. 2.		Engine No. 3.		Engine No. 4.		Total Strokes.
	Counters.	Strokes.	Counters.	Strokes.	Counters.	Strokes.	Counters.	Strokes.	
1889.									
Aug. 19	636038	25664	738138	16959	..	..	309032	22122	64745
" 20	665168	29130	768208	30070	166122	15682	321653	12621	87503
" 21	701485	36317	802961	34753	183254	17132	..	..	88202
" 22	729955	28470	803550	0589	204855	21601	330368	8715	59375
" 23	749708	19753	858848	55298	221554	16699	355362	24994	116744
" 24	778283	28575	886142	27294	231050	9496	365176	9814	75179
" 25	795314	17031	892638	6496	262658	31608	382711	17535	72670
" 26	814820	19506	917741	25103	277982	15324	393428	10717	70650
" 27	836188	21368	952365	34624	..	..	415878	22450	78442
" 28	864620	28432	984077	31712	..	..	447070	31192	91336
" 29	878750	14130	015573	31496	..	..	479893	32823	78449
" 30	905450	26700	50818	35245	..	..	505920	26027	87972
" 31	933085	27635	87038	36220	..	..	526610	20690	84545

NOTE.—A glance at the total number of strokes made daily by all the engines, or by each individual engine, shows some remarkable discrepancies which, if correct, point to enormous variations in the volume of sewage. On some days, as for instance, on the 30th June, the average number of strokes per minute made by all the engines was 17·13, while on the 6th of the same month the average number of strokes per minute was 81·42, or the volume of sewage pumped in one day exceeded the other by 4 $\frac{2}{3}$ times its volume.

The return also shows that occasionally one engine raises an improbable quantity: for example, on the 6th June, 1889, No. 1 engine is supposed to have made an average number of strokes throughout the whole day at the rate of 44·82 per minute. Now, as I was informed, if these pumping engines run at a greater speed than 16 or 17 strokes per minute they slip sewage to an enormous extent; it is, therefore, evident that there is something seriously wrong in the engines, or the counters are not to be relied upon.

In the one hundred days included in the foregoing table, the average number of strokes per minute was 47·275, and the volume of sewage raised, when calculated on the reduced capacity of the pumps, exceeded 13 million gallons per day. If the volume of sewage was calculated on the actual capacity of the pumps, the volume raised would have been about 24 million gallons per day.

B. L.

13, VICTORIA STREET, WESTMINSTER,
27th May, 1890.

STATEMENT FURNISHED TO MR. LATHAM FOR INSERTION IN REPORT.

	Gallons.
Pumping capacity per diem of each of the engines at the Love Grove pumping-station	7,244,000*
Combined pumping capacity per diem of the four engines	<u>28,976,000</u>
Estimated quantity of the sullage water carried by the new ovoid sewer on the flats, taking the present population at 927,740 and the sullage water at 10 gallons per head, one-third ($\frac{1}{3}$) of the water supply per head being lost by absorption, evaporation, &c.	9,277,400†
Water used for flushing the ovoid sewers at Carnac Bunder and Queen's Road. This is computed on the basis that the sea-water runs into the new ovoid sewer through Carnac Bunder and Sonapore sluices daily for 10 minutes over the average level of the sullage water in the sewers up to the mean high-water level, which is 84.50 feet above Town Hall datum	<u>230,781</u>
Total quantity of sullage required to be raised by the pumps at Love Grove	<u>9,508,181</u>

LIST OF PLANS, ETC., SUBMITTED TO
MR. BALDWIN LATHAM.

No.	Description of Documents.
1.	General plan showing the sewerage scheme of Bombay.
2.	Plans of outfall sewer.
3.	" main sewer, Kamatipura ovoid sewer, Queen's Road sewer, Clerk Road sewer, Ripon Road sewer, and Mint Road sewer.
4.	" pipe sewers in the first portion of the drainage scheme.
5.	" Fort pipe sewers.
6.	" Mody Bay sewers.
7.	" Queen's Road and Girgam pipe sewers.
8.	" Agripada pipe sewers.

* Assuming that the engines lift the full capacity of the pumps, which at present is not the case, for reasons given in Report, p. 55.

† *Vide* figures in Report, pp. 68 and 106.

No.	Description of Documents.
42.	Plans and sections of storm-water drain from the open main drain at the Clerk Road to the new proposed outfall at Warli.
43.	" " " from Paidhoni to Bellasis Bridge.
44.	" " " from Gowalia tank to old main drain.
45.	" " " from 12th Khetwadi Lane to 15th Khetwadi Lane.
46.	" " " in Ripon Road.
47.	" " " in Kamatipura.
48.	Details of masonry, gullies, or water-entrances.
49.	" Love Grove pumping station, showing arrangements of engines, pumps, &c.
50.	Details of engine house at Love Grove.
51.	General plans of arrangements at Love Grove pumping-station.
52.	Details of ahred lifter " " "
53.	" boiler house " " "
54.	" cooling-tank " " "
55.	Designs for latrines (pail, basket, and water systems).
56.	" urinals.
57.	Carnac Bunder night-soil depots.
58.	Plans of the house-sullage water connections in first portion of the drainage scheme.
59.	" " " in Kamatipura.
60.	" " " in Khetwadi.
61.	" " " in Queen's Road and Girgam district.
62.	" " " in Agripada district.
63.	General plans for night-soil depots.
64.	Details of Clerk Road culvert.
65.	Plans of Port Trust drains.
66.	Plan showing the levels of the bottom of the channel in front of Love Grove sluices.
67.	Plan and sections showing to the Dharavi existing and proposed water-courses.
68.	Plans of outfalls of existing sewers.
69.	Storm-water channel near Love Grove sluices.
70.	Section of existing drain and proposed ovoid sewer in Frere Road.

No.	Description of Documents.
71.	Map of Bombay, showing Mr. Aitken's scheme of drainage.
72.	" " " " contour of main drain, &c.
73.	Plan showing sites proposed for outfall at Colaba, by Mr. Aitken.
74.	" " existing drain to the native town.
75.	" " " " and proposed sewers.
76.	Section from Null Bazaar to Colaba reservoir.
77.	Plan and section of low level sewer on flats.
78.	Plan of site of Warli sluices.
79.	Plan of the Mahalaxmi storm-water reservoir and surroundings.
80.	Plan showing existing sewers in Fort.
81.	Plan of the native town, showing the existing covered drains.
82.	Map showing different sewers.
83.	" " " " storm-water arrangements.
84.	Details of Warli sluices.
85.	Map showing surface levels of the island of Bombay.
86.	" " sub-soil water " " "
87.	Section of proposed outfall sewer from Parel Tank to Colaba, by Mr. Baldwin Latham.
88.	Indicator diagrams from the Love Grove pumping-station engines.*
89.	Copy of the Plan showing the Island of Bombay and the portion of land up to Kurla; scale, 20 cables to an inch.
90.	Sections of ovoid sewers, showing the observations taken on 27th January, 1890.
91.	Section of 15-inch pipe sewer, in Marine Lines, showing the observations on 20th February, 1890.
92.	Report on the Drainage of Bombay, by Mr. Berkley.
93.	" " " " Mr. Tracey.
94.	" " " " Mr. Aitkina.
95.	" " " " Major Tulloch.
96.	" " " " Mr. Sowerby.
97.	" " " " Mr. Braham.
98.	" " " " Dr. Blaney.
99.	" " " " Dr. Hewlett.
100.	" " " " Mr. Walton.
101.	Army Sanitary Commissioner's Report, with Mr. Rawlinson's endorsement.
102.	Drainage Commission Report (1879).
103.	Surface Drainage Report, by the Commissioner.
104.	Report on the Carnac Bunder night-soil depot, by the Commissioner, (1884).

* Vide Plate 4.

- | No. | Description of Documents. |
|------|---|
| 105. | Statement of Extraordinary Expenditure, by the Commissioner (1883-84). |
| 106. | Report of the Bombay Extension Committee. |
| 107. | Mr. White's Report on the removal of kachra to Kurla. |
| 108. | Report on the Drainage of Marine Lines, by a Committee appointed by Government, with Dr. McRury's letters. |
| 109. | Bombay Meteorological Reports, from 1846 to 1862, and 1864 to 1888-89. |
| 110. | Tide Tables for the Port of Bombay, 1890. |
| 111. | Chart of the West Coast of the Bombay Presidency. |
| 112. | Twenty-four Diagrams, Nos. 268 to 291, of the Tidal Registrations at the Apollo Bunder during 1889. |
| 113. | Administration Reports of the Bombay Municipality, from 1878 to 1888-89. |
| 114. | Executive Engineer's Report (with plans and estimates) on the sewerage of Colaba. |
| 115. | Executive Engineer's Report (with plans and estimates) on the sewerage of Parel, Umarchadi, and Mazagon district. |
| 116. | File of Acting Army Sanitary Commissioner's Reports. |
| 117. | Drainage Commission Report, and Mr. Rawlinson's Report on the Drainage of Bomlay, sent by Mr. Hughes, Secretary to Government, P.W.D. |
| 118. | List of Counter Readings taken of the Engines at the Love Grove pumping-station, from May to August, 1889. |
| 119. | Return of Births and Deaths from the Health Officer. |
| 120. | Samples of Kachra |
| 121. | Float experiments by Mr. Raghunath Putlaji, Head Surveyor Bombay Port Trust Engineer's Office. |
| 122. | Census Report, 1881. |

STATEMENTS SUBMITTED TO MR. LATHAM.

1. Details of ovoid sewer from Carnac Bunder Road to Love Grove pumping-station.
Branch sewers :—
 - (1) From Town Hall to the junction of Shek Memn Street.
 - (2) From Queen's Road to the junction of Khetwadi Tenth Lane.
2. Details of pipe sewers, first portion of drainage scheme.
3. Details of pipe sewers, Queen's Road and Girgam drainage scheme.
4. Details of pipe sewers, Parel, Mazagon, and Umarchadi districts.

- | No. | Description of Documents. |
|-----|---|
| 5. | Total lengths of ovoid and outfall sewers. |
| 6. | Statement showing the size, lengths of different sizes, gradients, discharging capacities, velocities, and populations served by the different portions of the main sewers (ovoid). |
| 7. | Ditto, ditto, by the Hornby Road and Mint Road ovoid sewer, the Queen's Road ovoid sewer, the Kamatipura ovoid sewer, the Clerk's Road ovoid sewer, the Ripon Road ovoid sewer. |
| 8. | Summary of the lengths of the pipe sewers of different diameters. |
| 9. | Lengths of the pipe sewers of the different districts. |
| 10. | Size, lengths, gradients, and velocities of the pipe sewers in the various streets, included in the first portion of the drainage scheme. |
| 11. | Ditto, ditto, included in the Fort pipe-sewer scheme. |
| 12. | Ditto, ditto, included in the Mody Bay pipe-sewers scheme. |
| 13. | Ditto, ditto, included in the Queen's Road and Girgam drainage districts. |
| 14. | Ditto, ditto, included in the Agripada districts. |
| 15. | Ditto, ditto, included in the pipe-sewers extension of the original scheme. |
| 16. | Scheme for drainage of the northern parts of the island of Bombay, if made to fall to present pumping-station at Love Grove. |
| 17. | Ventilating shafts on ovoid sewers. |
| 18. | „ „ pipe sewers. |
| 19. | Manhole and sewer inspection establishment. |
| 20. | Statement showing the establishment required for cleaning the pipe sewers and ovoid sewers. |
| 21. | Engines at Love Grove pumping-station. |
| 22. | Total daily discharge of sewage, calculated from observations in outfall sewer, taken daily from 6 a.m. to 6 p.m. |
| 23. | Letter to the Municipal Commissioner regarding the capacity of the ovoid sewers on flats near Love Grove pumping-station. |
| 24. | Statement showing the acreage and populations served by ovoid sewers of different sizes. |
| 25. | Statement of observations taken in ovoid sewers 27th Jan., 1890. |
| 26. | Statement of observations taken in 15-inch pipe sewer in Marine Lines on 20th February, 1890. |
| 27. | Statement showing the time the tides in Bombay Harbour were below various levels, in the months of June, July, and August, 1889. |
| 28. | Statement showing various surface water drainage areas of Bombay. |

I may here mention that it is not an unusual occurrence for sewage pumping engines to raise 95 per cent. of the capacity of the pumps. The valves of the pumps are too slight and flimsy to be effective, as they do not close sufficiently quickly after the engine has passed the centres. No doubt the slamming of the pump valves has led to the introduction of sniffling valves that admit a large proportion of air into the pump barrels at every stroke, and the efficiency of the engine is destroyed in order to procure quietness.

Pump valves.

Sniffling valves.

The deficiency in filling the pumps does not constitute the whole loss, as the indicator diagrams taken on the 1st of February of the present year show that the friction is very considerable, and that, consequently, the total efficiency of the pumping engines did not, on that date, exceed 36 per cent., or about one-half of what it ought to be, which means that twice as much cost is incurred for coals as ought to be expended in doing the work.

Efficiency of engines and pumps 36 per cent.

Elphinstone Estate Sewers.—The sewers from the Elphinstone Estate, at the time of the monsoon, discharge both sewage and rain water direct into the harbour, as there is but one system of sewers in this district, common to both rain and sewage. The outfall sewer into the harbour is not protected with a tidal flap, so that when the sewers are put in communication with the harbour in monsoon periods, the tide just as readily enters all sewers below high water as the sewage flows out. This liability to reverse currents in the sewers is very disadvantageous to them, and this part of the district will require to be resewered on the separate system.

Discharge of sewage into harbour.

Reverse currents in sewers.

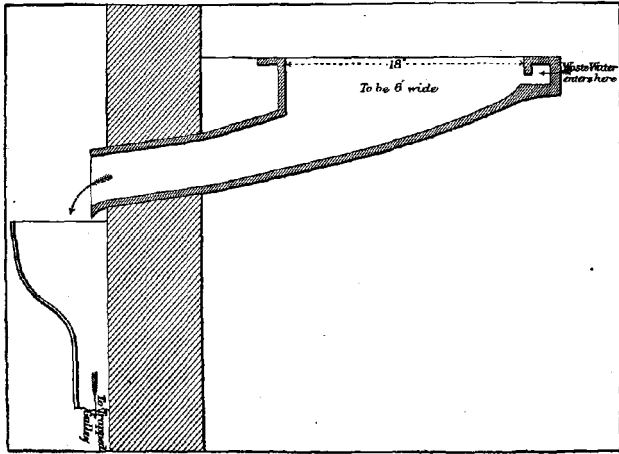
Mody Bay Reclamation.—From Mody Bay Reclamation there is in Mandvi Street an outfall sewer which discharges sewage direct into the harbour. In this district the sewers require to be extended, and all the houses

Sewage discharged into harbour.

closets, which are simpler and more sanitary than any form of closet fitted with moving valves or receivers.

Self-acting closets.

Any of the arrangements of native closets shown can be fitted with a treadle platform so as to make them self-acting closets.



Open space at side of house.

The present arrangement of the houses in Bombay with open spaces (gullies) at the side is such that with perfect sanitary works, a very material advantage would be secured in promoting ventilation about the buildings; but owing to the vile purposes to which these gullies are put, that which would be a great sanitary advantage is often a great nuisance, and I have not the slightest hesitation in saying is very detrimental to the health of the inhabitants. The nuisance of these gullies in a country like England would not be permitted for a single moment, and should anything like such a state of things occur, the owners of the property would be summoned before a justice of the peace and summarily dealt with, and I think

Proper administration of law required.

- | No. | Description of Documents. |
|-----|---|
| 9. | Plans of pipe sewers (extension of the original scheme to Marine Lines, Arthur Road, Bellasis Road, and De Lisle Road). |
| 10. | Plan for drainage of the northern part of the Island. |
| 11. | Ventilating shafts on ovoid sewers. |
| 12. | „ „ pipe sewers. |
| 13. | Daily diagrams of sewage, from observations at various points. |
| 14. | Plans of pipe sewers in Kamatipura. |
| 15. | Proposed sewerage of Colaba. |
| 16. | „ „ Parel. |
| 17. | „ „ Umarkhadi. |
| 18. | „ „ Mazagon. |
| 19. | Design for bell-mouth junctions for the Fort, Kavasji, Patel Tank, Khetwadi, Grant Road, and Clerk Road sewers. |
| 20. | Cross-sections showing the different sizes of the sewers. |
| 21. | Details of Carnac Bunder penstocks. |
| 22. | Details of connection of the Marine Street and Elphinstone Circle drain with the Mint Road sewer. |
| 23. | „ connection of Marine Lines, Sonapore, and Charni Road drains. |
| 24. | „ connection of manholes on ovoid and pipe sewers. |
| 25. | „ lampholes on pipe sewers. |
| 26. | „ flushing chambers. |
| 27. | „ „ tank for the head of a house-gully. |
| 28. | „ masonry, cast-iron and zinc ventilating-shafts. |
| 29. | „ „ for underground channel „ |
| 30. | „ gully-trap, siphon, and 2½-in. ventilating-pipes. |
| 31. | „ house-connections. |
| 32. | „ step-arrangements for receiving an ordinary sewage, while excluding a rush of storm-water. |
| 33. | Plans of Kamatipura old drainage. |
| 34. | Longitudinal sections of old open main drain. |
| 35. | Cross sections of old open main drain. |
| 36. | Details of connection of the old open main drain with the new main sewer. |
| 37. | „ outlet sluices of reservoir at Love Grove. |
| 38. | Plan of storm-water reservoir. |
| 39. | Cross-sections through reservoir. |
| 40. | Plan showing drainage areas of different storm-water drains. |
| 41. | Plans and sections of storm-water drain from Haines Road to Warli. |