XII. — *An Account of the Fall of Rain at Manchester, from the Year* 1786 *to* 1857 *inclusive.*

By Mr. John Curtis.

Read November 16th, 1858.

This paper has been prepared with a view of making the tables complete to the end of last year, and of showing at a glance the amount of rain which has fallen during the last 72 years. The account of the fall of rain from 1786 to 1793 inclusive is taken from the tables prepared by Mr. George Walker, and published in the Society's Memoirs, vol. iv. pp. 584 and 585, old series. From 1794 to 1840 inclusive, from the tables prepared by Dr. Dalton, and published in the Society's Memoirs, vol. v. part ii. p. 668, old series; vol. iii. p. 496, and vol. vi. pp. 575 and 576, new series. From 1841 to 1854 inclusive, from observations taken by Mr. Joseph Casartelli, of this city, who kindly communicated them to me. And from 1855 to 1857 inclusive, from observations taken by myself in Plymouth Grove, Chorlton-upon-Medlock, on the south side of the town. The gauge I employ is a funnel $8\frac{1}{2}$ inches in diameter, with a perpendicular rim 5 inches high, and the top of the rim is 2 feet 3 inches above the ground, the fall of rain being registered daily at ten p.m. in a graduated glass cylinder. The gauge is situated in a garden perfectly free from surrounding objects, the nearest buildings being on the south side, and twenty to thirty yards distant; while it is more than thrice the above distance on the other sides from elevated objects. Dr. Dalton's gauge was a funnel 10 inches in diameter, surrounded by a perpendicular rim 3 inches high, the top of which was a little more than two

feet from the ground, and was situated in a garden on the south-east side of the town, and twenty yards distant from any house or elevated object.* Mr. Casartelli's gauge was a funnel 5 inches in diameter, with a perpendicular rim 2 inches high, the top of which was between two and three feet above the ground, and was situated on the south-east side of the town, ten yards distant from a house on two sides, and the same from a wall nine feet high on the two other sides. It will thus be seen that the gauges employed in registering these observations were all of the same construction, with very little difference in their distance from the ground, and that the places where they were registered were within one mile from each other. They are also of the kind now recommended by Mr. Glaisher, of the British Meteorological Society, as the best for taking observations on the fall of rain.

It may be well here to state that Dr. Dalton found Mr. Walker's returns to exceed his own by about four inches in the year, and that on inspecting Mr. Walker's gauge he had reason to think that the method of measuring the rain employed was not susceptible of sufficient accuracy, and on his suggesting the same to Mr. Walker, the latter seemed to acquiesce.† For this reason I have given the fall of rain as collected by Mr. Walker in a separate table, so as to enable me to give two averages, the one with his observations included and the other without.

In Dr. Dalton's observations the fall of rain in the months of March and April 1807, December 1809, and January and February 1810, are not given. To fill up these blanks, and make the tables complete, I have inserted the average fall of rain in those months, so that I am enabled to give the mean and total for each month and year, and also the mean and total for each month and year during the entire series of seventy-two years.

* See vol. iii. p. 195, second series, of the Society's Memoirs.

† See Dr. Dalton's remarks, vol. iii. p. 498, new series.

From the foregoing tables it will be seen that, including Mr. Walker's returns, the average fall of rain during the 72 years is 36·3988; and, excluding his returns, the average for the remaining 64 years is 35·5620. Dr. Dalton's average of 47 years is 35·523, showing the small difference of ·039 between the two latter averages. I think we may, therefore, assume that Dr. Dalton was right in supposing that Mr. Walker's returns were in excess of the reality; and, for the purpose of arriving at a correct average, it will be safer to omit them and adopt 35·5620 as the average fall of rain for Manchester.

As the situation of the rain-gauge employed, and the influence of surrounding objects on it will produce different results, the following table has been prepared to show the mean monthly and yearly fall of rain, as registered by each observer, of the whole period and of the 64 years, the average obtained during the latter period being that which I recommend being adopted as nearest the truth.

	Walker. 8 years. 1786 to 1793 inclusive.	Dalton. 47 years. 1794 to 1840 inclusive.	Casartelli. 14 years. 1841 to 1854 inclusive.	Curtis. 3 years. 1855 to 1857 inclusive.	Total 72 years. 1786 to 1857 inclusive.	64 years. 1794 to 1857 inclusive.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
January .	2·4685	2·257	3·335	2·150	2·4890	2·4915
February	2·7499	2·443	2·437	1·946	2·4556	2·4190
March . .	2·1145	2·308	2·261	1·526	2·2427	2·2588
April . . .	2·3019	2·114	1·697	2·123	2·0536	2·0225
May. . . .	3·5103	2·446	2·134	2·376	2·5008	2·3746
June . . .	3·3000	2·691	3·319	3·106	2·8985	2·8483
July . . .	4·5832	3·706	3·793	3·663	3·8187	3·7231
August .	4·7499	3·463	3·767	4·356	3·7025	3·5715
September	4·2144	3·192	3·103	2·356	3·2552	3·1353
October .	4·5104	3·754	4·262	3·223	3·9150	3·8404
November	3·3019	3·712	3·416	2·020	3·5386	3·5682
December	5·2873	3·437	3·148	2·012	3·5286	3·3088
Total . . .	43·0922	35·523	36·672	30·857	36·3988	35·5620
First 6 months	16·4451	14·259	15·183	13·227	14·6402	14·4147
Second 6 mos.	26·6471	21·264	21·489	17·630	21·7586	21·1473

The preceding table shows that, taking the average, April is the driest and October the wettest month in the

year, and that the fall of rain in the first 6 months of the year is to that of the last 6 months as 2 to 3 — that there is less difference between the two periods in the later returns than in the earlier ones; for Mr. Walker's returns show a proportion of 16 to 26, Dr. Dalton's of 14 to 21, Mr. Casartelli's of 15·1 to 21·24, and my own of 13·2 to 17·6. Whether this progressive diminution of difference between the first and the last half of the year is owing to the later returns being for shorter periods than the former ones, or to some change in the fall of rain influenced by a change of circumstances, future returns will show.

The following table shows the greatest and least amount of rain which has fallen in every month during the 72 years, with the year in which it fell, and the name of the collector.

	Year.	Inches.		Year.	Inches.	
January .	1806	5·851	Dalton.	1833 } 1838 }	0·320	Dalton.
February	1848	6·565	Casartelli.	1800	0·440	Dalton.
March . .	1827	6·030	Dalton.	1808 } 1829 }	0·180	Dalton.
April . . .	1791	4·750	Walker.	1842	0·160	Casartelli.
May . . .	1792	8·000	Walker.	1844	0·090	Casartelli.
June . . .	1830	7·055	Dalton.	1826	0·200	Dalton.
July . . .	1828	11·480	Dalton.	1800	0·290	Dalton.
August .	1799	8·740	Dalton.	1801	0·730	Dalton.
September	1792	9·000	Walker.	1804	0·240	Dalton.
October .	1787	9·000	Walker.	1817	0·604	Dalton.
November	1825	7·375	Dalton.	1805	0·624	Dalton.
December	1792	9·500	Walker.	1844	0·070	Casartelli.

The largest amount of rain fell in 1792, and was 55·250 inches; the least amount of rain fell in 1826, and was 24·910 inches.

The rain which fell from 1793 to 1814 was below the average of the 64 years; from 1815 to 1852 it was above; and from 1853 to the present time it has again fallen below, leading to the inference that we have entered into a low series, and that, consequently, we may for some time expect the rain fall to remain below the average, though

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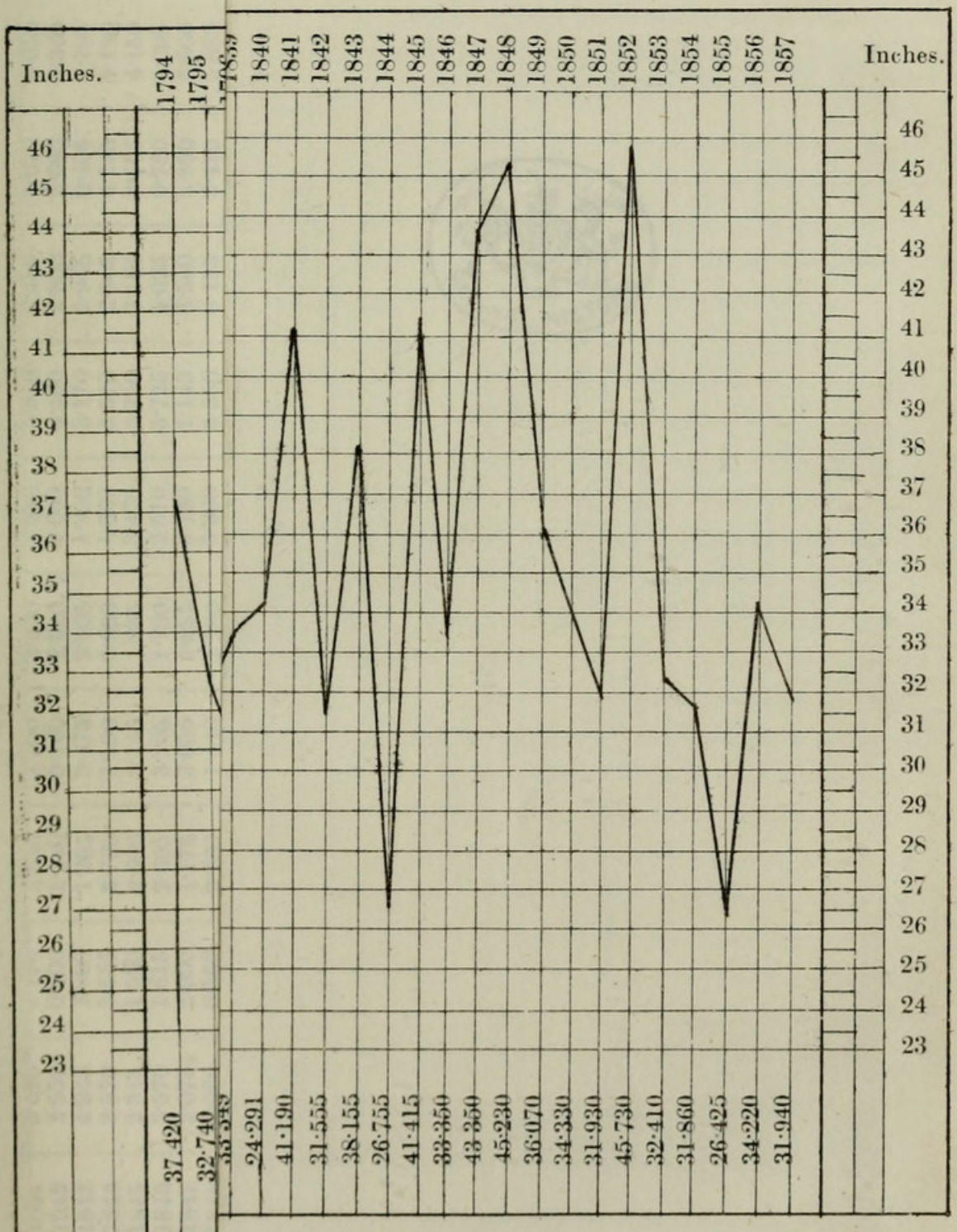
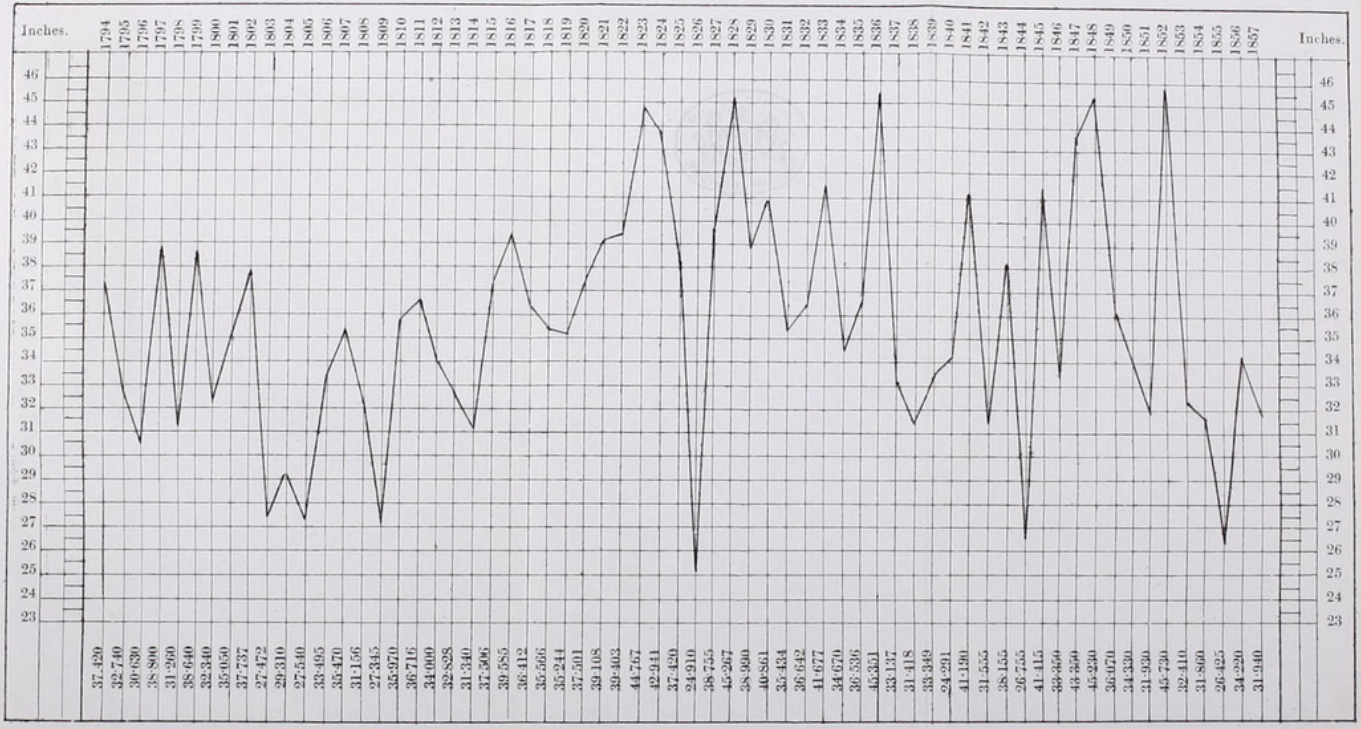


Diagram showing the Fall of Rain in Manchester, to the scale of one-sixth of a standard inch, for one standard inch, by Mr. John Curtis, from the data of Dr. John Dalton, from 1794 *to* 1840 *inclusive; of Mr. Joseph Casartelli from* 1841 *to* 1854 *inclusive; and of Mr. John Curtis from* 1855 *to* 1857 *inclusive.*



1841	[illegible]	[illegible]	2·540	1·360	2·950	2·980	5·540	3·480	4·670	5·050	3·500	5·260	41·190
1842	2·550	0·800	5·140	0·160	2·620	2·600	3·400	1·890	2·695	2·360	4·560	2·780	31·555
1843	4·945	1·020	1·285	3·475	3·405	1·990	5·170	2·945	0·405	7·795	5·235	0·485	38·155
1844	2·570	3·555	3·760	1·190	0·090	1·560	3·510	2·345	4·145	2·180	1·780	0·070	26·755
1845	2·345	1·590	2·600	2·145	1·285	3·470	3·790	7·165	3·555	4·150	2·940	6·380	41·415
1846	3·570	1·615	2·605	3·205	1·290	2·510	3·725	5·025	0·780	4·995	2·450	1·580	33·350
1847	2·075	2·900	1·175	3·050	5·255	3·130	1·145	4·540	5·890	5·660	3·555	4·980	43·355
1848	2·060	6·565	3·160	1·440	1·280	5·960	3·550	6·195	3·430	5·580	2·610	3·400	45·230
1849	4·670	1·950	0·580	1·250	3·150	1·640	4·880	2·620	4·755	3·585	4·070	2·920	36·070
1850	3·640	2·700	0·810	3·100	1·230	1·520	3·580	4·560	2·650	3·840	4·450	2·250	34·330
1851	3·230	1·740	3·680	0·450	2·140	5·440	3·190	1·260	3·470	3·880	1·860	1·590	31·930
1852	5·690	4·810	0·630	0 560	1·350	6·020	4·170	5·420	2·450	3·790	5·230	5·610	45·730
1853	3·320	1·070	2·040	1·870	1·470	5·460	4·090	2·950	2·570	3·650	2·950	0·970	32·410
1854	3·360	2·620	1·550	0·510	2·360	2·190	3·360	2·340	1·980	3·150	2·640	5·800	31·860
1855	0·910	1·220	2·070	1·100	1·710	3·750	3·690	3·990	1·030	5·210	0·680	1·065	26·425
1856	2·500	3·060	0·220	2·530	3·070	2·730	3·070	4·190	3·040	2·620	3·760	3·430	34·220
1857	3·040	1·560	2·290	2·740	2·350	2·840	4·230	4·890	3·000	1·840	1·620	1·540	31·940
Totals.	159·454	154·810	144·557	129·440	151·975	182·296	238·279	228·579	200·664	245·790	228·366	211·764	2275·974
Means.	2·4915	2·4190	2.2588	2·0225	2·3746	2·8483	3·7231	3·5715	3·1353	3·8404	3·5682	3·3088	35·5620

Fall of Rain at Manchester from 1786 *to* 1857 *inclusive, as per the above tables, showing the monthly and yearly mean average of the whole.*

Amount from	January. Inches.	February. Inches.	March. Inches.	April. Inches.	May. Inches.	June. Inches.	July. Inches.	August. Inches.	September. Inches.	October. Inches.	November. Inches.	December. Inches.	Total Yearly Fall. Inches.
1786 to 1793	19·750	21·999	16·916	18·415	28·083	26·400	36 665	37·999	33·715	36 083	26·415	42·298	344·738
1794 to 1857	159·454	154·810	144·557	129·440	151·975	182·296	238·279	228·579	200·664	245·790	228·366	211·764	2275·974
Totals	179·204	176.809	161·473	147·855	180·058	208·696	274·944	266·578	234·379	281·873	254·781	254·062	2620·712
Means.....	2·4890	2·4556	2·2427	2·0536	2·5008	2·8985	3·8187	3·7025	3·2552	3·9150	3·5386	3·5286	36·3988

Fall of Rain at Manchester from 1786 *to* 1793 *inclusive, as collected by Mr. Walker; with the monthly and yearly fall and the monthly and yearly mean average of the same.*

Year.	January. Inches.	February. Inches.	March. Inches.	April. Inches.	May. Inches.	June. Inches.	July. Inches.	August. Inches.	September. Inches.	October. Inches.	November. Inches.	December. Inches.	Total Yearly Fall. Inches.
1786	2·500	1·500	2·166	0·916	3·500	4·000	2·666	6·500	7·833	2·750	1·416	4·666	40·413
1787	1·000	3·500	3·000	1·750	2·750	2·500	7·666	3·666	2·166	9·000	5·666	4·833	47·497
1788	1·750	1·666	2·500	1·833	1·833	1·000	4·833	3·750	2·000	2·833	2·333	1·000	27·331
1789	2·000	5·333	1·500	2·666	4·500	6·500	7·250	0·833	4·250	5·750	4·750	5·666	50·998
1790	2·250	1·250	1·000	2·250	3·250	5·500	5·750	4·500	3·750	2·750	3·250	7·250	42·750
1791	5·500	3·000	1·500	4·750	2·750	0·750	3·500	6·000	1·416	4·500	4·500	5·833	43·999
1792	2·000	2·000	2·750	2·500	8·000	3·500	3·750	6·250	9·000	4·000	2·000	9·500	55·250
1793	2·750	3·750	2·500	1·750	1·500	2·650	1·250	6·500	3·300	4·500	2·500	3·550	36·500
Totals.	19·750	21·999	16·916	18·415	28·083	26·400	36·665	37·999	33·715	36·083	26·415	42·298	344·738
Means.	2·4685	2·7499	2·1145	2·3019	3·5103	3·3000	4·5832	4·7499	4·2144	4·5104	3·3019	5·2873	43·0922

Fall of Rain at Manchester from 1794 *to* 1857 *inclusive, as collected from* 1794 *to* 1840 *by Dr. Dalton, from* 1841 *to* 1854 *by Mr. Casartelli, and from* 1855 *to* 1857 *by Mr. John Curtis; with the monthly and yearly fall and the monthly and yearly mean average of the whole.*

Year.	January. Inches.	February. Inches.	March. Inches.	April. Inches.	May. Inches.	June. Inches.	July. Inches.	August. Inches.	September. Inches.	October. Inches.	November. Inches.	December. Inches.	Total Yearly Fall. Inches.
1794	1·090	3·770	2·030	3·910	2·270	1·250	3·400	4·380	4·660	5·100	3·450	2·110	37·420
1795	0·950	2·460	2·020	3·230	1·010	2·060	3·010	4·280	0·460	5·490	4·160	3·610	32·740
1796	3·100	2·290	0·580	1·600	5·090	2·350	5·190	1·040	2·630	2·870	2·130	1·760	30·630
1797	1·580	1·210	0·940	2·180	5·960	4·260	2·520	5·490	3·860	2·310	2·990	5·500	38·800
1798	2·700	1·910	1·180	1·370	1·480	0·850	4·750	4·130	3·350	3·510	3·680	2·350	31·260
1799	1·760	4·160	2·160	2·190	2·130	2·050	4·080	8·740	5·350	3·770	1·900	0·350	38·640
1800	2·860	0·440	2·370	4·100	2·850	0·710	0·290	1·050	6·550	4·370	3·700	3·050	32·340
1801	2·420	1·850	2·890	0·790	2·600	0·530	4·850	0·730	6·410	4·270	3·150	4·560	35·050
1802	1·967	3·728	0·860	1·972	0·860	3·120	6·233	3·221	2·176	6·126	1·882	3·592	35·737
1803	1·654	2·664	2·589	1·333	2·496	3·534	1·105	1·728	1·264	1·398	3·749	3·958	27·472
1804	2·700	1·468	2·037	3·060	1·364	1·802	3·170	2·890	0·240	6·023	3·064	1·492	29·310
1805	2·180	2·988	2·450	1·134	2·164	2·626	3·663	2·918	1·460	1·269	0·624	4·064	27·540
1806	5·851	1·604	1·060	0·500	1·114	1·400	1·970	2·904	2·006	1·944	5·858	7·284	33·495
1807	2·340	3·220	2·242	2·053	2·976	2·160	2·267	2·512	5·806	2·216	5·000	2·710	35·502
1808	2·676	1·512	0·180	1·982	2·702	2·078	2·012	3·828	2·702	5·648	3·628	2·208	31·156
1809	0·800	1·650	0·444	0·994	3·366	3·083	2·152	4·656	5·300	0·760	2·600	3·528	29·333
1810	2·488	2·455	2·000	1·368	0·948	2·208	2·980	4·082	2·076	5·091	4·074	6·234	36·004
1811	2·116	3·118	3·566	1·738	5·136	1·676	2·812	3·508	0·320	5·270	3·928	3·528	36·716
1812	1·500	3·760	4·584	1·270	3·022	3·018	4·415	1·058	2·682	4·942	2·304	1·445	34·000
1813	1·500	2·500	1·154	1·818	5·574	1·698	3·208	1·932	3·060	5·304	4·940	1·140	33·828
1814	0·948	1·254	1·440	2·864	0·300	2·076	2·354	4·490	1·158	5·368	3·756	5·332	31·340
1815	1·150	2·984	4·132	0·944	3·966	1·734	3·100	4·646	3·116	3·182	3·426	5·126	37·506
1816	3·528	1·828	2·830	2·318	3·538	2·762	6·888	1·184	2·926	4·236	3·496	4·051	39·585
1817	1·284	4·354	2·190	0·170	2·702	4·044	6·468	5·507	1·313	0·604	2·516	5·260	36·412
1818	5·520	3·458	5·026	3·154	1·188	2·072	2·134	1·088	3·718	3·292	4·526	0·390	35·566
1819	4·158	4·232	1·408	2·320	1·222	4·060	2·530	2·290	2·010	3·846	2·016	5·152	35·244
1820	1·555	1·632	1·426	3·282	5·812	4·198	2·228	4·232	3·086	3·944	2·412	3·694	37·501
1821	1·324	0·864	3·145	3·984	3·194	1·458	2·496	3·519	5·466	3·287	5·400	4·971	39·108
1822	2·252	3·602	5·504	1·514	2·730	0·514	7·270	3·865	1·308	3·542	5·280	2·022	39·403
1823	1·892	4·272	3·036	2·298	2·930	3·000	5·724	6·274	5·090	3·470	2·505	4·276	44·767
1824	2·001	0·970	3·454	2·154	1·584	3·478	1·088	2·436	5·440	6·896	5·510	7·930	42·941
1825	2·325	1·955	1·265	2·010	5·110	3·315	0·600	4·740	1·605	4·260	7·375	2·860	37·420
1826	0·755	3·190	1·280	2·095	0·385	0·200	3·000	2·460	2·795	3·960	1·630	3·160	24·910
1827	3·695	1·090	6·030	1·365	1·850	1·870	2·225	4·850	2·650	4·890	3·050	5·190	38·755
1828	3·305	2·110	2·205	3·525	1·170	2·720	11·480	3·805	3·390	3·080	3·697	4·780	45·267
1829	0·610	1·570	0·180	3·110	1·210	2·870	5·480	5·370	4·955	3·550	4·345	0·740	33·990
1830	0·925	3·440	1·330	4·295	2·906	7·055	4·280	2·610	5·885	1·910	3·965	2·260	40·861
1831	0·430	2·605	3·675	1·690	0·975	2·532	4·217	3·055	2·355	4·105	6·520	3·275	35·434
1832	1·245	0·800	2·310	2·275	2·990	4·085	2·300	5·555	1·025	4·025	5·180	4·852	36·612
1833	0·320	3·260	1·485	3·425	0·340	6·980	2·495	5·122	3·085	3·530	4·575	7·060	41·677
1834	5·640	2·775	2·815	1·570	1·085	3·265	7·225	2·160	3·410	1·760	1·690	1·275	34·670
1835	4·250	3·095	3·265	1·296	2·520	2·185	2·185	2·935	5·440	4·005	3·690	1·720	36·536
1836	3·960	2·615	4·240	2·825	0·670	4·305	5·615	1·870	4·406	3·580	7·230	4·035	45·351
1837	2·835	3·305	1·730	1·400	2·950	2·000	2·750	1·830	1·860	4·877	4·530	3·070	33·137
1838	0·320	1·327	1·980	3·220	2·361	4·340	3·660	4·150	1·400	4·470	1·460	2·730	31·418
1839	2·310	2·260	3·460	0·820	0·250	3·185	4·280	3·589	5·295	2·700	3·410	1·790	33·349
1840	3·540	1·241	0·245	0·790	3·920	3·790	6·040	4·065	3·600	2·405	4·475	0·180	34·291
1841	2·670	1·190	2·540	1·360	2·950	2·980	5·540	3·480	4·670	5·050	3·500	5·260	41·140
1842	2·550	0·800	5·140	0·160	2·620	2·600	3·400	1·890	2·695	2·360	4·560	2·780	31·555
1843	4·945	1·020	1·285	3·475	3·405	1·990	5·170	2·945	0·405	7·795	5·235	0·485	38·155
1844	2·570	3·555	3·760	1·190	0·090	1·560	3·510	2·345	4·145	2·180	1·780	0·070	26·755
1845	2·345	1·590	2·600	2·145	1·285	3·470	3·790	7·165	3·555	4·150	2·940	6·380	41·415
1846	3·570	1·615	2·605	1·290	2·510	3·725	5·025	0·780	4·995	2·450	1·580	33·350	
1847	2·075	2·900	1·175	3·050	5·255	3·130	1·145	4·540	5·890	5·660	3·555	4·980	43·355
1848	2·060	6·565	3·160	1·440	2·880	5·960	3·550	6·195	3·430	5·580	2·610	3·400	45·230
1849	4·670	1·950	0·580	1·250	3·150	1·640	4·880	2·620	4·755	3·585	4·070	2·920	36·070
1850	3·640	2·700	0·810	3·100	1·230	1·520	3·580	4·560	2·650	3·840	4·450	2·250	34·330
1851	3·230	1·740	3·680	0·450	2·140	5·440	3·190	1·260	3·470	3·880	1·860	1·590	31·930
1852	5·690	4·810	0·630	0·560	1·350	6·020	4·170	5·420	2·450	3·790	5·230	5·610	45·730
1853	3·320	1·070	2·040	1·870	1·470	5·460	4·090	2·950	2·570	3·650	2·950	0·970	32·410
1854	3·360	2·620	1·550	0·510	2·360	2·190	3·360	2·340	1·980	3·150	2·640	5·800	31·860
1855	0·910	1·220	2·070	1·100	1·710	3·750	3·690	3·990	1·030	5·210	0·680	1·065	26·425
1856	2·500	3·060	0·220	2·530	3·070	2·730	3·070	4·190	3·040	2·620	3·760	3·430	34·220
1857	3·040	1·560	2·290	2·740	2·350	2·840	4·230	4·890	3·000	1·840	1·620	1·540	31·940
Totals.	159·454	154·810	144·557	129·440	151·975	182·296	238·279	228·579	200·664	245·790	228·366	211·764	2275·974
Means.	2·4915	2·4190	2·2588	2·0225	2·3746	2·8483	3·7231	3·5715	3·1353	3·8404	3·5682	3·3088	35·5620

Fall of Rain at Manchester from 1786 *to* 1857 *inclusive, as per the above tables, showing the monthly and yearly mean average of the whole.*

Amount from	January. Inches.	February. Inches.	March. Inches.	April. Inches.	May. Inches.	June. Inches.	July. Inches.	August. Inches.	September. Inches.	October. Inches.	November. Inches.	December. Inches.	Total Yearly Fall. Inches.
1786 to 1793	19·750	21·999	16·916	18·415	28·083	26·400	36 665	37·999	33·715	36 083	26·415	42·298	344·738
1794 to 1857	159·454	154·810	144·557	129·440	151·975	182·296	238·279	228·579	200·664	245·790	228·366	211·764	2275·974
Totals	179·204	176.809	161·473	147·855	180·058	208·696	274·944	266·578	234·379	281·873	254·781	254·062	2620·712
Means	2·4890	2·4556	2·2427	2·0536	2·5008	2·8985	3·8187	3·7025	3·2552	3·9150	3·5386	3·5286	36·3988

there will doubtless be some years among the series in which it will be above the average. A reference to the chart will show the variation of the series very clearly, and by reference to the tables the following remarkable differences will be found. From 1795 to 1814 inclusive the mean of 20 years is 33·044 inches; from 1815 to 1836 inclusive the mean of 22 years is 38·161; from 1837 to 1852 inclusive the mean of 16 years is 36·328; while from 1853 to 1857 inclusive the mean of 5 years is only 31·371; showing the correctness of Dr. Dalton's remarks as to the importance of a long continued series of observations to obtain a satisfactory table of the mean quantity either for each month or the whole year.