Statistics of Smallpox Mortality, Heredity, Geographic Description and Other Material

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F. Galton Manuscript
on <u>Smallpox</u>

sent to Sir Michael Foster. March 19, 1890
Apparently sold by his Executors & purchased
by the Galton Laboratory May 9. 1914 from
W. Heffer & Sons.

f1

Decrease of mortality by Small Pox
between 1838 and 1887.

F. Galton   42 Rutland Gate   SW
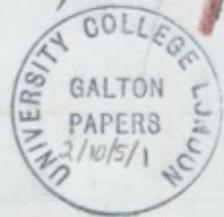
The question of "how much has the mortality from
Small Pox decreased between the years 1838 and
1887" is not to be answered, as I understand,
by subtracting the number of deaths per million
in the latter year from those in the former. The
question is really meant to refer to the decrease between two
imaginary averages, whose nature is vaguely
understood at the best, and which (may be estimated
differently by different persons. The general but vague
idea is
that annual irregularities should first be smoothed
down by some appropriate process, and that the
smoothed values for the two years in question should
be compared. Though the frequency changes,
if the returns matter it impossible to discover what
the most appropriate process may be. It will be
shown that although such values (obtained in this way) are trustworthy
within moderate limits and specified limits, whatever
may be the particular method adopted of smoothing the traces
though different may be

Small Pox traces

F. Galton
42 Rutland late
London SW

The data ~~to be~~ to be discussed are the traces in a diagram ~~sent F me~~ headed Rates in Table A, together with the following particulars.

(1). The spike corresponding to the year 1871 ~~must~~ is to be taken in connection with the great epidemic of small pox which swept over all Europe in that year.

(2) The rise at which the trace begins in 1838 is paralleled by a spike in that year in the Small pox Returns taken from the London burial data. It is therefore presumably a spike due to a severe and transient epidemic of this disease.

(3) The gap for the years 1843–6 is ~~is~~ should be considered in connection with 2 facts;– first the ~~own~~ non-existence of any record Either of peculiar absence or of peculiar presence of small pox during those years, in the place to which the trace refers, and secondly to the ~~these~~ existence of a ridge at 1844 in the London burial data, which concur with the ~~traces~~ in hand, in showing a spike in 1838 and a ridge in 1848.

/ A remarkable feature in the trace is the regularity of the intervals between the ridges and the furrows . ~~which~~ This is equally apparent in the trace from the London burials. If we interpolate the ridge (in italic numerals) ~~spoken of in paragraph 3~~ (and drawn in green in the chart) _entirely_ , and , the values for 1842 & 1847 , which would then become furrows , by italic numerals also, we obtain the following series.—

Ridges at the years	'38	44	48	52	58	64	71	77	81	85
at intervals of years		6	4	4	6	6	7	6	4	4

Furrows at	42	47	50	56	61	69	75	79	83	86
at intervals of years		5	3	6	5	8	6	4	4	3

In both sets, the values in Italics run in sequence with the others. Seeing how (clearly the sequence (1) of) the ridges & the furrows, and (3) the facts of London burial trace all agree in telling the same tale, we are justified in accepting the interpollated ridge , ~~whose value~~ we may ~~fairly take~~ as indicating 420 per million. (see chart)

Another remarkable feature in the trace is the regularity with which the oscillations, exclusive of the two spikes, diminishes. This affords additional evidence of the fundamental regularity of the trace, and therefore of the possibility of interpreting it justly. We may, by doing but little violence to the data, draw a bold curve that shall signify the locus of the tops of the ridges and another to signify that of the bottoms of the furrows, which will have the same general twist but which steadily approach each other. (see faint pencillings on the chart). Therefore a trace intermediate between the two curves is likely to express fairly well the general rate of decrease. The violence to the data is chiefly at the years where one period is succeeded by the next, and at which there appears to be slight but clear indication of steps, which compel us to treat the 3 periods independently when aiming at the best results. It is almost needless to say that these steps (at these transition periods) might have been effected.

The best way of proceeding appears to be, first to obtain the average value by various methods of treatment for each of the three periods, including methods among them that are based on extreme suppositions. We shall then obtain limits between which the desired averages must lie, and again these averages may be taken as the smoothed values for the middle year of the periods, namely for midway between 1845-6, between 1862-3, and between 1879-80.

Lastly, guided by the general slope of the curve, we must make allowances between two reasonable limits for the difference between 1838 and 1845-6 and again for that between 1879-80 & 1887. We shall then obtain limiting values for 1838 and others similarly for 1887. The greatest and least difference that can reasonably be assigned to the small pox mortality between 1838 & 1887 can then be determined by simple subtraction.

Considering the regularity in the ups & downs of the traces, it seems ~~best to work by, dealing~~ a good and perhaps the best method to with their ~~respective~~ ~~averages for each of the three periods, & to~~ accept the mean between the average of the maxima and that of the minima during each period, as the general mean to that period. ~~It is necessary~~ we will to do this ~~both~~ (a) for all the values and ~~again~~ (b) after excluding the questionable values namely those at the two spikes and ~~those that are interpolated~~ interpolations for the years 1843–6 where. The questionable values ~~are~~ with ~~the~~ put within brackets. ~~These~~ ~~first methods~~ give a ~~superior~~ limits ~~below~~ which the truth ~~may be~~ almost ~~certainly expected to~~ lies, because the questionable ridges are all largely additive, whereas in the values we seek, which disregard great and rare catastrophes, the ridges would be but moderate. For the calculation see Appendix (A). The results of the calculation are given further on in a table.

	1st Period	2nd Period	3rd Period
(a) All values	385	313	170
(b) the questionable values ~~those in brackets~~ excluded	332	219	82

We find from the unbracketted figures in the
Table A, in the Appendix, that the lowest ridge in period (1) overtops
the highest ridge in period (2), and that the
lowest ridge in period (2) overtops the highest
ridge in period 3.   It is just the same
with respect to the furrows.

	lowest in first period	highest in second period	lowest in second period	highest in third period
for the Ridges	4~~50~~ 420	370	335	170
for the Furrows	265 ~~760~~	120	70	40

There cannot then be the slightest reasonable
doubt, that the mortality decreases successively
in the three periods.

Next let us take the averages of the values in the ordinary way, for each of the 3 periods. So far as the smaller ups and downs are concerned, there is no doubt about the fairness of the method of averages but the (Exceptionally high values) ~~high spikes~~ at 1839, 39 & 40, and again at 1871-2 ~~throw~~ throw doubt on its applicability. But it proves to be of little importance to the result, whether these ^high^ values ~~corresponding to these spikes~~ are included or excluded from the series to be averaged. There are only 3 alternative cases worth considering; namely —

(c) to include all observed values and the four interpollations,

(d) to exclude the ~~the~~ highest spikes only, viz, those at 1838 & 1871 ^1872^ (e) to exclude the Exceptionally high values at 1839 & 1840 ~~and 1871~~ also. The results are given in the ~~table.~~ three bottom lines of the following Table. The calculations are in Appendix (B)

| Method employed | Average values for | | | Decrease from 1845-6 to 1879-80 |
	1st Period = smoothed value for 1845-6	2nd Period = smoothed value for 1862-3	3rd Period = smoothed value for 1879-80	
mean of maxima } { a	385	313	170	215
and minima } { b	332	219	82	250
Simple Averages { all values c	397	216	120	277
{ excluding 1838, 1871, 1872 d	352	171	73	279 279
{ excluding also 1839 1840 e	311	171	73	248

Hence the ~~greatest~~ decrease between 1845-6 and 1879-80 may at the highest of these estimates be taken as 279 per million, at the lowest estimate as 215 per million.

The highest & lowest values for 1845-6 and for 1879-80 respectively are 397, 311 ; 170, 73. These are marked in blue on the chart as A B; C, D. The greatest improbable difference is from A to D, that is between 397 & 73, or a decrease of 324 per million. the least is from B to C, that is between 311 and 170, or a decrease of 141 per million.

As regards the allowance to be made for the interval between 1838 & 1845-6 the data is so fragmentary that it seems impossible to assign closer limits than that A may ~~have~~ be connected with a mortality for 1838, ~~as high as~~ that is 100 per million higher, say of a value 500 per million; ~~this~~ is marked E on the chart. Again that B may be connected with a mortality for 1838 no higher than itself, say of a value 310 per million. This is marked F on the chart. Hence the widest limits of mortality for 1838 with which we need concern ourselves are 500 and 310 per million.

At the other end of the ~~far~~ curve the greatest supposable mortality at 1879-80 may possibly drop only 10 per million between then and 1879, that is from 170 to 160, a from B to the ~~point~~ G on the chart; while the least supposable mortality at 1879-80 cannot possibly drop lower than zero, that is from say 70 to 0

Hence for the entire period under review the greatest decrease that we may reasonably ~~suppose~~ to have taken place, is from E to H, that is from 500 to 0 per million, or a decrease of 500 per million, and the least decrease is from F to G that is from 310 to 160 or a decrease of 150 per million.

It must be recollected with respect to the latter possibility, that it is not prejudiced by the fact that a line drawn from F to H obviously can not satisfy the general run of the curve. The reason is that the higher spikes have been supposed to be smoothed, by distributing their contents over the lower levels. If this had been done graphically in the chart, then F and H would both have been raised to a higher level while their <u>differences</u> remained unaltered. A glance at the chart supposing this to have been done shows that the imaginary line, which we may call F' H', is not too extravagant a supposition.

In conclusion I would remark that if the decrease from 1845–6 to 1879–80 were available for the purposes of the inquiry, in lieu of that from 1838 to 1887, its determination as given above is much more precise; it lies between 324 and 141 per million

Francis Galton
March 29 / 90

Appendix (A)

	Highest Values	their mean	Lowest Values	their Mean	Sum of the two Means	their Average
1st Period say	(1065)		(160)			
	(420)		(250)			
	400		265			
	400					
All values	(2285)	(556) ~~575~~	(675)	(225)	(771)	(385)
Those in brackets excluded	800	400	265	265	665	332
2nd Period	335		120			
	370		70			
	(1015)		70			
All values	(1620)	(540)	260	86	(626)	(313)
Those in brackets excluded	705	352	260	86	438	219
3rd Period	(840)*		40			
	170		25			
	125		40			
	110		15			
All values	(1240)	(310)	120	30	(340)	(170)
Those in brackets excluded	405	135	120	30	165	82

* This is not a ridge but being the highest in the period it must be included.

ₚB

Appendix (B)

Years	dealthy by Small Pox.
1835	1064
9	589
	661
	420
	168
*	290
*	400
*	350
*	300
	246
	397
	264
	262
	389
	401
1853	171

2314

```
            6352
Subtract    1064
     15 ) 5288 ( 352
          45
          78
          75
           38
```

This is all the effect of leaving out the spike of 1838

```
          6352
          2314
    13 ) 4038 ( 311
          39
           13
           13
```

Here all the 3 Abnormals are left out

```
16 ) 6352 ( 397
     48
     155
     144
      112
      112
```

1854

151

134

119

204

332

195

138

66

80

289

367

303

141

116

93

70

116

$$18 \,/\, \overline{\begin{array}{c} 1015 \\ 3929 \end{array}} \,(216$$

3 6 8

3 2

1 8

1 4 9

1 2 9

3929
1015

$$17 \,/\, \overline{2914} \,(171$$

1 7

1 2 1

1 1 9

2 4

multy spike.

1872

824
101
91
40
103
178
79
25
29
124
54
39
87
107
13

1915
824
15) 1091 (73
105
41

21
16) 1915 (120
16
31
16
155
144

APPENDIX II.

(Papers handed in by Mr. William Ogle, M.D., 3rd and 10th July 1889.)

ENGLAND AND WALES.

TABLE A.

DEATHS from SMALL-POX per million living, 1838-42 and 1847-87.

Year.	Deaths.	Year.	Deaths.	Year.	Deaths.	Year.	Deaths.
1838	1,004	1851	380	1864	367	1877	178
1839	389	1852	401	1865	305	1878	79
1840	631	1853	171	1866	141	1879	35
1841	600	1854	131	1867	136	1880	29
1842	168	1855	134	1868	93	1881	124
1843	?	1856	119	1869	79	1882	51
1844	?	1857	201	1870	116	1883	29
1845	?	1858	322	1871	1,015	1884	87
1846	?	1859	290	1872	824	1885	197
1847	246	1860	138	1873	101	1886	13
1848	397	1861	65	1874	91	1887	21
1849	264	1862	80	1875	40	—	—
1850	262	1863	289	1876	101	—	—

N.B.—The above figures include deaths from chicken-pox.

TABLE B.

MEAN ANNUAL DEATHS from SMALL-POX, at successive life-periods, per million living at each such life-period, 1847-53, 1854-71, and 1872-87.

Period.	All ages.	0-5.	5-10.	10-15.	15-25.	25-45.	45 and upwards.
(1.) Vaccination optional, 1847-53.*	305	1,617	337	94	109	66	22
(2.) Vaccination obligatory, but not efficiently enforced, 1854-71.	223	817	245	88	163	151	52
(3.) Vaccination obligatory, but more efficiently enforced by vaccination officers, 1872-87.	114	242	120	69	122	107	47

* In this table the period of optional vaccination begins with 1847, not with 1838, because the deaths were not abstracted in combination with ages until 1847.

TABLE C.

MEAN ANNUAL DEATHS from FEVER, at successive life-periods, per million living at each such life-period, 1847-53, 1854-71, and 1872-87.

Period.	All ages.	0-5.	5-10.	10-15.	15-25.	25-45.	45 and upwards.
1847-53	1,139	1,512	1,118	911	1,105	910	1,388
1854-71	870	1,297	933	711	807	656	972
1872-87	367	425	379	344	434	327	355

TABLE D.

NUMBER of DEATHS, and VACCINATIONAL CONDITION, of those being over 3 months but under 10 years of age who died from Small-pox in England and Wales, 1881-87.

Vaccinational Condition.	Deaths, 1881-87.
Vaccinated	145
Unvaccinated	1,427
No statement	1,402
Total	2,974

NOTE.—The unvaccinated are 90.8 per cent. of those as to whose vaccinational condition there was information, and 48.0 per cent. of the whole.

TABLE E.

PROPORTION of DEATHS under and over 15 years of age, per 1,000 deaths from Small-pox in Vaccinated and Unvaccinated Persons respectively, 1881-87. (excluding deaths under three months).

Age.	Unvaccinated.	Vaccinated.
Three months and under 15 years	597	126
Fifteen years and upwards	403	874
	1,000	1,000

Year.	Population at the end of the Year.	Born Alive during the Year.	Mortality during the Year.		
			Total.	From Small-pox.	From Typhus and Typhoid Fever.
1803	—	74,654	56,577	1,464	6,265
1804	—	76,443	59,584	1,460	6,859
1805	2,427,408	76,532	56,603	1,690	6,021
1806	—	74,581	65,728	1,482	7,179
1807	—	73,542	62,318	2,129	8,065
1808	—	73,965	82,311	1,814	12,527
1809	—	64,300	93,532	2,404	21,171
1810	2,377,851	78,256	75,087	824	9,195
1811	—	84,865	69,246	608	7,430
1812	—	83,979	73,095	604	8,058
1813	—	72,021	66,296	547	6,261
1814	—	75,837	60,989	308	5,555
1815	2,465,066	85,239	57,829	472	3,325
1816	—	87,644	56,225	690	4,590
1817	—	83,821	60,863	242	5,789
1818	—	85,714	61,745	305	6,559
1819	—	84,250	69,881	161	7,219
1820	2,584,690	84,841	62,930	143	5,877
1821	—	92,072	66,416	37	5,883
1822	—	94,300	59,396	11	5,141
1823	2,687,457	98,250	56,087	39	4,166
1824	—	93,377	56,256	618	3,963
1825	2,771,252	100,315	56,465	1,241	3,962
1826	2,805,350	97,125	63,027	625	5,294
1827	2,828,568	88,138	64,920	606	7,871
1828	2,848,022	95,354	75,800	237	9,847
1829	2,864,831	99,488	82,719	53	9,264
1830	2,888,082	94,626	69,251	104	7,353
1831	2,901,061	88,253	75,274	422	
1832	2,922,845	80,865	68,078	622	
1833	2,939,257	100,399	65,947	1,345	
1834	2,983,144	103,231	76,294	1,849	
1835	3,025,430	98,144	55,238	445	The causes of death from disease not longer specified except the Small-pox.
1836	3,061,533	96,857	60,763	138	
1837	3,080,538	94,616	73,611	361	
1838	3,096,794	96,565	74,399	1,805	
1839	3,115,169	91,363	72,498	1,984	
1840	3,138,887	98,100	61,555	420	
1841	3,175,340	93,784	61,279	237	
1842	3,207,141	105,976	67,177	58	
1843	3,237,180	99,154	69,115	9	
1844	3,273,864	104,698	66,009	6	
1845	3,316,536	105,600	62,674	6	

Year.	Population at the end of the Year.	Born Alive during the Year.	Mortality during the Year.		
			Total.	From Small-pox.	From Typhus and Typhoid Fever.
1846	3,343,556	99,765	72,683	2	
1847	3,363,320	99,179	79,635	13	
1848	3,380,541	102,584	66,513	71	
1849	3,463,905	112,364	67,842	341	
1850	3,492,541	110,390	68,514	1,876	The causes of death from disease not longer specified except the Small-pox.
1851	3,516,889	111,063	72,506	2,488	
1852	3,541,320	108,365	80,090	1,554	
1853	3,562,602	111,407	84,097	279	
1854	3,606,087	120,167	70,846	204	
1855	3,639,382	115,972	77,734	41	

2. Norway.

I. The Committee must answer this question affirmatively on the whole, but feel it their duty to remark, that, during periods of intercurrent epidemic small-pox, some few fatal cases have occurred among persons who have been vaccinated. Our experience dates from 1811, when vaccination was made obligatory in this country by law. The Committee do not, however, venture to affirm that vaccination has always been performed here in the most satisfactory manner possible, as an effective vaccination ought usually to be accompanied by fever. The intensity of the matter and the number of punctures should probably be specially considered.

II. As almost all persons in Norway are vaccinated, and as we are without data for an exact comparison with a previous time, the Committee are not able to answer the question as to typhoid fever and other infective diseases. With respect to scrofula and phthisis, there are certainly some medical men of opinion that these diseases have of late become more prevalent; but, as regards this being attributable to vaccination, we have no experience to warrant an opinion.

III. The Committee do not venture to assert, with positive facts in view, that other diseases are transmitted by vaccination, but they cannot avoid remarking that there are in Norway enlightened medical men who conceive that they have proofs of such transmission having taken place.

IV. Experience has taught us that in the great majority of cases vaccination may be performed without danger in the earliest infancy; but the experience of the Committee, as well as that of several other medical men, has also shown, on many occasions, that infants, after vaccination, do not unfrequently become sickly in various ways. As it hardly ever happens that the first case of epidemic small-pox occurs in a child, the Committee (particularly on account of the difficulty of control), in their proposal for a new law on vaccination have not hesitated to recommend deferring it until school time begins.

TABLE OF BURIALS within the LONDON BILLS OF MORTALITY from Plague, Fever, Small-Pox, and all Causes. 1603–1848.

| Year.	Plague.	Fever.	Small-pox.	All-Causes.	Year.	Plague.	Fever.	Small-pox.	All Causes.
1603	30,561	—	—	37,294	1679	2	2,763	1,967	21,730
1604	896	—	—	5,219	1680	0	3,324	689	21,053
1605	444	—	—	6,392	1681		3,174	2,982	23,951
1606	2,124	—	—	7,920	1682		2,696	1,408	20,691
1607	2,352	—	—	8,022	1683		2,250	2,096	20,587
1608	2,262	—	—	9,020	1684		2,836	1,560	23,202
1609	4,240	—	—	11,785	1685		3,832	2,496	23,222
1610	1,805	—	—	9,087	1686		4,185	1,062	22,609
1611	627	—	—	7,343	1687		2,847	1,551	21,460
1612	64	—	—	7,842	1688		3,196	1,318	22,921
1613	16	—	—	7,519	1689		3,313	1,389	23,502
1614	22	—	—	7,389	1690		3,350	778	21,461
1615	37	—	—	7,887	1691		3,490	1,241	22,691
1616	9	—	—	8,072	1692		3,205	1,592	20,874
1617	6	—	—	8,286	1693		3,211	1,164	20,959
1618	18	—	—	9,614	1694		5,036	1,683	24,100
1619	9	—	—	8,008	1695		3,019	784	19,047
1620	21	—	—	9,712	1696		2,775	196	18,638
1621	11	—	—	8,123	1697		3,111	651	20,972
1622	16*	—	—	8,959	1698		3,343	1,813	20,183
1623	17	—	—	11,102	1699		3,505	890	20,795
1624	11	—	—	12,210	1700		3,675	1,031	19,443
1625	35,417	—	—	54,265	1701		2,902*	1,099	20,471
1626	134	—	—	7,535	1702		2,682	311	19,481
1627	4	—	—	7,715	1703		3,162†	398	20,720
1628	3	—	—	7,743	1704		3,243	1,501	22,684
1629	0	956	72	8,771	1705		3,290	1,095	22,097
1630	1,317	1,091	40	10,554	1706		2,662	721	19,847
1631	274	1,115	58	8,562	1707		2,947	1,078	21,600
1632	8	1,108	531	9,535	1708		2,738	1,687	21,291
1633	0	953	72	8,393	1709		3,140	1,024	21,800
1634	1	1,279	1,354	10,400	1710		4,397	3,138	24,620
1635	0	1,622	293	10,651	1711		3,461	915	19,833
1636	10,400	2,360	127	23,359	1712		3,131	1,943	21,198
1637	3,082	—	—	11,763	1713		3,089	1,614	21,057
1638	363	—	—	13,624	1714		4,631	2,810	26,569
1639	314	—	—	9,862	1715		3,588	1,057	22,232
1640	1,450	—	—	12,771	1716		3,078	2,427	24,436
1641	1,375	—	—	13,142	1717		2,940	2,211	23,446
1642	1,274	—	—	13,273	1718		3,475	1,884	26,523
1643	996	—	—	13,212	1719		3,803	3,229	28,347
1644	1,492	—	—	10,933	1720		3,910	1,442	25,454
1645	1,871	—	—	11,479	1721		3,331	2,375	26,142
1646	2,365	—	—	12,780	1722		3,088	2,167	25,750
1647	3,597	1,260	139	14,059	1723		3,321	3,271	29,197
1648	611	884	401	9,894	1724		3,262	1,227	25,952
1649	67	751	1,190	10,566	1725		3,277	3,188	25,523
1650	15	970	184	8,754	1726		4,656	1,569	29,647
1651	23	1,038	525	10,827	1727		4,728	2,379	28,418
1652	16	1,212	1,279	12,569	1728		4,716	2,105	27,810
1653	6	282	139	10,087	1729		5,235	2,849	29,722
1654	16	1,371	832	13,247	1730		4,011	1,914	26,761
1655	9	689	1,294	11,357	1731		3,225‡	2,640	25,262
1656	6	875	823	13,921	1732		2,939	1,197	23,358
1657	4	999	835	12,434	1733		3,831	1,370	29,233
1658	14	1,800	409	14,993	1734		3,116	2,688	26,062
1659	36	2,303	1,523	14,756	1735		2,544	1,594	28,538
1660	13	2,148	354	12,681	1736		3,361	3,014	27,581
1661	20	3,490	1,246	16,665	1737		4,580	2,084	27,823
1662	12	2,601	768	13,664	1738		3,890	1,590	25,825
1663	9	2,107	411	12,741	1739		3,354	1,690	25,432
1664	5	2,258	1,233	15,453	1740		4,003	2,725	30,811
1665	68,596	5,257	655	97,306	1741		7,528	1,977	32,169
1666	1,998	741	38	12,738	1742		5,108	1,429	27,483
1667	35	916*	1,196	15,842	1743		3,837	2,029	25,200
1668	14	1,247†	1,987	17,278	1744		2,670	1,633	20,606
1669	3	1,499	951	19,432	1745		2,690	1,206	21,296
1670	0	1,729	1,465	20,198	1746		4,167	3,236	28,157
1671	5	1,343	696	15,729	1747		4,779	1,380	25,494
1672	5	1,615	1,116	18,230	1748		3,981	1,789	23,069
1673	5	1,804	853	17,504	1749		4,458	2,625	25,516
1674	3	2,164	2,507	21,201	1750		4,294	1,229	23,727
1675	1	2,154	997	17,244	1751		3,219	998	21,028
1676	2	2,112	359	18,732	1752		2,070	3,538	20,485
1677	2	1,749	1,678	19,067	1753		2,292	774	19,276
1678	5	2,376	1,798	20,678	1754		2,964	2,359	22,696

* Ague, 31 deaths. † Ague, 21 deaths.

* Ague for this and five following years, 6, 3, 7, 6, 3, 2.
† Scarlet fever, 7 deaths.
‡ Scarlet fever included from this year (deaths from it in previous years very few).

Year.	Plague.	Fever.	Small-pox.	All Causes.	Year.	Plague.	Fever.	Small-pox.	All Causes.
1755		3,042	1,988	21,917	1802		2,201	1,579	19,379
1756		3,579	1,608	20,872	1803		2,326	1,202	19,582
1757		2,564	3,296	21,313	1804		1,702	622	17,034
1758		2,471	1,273	17,576	1805		1,307	1,685	17,565
1759		2,314	2,596	19,604	1806		1,354	1,158	17,938
1760		2,136	2,181	19,830	1807		1,033	1,297	18,334
1761		2,475	1,525	21,063	1808		1,168	1,169	19,954
1762		3,742	2,743	26,326	1809		1,066	1,163	16,680
1763		3,414	3,582	26,148	1810		1,139	1,198	19,983
1764		3,942	2,382	25,202	1811		906	751	17,043
1765		3,921	2,498	23,230	1812		783	1,287	18,295
1766		3,738	2,334	23,911	1813		714	898	17,322
1767		3,765	2,188	22,612	1814		908	638	19,283
1768		3,596	3,028	23,639	1815		1,309	725	19,560
1769		3,430	1,968	21,847	1816		1,299	653	20,316
1770		3,214	1,986	22,434	1817		1,299	1,051	19,968
1771		2,273	1,660	21,780	1818		1,170	421	19,705
1772		3,207	3,992	26,053	1819		1,093	712	19,928
1773		3,608	1,039	21,656	1820		1,109	792	19,348
1774		2,607	2,479	20,884	1821		1,101	508	18,451
1775		2,244	2,669	20,514	1822		1,124	604	18,865
1776		1,893	1,728	19,048	1823		721	774	20,587
1777		2,760	2,567	23,334	1824		787	725	20,237
1778		2,647	1,425	20,399	1825		895	1,299	21,026
1779		2,336	2,493	20,420	1826		1,023	503	20,758
1780		2,316	871	20,517	1827		847	616	22,292
1781		2,249	3,500	20,709	1828		921	598	21,709
1782		2,552	656	17,918	1829		1,270	736	23,524
1783		2,313	1,550	19,029	1830		996	627	21,645
1784		1,973	1,759	17,828	1831		1,331	563	25,337
1785		2,310	1,999	18,919	1832		1,513	771	—
1786		2,981	1,210	20,454	1833		1,411	574	—
1787		2,887	2,418	19,349	1834		1,110	334	—
1788		2,769	1,101	19,697	1835		937	863	—
1789		2,380	2,077	20,749	1836		674	536	—
1790		2,185	1,617	18,038	1837		1,090	217	—
1791		2,013	1,747	18,760	1838*		4,078	3,817	—
1792		2,236	1,568	20,213	1839		1,819	634	—
1793		2,426	2,382	21,749	1840		1,262	1,235	—
1794		1,935	1,913	19,241	1841		1,151	1,053	45,507
1795		1,347	1,040	21,179	1842		1,174	360	45,400
1796		1,547	3,548	19,288	1843		2,083	438	48,718
1797		1,326	522	17,014	1844		1,696	1,804	51,110
1798		1,734	2,237	18,155	1845		1,301	909	48,318
1799		1,784	1,111	18,134	1846		1,796	257	49,450
1800		2,712	2,409	23,068	1847		3,184	955	59,131
1801		2,908	1,461	19,374	1848		3,509	1,617	57,771

* First year of complete registration of deaths.

THE RATES IN TABLE A IN FORM OF A DIAGRAM.

To face page 114.
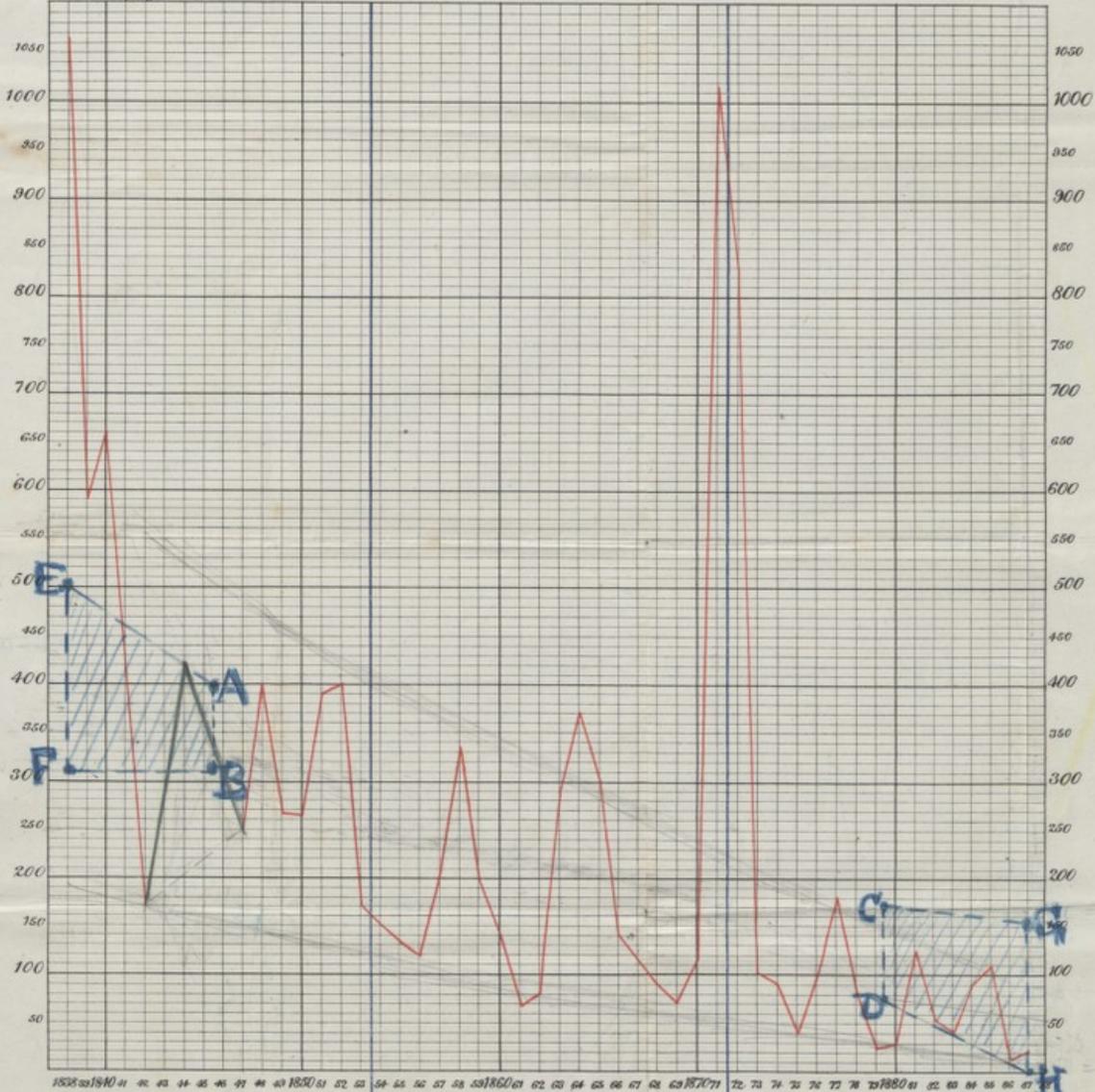
Vaccination optional (1847–53.)

Vaccination obligatory, but not efficiently enforced, (1854–71.)

Vaccination obligatory, but more efficiently enforced by Vaccination Officers 1872–87.

Dulness of books of travel

English language entrusted to us
Geog a description science

picked sentences
long works - mental fatigue
length & attention   New Test. Shakesp written
Times (a double number) ... ...
a has 8 columns & 14 or 15 hundred words in 1 page
              90 × 10 say 8,500 words in a page × 34 pages
              84 × 1000   = 21 pages of Fortnightly
       → 84 times =
       21
       3 4   = 714 pages of Fortnightly
       6 4
       7 1

       Bacon about epigrammatic sentences
       Tennyson   Carlyle.

Language like a mosaic from natural stones
       Roget's Thesaurus — we want a list of useful words
Even of phrases & quotations

       realism

       Can't put true & new geogr ideas into the novel
must illustrate (what is familiar — neg magnify
scale on which the imagination works
       all the senses, not sight only — scientific relation to

Detailed description
   Hahn's pointing out
   Scales of heat   ...) an ampler choice than common
   measures
   Angular measures)

Dulness of readers imagination
   imagine a cultured lady friend to whom you are
       talking
   Tell what would be probably new to her   a ready
   guide, letters used for granted   Plunge into the middle
   of things

34) Notes for an Address
on the "Art of Geographical Description

Sep /09
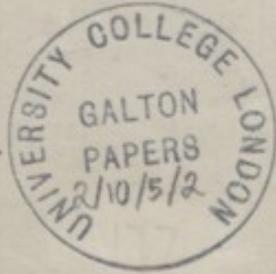
... of sample perfect

the idea of a sample is that it shall represent
on a small scale all the peculiarities of a large
collection so that by the latter can complete collection
can be reproduced by a sample multiplication of the
contents of the sample. This is obvious inasmuch
of the individual peculiarities are to be regarded in a collection
of organic units which differentiate each member
of the collection from all the rest, are intended to
be regarded, but becomes possible if individual
peculiarities are unheeded and those of a
generic character are alone taken notice of, then
it becomes easy to select a sample in which
each genus shall be represented. It is only when the number
of individuals comprised in each genus be large
that the sample may be correspondingly be
small and yet sufficient.

Method of selection
When the a sample is taken very much larger than would
suffice, if its elements were judiciously selected
the principle on which the selection is made would matters little, so long

as there is no ~~particular~~ tendency to exclude representatives of particular classes. A purely random selection such as a conscription, will ensure that the selected individuals shall more or less fairly represent the nation from whom they are taken. But further in the irregularities of the members of some one class form but a minute fraction of the entire population . In a population where one person on the average in every two thousand was a deaf mute it would not unfrequently happen that a batch of ten thousand men selected at random would fairly contain not a single deaf mute It would be roughly 100 to 1 against a batch of 20 persons containing one or more of them

Decimal circles

π

proportions

f/v
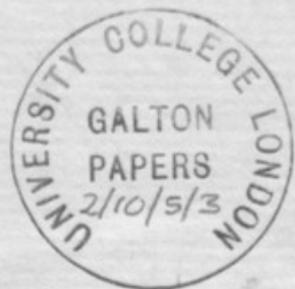
<u>Homing Pigeons</u>

Cute & rough draft of paper sent
to Homing Pigeon newspaper 148 Manchester R.
                                                Oldham
Cimiez
heard 30/9   Francis GALTON,   in pursuance of
                                                that paper of March 23

                    Villa Garin
        18. XI
                    Cimiez

                    Alpes Maritimes

                    France

NICE
9H 30
MARS
94
ALPES-MARᴱˢ

Egypt

Dynasty

Prehistoric the Shesu — hor = servants

I (followers &c of Horus

...

II. Menes
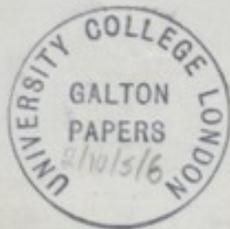
III. Lybians revolted called Rebu
   or Lebu
   ~~~~~~~~~ a dark people
   in early monuments
   under the Empire they have Caucasian
                              features

IV Cheops
   Kafra his portrait is a good one
              more Caucasian than afterwards

V.

VI. life at this age coarser
    wars on the Amu & Herusha
    nomads of the Eastern desert but
    had tombs a for Isles

|
northern monumental
with XI
XII Theban line firmly established
     Grottoes of Beni Hassan

XIII loth? Hyksos
| 511
XVII   years)

XVIII Egypt in great splendour
       Expedition to Punt either
            Somaliland u Arabia Felix

Shasu = wandering Arabs of the desert
Syria is called Khal   (Amorites)
the great nation then was the Rutens n
Kheta a northern division of the Hittites
Phoenicians appear to be Kefa (Canaanites)
Amenophis & his people are drawn
very ugly & emaciated
The Kheta had now conquered the Rutens
Here about is the Exodus

f1

/92

Mars

inter planetas laugha // Mars

Draft of a letter to Spectator. they sent the
meaproof but did not eventually publish it

Being at some distance from town I

I ~~have been~~ in the county & ~~seen~~ shall
see only few newspapers, but ~~have~~ noticed in the Spectator of
last week a reference to ~~the~~ previous remarks of your
on the ~~limited~~ narrowness of the possible range of communication
with Mars, supposing free communication by flashes
~~to be possible~~. It ~~appears~~ would seem that you limited
it to the ~~a~~ response to the 3 flashes that ~~I~~ suggested
(in a letter to the Times) as a mere illustration
~~on the contrary~~. But by read more than they would
be probable. To simplify the ~~con~~ suppose
~~we are separated~~ we could literally provide
their knowledge of algebra & the civil Service
Examiners could examine them if they pleased
both parties were pleased to take the trouble
of acting as examiners. ~~Examinees~~
To simplify the explanation, let ~~each~~ mean a flash
with followed by an interval, and any word in brackets
signify some appropriate (dot and dash combination)
of symbols that they would always be used to signify
the sense of ~~this~~ word, suppose that which as supposed as yet
to be unknown to the people in Mars. When it is
known let it be written in Italics.

First Experiment (a) Flash (plus) Flash (equal) Flash Flash.
(b) Flash (plus) Flash Flash (equal) Flash Flash Flash.
(c) Flash, Flash, (plus) Flash (equal) Flash Flash Flash.
any body with the smallest algebraical knowledge would
understand that (plus) meant Plus, and (equal) meant
equal, & would respond by analogous signals such as
Flash Flash (plus) Flash (equal) Flash Flash Flash &c
To this we should send back (right)
By an analogous fashion (minus) would be understood
after a while. (wrong)

Next might come fl: fl: (multiplied into) fl: fl
equal fl fl fl fl. then ~~the same~~ ... (divided
.. equal / % .. . Then squares & cubes; square
roots & cube roots. ~~the knowledge of the symbol~~
~~for equal would be very helpful (raised to the power of)~~
~~would be learnt by~~ the knowledge of the symbol
for equal would enable the (symbolic) names of the
numbers to be communicated thus ~~= to~~ dot dot
= dot dot dot — dot = dot plus dot = (two) × & so on
Next the symbol for (raised to the power of)
would be learnt by ~~india expressions as~~ $\cdots$ =
$2^2 \cdot 2$ (raised to the power of) $2 = 4$. ~~& so on~~
on a similar principle the meaning of ~~on~~ the usual
~~symbol for any known~~ specified quantity could be hammered
out ~~& so on~~

Next by ~~an~~ binomial expansions $(2+1)^2 = 4+4+1$
$(2+2)^2 = 4+8+4$ $(2+1)^3$ $(2+2)^3$ &c
& finally $(a)^n + (b)^n$ (where that was quite straightforward) every one of which, after
so much preparatory leading, the Martials would
make out. Since & cosine, it would be conveyed
by their algebraical expressions and by ~~their help~~
~~circles would be straightened.~~ Running algebraic
expressions ~~for side by side~~ with their geometrical
~~equivalents~~ a ~~large~~ innumerable

number of useful words would be in time determined circle
~~straight~~, line, intersection, angle, perpendicular, ~~the~~
~~angular distribution of the circle~~ squares rectangle &c
Then the formula for gravity & the numerical
values that we know, for that at the surface of
Mass to which they wd respond by becoming
every "that at the surface" becoming then used for
the Earth & then used for

BOOK POST