SNOW ON CHOLERA

BEING

A REPRINT OF TWO PAPERS

BY

JOHN SNOW, M.D.

TOGETHER WITH

A BIOGRAPHICAL MEMOIR

BY

B. W. RICHARDSON, M.D.

AND

AN INTRODUCTION

BY

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PREFACE.

The republication of these significant papers was suggested to the Commonwealth Fund by Delta Omega, honorary professional society in public health, whose interest in a series of public health classics was first expressed in 1931 in a reprint of William Budd's Typhoid Fever, Its Nature, Mode of Spreading, and Prevention. The publication committee of that society assembled the greater part of the material for the present volume. Acknowledgment is also made to the committee's chairman, Homer N. Calver, for helpful suggestions; to the staff of the London School of Hygiene and Tropical Medicine for interesting and valuable references; to the United States Army Medical Library for making original material available; and to Messrs. J. and A. Churchill and to Longmans, Green and Company, who courteously agreed to this republication of material originally published by them or their predecessors. Especial thanks are due to Dr. Wade Hampton Frost for his assistance in the selection and arrangement of the material and more particularly for his interpretative introduction which orients the present-day reader with respect to the significance of Dr. Snow's contribution.
A NOTE
ON THE TYPOGRAPHY OF THIS BOOK

The Scotch-face type in which this book is set is a close approximation of the type used in the second edition of "On the Mode of Communication of Cholera." This article has been set to resemble the original, the pages and even the lines corresponding exactly to it; and the inconsistencies in spelling and footnotes and the division of words, which in some instances do not correspond with modern usage, have also been carefully followed. The other two articles, "On Continuous Molecular Changes" by Dr. Snow and "John Snow, M.D." by Dr. Richardson, appeared originally in different formats; their reproduction in this book matches the format of the first article and also somewhat retains the spirit of their original style. The binding resembles that used on the second edition of "On the Mode of Communication of Cholera," the lettering and the blind stamping of the original shelf-back are reproduced and the cloth is of the same color.
CONTENTS.

INTRODUCTION ix

JOHN SNOW, M.D., A REPRESENTATIVE OF MEDICAL SCIENCE

AND ART OF THE VICTORIAN ERA, BY B. W. RICHARDSON xxiii

ON THE MODE OF COMMUNICATION OF CHOLERA

PREFACE TO THE SECOND EDITION [iii]

CONTENTS [v]

ON THE MODE OF COMMUNICATION OF CHOLERA 1

ON CONTINUOUS MOLECULAR CHANGES

PREFACE 145

ON CONTINUOUS MOLECULAR CHANGES 147

APPENDIX

I. CHOLERA AND THE WATER SUPPLY: LATER PAPERS 179

II. THE PRINCIPAL WRITINGS OF JOHN SNOW, M.D. 187
INTRODUCTION.

Epidemiology at any given time is something more than the total of its established facts. It includes their orderly arrangement into chains of inference which extend more or less beyond the bounds of direct observation. Such of these chains as are well and truly laid guide investigation to the facts of the future; those that are ill made fetter progress. But it is not easy, when divergent theories are presented, to distinguish immediately between those which are sound and those which are merely plausible. Therefore it is instructive to turn back to arguments which have been tested by the subsequent course of events; to cultivate discrimination by the study of those which the advance of definite knowledge has confirmed.

A nearly perfect model is John Snow's analysis of the epidemiology of cholera which led him to the confident conclusion that the specific cause of the disease was a parasitic micro-organism, conforming in all essentials of its natural history to what is now known of the *Vibrio cholerae*. His central conclusion lies now within the boundaries of direct observation; it is reached by a shorter and easier path than that which
he was obliged to follow. But his argument has the permanence of a masterpiece in the ordering and analysis of a kind of evidence which enters at some stage and in some degree into every problem in epidemiology.

Looking back to the time when Snow wrote, we are apt to be more impressed with the deficiency of his knowledge, lacking all that the technique of modern bacteriology has since supplied, than with the extent and significance of the positive facts at his command. With some exceptions, the communicable diseases of man and the domestic animals which are of common occurrence in Europe had been differentiated clinically; their gross and microscopic pathology was fairly well established; their characteristic distributions in nature were known, and it had been demonstrated for not a few of them that they could be artificially transmitted by inoculation of "morbid matter" in minute quantity. But for certain diseases, including the enteric infections, this demonstration was lacking, and the indirect evidence of communicability was by no means so plain as to be incontestable.

Ideas as to the nature of the *materies morbi* were converging toward present-day conceptions, but were not at all clearly focused. The analogy between infection and fermentation, which Fracastorius had perceived three hundred years earlier, was generally recognized; and moreover it was known that the proc-
esses of fermentation and putrefaction were constantly associated with the presence of living organisms of microscopic size, though whether or not these were spontaneously generated was still a matter of controversy. The active agent in conveyance of infection was generally pictured as being related in some way to the lower orders of known micro-organisms, but not usually as being itself a living organism, still less commonly as being an obligate parasite, bound by the law of biogenesis as now accepted. A general theory of infection closely approximating modern views had, indeed, been clearly formulated by Henle, in 1840, but it had not been widely accepted. The more common view related infectious diseases to micro-organisms much more loosely; and in England, the ideas embodied in the so-called "pythogenic" theory were much in favor.

In this state of uncertainty as to the nature of the more common diseases, cholera presented a riddle peculiarly difficult to solve by the indirect method of inference from its mode of occurrence. The difficulty was not lack of detailed information. The epidemics which swept across Europe in the middle third of the century were matters of tremendous concern and were diligently studied by official commissions and individuals. In England, where epidemics prevailed in 1831–32, 1848–49, and 1853–54, the studies were of notable excellence. The genius and industry of William
Farr produced comprehensive reports of the epidemics of 1848–49 and 1853–54, and supplied current information while they were in progress; admirable factual reports were made by the General Board of Health and the Royal College of Physicians; and the literature of the day contained innumerable detailed accounts of the local dissemination of the disease. But the facts themselves were most confusing. Instances of local spread with every appearance of direct communication from person to person were offset by equally striking instances of failure to spread to those in close contact with the sick, and of the disease developing without traceable relation to prior cases. Moreover, the variations in the local prevalence of cholera appeared to be capricious in the extreme. If it seemed to be the rule that it prevailed most severely in low-lying places, and in a notably filthy environment, the exceptions to these and similar laws were too numerous to be disregarded.

The theories evolved to explain these complex facts were numerous and diverse, but so far as any one idea was dominant it was probably that expressed by Sutherland as follows:

It appears as if some organic matter, which constitutes the essence of the epidemic, when brought in contact with other organic matter proceeding from living bodies, or from decomposition, has the power of so changing the condition of the latter as to impress
it with poisonous qualities of a peculiar kind similar to its own.*

To this was added the conception of "localizing influences" promoting the propagation of the poison, and "predisposing causes," increasing susceptibility to its effects. There were many differences of opinion as to whether the "cholera poison" might be spontaneously generated in different countries, or must be introduced from pre-existing foci; whether it was spread solely by diffusion through the atmosphere or attached itself to solid bodies; whether or not it was communicated by an effluvium (contagion) given off by the sick.

It is easier, at this distance, to see the defects in the current theories than to do them justice. Some were so vague and general as to be manifestly worthless, fitting one set of facts as well as another; others simply ignored some of the plain facts, as for instance when the General Board of Health resolutely closed its eyes to all evidence of communication from person to person or by commerce. But there were at least a few theories, such as Farr's, emphasizing the importance of elevation and drainage, which were well reasoned in accordance with an impressive array of facts. It is perhaps significant that they were directed so largely toward explanation of those phenomena of cholera which are still least explicable: its sudden extensions

around the world, the vagaries of its geographic distribution, and its relation to climate, season, and weather.

How Snow perceived the thread of consistency which connected a seemingly chaotic mass of facts and followed it through to the conclusion that bacteriology has since confirmed, he himself tells plainly and simply, with the fresh enthusiasm of discovery, the restraint of a scientist. His account should be read once as a story of exploration, many times as a lesson in epidemiology.

In order to present the whole of Snow's argument, this volume reproduces in their entirety two of his works, his treatise *On the Mode of Communication of Cholera*, as published in 1855, and his address *On Continuous Molecular Changes, More Particularly in Their Relation to Epidemic Diseases*, delivered in 1853. The first of these is, by itself, a full and sufficient exposition of Snow's theory, evidence, and methods as applied to the specific problem of cholera. The second is important as connecting his views on cholera with his broad conception of epidemic diseases in general and relating these, in turn, to other natural phenomena. Together, these two dissertations show, one in broad outline, the other in detail, the pattern of his thought in epidemiology; his other papers in this field are not without interest, but they all fit into this general pattern, and their reproduction is not essential to the main pur-
pose which this volume is intended to serve. Two of them, however, need to be mentioned, a prelude and a postscript, respectively, to his major work on cholera.

The treatise *On the Mode of Communication of Cholera* which is reprinted here is a second edition, "much enlarged," of a pamphlet published in the summer of 1849. This was followed immediately by a somewhat more extended paper published under the title "On the Pathology and Mode of Communication of Cholera" in the *Medical Times and Gazette* of November 2 and November 30, 1849. The essential difference between these two earlier papers and the expanded edition of 1855 is that the latter contains much new factual evidence, chiefly the analyses of mortality as related to the several water supplies of London in 1832 and 1849 and, of course, all the observations made in 1854. It has seemed unnecessary to reproduce the first paper in this volume, since it is included, for the most part in identical or slightly revised language, in the second edition; but it is important to remember that when Snow undertook his personal investigations in the epidemic of 1854 he already had in mind a definite and well matured theory which he was eager to put to the rigid test which the intermingling of two water supplies made possible.

The postscript to Snow's work of 1855 is his paper on *Cholera and the Water Supply in the South Districts of London*, published in October, 1856, when detailed
statistics of the population using the two principal water supplies in each subdivision of this area became available from the report of an official inquiry conducted by the General Board of Health. Of this a brief account is given in an appendix to this volume. It is not altogether essential to Snow’s original argument, which was already well established, but confirms it in detail and shows his keenness in statistical analysis.

How far Snow’s ideas were original is difficult to determine. He read widely and drew upon the ideas as well as the facts of his day, and it is certain that the general conception of epidemic disease which he expressed was not altogether unfamiliar at the time. Henle, approaching the subject from a different angle, had already expressed broadly similar views as to the nature of infectious diseases and, though no direct allusion to his work has been found in Snow’s writings, he must have known of it, at second hand if not in the original. Budd certainly shared Snow’s views, but notwithstanding that he himself had arrived at similar conclusions concerning cholera as early as 1849, he generously accords Snow full credit for independent and more complete development of the theory. The belief that cholera was communicable from person to person through a specific poison was not unusual. Some part of Snow’s conception that cholera was due to a specific micro-organism, an obligate parasite, propagating only in the human intestinal tract and disseminated
by ingestion of excreta, was expressed by a number of contemporary writers; but seldom if ever was the whole idea expressed, and no one else followed it through to such full development. That Snow's contemporaries considered his theory of cholera to be original is evidenced by the fact that they referred to it as "Dr. Snow's theory" and, in their discussions, differentiated it from all the other theories which it was customary to mention.

The extent to which the ideas and evidence advanced by Snow were to be accepted in his lifetime is foreshadowed in this passage from his own first paper on cholera (1849):

Many medical men to whom the above circumstances respecting the water have been mentioned, admit the influence of the water, without admitting the special effect of the new element introduced into it—viz., the cholera evacuations, in communicating the disease. They look upon the bad water as only a predisposing cause, making the disease more prevalent amongst those who use it—a view which, in a hygienic sense, is calculated to be to some extent as useful as the admission of what I believe to be real truth, but which, I think, will be found to be untenable, when the circumstances are closely examined.

After Snow's evidence convicting the water supply of the Southwark and Vauxhall Company had been published, none but the most stubborn could deny the influence of contaminated water. And when the
facts had been confirmed by the official inquiry which was completed in 1856, the case was not open to further argument. But what was accepted was merely the fact that impure water had, in some way, the effect of increasing the risk of cholera, and this had long been admitted by many. Snow's explanation of the fact was by no means accepted. Simon's report on the official inquiry which confirmed Snow's facts took pains to make this clear, coming to the conclusion that "under the specific influence which determines an epidemic period, fecalized drinking-water and fecalized air equally may breed and convey the poison."* Even Farr, who had immediately seen the significance of Snow's first observations, who had given whole-hearted aid in extending them, and who was destined himself to play the principal rôle in proving that the next epidemic of cholera in London (1866) was water-borne—even Farr gave only a qualified acceptance to Snow's explanation. Nearly twenty years later such an authority as Hirsch was still referring to contaminated water as a "predisposing cause" of cholera. Among English writers of distinction Budd seems to have stood nearly if not quite alone in prompt and unqualified acceptance of Snow's theory as well as his facts.

Any immediate influence which Snow's work may

* Report on the last two cholera epidemics of London as affected by the consumption of impure water; addressed to the Rt. Hon. the President of the General Board of Health by the Medical Officer of the Board.
have had in promoting the improvement of public water supplies is obscured by the fact that extensive improvements in several of London’s supplies, including that of the Southwark and Vauxhall Company, had already been ordered before the epidemic of 1853–54, to be effective within specified time limits. Nevertheless he did succeed in convincing his contemporaries that sewage pollution of drinking-water was a major rather than a minor factor in the conveyance of cholera. Thirty years later, when all controversy on this point had subsided, Sir John Simon, who, in Snow’s lifetime, had stood aloof from him, classed his proof of this principle as “the most important truth yet acquired by medical science for the prevention of epidemics of cholera.”*

Snow lived only four years after the epidemic of 1854, and in this time he had no opportunity to add to his observations of cholera, which had disappeared from Great Britain. He continued, however, to pursue studies extending to other diseases two principles which he had established for cholera: the tremendous importance of water as a vehicle of specific infection, and the harmlessness—as regards infectious disease—of the “effluvia” from dead organic matter, which were so generally considered at the time to breed pestilence. For both these doctrines, especially the

latter, he was severely criticized, but avoiding heated controversy, he sought facts. In 1858, in a paper on *Drainage and Water Supply in Connexion with the Public Health*, one of the last published in his lifetime, he deals with both subjects. Drawing upon the reports of the Registrar-General for his data, he first shows that among workers in the notoriously offensive trades, such as tanning and soap boiling, mortality rates are, in general, no higher than at corresponding ages in the whole group of industrially employed males. He then turns, by contrast, to the demonstrable relation between mortality and the sewage pollution of water. Presenting tables compiled from the Registrar-General's reports, he shows that prior to improvements in the water supply of the south districts of London, which were completed in the second quarter of 1855, the mortality rates from all causes, from typhus (mostly typhoid fever), and from diarrhoea in this area had consistently exceeded the rates in the districts north of the Thames. Dating from the change in water supply, this relationship was reversed, the rates of mortality being lower in the south districts than in the north. Here his work ended.

Of Snow's character, the circumstances of his life, the range of his interests, and the position which he held in his profession, an illuminating account is given in the memoir by Richardson, his warm friend and admirer. It gives the picture of a man singu-
larly endowed with the ability to think in straight lines and the courage to follow his own thought. In medicine these abilities placed him in the front ranks of his day; in epidemiology they carried him a generation beyond it.

WADE HAMPTON FROST
APPENDIX.

I. CHOLERA AND THE WATER SUPPLY: LATER PAPERS

When Snow made his study of cholera mortality as related to the two principal water supplies in the South Districts of London, he had information on the total number of houses supplied by each company but no exact information as to the number of houses supplied in each sub-district. Therefore, while he was able to ascertain the number of deaths from cholera in the consumers of each water supply in each sub-district and to show that quite uniformly the number of deaths was greater among the consumers of the Southwark and Vauxhall than of the Lambeth supply, he was not able to calculate actual mortality rates in the two groups by sub-districts. However, shortly after the results of his study were made known the General Board of Health undertook an official inquiry which eventually supplied the detailed statistics of population which Snow had lacked.

Lists of the houses receiving water from the Southwark and Vauxhall and the Lambeth water companies, respectively, were obtained from the companies, and compared in detail with the records of deaths on file in the General Register Office. The report on this inquiry, prepared by John Simon, was published in May, 1856. Without alluding in any way to Snow, the report confirmed his findings by the conclusion that, in the epidemic of 1853–54: "The population drinking dirty water accordingly appears to have suffered 3.5 times as much mortality [from cholera] as the population drinking other water." Tables were appended giving, for each district and sub-district, the number of houses and the estimated population supplied by the two water companies, and the deaths therein.

In a paper on "Cholera and the water supply in the South
Districts of London in 1854," published in the October, 1856, issue of the Journal of Public Health, Snow extends his previous discussion of the subject, using the detailed population statistics given in Simon’s report. After giving a full but succinct outline of his studies as previously published, he proceeds:

The results of my inquiry into the supply of water were, of course, obtained separately for each district and subdistrict in which the inquiry was made, and were so published; but I was unable at the time to show the relation between the supply of houses in which fatal attacks took place, and the entire supply of each district and subdistrict, on account of the latter circumstance not being known. I expressed myself as follows in an article which I published soon after my inquiry was made: “I hope shortly to learn the number of houses in each subdistrict supplied by each of the water companies respectively, when the effect of the impure water in propagating cholera will be shown in a very striking manner, and with great detail.” This information did not, however, come within my reach till recently, and not even then with all the accuracy I could desire. In the Report on the Cholera Epidemics of London as affected by the Consumption of Impure Water, lately written by Mr. Simon, and published by the General Board of Health, there is a statement of the number of houses supplied by each of the water companies respectively in each district and subdistrict. The line has not been very accurately drawn where a street, as often happens, is partly in one district and partly in another; and thus, in the recent Report, the subdistricts of St. Saviour’s, Southwark, Leather Market, Bermondsey, Battersea, and Peckham, have been represented to contain a few houses supplied by the Lambeth Company, although they do not contain any. With regard to Bermondsey, it is stated in a foot note that some ends of streets may have been included which have passed the registration boundary, and this has happened in other cases; but the errors arising from this cause are limited in amount, and cannot much affect the statistical calculations that I have made. There is also a further imperfection in the account of the water supply of the subdistricts. The numbers which are stated to represent the houses supplied by each water company in each subdistrict are found on adding up the tables not to do so, but to represent the number of houses, minus those situated in streets in which no death occurred; the latter being placed all together at the end of each group of subdistricts which constitutes a district. Streets vary in size from one or

* Medical Times and Gazette, October 7, 1854, p. 365.
two houses to two or three hundred, and the small streets would obviously be the most likely to be exempt from mortality; it could, therefore, do little good to distinguish such streets; however, if thought desirable, this could as well have been done by simply stating the number of the houses, without deducting them from the gross number in each subdistrict. The number of houses in these exempted streets is about one-ninth of the whole. Instead of being able to compare, as I could wish, the mortality in the houses supplied by each company with the exact number of houses supplied, I have only been able to compare it with the number of houses in the streets in which deaths occurred. This will necessarily raise the proportion of deaths about one-ninth; but there is every reason to believe that the relative proportion of deaths in the population supplied by the two companies respectively, which is the real object of the inquiry, will remain almost unaltered.

As the first four weeks of the epidemic did not furnish a sufficient number of cases in all the subdistricts to serve for a statistical inquiry in detail, I have commenced by taking the first seven weeks of the epidemic collectively; and the first of the tables which accompanies this paper exhibits the results of my personal inquiry, when placed in connexion with the number of persons and houses supplied in each subdistrict by each water company respectively. The reader will observe from the last division of the table that the proportion of deaths was, in every subdistrict, very much greater amongst the population supplied by the Southwark and Vauxhall Company than amongst that supplied by the Lambeth Company, and that the relative mortality is nearly the same throughout, except in two or three instances, where there were but one or two deaths for the basis of calculation amongst the customers of the Lambeth Company. The second table shows the results of that part of the inquiry, conducted by Mr. Whiting, treated in a similar manner. In the subdistricts here enumerated, which were supplied, except just on the border of three of them, exclusively by the Southwark and Vauxhall Company, the mortality will be observed to be nearly the same, only a little higher, than amongst the population supplied by the same company, and mixed with that supplied by the Lambeth Company, as shown in the previous table.

In a third table, he summarizes the data of Tables I and II by districts, and in Table IV he shows by districts the results of the inquiry as conducted by the General Register Office during the last ten weeks of the epidemic. As Tables III and IV are
included in Table V, they are omitted here. In presenting Table V, Snow states:

In the fifth table the numbers in the previous ones are added together, and fresh calculations made, so as to show the result of the inquiry for the whole epidemic. The instances in which the water supply was not specified, or not ascertained, in the returns made by the district registrars must evidently nearly all have been cases in which the house was supplied by one or other of the water companies, for, if the persons received no such supply, and obtained water from a pump well, canal, or ditch, there could be no difficulty in knowing the fact. Moreover, as the two water companies are guided by precisely the same regulations, the difficulty in ascertaining the supply is exactly the same with regard to one as the other; I, therefore, concluded that I could not be wrong in dividing the non-ascertained cases between the two companies in the same proportion as those which were ascertained, and I have done so at the foot of Table V, in order to obtain a complete view of the influence of the water supply during the whole epidemic of 1854. These general results I have employed as the basis of some further calculations.

In a final table, not reproduced here, he calculates, for each subdistrict, for the whole period of seventeen weeks, the number of deaths which would result from applying to the consumers of each water supply the mortality rates (160 and 27 per 10,000, respectively) shown for each water-supply group as a whole in Table V. He notes that these hypothetical figures agree rather closely with the observed deaths in each subdistrict, except where the numbers are very small. This table is interesting, but not essential.

Discussing Table V, Snow expresses the belief that, because of duplication of house-numbers, it is impossible to allocate deaths correctly to their place of occurrence except by "personal inquiry, made on the spot, at the time"; and is convinced that in the official inquiry many errors must have been made. He cites reasons why these would tend generally to increase the apparent mortality rate in consumers of the Lambeth water supply and to decrease it in consumers of the Southwark and Vauxhall supply. He considers that his Table V represents a much more exact allocation of deaths to water supply than does
TABLE I. Shewing the results of the Author's personal inquiry in Twenty-One Sub-Districts.

<table>
<thead>
<tr>
<th>Registration Districts</th>
<th>Registration Sub-Districts</th>
<th>Number of inhabited houses in 1851</th>
<th>Population in 1851</th>
<th>Estimated constant population per house</th>
<th>“Number of houses, and estimated number of persons, supplied in 1854 with water as under.”</th>
<th>Water supply of the houses in which fatal attacks of cholera took place during first seven weeks of epidemic of 1854</th>
<th>Deaths from cholera in first week of epidemic in 1854</th>
<th>Mortality per 10,000 supplied with water as under</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Saviour, Southw.</td>
<td>1. Christchurch</td>
<td>1,887</td>
<td>16,022</td>
<td>8.3</td>
<td>848</td>
<td>2,915</td>
<td>1,557</td>
<td>13,284</td>
</tr>
<tr>
<td></td>
<td>2. Kent Road</td>
<td>2,338</td>
<td>18,126</td>
<td>7.1</td>
<td>1,779</td>
<td>12,603</td>
<td>563</td>
<td>3,997</td>
</tr>
<tr>
<td></td>
<td>3. Borough Road</td>
<td>2,069</td>
<td>15,862</td>
<td>7.7</td>
<td>1,176</td>
<td>8,937</td>
<td>878</td>
<td>6,672</td>
</tr>
<tr>
<td></td>
<td>4. London Road</td>
<td>2,953</td>
<td>17,586</td>
<td>7.5</td>
<td>398</td>
<td>2,872</td>
<td>1,383</td>
<td>11,497</td>
</tr>
<tr>
<td>Newington</td>
<td>1. Trinity</td>
<td>3,824</td>
<td>20,922</td>
<td>6.5</td>
<td>1,061</td>
<td>10,132</td>
<td>1,372</td>
<td>8,370</td>
</tr>
<tr>
<td></td>
<td>2. St. Peter, Walworth</td>
<td>4,925</td>
<td>29,861</td>
<td>6.1</td>
<td>2,540</td>
<td>14,274</td>
<td>1,758</td>
<td>10,724</td>
</tr>
<tr>
<td></td>
<td>3. St. Mary</td>
<td>3,003</td>
<td>14,083</td>
<td>6.1</td>
<td>488</td>
<td>2,983</td>
<td>899</td>
<td>5,484</td>
</tr>
<tr>
<td>Lambeth</td>
<td>1. Waterloo, part 1</td>
<td>1,729</td>
<td>14,088</td>
<td>8.1</td>
<td>438</td>
<td>3,548</td>
<td>1,474</td>
<td>11,099</td>
</tr>
<tr>
<td></td>
<td>2. Waterloo, part 2</td>
<td>2,191</td>
<td>18,343</td>
<td>8.4</td>
<td>864</td>
<td>7,171</td>
<td>1,510</td>
<td>12,383</td>
</tr>
<tr>
<td></td>
<td>3. Lambeth church, pt. 1</td>
<td>2,451</td>
<td>18,409</td>
<td>7.5</td>
<td>415</td>
<td>3,113</td>
<td>2,117</td>
<td>15,878</td>
</tr>
<tr>
<td></td>
<td>4. Lambeth church, pt. 2</td>
<td>3,849</td>
<td>26,784</td>
<td>7.0</td>
<td>1,124</td>
<td>7,868</td>
<td>2,389</td>
<td>16,923</td>
</tr>
<tr>
<td></td>
<td>5. Kennington, part 1</td>
<td>3,977</td>
<td>24,261</td>
<td>6.1</td>
<td>2,586</td>
<td>15,775</td>
<td>444</td>
<td>2,708</td>
</tr>
<tr>
<td></td>
<td>6. Kennington, part 2</td>
<td>3,588</td>
<td>18,845</td>
<td>5.7</td>
<td>1,206</td>
<td>7,874</td>
<td>986</td>
<td>5,680</td>
</tr>
<tr>
<td></td>
<td>7. Brixton</td>
<td>2,962</td>
<td>14,610</td>
<td>6.1</td>
<td>310</td>
<td>1,922</td>
<td>1,509</td>
<td>9,356</td>
</tr>
<tr>
<td></td>
<td>8. Norwood</td>
<td>600</td>
<td>3,977</td>
<td>6.6</td>
<td>0</td>
<td>0</td>
<td>160</td>
<td>1,066</td>
</tr>
<tr>
<td>Wandsworth</td>
<td>1. Wandsworth</td>
<td>1,542</td>
<td>9,611</td>
<td>6.3</td>
<td>144</td>
<td>907</td>
<td>13</td>
<td>94</td>
</tr>
<tr>
<td></td>
<td>2. Putney</td>
<td>918</td>
<td>5,280</td>
<td>5.7</td>
<td>18</td>
<td>74</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3. Streatham</td>
<td>1,419</td>
<td>9,023</td>
<td>6.4</td>
<td>0</td>
<td>0</td>
<td>515</td>
<td>3,344</td>
</tr>
<tr>
<td>Camberwell</td>
<td>1. Dulwich</td>
<td>259</td>
<td>1,638</td>
<td>6.4</td>
<td>0</td>
<td>4</td>
<td>25</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>4. St. George</td>
<td>2,945</td>
<td>15,949</td>
<td>5.6</td>
<td>767</td>
<td>4,293</td>
<td>971</td>
<td>5,437</td>
</tr>
<tr>
<td></td>
<td>5. Sydenham</td>
<td>801</td>
<td>4,601</td>
<td>5.8</td>
<td>0</td>
<td>0</td>
<td>unkno</td>
<td>unkno</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>47,548</td>
<td>317,883</td>
<td>6.6</td>
<td>16,038</td>
<td>107,290</td>
<td>20,554</td>
<td>143,901</td>
</tr>
</tbody>
</table>
the official inquiry. He concludes that the relative mortality in the consumers of the two water supplies was actually in the ratio of about 6 to 1, as is shown in his table, rather than 3.5 to 1, as given in the official inquiry.

It is impossible to check the deaths in Snow's Table V against the tables given in Simon's report. The latter includes the whole epidemic period of 1853-54, while Snow's table refers to the seventeen weeks from July 9th to November 4th, 1854, during which time the sources of water supply in the houses where deaths occurred were ascertained by Snow himself, by Mr. Whiting, or by the local registrars. It appears, however, from comparison of Snow's data with those given in Simon's report, that Snow was justified in believing his to be more accurate.

Quite aside from this question, Tables I and II of this paper confirm, in detail, the inferences drawn from Table VIII of *The Mode of Communication of Cholera.*

W. H. F.

References:
(Letter to the Registrar General... by William Farr, quoting from the Weekly Returns of October 14 and December 3, 1854).
TABLE II.

Shewing the results of the Inquiry made by Mr. Whiting in Eleven Sub-Districts.

<table>
<thead>
<tr>
<th>Registration Districts</th>
<th>Registration Sub-Districts</th>
<th>Number of Inhabited Houses in 1851</th>
<th>Population in 1861</th>
<th>Estimated constant population per house</th>
<th>&quot;Number of houses, and estimated number of persons, supplied in 1854 with water as under.&quot;</th>
<th>Water supply of the houses in which fatal attacks of cholera took place during first seven weeks of epidemic of 1854.</th>
<th>Mortality per 10,000 supplied with water as under</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>By Southwark and Vauxhall Co.</td>
<td>By the Lambeth Company.</td>
<td>Southwark and Vauxhall Co.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No. of houses</td>
<td>Estimated Population</td>
<td>No. of houses</td>
<td>Estimated Population</td>
<td>Southwark and Vauxhall Co.</td>
<td>Lambeth Co.</td>
</tr>
<tr>
<td>St. Saviour, Southw.</td>
<td>2. St. Saviour</td>
<td>2,713</td>
<td>19,709</td>
<td>7.3</td>
<td>2,283</td>
<td>16,337</td>
<td>125</td>
</tr>
<tr>
<td>St. Olave, Southwark</td>
<td>1. St. Olave</td>
<td>880</td>
<td>8,015</td>
<td>9.1</td>
<td>961</td>
<td>8,747</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2. St. John, Horselydown</td>
<td>1,480</td>
<td>11,360</td>
<td>7.7</td>
<td>1,170</td>
<td>9,360</td>
<td>0</td>
</tr>
<tr>
<td>Bermondsey</td>
<td>1. St. James</td>
<td>2,835</td>
<td>14,899</td>
<td>5.6</td>
<td>2,511</td>
<td>13,173</td>
<td>105</td>
</tr>
<tr>
<td></td>
<td>2. St. Mary Magdalen</td>
<td>1,865</td>
<td>10,284</td>
<td>7.5</td>
<td>2,501</td>
<td>17,258</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>3. Leather Market</td>
<td>2,279</td>
<td>15,205</td>
<td>6.7</td>
<td>2,090</td>
<td>14,010</td>
<td>168</td>
</tr>
<tr>
<td>Wandsworth</td>
<td>1. Clapham</td>
<td>2,657</td>
<td>16,920</td>
<td>8.1</td>
<td>1,106</td>
<td>6,747</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>2. Battersea</td>
<td>1,760</td>
<td>10,660</td>
<td>6.0</td>
<td>1,046</td>
<td>6,267</td>
<td>46</td>
</tr>
<tr>
<td>Camberwell</td>
<td>2. Camberwell</td>
<td>2,851</td>
<td>17,742</td>
<td>6.2</td>
<td>1,474</td>
<td>9,139</td>
<td>108</td>
</tr>
<tr>
<td></td>
<td>3. Peckham</td>
<td>3,457</td>
<td>19,444</td>
<td>5.6</td>
<td>971</td>
<td>5,483</td>
<td>70</td>
</tr>
<tr>
<td>Rotherhithe</td>
<td>Rotherhithe</td>
<td>2,792</td>
<td>17,805</td>
<td>6.4</td>
<td>1,099</td>
<td>12,218</td>
<td>0</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>25,597</td>
<td>169,035</td>
<td>6.5</td>
<td>18,777</td>
<td>128,694</td>
<td>832</td>
</tr>
<tr>
<td>Totals of Table 1</td>
<td></td>
<td>47,548</td>
<td>317,883</td>
<td>6.0</td>
<td>16,093</td>
<td>107,290</td>
<td>20,554</td>
</tr>
<tr>
<td>Houses in streets where no death occurred</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Not identified</td>
<td></td>
<td>.</td>
<td>.</td>
<td>411</td>
<td>2,712</td>
<td>25</td>
<td>105</td>
</tr>
<tr>
<td>Totals of thirty-two Sub-districts</td>
<td>.</td>
<td>73,145</td>
<td>486,036</td>
<td>6.8</td>
<td>39,726</td>
<td>267,625</td>
<td>24,854</td>
</tr>
</tbody>
</table>
TABLE V.

Shewing the results of the Inquiry for the whole Epidemic of 1854.

<table>
<thead>
<tr>
<th>Registration Districts</th>
<th>Number of inhabited houses in 1851</th>
<th>Population in 1851</th>
<th>Estimated constant population per house</th>
<th>&quot;Number of houses, and estimated number of persons, supplied in 1854 with water as under.&quot;</th>
<th>Water supply of the houses in which fatal attacks of cholera took place</th>
<th>Deaths from cholera in the epidemic of 1854</th>
<th>Mortality per 10,000 supplied with water as under.</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Saviour, Southwark</td>
<td>4,600</td>
<td>35,731</td>
<td>7.8</td>
<td>2,631 19,167 1,689 14,201</td>
<td>406 72 10 3</td>
<td>491</td>
<td>207 50</td>
</tr>
<tr>
<td>St. Olave, Southwark</td>
<td>2,360</td>
<td>19,375</td>
<td>8.2</td>
<td>2,193 18,638 0 0</td>
<td>277 0 8 28</td>
<td>813</td>
<td>148 ..</td>
</tr>
<tr>
<td>Bermondsey</td>
<td>7,007</td>
<td>48,128</td>
<td>6.9</td>
<td>8,402 57,884 268 1,785</td>
<td>821 0 25 0</td>
<td>846</td>
<td>142 ..</td>
</tr>
<tr>
<td>St. George, Southwark</td>
<td>6,992</td>
<td>51,924</td>
<td>7.4</td>
<td>3,419 25,039 3,183 23,712</td>
<td>388 99 0 50</td>
<td>543</td>
<td>155 41</td>
</tr>
<tr>
<td>Newington</td>
<td>10,438</td>
<td>64,816</td>
<td>6.2</td>
<td>2,244 31,940 5,473 33,631</td>
<td>458 58 2 176</td>
<td>694</td>
<td>143 17</td>
</tr>
<tr>
<td>Lambeth</td>
<td>20,447</td>
<td>139,325</td>
<td>6.8</td>
<td>8,077 54,082 11,763 83,786</td>
<td>525 138 24 240</td>
<td>927</td>
<td>96 16</td>
</tr>
<tr>
<td>Wandsworth</td>
<td>8,276</td>
<td>50,764</td>
<td>6.1</td>
<td>3,028 18,390 618 3,870</td>
<td>265 7 106 40</td>
<td>421</td>
<td>145 18</td>
</tr>
<tr>
<td>Camberwell</td>
<td>5,412</td>
<td>54,007</td>
<td>5.8</td>
<td>4,003 25,472 1,835 10,478</td>
<td>332 33 115 49</td>
<td>549</td>
<td>150 31</td>
</tr>
<tr>
<td>Rotherhithe</td>
<td>2,792</td>
<td>17,805</td>
<td>6.4</td>
<td>2,296 14,951 0 0</td>
<td>207 0 46 90</td>
<td>283</td>
<td>138 ..</td>
</tr>
<tr>
<td>Greenwich &amp; sub-dis. Sydenham</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>.. 4,112 4,712 25 165</td>
<td>.. 4 4 2 1</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>Houses not identified</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>.. 4,112 4,712 25 165</td>
<td>.. 4 4 2 1</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>75,344</strong></td>
<td><strong>482,435</strong></td>
<td><strong>6.7</strong></td>
<td><strong>30,726 267,625 24,834 171,528</strong></td>
<td><strong>3,706 411 338 623</strong></td>
<td><strong>5,078</strong></td>
<td><strong>138 23</strong></td>
</tr>
<tr>
<td>Non-ascertained cases distrib.</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>.. 266,516 173,748</td>
<td>.. 4,267 473 338 5,078</td>
<td>..</td>
<td>..</td>
</tr>
<tr>
<td>(Registrar-General)</td>
<td>..</td>
<td>..</td>
<td>..</td>
<td>.. 266,516 173,748</td>
<td>.. 4,267 473 338 5,078</td>
<td>..</td>
<td>..</td>
</tr>
</tbody>
</table>
II. THE PRINCIPAL WRITINGS OF JOHN SNOW, M.D.


1847. On the inhalation of the vapour of ether in surgical operations: containing a description of the various stages of etherization and a statement of the result of nearly eighty operations in which ether has been employed in St. George’s and University College Hospitals. *London, J. Churchill*, 1847, 88 pp. 8º.


Remarks on the fatal case of inhalation of chloroform; ... *London Med. Gazette*, vol. 41, Feb. 18, 1848, pp. 277-278.


Letter to the Right Honourable Lord Campbell, Lord Chief Justice of the Court of Queen’s Bench, on the clause respecting chloroform in the proposed “prevention of
PRINCIPAL WRITINGS


"Dr. Snow's report" in Report on the cholera outbreak
in the Parish of St. James, Westminster, during the
autumn of 1854 presented to the Vestry by the Cholera
120.

Employment of chloroform in surgical operations. Lan-

A letter to the Right Honourable Sir Benjamin Hall,
Bart., President of the General Board of Health. Lon-
don, J. Churchill, 1855, 15 pp. 8º.

On the comparative mortality of large towns and rural
districts, and the causes by which it is influenced. Read
before the Epidemiological Society of London, May 2,
1853. Trans. of the Epid. Soc. of London for the year
1855, pp. 16–24.

The breathing and the pulse under the influence of chlor-
313–318.

On the chief cause of the recent sickness and mortality
in the Crimea. Med. Times and Gazette, n. s. vol. 10,
Apr. 28, 1855, pp. 457–458.

1856. Ueber die Verbreitungsweise der Cholera. Translated
by A. F. W. Assmann from the second London edition
of 1855. Quedlinburg, H. C. Huch, 1856, 150 pp. 8º.

Further remarks on the cause and prevention of death


On the supposed influence of offensive trades on mortality.
Lancet, July 26, 1856, pp. 95–97.

Cholera and the water supply in the south districts of


