Document 31 (Online Companion)

The second General Board of Health's interpretations of the 1854 cholera epidemic

Benjamin Hall became President of the second Board on 12 August 1854. The cholera epidemic was in its fifth week and escalating. On 31 August—the same day the outbreak commenced in St. James, Westminster—he appointed medical inspectors to investigate localities where cholera was prevalent, to submit daily reports, and to facilitate public health responses by local authorities. John Sutherland would coordinate their activities as superintending medical inspector.

Hall also created a medical council to advise him and undertake a variety of investigations into the nature and cause of cholera. Thirteen men, drawn from all three branches of the profession, met for the first time on 6 September 1854. Two days later, the medical council divided itself into three committees: scientific Inquiries, treatment, and foreign correspondence. The following extracts come from reports submitted to Hall by the committee for scientific inquiries, Dr. Sutherland, and an overview of all investigations conducted under the authority of the medical council.

This document contains extracts, in addition to those used in the book, from the concluding report and appendix issued by the committee for scientific inquiries within the medical council, from Sutherland's report on the work of medical inspectors in the London metropolis, and from the medical council's general report to Hall. In addition, the document contains the table of contents for the supplement to its report produced by the committee for scientific inquiries.

I. "Rivalry of foulness" in the metropolis: The Committee for Scientific Inquiries[1]

To the right honorable, president of the General Board of Health:

London, 14 July 1855

Soon after your having constituted a medical council to advise the [General] Board of Health on matters relative to the then prevailing epidemic of cholera, . . . we, the undersigned, were requested to become a committee for the scientific purposes of the council. . . . We ask indulgence for much that is unavoidably imperfect in our work. To do such things fitly, all needful organization must be prior to the emergency. . . . The reconstitution of the General Board, under which you became its president, was affected only on 12 August [1854]. The first meeting of the medical council was only on 6 September. We were appointed a committee two days later, already in the tenth week of a pestilence which some days previously had [5/6] attained its utmost extension and was now in the process of decline.

[1] GBoH, Medical Council, *Report of the Committee for Scientific Inquiries in relation to the cholera epidemic of 1854* (London: HMSO, 14 July 1855), in http://johnsnow.matrix.msu.edu/work.php?id=15-78-BE , and References (Online Companion).

[13] The population of London is distributed over the low ground on both sides of the Thames and over a great number of elevations and depressions which ascend from the south bank of the river up to Blackheath and Norwood, and from the north bank up to Highgate and to Hampstead. . . . The mean mortality by cholera to 10,000 in the [last] two epidemics was at the rate of 156 in the four lowest districts, 15 in the four highest districts. . . . [13/14] If the thirty-six districts of London are arranged in the order of their elevation above the high water mark of the Thames, the mortality by cholera is found not to be invariably in each district inversely as the elevation. But by taking groups of districts together in the two epidemics, a nearly regular series is obtained. . . .

[15] The distribution of choleraic attacks (though in widely different degrees of frequency and, perhaps, also of severity) throughout the whole metropolitan area seems to establish that the *cholera leaven*, be what it may, was scarcely less diffused in the districts that suffered the lowest mortality than it was in the districts where the disease was ten-fold more fatal. But while the presence of this *leaven* seems to have been universal throughout the districts of the metropolis, the consequences excited by its presence have greatly varied in different localities.

Independently of any hypothesis, it may now be stated as the experience [from investigating] two epidemics in London that such local varieties of effect, grouped into masses for comparison, have been more nearly inverse to the elevation of the soil in the affected districts than proportionate to any other general influence that we could **measure**. Approaching London [15/16] along the roads from the surrounding country and descending through the successive regions, succeeding each other in circles down to the waters of the polluted Thames, we see in the epidemic the people fall upon the right hand and upon the left in numbers that increase on every circle and express arithmetically the growing force of those physical influences on which the poison of cholera apparently depends for its powers of existence or of development.

measure: The committee footnotes Farr's elevation formula from the GRO's *Report* on the 1848–49 epidemic; see Document 11 <CWS>, 24.

[24] Mr. **Glaisher**'s report is of peculiar interest. It presents the result of meteorological diaries kept not only at ten stations previously existing, but at thirteen others established for the occasion [the current epidemic]. . . . [27] In comparing the extreme readings of the Greenwich and other outlying stations with those of London proper, Mr. Glaisher discovers the startling fact that his central stations undergo a much less daily range of temperature. Because of the dense veil which overhangs them, they during the day time cannot get equal heat from the sun nor, during the night time, can equally cool themselves into space. Such excesses of night temperature [amounted in some weeks to 15° to 20°] . . . a period marked by this extreme difference extended but for twelve nights . . . from 26 August to 4 September.

James Glaisher: With the Royal Observatory, Greenwich and head of a commission that established twenty-three stations throughout the metropolis to take daily observations during the epidemic (began on 8 July 1854).

Remembering that amid the districts which most of all present this high night temperature, there is spread the vast evaporating surface of the Thames—a river which (so far at least as London is a drained city) represents the main sewer of the metropolis. Remembering that, from its putrescent banks and waters there arise vapour and miasm in proportion to that level of temperature, we must recognise the full right with which Mr. Glaisher insists upon this feature of our London climate. Almost uninterruptedly, too, the heat of the water is some degrees greater than the superincumbent air. For 28 consecutive nights ending 12 September, this excess averaged 16.3°. There was another fortnight, beginning a few days later, during which it averaged 16.5°. At such periods, we may (as Mr. Glaisher expresses it) infer the water to have been simmering and the whole area of the Thames to have been giving off incessant and vast volumes of vapour which, unsustained by the colder air, hovered over the city, thickened its atmosphere, occasioned the frequent prevalence of fog and mist, and explained the less daily range of temperature in stations overshadowed by its influence.

[34] Special examinations of the atmosphere were to some extent conducted, both chemically and microscopically, in reference to the causation of the disease, whether any peculiar organic forms of unusual chemical products could be detected either in the general air of an infected locality, or in its sewer gases, or in the immediate atmosphere and exhalations of the sick. The spot chosen for these observations was in the low-lying district of St. Olave, Southwark where the epidemic had great prevalence and where the wards of St. Thomas's Hospital gave the observers every facility for the requisite access to infected persons. The experiments were conducted by Dr. Thomson and Mr. Rainey, whose respective reports are contained in our Appendix . . . . [34/35}

In the atmosphere of a ward filled with cholera patients while the disease was at its height, there were diffused various substances, some not possessed of life . . . [and] others distinctly having life, showing growth or movement. Of the latter, Mr. Rainey reports that they had the appearance of small flocculent masses, visible to the naked eye, in the fluid at the bottom of [a] vessel. . . . They were found to consist of the mycelia of fungi . . . mixed with dusty impurities . . . . [Dr. Thomson] could discover no appreciable difference between these growths and the mycelia of fungi . . . where no cholera was present. Besides the fungi, there were extremely minute, colourless, indistinctly beaded fibres (resembling in their general character that form of Vibrionia called bacterium) . . . that he does not recollect to have seen on

mycelia growing in astringent vegetable solutions prepared for the purpose of producing fungi.

In the atmosphere of a ward only partially filled with cholera patients when the disease was very much in decline, the dead and living form (separated by filtration) wee of the same kind as those just described. But the vibrionic fibres were much less numerous . . . . In a third examination, made when cholera had left the district and when, consequently, the ward was empty, dust particles were found, with the mycelia of fungi in considerable abundance and apparently active vegetation. But Mr. Rainey, with very careful research, could find no trace of the vibrionic forms. In the external atmosphere adjacent to the hospital, various dusty impurities were observed, as also . . . [35/36] fungi to a considerable extent, but no vibriones. The collection of this air for examination began on 21 October.

In air collected from within a sewer during twenty-seven days, beginning 22 November, there was found less dusty admixture than in the upper air. Vibriones were seen in much larger quantity than in any of the previous specimens, traversing the field of the microscope with great rapidity, and fungi were also present.

The above results of a local examination have, at present, little more than a negative interest. The presence of fungi and their sporules in the atmosphere appears to have had no relation to the proximity of cholera patients, to have continued in the ward when vacated of all inmates, and to have been found in the exterior air (including that of the sewer) when cholera had long ceased to be epidemic in the metropolis. More importance might at first sight seem to belong to the presence of vibriones in the air, especially since they diminished when cholera patients were fewer in the ward and vanished when no such patients remained. Yet, considering what is generally known of the habits of these peculiar forms, we cannot conclude that this was an essential coincidence. The development of vibriones is intimately related to animal decomposition. And the discovery of their profuse existence in sewer gas when cholera was no longer present, illustrates how they may multiply in an air that is loaded with organic miasm. . . . [36/37]

We cannot pass this very interesting part of our subject without expressing our regret that researches of so much importance could not have commenced at an earlier date . . . . A very complete and exact inquiry into the chemistry of organic decomposition during the prevalence of epidemic cholera—especially into the successive transformations of animal refuse at such times—might furnish all-important information as to the characteristic poison of the disease.

Valuable information relative to local atmospheres has been gathered from other sources than direct chemical analysis. Nine sanitary inspectors were employed to visit all the localities most severely affected with cholera. Dr. Sutherland, late superintending inspector of the Board, has compiled from their statements an account . . . .[2]

Dr. Thomson's and Dr. Hassall's inquiries have [43/44] extended to the examination of many well waters in and about London. In respect of superficial wells—those common sources of pump water in the metropolis and elsewhere—the testimony now given strongly corroborates all that has frequently been urged as to the dangerous nature of such a supply. Both observers, though from different points of view, discover in these waters just such qualities as might be expected from their having filtered through a porous soil, full of organic impurities. They contain sometimes evident sewage matter, sometimes an abundance of nitrates or ammonia derived from the decomposition of animal substances, sometimes a variety of those animal and vegetable organisms which attest the progress of decay. . . .

[46] With respect to the living animal and vegetable forms traced by Dr. Hassall through the whole series of waters, there seems no evidence that they, by their own action on the human body, could be productive of choleraic symptoms. . . . [48] The present state of scientific knowledge does not justify dogmatic assertions on this subject. But there are reasons for believing, in respect not only of cholera but of may kindred diseases, that the means and agencies of morbid infection stand in intimate relation to decaying animal products within and without the body. The slightest taint of organic decomposition within the drinking water of a large population, therefore, constitutes a danger which we cannot but regard with as much alarm as disgust.

[48] The doctrine of epidemic cholera, which has gained almost universal acceptance, does not affect to explain what may be that power—the exciting cause of the epidemic manifestation—which at intervals of time has forayed from place to place about our globe, sometimes vaguely spreading over a widened area, sometimes seeming to move in more defined procession and which now for the third time has shed its fatal influence in our land. But with this mystery still unsolved, there has grown more and more into shape a doctrine which is both intelligible and practical—that the undiscovered power in its wanderings acts after the manner of a *ferment*. It therefore takes effect only amid congenial circumstances and the stuff out of which it brews poison must be air or water abounding with organic impurity. Taking this as hypothesis and testing it by the facts before us, we find that it would include and explain them.

Either in air or in water, it seems probable that the infection can grow. Often it is not easy to say which of these media may have been the

[2] John Sutherland, *Report on Epidemic Cholera in the Metropolis* (January 1855).

chief scene of poisonous fermentation. The impurity of one commonly implies the impurity of both. In considerable parts of the metropolis where cholera has severely raged there is rivalry of foulness between the two. But, on the whole, . . . it seems impossible to doubt that the influences which determine in mass the geographical distribution of cholera in London belongs less to the water than to the air.

In our statistical section, it appears that gradual exemption from the epidemic mortality "has more nearly followed the degrees of elevation of soil than been proportionate to [48/49] any other general influence we could measure." But in this lessening scale—varying from a death rate of 156 beside the river to one of 10 at the highest levels of London—there are now so many and so considerable exceptions as to show that the low level invites the epidemic invasion by reason of some attribute of its position which may elsewhere equally abound. Such an attribute is the excess of organic impurity which, from the relation of the river of our London drainage, habitually saturates those alluvial parts. Through sanitary mismanagement or personal neglect, [it] may [also] prevail against the intentions of nature at the highest level in the land.

Even among the best placed parts of London thee are districts so habitually foul and unwholesome that a spectator may wonder whether by any result of tidal drainage the southern flats of the metropolis can have been rendered more foetid and poisonous than they. But the meteorological history of London here comes to our aid, explaining how, even if there be equal filthiness in all districts, the poisonous consequences of filth must be inverse to the elevation of the soil. For on the supposition (which this result greatly confirms) that the choleraic infection multiplies rather in air than in water, meteorology explains how the balance of healthfulness is weighted in favour of the higher levels by their less participation in the high night temperature of the metropolis, by their comparative clearness from mist, and above all, by the curative resources of more free ventilation.

Remarks on the outbreak of cholera in Soho

One local outbreak of the epidemic—that which befell the neighbourhood of Berwick Street—was of such severity as to suggest that some especial causes must be concerned in its production. The circumstances of this remarkable attack have been investigated in a house-to-house visitation of the affected locality. The results of that inquiry are stated in a report (App[endix] No. IV) by the three gentlemen who conducted it—Dr. Fraser, Mr. Hughes, and Mr. Ludlow.

In the three registration subdistricts of St. Anne's, Golden Square, and Berwick Street, together comprising a population of 42,000 persons, it appears that there [49/50] occurred 537 deaths from cholera. [This is a] rate of 128 to every 10,000 inhabitants, while the general cholera rate of the metropolis was only sixty to the same number. This high mortality was . . . remarkable [since] the affected districts are not situated at a low level nor disproportionately inhabited by a poor population.

A striking feature of the outbreak was its extreme suddenness, as measured by the large number of persons almost simultaneously attacked. Its greatest local diffusion appears to have been reached on the second, if not on the first, day from its commencement. It remained of equal prevalence for two days. On each of the two following [it] underwent a decline of 50 percent.

In respect of this explosive appearance of the epidemic, it deserves particular mention that for some time the district had been enjoying an exemption from disease quite out of keeping with its sanitary condition. Influences, universally recognised to be causes of disease, had been present. But in a manner for which we are unable to account, [they] had remained almost inoperative. Till the very eve of this dreadful outbreak, the district might have boasted itself as one of average healthiness.

This fact is one of so much interest and importance that we have thought it advisable to have it thoroughly investigated by an inquiry into the mortuary statistics of the last seven years. The death rate of the district during this period, if we could exclude from it those few days of epidemic visitation, would have been only 20½ per 1,000 per annum. Though far above what sanitary science can ensure to well-regulated districts, [it] is considerably below our average metropolitan death rate. Zymotic diseases, too, had made less than 1/22 of this total.

It likewise deserves to mention that of the 537 deaths of the late epidemic, 323 occurred in houses which during the past seven years had suffered no deaths from other zymotic diseases. In comparison especially with the slight visitation of cholera which this district suffered in 1849, we discover that out of 86 houses in which cholera deaths then occurred, only 10 reappear in the list of 310 houses in which cholera deaths occurred in the late epidemic. Since these results of our inquiry differ from what has been generally believed of the habits of the disease, we append (see p. 119) in detail the tables on which they are founded. [50/51]

With respect to the causes of this particular outbreak, we find no apparent exception to the conclusions arrived at in the preceding section of our report. Anticipating that for such an epidemic prevalence of cholera—whatever may have been the foreign influence that excited it—there must have pre-existed a certain local state of uncleanliness with putrefiable matters, we trace no anomaly in this visitation.

That such local uncleanliness prevailed most intensely throughout the suffering districts is evident from the reported result of house-to-house

visitation. The exterior atmosphere was offensive effluvia from ill-conditioned sewers. The houses were almost universally affected in the same manner, partly from the same source, partly from their own extreme defects of drainage and cleanliness, partly from unregulated slaughtering and other offensive trades. The inhabitants were overcrowded, perhaps to the greatest degree known even in London. The general architecture of the locality was such as to render it almost insusceptible to ventilation.

On the principles to which we have referred and which we believe to be commonly recognised as presenting the most probable theory of choleraic irruptions, it will be obvious that the locality, notwithstanding its high level, contained every predisposing condition which (given the exciting cause} should render it prone to a violent epidemic explosion. We believe that any person conversant with the laws of disease might have predicted its extreme liability to suffer what afterwards befell it.

Why, however, this district should have suffered in marked disproportion to many other districts hardly, if at all, superior in their sanitary arrangements; or why, generally, it should be the tendency of cholera in its visitation to select particular foci for extreme outbreaks instead of diffusing itself more equally over all ill-conditioned districts, is a difficulty which hitherto we have no scientific material to solve.

The meteorological conditions of the districts were not minutely examined at the time of the attack. But the reporters' mention of an atmospheric haze and of a singularly stagnant, sultry and oppressive air leads us to believe that, if scientifically observed, they would have been found accordant with the generalizations in Mr. Glaisher's metropolitan report. [51/52]

In explanation of the remarkable intensity of this outbreak within very definite limits, it has been suggested by Dr. Snow that the real cause of whatever was peculiar lay in the general use of one particular well, situate[d] in Broad Street in the middle of the district, and having (it was imagined) its waters contaminated with the rice-water evacuations of cholera patients. After careful inquiry, we see no reason to adopt this belief. We do not find it established that the water was contaminated in the manner alleged. Nor is there before us any sufficient evidence to show whether inhabitants of the district, drinking from that well, suffered in proportion more than other inhabitants of the district who drank from other sources.

There is mentioned, however, a remarkable instance in which it seems probable that the water of this well did really act as a vehicle of choleraic infection. But, assuming the absence of fallacy in the case, this probability might easily be admitted without its therefrom resulting that infection depended on the specific material alleged. The water was undeniably impure with organic contamination. We have already argued that, if at the times of epidemic invasion there be operating in the air some influence which converts putrefiable impurities into a specific poison, the water of the locality (in proportion as it contains such impurities) would probably be liable to similar poisonous conversion. Thus, if the Broad Street pump did actually become a source of disease to persons dwelling at a distance, we believe that this may have depended on other organic impurities than those exclusively referred to and may have arisen, not in it containing choleraic excrements, but simply in the fact of its impure waters having participate in the atmospheric infection of the district.

[55] The important observations of Mr. Glaisher . . . demonstrate that, not only in 1854, but likewise in 1849 and, as far as can now be ascertained, 1832, many conditions of the London atmosphere were such as would favor retention and increase of any poisonous matter in the air. [Moreover,] these conditions increased concurrently with the rise of the epidemic and diminished with its decline. Such facts accord well with the view that the poison enters the human body through the lungs. . . .

In further research for such possible foreign elements, . . . Dr. Hassall found vibriones abounding in the mucus of the bronchial tubes, but remarks that their presence was probably due to incipient putrefaction. [55/56] . . . [He] states that the very various animal and vegetable living products which abounded in the water of cholera districts belong to species which are well known and are to be found in the wasters of districts not visited by the epidemic. They have no especial relation with the presence of cholera. [They are] important only as affording evidence of the impurity of the water. In the intestinal discharges, Dr. Hassall has discovered no sporules or threads of any species of fungus and no peculiar body of any kind other than vibriones. . . . They may be found also in the contents of the intestinal canal after death from other diseases . . . . Their extraordinary numbers in the rice water discharges, therefore, probably shows merely a great proneness to decomposition in the fluids poured into the intestines in cholera. . . . Dr. Hassall states that neither vibriones nor the sporules of fungi rise into the atmosphere through the mere evaporation of the fluid containing them. Yet, in a cholera ward, portions of the intestinal discharges would certainly be spilled on the floor or on the bed linen and become dry there. Vibriones contained in them might in this dried state be disseminated through the air of the ward. . . .

In reference to the possibility of infection through the gastro-intestinal membrane, we may here mention an exclusive form in which the doctrine has been urged—. . . that this is the only channel through which infection can occur and that its invariable means consist in the swallowing of matters (chiefly water) specifically contaminated by the feces of previous cholera patients. We cannot doubt that drinking water fouled with excre-

ment, whether diarrheal or healthy, would represent in a high degree those qualities of organic taint against which we have already in general expressed our opinion. But, while quite prepared to admit the danger of that class of ingesta to which such water would belong, we can find nothing in support of the exclusive theory adverted to. . . . As already stated, the geographical distribution of cholera in the metropolis, at each of its three visitation, has in its main features expressed, beyond the possibility of reasonable doubt, that its diffusion chiefly depends on other than dietetic influences. . . .

[58] With reference to the communication of the disease from person to person, no large body of evidence, either of a positive or a negative tendency, has been received. . . .

[59] Professor Liebig had stated as the result of experiments that the rice water discharges acquired at a certain stage of putrefaction the property of inducing a disease similar to cholera in animals to which they were administered. Dr. communicates the particulars of an experiment of this kind, instituted by himself. The result was negative. But Dr. Thomson does not regard this single observation as conclusive. . . . There is no sufficient ground for thinking that the lower animals are susceptible of epidemic cholera. . . .

Some microscopic observations of Dr. Hassall on the clothes of cholera patients have an indirect bearing on the question of the mode of diffusion of cholera. For, even though the cause of cholera be not an emanation from the bodies of the sick, if it be a matter which increases in foul air, it may possibly be conveyed in the clothes of men from one locality to another. Dr. Hassall found . . . no peculiar organic body. . . . Vibriones were abundant only in clothes which were stained with rice water discharges. . . .

[66] We have the honor to be, Sir, your obedient, humble servants,

N. Arnott
William Baly
William Farr
Richard Owen
John Simon

Supplement to the Report of the Committee for Scientific Inquiries[3]

1. Letter by the president of the General Board of Health to medical practitioners (September 1854) [68–69].

List of legally qualified medical practitioners, medical officers of hospitals, etc., in England, Scotland, and Wales who have furnished returns of cases of cholera and diarrhoea to the General Board of Health [69–79].

Instructions and forms for returns of cases: A—Diarrheoa; B—Cholera [80–84}.

Memorandum on the foregoing instructions and forms for returns of cases of diarrhoea and cholera [85–86].

2. Statistical tables and other documents illustrating the report of the medical council's committee for scientific purposes [87–118].

3. Summary of tables of houses, populations, and mortality in the Golden Square districts (prepared by Mr. H. Edwards, from the Registrar-General's [*Weekly*] *Returns*) [119–26].

[Alphabetically by streets, listing 1851 population, number of houses, and mortality figures during the period 1848–54].

4. Pathological memoranda circulated among medical officers of public institutions and other members of the medical profession[127–29].

[3] GBoH, Medical Council, *Supplement to the Report of the Committee for Scientific Inquiries* (London: HMSO, July 1855) <>.

II. Extracts from *Appendix to Report of the Committee for Scientific Inquiries*[4]

No. 1. James Glaisher, "Report upon the meteorology of London in relation to the cholera epidemic of 1853–54" [1–118].

[116] The three epidemics [1832, 1848–49, and 1853–54] were attended with a particular state of atmosphere, characterized by a prevalent mist, thin in high places, dense in low. During the height of the epidemic in all cases, the reading of the barometer was remarkably high and the atmosphere thick. In 1849 and 1854, the temperature was above its average; a total absence of rain and a stillness of air amounting almost to calm accompanied the progress of the disease on each occasion. In places near the river, the night temperatures were high with small diurnal range, a dense torpid mist, and air charged with the many impurities arising from the exhalation of the river and adjoining marshes, and a deficiency of electricity. [In addition, there was,] as shown in 1854, a total absence of [116/117] ozone, most probably destroyed by the decomposition of the organic matter with which the air in these situations is strongly charged.

In 1849 and 1854, the first decline of the disease was marked by a decrease in the readings of the barometer and in the temperature of air and water. The air, which previously for a long time had continued calm, was succeeded by a strong SW wind, which soon dissipated the former stagnant and poisonous atmosphere. In both periods at the end of September, the temperature of the Thames fell below 60". But in 1854, the barometer again increased, the air became again stagnant, and the decline of the disease was considerably checked. It continued, however, gradually to subside, although the months of November and December were nearly as misty s that of September. By the close of the year, diarrhoea and cholera had subsided, but a high rate of mortality still continued.

The coexistence of cholera with coincident meteorological phenomena is, to say the least of it, remarkable. So is the stagnant atmosphere prevalent during the time of cholera in each of the three periods, which would seem to be a necessary condition to the activity of the disease.

The inimical nature of the influence it exercises upon the public health I regard as intimately connected with the state of the water and the marshes, which in the preceding pages are shown to be large, evaporating surfaces with every description of poisonous exhalations. Impure water and impure air are inseparable. The impurities of the former will be concentrated into the surrounding atmosphere and there remain, unless rapidly dispersed under favourable atmospheric conditions.

[4] GBoH, Medical Council, *Appendix to Report of the Committee for Scientific Inquiries* (London: HMSO, July 1855), in http://johnsnow.matrix.msu.edu/work.php?id=15-78-C0 and References (Online Companion).

The agency of the river in fostering diseases is confirmed by the history of cholera just traced. . . . We find [it] to have been most fatal in low situations, in London in those places on the south side of the Thames which afford an undisturbed lodgment for the reception of the air charged with the poisonous elements from evaporation and exhalation. The effect of a gentle wind is to float this atmosphere to enclosed spots were its malignity becomes concentrated. . . .

I cannot consider the birth of cholera attributable solely to atmospheric influences. At the same time, the preceding pages have shown, beyond doubt, the activity of London climate in accelerating the disease, thereby showing its progress to be intimately connected with meteorological influences. What other causes are combined with those of meteorology to aid the progress of this formidable epidemic have yet to be ascertained.

No. 2. Robert Dundas **Thomson**, MD, "Report on the examination of certain atmospheres during the epidemic of cholera" [119–33].

Thomson: MD, Glasgow (1834).

[131] Summary.

From the results which have been obtained in the course of the present researches, the following deductions may be drawn:

1. That in the atmosphere of a cholera ward, mechanical matters were diffused throughout the air derived from the inmates, that sporules of fungi and germs of vibriones, or vibriones themselves, were obtained by filtration from the atmosphere—all of these bodies being adulterations, so to speak, of the pure oxygen and hydrogen which alone constitute the wholesome, predominating constituents of the elastic fluids destined for respiration.

2. That from a ward only partially filled with patients affected with cholera, substances were separated which were mechanically [131/132] dispersed to the very summit of the apartment, mixed with fungi or their sporules. No vibriones, unless in the form of faint traces, could be detected.

3. That in the atmosphere of an empty ward, communicating, however, with a ward containing cholera patients, mechanical matters were obtained and traces of fungi and, perhaps, of vibriones.

4. That in the external air adjacent to an hospital, substances mechanically distributed were likewise found. Sporules with fungi were also detected to a considerable extent, but no vibriones.

5. That in the atmosphere of a sewer, bodies were also found in mechanical diffusion associated with sporules, fungi, and vibriones.

6. That in air contained under the three first conditions from wards possessed an acid reaction, that the external atmosphere likewise indicated a

similar chemical condition, and that the sewer atmosphere was alone alkaline.

7. That although animal and vegetable life seem unequivocally to be diffused through cholera atmospheres, it would be premature to infer a connexion between the disease and these organisms until comparative trials have been extensively made on other conditions of air. The present researches must be only considered as a single stone places as a contribution towards the foundation of a larger structure.

St. Thomas's Hospital
18 February 1855

Rainey: MRCS; Lecturer on Practical Anatomy and Demonstrator of Microscopical Analysis, St. Thomas's Hospital Medical School.

No. 3. George **Rainey**, "Report on the microscopical examination of certain atmospheres during the epidemic of cholera" [134–37].

[134] Some of the distilled water through which the air of the cholera ward had been transmitted when the disease was at its height . . . contained a great variety of substances, some of which were alive and evidently in an active state of growth. These were so apparent as to be visible to the naked eye. . . . [135] Such impurities are not confined to the atmosphere of the wards of hospitals. They exist, of course, in the air of all apartments where persons sleep . . . . These impurities are also present in the open air, especially in densely populated districts . . . . The living organic bodies . . . had the appearance of small flocculent masses in the fluid at the bottom of the vessel, visible to the naked eye. [They] . . . were found to consist of the mycelia of fungi . . . [and] extremely minute, colourless, indistinctly beaded fibres, resembling in their general characters that form of vibrionia called "bacterium." . . . These bodies are so extremely minute that, under a magnifying power of 900 diameters and good illumination, they do not present very definite structural characters. . . . When the disease was very much on the decline, . . . the vibrio-like fibres [drawn from atmospheric air] were much less numerous . . . .

[137] I have made also some examinations of the rice water motions [of cholera victims], but without being able to detect in anything which had not been before noticed. The very early appearance of vibriones in these motions, even directly after they had been voided, seemed at first to be a remarkable circumstance. On examining the contents of the different divisions of the intestinal canal, . . . I also found them in the contents of all these parts in considerable abundance . . . . [However,] I examined the contents of the intestinal canal of individuals . . . who had died of other complaints and I still found the vibriones. So it appears these bodies [exist] in the secretions of the intestinal canal [and] do not form one of the peculiarities of cholera.

No. 4. Dr. Donald Fraser, Mr. Thomas Hughes, and Mr. J. M. Ludlow, "Report on a sanitary inspection of the Golden Square District" [138–65].

See Document 28 in the book, and Document 28 (Online Companion) for extracts.

No. 5. William **Lawrence**, "Memorandum on the sanitary condition of Bethlem Hospital and of the City House of Occupations" [166–67].

Lawrence: FRCS (1844). Surgeon and Lecturer on Surgery, Barts Hospital and Medical School; surgeon to Bridewell and Bethlem Hospitals.

[These two institutions in the parish of St. George Southwark] have the advantage of being surrounded on all sides by a clear space . . . . Their ventilation and drainage have been most carefully attended to . . . [and] is perfectly satisfactory. . . . The house of occupations is an asylum and training institution for neglected, destitute, and, in many instances, criminal children of both sexes who are instructed in various useful employments and in reading, writing, and arithmetic if they should not have already made those acquirements. . . .

All water used in both establishments for every purpose is now derived from [an artesian well] . . . 220 feet [deep]. Nothing but this pure kind of water has been used for nearly thirty years. There has not been a single case of cholera in the hospital or the house of occupations, either in the two former epidemics of 1832 and 1849 or in the present, although the disease has prevailed extensively in the parish of St. George . . . .

27 September 1854

No. 6. N. **Arnott**, "Memorandum on Asiatic cholera and other epidemics as influenced by atmospheric impurity" [168–75].

Neil Arnott: MD, London.

[168] Observation has now clearly ascertained that the travelling morbific cause [of cholera], whatever it be, can . . . [not] produce a true pestilence unless it meet with much filth of decomposing animal and vegetable matters . . . . It thus appears that the ravages of cholera may be prevented by preventing local accumulations of organic impurities. . . . The laborious researches of medical men and others in regard to cholera have detected many other things or conditions besides filth which exert powerful influence on the spreading and destructiveness of the disease. . . . All belong to two classes. The one is of things which favour the accumulation of filth and its rotting or decomposition into foul effluvia. The other is of agents which weaken the living system and render it susceptible of harm from filth or other cause. . . .

[170] Modern houses, since the introduction of close-fitting glass windows and chimney flues with low openings for fire places have rendered [them] . . . singularly efficacious traps for catching and long retaining all impure air or effluvium which may enter into them from without or be produced within them. . . .

[171] There are many facts to show that the impurity of retained and corrupted breath . . . has been the chief element of the foul atmosphere which has led to numerous cholera outbreaks.

No. 7. R. D. Thomson, "Report on the chemical composition of metropolitan waters during the year 1854" [176–214].

[180–81] [Table showing number of gallons pumped daily and number of houses supplied in 1853 by nine private water companies, as well as the current sources of supply for each.]

[183] A peculiarity which pertains to Thames water as high at least as Chelsea during the tidal flow, in common with sea water and some wells, is the property which the saline residue obtained by boiling away the water possesses of fusing in the flame of a lamp or candle. . . . By this test it was easy to distinguish Lambeth and Southwark [183/184] waters. . . . But at certain periods of low water, the characteristics of river water recovered. . . .

[185] The Lambeth and Southwark companies supply contiguous houses throughout the same district. The elevation of their sites in relation to the river is identical. [And] the inhabitants supplied by both companies are exactly similar with regard to means. Yet, the mortality in the houses supplied by the Southwark Company exceeded by nearly 2000 the deaths that would have occurred if cholera had only been as fatal as it was in the houses that derived their water supply form the Lambeth Company (GRO, *Weekly Return*, 6 December 1854). Without viewing the subject in an extreme aspect, it is impossible to avoid drawing the conclusion that the Southwark water must at least have had a more predisposing influence in the production of the disease than that of the Lambeth Company. It does not appear that sufficient data exists to enable us to decide as to the peculiar nature of the influence in the production of the disease communicated by impure water to the human system. Whether it be the seeds of the disease existing in the water, according to an old and very prevalent oriental theory; or whether, by the access of other local and general influences, a predisposition to the lodgment of the epidemic is engendered in the animal frame by the use of water tainted with organic matter [is] uncertain. It is just possible that the conditions under both hypotheses, when certain circumstances prevail, may influence the production and communication of the epidemic.[5]

The latter view seems most reconcilable with a general survey of the cholera as it occurs in different localities and climates. The facts connected with the occurrence of cholera on river margins have been elaborately urged by Dr. Snow in favour of the Indian theory, while the same circumstances have been most ingeniously applied by another theorist to the use of autumnal stores of unsound flour. The law of elevation, however, established by Dr. Farr takes cognizance of such facts and affords a general view of the subject. Exclusive theories are objectionable on the ground of their overlooking circumstances of moment, not only in regard to theory but even in respect to the practical management of the disease. The oriental and farinaceous theories will receive the acquiescence of all in so far as they condemn impure waters and decomposing flour. There are some instances, however, on which, so far as the evidence before us leads, the disease appears to be propagated entirely by atmospheric media. . . .

[186] On 31 August and 1 September [1854] the epidemic broke out with great virulence in the neighbourhood of Golden Square, Soho [186/187] and spread with a fatality scarcely exceeded by the mortality of the plague as described by the romantic pen of Defoe. The number of deaths from cholera in this limited district in six weeks exceeded 600. The fatal character of the disease on 9 September, when the samples of water were taken, had become extensively known and had produced such alarm among the residents that the greatest gloom pervaded the locality from the suddenness and almost explosive nature of the attacks. Specimens of water were taken from five houses supplied by the Grand Junction Company, in which 15 cases of cholera had occurred, and from seven houses supplied by the New River Company where 40 cases of cholera and diarrhoea prevailed. The pump water in Broad Street was also preserved for examination. On analysis, it was soon evident that the water supplied by the New River Company presented a remarkable anomaly . . . . The water . . . was totally different in its chemical character [greater amounts of both general and organic impurities] from that contained in the company's reservoir at Sadler's Wells. . . .

[188] [The water in the well] in Broad Street, when examined [on 9 September 1854], was found to contain 92.06 degrees of impurity or grains per gallon, of which 7.8 were due to organic matter, nitric acid, and ammonia. The organic matter seemed to have but recently reached its destination since, from the absence of much nitric acid oxidation, [it] had but slightly commenced to change its form. It is scarcely possible to condemn in too strong terms such a source of supply of water as a shallow well in a great city. Chemical and physical examination universally proves [it] to be a pool of water [that] derives its contents from oozings of fluids from cesspools and sewers, mixed with rain water and holding in solution more or less all noxious soluble filth contained in the soil. . . .

St. Thomas's Hospital
15 June 1855

[191] "Report on the chemical composition of some London and provincial

[5] Analogy leads to the inference that a morbid, organized poison cannot both act by intestinal and by pulmonary absorption.

wells."

[201] The shallow wells of London and other localities in the immediate neighbourhood of human habitations, being surrounded by matter soaking in from cesspools and surface filth, are liable to be impregnated with surface impurities. Their closure would be a benefit to the health of the community.

St. Thomas's Hospital
January 1855

Arthur Hill Hassall: MRCS (1839); LSA (1841); MD, London (1851). General practitioner and specialist in microscopy who had conducted a recent analysis of London water supply.

No. 8. Arthur Hill **Hassall**, "Report on the microscopical examination of different waters (principally those used in the metropolis) during the cholera epidemic of 1854" [216–83].

[217] Organic matter has a chemical constitution wholly distinct from that of water. Its great distinguishing characteristic [is] that it contains nitrogen, which is greater in animal than in vegetable productions. . . . The presence of organic matter in water, whether in the fluid [217/218] state or solid, dead or living, animal or vegetable—especially living animalcules in water—are to be regarded as undoubted proofs of contamination or impurity. . . .

[237] Results of the microscopical examination of different specimens of well and pump water, procured in neighbourhoods in which cholera was prevalent

A very large proportion of our secondary towns and all the villages and single houses scattered throughout the country derive their supply of water from wells. In such localities, there is usually no regular system of sewerage. The refuse matters of the houses pass into privies and cesspools, which are often contiguous to the well. It is, therefore, not surprising, especially when the absorbent character of most soils is taken into consideration, that the water of many of these wells should become contaminated. . . .

The evidence of this contamination is twofold. One evidence consists in the presence of animalculae and other organic productions. The other [is] the existence of nitrates in these waters. Both may be present in the same water, but usually this is not the case. Where animalculae abound, the nitrates are not often present in large amount. Where [nitrates] are abundant, animalculae, etc. are, for the most part, absent. (The presence of nitrates in well water may be suspected wen it presents a greenish tinge or color.) . . . When fluid or dead organic matter of any kind makes its way into the water of a well which is shallow, uncovered, and therefore exposed to air and light, the circumstances exist favourable to the development of infusorial life. When the well is deep and there is but little access [for] light and air, particularly the former, the conditions are then unfavourable to the formation of animalculae and the nitrogenized matter present becomes converted into nitrates. . . .

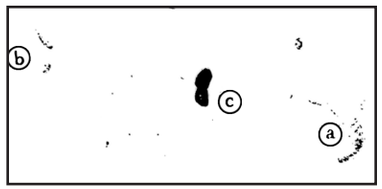
3. From pump in Broad Street, Golden Square—collected 17 September 1854 by Dr. Hassall and Mr. **Patterson**

John D. Patterson: MRCS and LSA (1825); special GBoH medical inspector for three North London districts, including St. James, Westminster.

This water was clear and bright. The only living organic productions contained in it were rather many animalculae of the genus monas, three or four small animalculae like a species of amphileptus, and a few ova cases. The animalcules were, however, present in sufficient quantity to show that this water could not be considered to be pure. This is the water to which Dr. Snow, during the recent outbreak of cholera, so strongly drew attention. Fig. 9. See analysis of Dr. Thomson. . . .

[241] Two samples [were taken] . . . and in neither of these was any peculiar body or production met with calculated to excite suspicion. . . .

21 December 1854



Broad Street Pump
a Amphileptus
b Monads and other infusoria
c Ova cases
(Detail, pl. 9, after 238.)

[278] Table II. . . . The microscopical examination of the water from the Broad Street pump furnished no very striking or important result. But the chemical analysis of Dr. Thomson shows that the impurity of this water was very much greater than from its bright and colourless appearance would have been supposed. . . .

Faraday: The English chemist and physicist.

No. 9. Michael Faraday, "Observations on the filth of the Thames, contained in a letter addressed to the editor of the *Times* newspaper" [284].

The river which flows for so many miles through London ought not to be allowed to become a fermenting sewer. . . .

No. 10. R. D. Thomson, "Report on the chemical examinations of rice water discharges" [285–88].

[Samples taken] from four cases in St. Thomas's hospital on 16 October 1854. The specimens were examined as soon after expulsion as possible. . . .

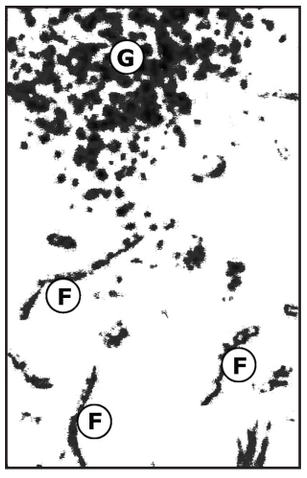
[287] There seems no reason to suppose that any substance or organized matter exists in the rice water [that is] capable of communicating the disease from one individual to another or from one animal to another. But as experiments are said to have been instituted on the continent which supports the view that a similar disease can be produced by the administration of human rice water fluids to small animals, some experiments were instituted for the purpose of elucidating this point. . . . [Since cholera was then

absent from London, we obtained vomit] from another locality affected with the disease. . . . It was allowed to evaporate slowly and spontaneously without the application of heat. . . . The whole of the putrefying residue . . . was administered to a healthy mouse, . . . [287/288] without [it] apparently being in the slightest degree influenced by the putrid diet. . . . The result of these experiments I do not consider sufficient to refute the statements of the German physiological chemists. Perhaps it may be admitted that they tend to show that experiments bearing in such a striking manner on the essential character of the disease require repetition before we can with certainty conclude that the intestinal fluids in cholera are possessed of contagious powers.

St. Thomas's Hospital
March 1855

No. 11. Arthur Hill Hassall, "Report on the microscopical examination of the blood and excretions of cholera patients" [289–307].

[289] Myriads of vibriones were detected in every drop of every sample of rice water discharge hitherto subjected to examination. Of these vibriones, many formed threads more or less twisted, while others were aggregated into masses which under the microscope presented a dotted appearance. . . . [290] In none of the samples were sporules or threads of any species of fungus present, or a peculiar body of any kind noticed other than the vibriones . . . . In order to determine [when they make their appearance], . . . I succeeded in examining several samples within two hours of their being voided and two others from separate cases immediately they were evacuated. In all of these the vibriones were present in large numbers. In one case I examined, in conjunction with Mr. Rainey, some of the rice water discharge taken direct from the small intestines about twelve hours after death. In this case, also, the vibriones equally abounded. In all cases, the species was the same. It thus appears that vibriones are constantly present in the rice water discharge of cholera and that they are developed in [the body] during life . . . .



Rice-water Discharge
F Vibrione
G Vibrione mass

(Modified detail, pl. 26, after 290)

We have next to inquire what is the origin or source of these vibriones and what [is] their relation to cholera. With respect to the first point, there is no doubt that there is more than one source of them. . . . It is possible that they may obtain entrance into the stomach and bowels by means of the atmosphere. It is perfectly certain that they do frequently gain admission through some of the impure waters consumed, in which I have not infrequently detected the presence of vibriones, sometimes in considerable numbers. Once introduced into the alimentary canal, they are brought into relation with conditions highly favourable to their development and [290/291] propagation, both of which take place with almost inconceivable rapidity. . . . I have made two or three examinations of healthy and natural fecal evacuations at the time of their being passed. In these I have detected the presence of comparatively a very small number of vibriones. . . . The circumstances favourable to their development do not exist in the same degree as in cholera. The disposition to decomposition does not exist to the same extent. Neither are the matters discharged equally alkaline.

Without at all supposing that there is any essential or primary connexion between these vibriones and cholera, their occurrence in such vast numbers in the rice water discharges of that disease is not without interest, and possibly is of importance.

[301] Microscopical examination of numerous specimens of blood obtained from the bodies of persons who had died of cholera. In all, eighteen specimens of blood were subjected to microscopical observation. These specimens were in all cases examined a few hours after death, and in some instances almost immediately after dissolution. . . . In none of the specimens were any organic productions present, animalculae or fungi, either living or dead. . . .

[302] So many cases having been reported from time to time of nurses who had been engaged in washing the clothes of cholera patients becoming themselves the subject of cholera, it was of importance to determine whether the presence of any body or substance could be discovered in the clothes worn during cholera which could explain the communication of the disease. With this view, the following examinations were made: . . . [303] Pieces of clothes were carefully washed in a little distilled water and the water itself, as well as any sediment which subsided from it after it had stood for some time, were examined microscopically. In some cases, no solid matter of any kind was to be detected. In other instances, vibriones abounded and were alive and in active motion. The presence of vibriones was sufficiently explained by the fact that the portions of clothes in these cases were stained with the rice water discharges . . . . If these vibriones possess any influence in the production of cholera, or if the rice water discharges contain any substance or principle capable of producing that disease, we can readily understand how the washing of clothes might, in some cases, give rise to cholera in those engaged in washing them. . . .

[304] The direct results of all the observations which have been made by means of the microscope into the condition of solids and fluids of the body in cholera is wholly opposed to the notion that the development of fungi has anything to do with the disease. . . .

[306] Concluding observations. . . . The one great result of these investigations is to show that neither the blood or urine, or on the skin or clothes, or in the water drank or in the air respired are any organic produc-

tions, either animalculae or fungi, to which the origin or propagation of cholera could be attributed. The only fluid examined which was found uniformly to contain living organic productions was the rice water discharge, which even while enclosed in the small intestines swarmed with vibriones. The presence of these vibriones exhibits at least a remarkable proneness of the contents of the small intestines to undergo rapid decomposition.

22 January 1855

No. 12. "Tables from a report of the Middlesex Hospital, illustrating the relation of consecutive fever to the collapse and discharges of cholera" [308–10].

Callender: Registrar and demonstrator of morbid anatomy.

No. 13. G. W. **Callender**, "Account of twelve post-mortem examinations made at St. Bartholomew's Hospital" {311–21].

No. 14. Donald Fraser, Thomas Hughes, and J. M. Ludlow, "Tables of house-to-house visitation in the Golden Square districts," [322–].

[322] [See Documents 23 and 28].

[323–] Tables [see http://johnsnow.matrix.msu.edu/broadstpump/documents/775-2/].

III. Extracts from John Sutherland's Report[6]

[5-18] Hall's letter sets forth the time line for actions he took after becoming president of GBoH, including appointing two superintending medical inspectors to liase with local authorities: Sutherland for London, Milroy for rest of country.

[before 19 -- On 30 December 1854, Sutherland submits his report, an abstract of reports submitted by medical inspectors from metropolitan parishes and unions.]

[25] Mr. Patterson is listed as the medical inspector for St. James, Westminster and the Strand Union. [there were nine in all, appointed in Sept by Hall, I believe.] Fraser was inspector for Chelsea and Paddington, but area reduced when he was appointed to undertake the special investigation.

[38] Mr. Patterson, who inspected those parts of the parishes of St. James, Westminster and St. Anne, Soho which were so severely affected by the epidemic, describes the dwellings as overcrowded, unventilated, without any efficient house drainage; the cesspools and privies overflowing; the supply of water scanty; some of the houses so filthy and unhealthy s to be unfit for human habitation; some of the sewers of the district in a foul condition pouring sewer air through the gulley grates into the streets and houses. He says there are in the district "almost every nuisance and abomination," slaughter houses, cow houses, boiling houses, and other noxious and deleterious trades.

[47] In proof that impure water, though a predisposing cause of cholera, does not act as a specific poison in producing cholera, Dr. Greenhow adduces several instances in which houses supplied by the Lambeth water suffered from cholera, while those supplied by the Southwark and Vauxhall water escaped. . . .

[71] The facts in the preceding report appear to me to warrant the following conclusions.

1. The chief causes which have localized epidemic cholera during the late and previous epidemics are known and removable.

2. However beneficial any temporary sanitary measures may be, such temporary measures are not enough to ward off attacks of pestilence. Permanent sanitary works and arrangements are necessary.

3. There is no local authority except in the City of London [that has] the necessary powers for executing permanent works. New local au-

[6] GBoH, Letter of the President of the General Board of Health . . . accompanying a report from Dr. Sutherland on *Epidemic Cholera in the Metropolis in 1854* (London: HMSO, 1855).

thorities, with adequate powers, are requisite for the public safety.

4. Such new local authorities, besides carrying forwards the permanent sanitary improvements of the metropolis, should be intrusted with powers, under supervision of the General Board of Health, for providing houses of refuge, house-to-house visitation, and other similar measures required for the protection of the working classes during extraordinary seasons of pestilence.

IV. Extracts from the "General Report"[1]

In presenting our report of inquiries conducted under your sanction into the course and phenomena of the late epidemic of cholera, the medical council may be allowed to express their satisfaction at science having at length been recognised by the state as the ally of civil jurisprudence and as the guide to a more enlightened code of medical police. They trust that this propitious movement may be regarded as the inauguration of a system ultimately destined to carry its ameliorating influence through all the ramifications of our sanitary institutions. [They hope] that the present fragmentary and imperfect application of medical knowledge in several departments of the State may give place to a complete and comprehensive system, under the sole direction and control of one central department.

From the multifarious character of the objects embraced by this wide inquiry, it was found expedient to distribute them into several classes and to entrust the examination of each class to a special section of the council. Of such special sections of the medical council, there were three: one, constituted to report on such *scientific inquiries* as it had seemed expedient to institute; a second, to digest from the general mass of contributed material whatever facts could illustrate the relative advantages of rival *methods of treatment*; a third, to invite from the cultivators of science in *foreign countries* any information which could be given as to the results of their kindred investigations.[2] [3/4] . . .

It was the paramount object of the council to collect from the members of their profession all the facts which medical observation and experience could afford. And it was their first duty to frame such a formula of instructions as might secure amplitude, accuracy, and technical uniformity in the returns they were desirous to obtain. When we consider the crushing pressure under which our medical brethren laboured during the ravages of this fearful epidemic, too much praise cannot be accorded to them for the alacrity and goodwill with which they responded to the call.

In adverting to the results respectively obtained by the three committees of their body, the council must first express regret that their *Committee for Foreign Correspondence* have not bee successful in their endeavours to elicit satisfactory information. . . . Difficulties of no ordinary kind

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[1] GBoH, Medical Council, *Report in relation to the cholera epidemic of 1854* (London: HMSO, 26 July 1855) .

[2] The members of the three committees were respectively as follows:
Committee for Scientific Inquiries: Dr. Arnott, Dr. Baly, Dr. Farr, Mr. Owen, Mr. Simon.
Treatment Committee: Dr. Alderson, Dr. Babington, Dr. Paris, Dr. Tweedie, Mr. Ward.
Committee for Foreign Correspondence: Dr. Babingrton, Mr. Bacot, Sir James Clark, Mr. Lawrence.

embarrassed all our inquiries, which no amount of zeal or diligence could overcome. It will be remembered that the medical council was not called into existence until the epidemic had already passed its culminating point. The way had not been sufficiently cleared by preliminary inquiries and the prospective path of investigation had not been traced or enlightened by any scientific pioneers.

The *Scientific Committee* have collected some valuable information with regard to the past epidemics, and much more as a guide to future inquiry. This is more especially the case with respect to the impure condition of the London atmosphere, and its capability of influencing the intensity of an epidemic; to the foul state of the Thames and its share in rendering the atmosphere impure; and to the farther intimate connexion between cholera and local sanitary defects. An **inquiry still pending** but nearly completed, will, it is believed, show an equally close relation of the water used as a beverage.

inquiry still pending: Perhaps John Simon's knockoff SoLo study?.

The various sources of atmospheric impurity are too well known to require enumeration, but there is one which, on account of its paramount importance, cannot be passed over without comment—the present system of sewers. The medical council do not presume to judge of the merits of conflicting systems or to decide which best fulfils certain theoretical conditions for the conveyance of a given volume of fluid. But they confidently assert that the existing sewers often fail in accomplishing their main object. Instead of carrying off almost inodorously the excrementitious and refuse matters [4/5] of the population, they evolve offensive effluvia, provoking general and grave complaint. And it is a fact worthy of remark, that the intensity of this nuisance is greatly aggravated in certain parts of the metropolis by obstructions to which their drainage is subject by reason of its outfall into a tidal river. The reckless disturbance of the contents of sewers, and their exposure on an extended surface, more especially pending an epidemic, is a practice which the medical council feel it necessary to reprobate.

The Scientific Committee lay great stress upon that source of impurity which results within dwellings from overcrowding the inhabitants, from defects of drainage, and from want of cleanliness and ventilation. And they deem it indispensable for the protection of the poor that the local authorities should vigilantly exercise the powers committed to them for preventing such evils. The good effects of sanitary improvements have been strikingly exemplified in the model lodging houses and in public baths and wash houses. The establishment of burial places beyond the boundaries of the metropolis is another circumstance of prime importance. The relief thus afforded to overcrowded churchyards will, no doubt, be regarded by future historians as one of the greatest improvements in the nineteenth century. . . .

These considerations are forcibly pressed upon us by the probability that epidemics of cholera may be frequent, if they do not actually become persistent. We are fearfully reminded that the interval between the epidemics of 1831–32 and that of 1848–49 was 17 years, whereas the late epidemic followed the second after an interval only of five years. Nor are such measures to be regarded merely as safeguards against the invasion of cholera. They are equally applicable, and not less effective, against the spread of other epidemics such as the varieties of continued fever and scarlatina, which have been lately stated by the College of Physicians to be far more destructive to human life than even the periodical scourge of cholera.

The Scientific Committee have taken pains to investigate the possible relations subsisting between the outbreaks of cholera and certain meteorological conditions. Mr. Glaisher [5/6] . . . has gone very far to establish high probabilities, which future observations may raise into certainties. . . . His admirable system of observations could not be fully organized until the epidemic had already attained its climax. He has, however, shown that during the three epidemics, there has existed a great predominance of calm, rendering the season defective in those atmospheric changes which renew the purity of the air and, at the same time, an undue height of the barometer, operating against vaporous diffusion. Further, [there was] a great excess in the temperature of the Thames at night, as compared with that of the superincumbent atmosphere, giving rise to nocturnal clouds of vapour, which are necessarily charged with impurities derived from the foul content of the river. The great principle which was first laid down in Dr. Farr's report to the Registrar-General respecting the relative immunity enjoyed at particular altitudes may be connected with this new link of evidence. Mr. Glaisher has clearly shown that in the low-lying districts, wherein the epidemic assumed its highest malignity, the air was stagnant and moisture, impregnated with impurities, was especially induced to hover.

Special examinations of the atmosphere were conducted by Dr. Thomson and Mr. Rainey. . . . They failed to discover any new or significant element of an organic or inorganic nature, as a possible agent in the causation of cholera.

The chemical and microscopical inquiries into the water supply of houses and districts suffering from cholera have been investigated by Dr. Thomson and Dr. Hassall, and the results are embodied in the report of the scientific committee. As the period is now at hand when the water companies will be required to have their sources of supply amended, the medical council state that the facts before them show the necessity of a stringent enforcement of the provisions of the Metropolis Water Act. An inquiry [is necessary to determine] how far these provisions are adequate to insure the purity and wholesomeness of the water supplied to the public. For the abolition of cesspools—in itself a sanitary advantage—has indirectly led

to another evil. The excrements of the population are now to a great extent poured into the Thames. And as might have been expected, our chemical and microscopical inquirers concur in stating that traces of this abominable [6/7] filth are found by them in the drinking water supplied to a large part of the population.

The extraordinary irruption of cholera in the Soho district which was carefully examined by [Dr.] Fraser, Mr. Hughes, and Mr. Ludlow does not appear to afford any exception to generalizations respecting local states of uncleanliness, overcrowding, and imperfect ventilation. The suddenness of the outbreak, its immediate climax and short duration, all point to some atmospheric or other widely diffused agent still to be discovered and forbid the assumption, in this instance, of any communication of the disease from person to person, either by infection or by contamination of water with the excretions of the sick.

In undertaking the pathology of the disease, the Committee for Scientific Inquiries laboured under the disadvantage to which we have frequently adverted—the delay of all inquiry until the epidemic had already passed a climax. As they justly remark, "in order to obtain large results, it is most desirable that such inquiry should be commenced at an early period of the epidemic. . . . Moreover, it should to some extent be continued in the absence of the disease which they aim at elucidating." Forms of instruction were, however, as speedily as possible prepared for circulation in order to obtain returns as to the stages of the disease, its duration, fatality, and relative frequency. A considerable amount of information was thus collected, and will be found embodied in a tabular form.

The duties of the *Treatment Committee* consisted, in the first place, in the invention of a mode by which the individual experience of practitioners might be brought under one comprehensive view. Thus, the science of statistics [has], for the first time, been applied on a large scale to medical treatment. The degree of faith which may be accorded to the inferences deduced by this method has been evidenced by the corroborative results of several separate sets of returns, or various materials separately worked, which have displayed corresponding results. The difficulty of devising a mode of extracting statistical facts from voluminous returns sufficiently shows that the work ought only to be considered as in the progress of development. The same consideration justifies a belief that the farther prosecution of the inquiry, aided by the experience now gained, may carry it forward towards a far greater state of perfection and elucidate truths of still greater value. [7/8]

The facts elicited relate chiefly to the absolute inutility or relative inefficiency of certain classes of medicine and measures. [They clear] away valueless modes of treatment and redeem from idle waste the few short and hurried, but precious, moments during which succour may be available. [In addition, they] secure that brief interval for the use of more promising means, or for others which are yet fairly open for judicious experiment. There is one feature in this inquiry to which the Treatment Committee direct particular attention. It appeared to them that a most interesting line of investigation, promising valuable and instructive practical results, was opened by tracing the success of certain modes of treatment under which, according to their analysis of the evidence, the stage of collapse was avoided and the far less dangerous alternative of consecutive fever was accepted. . . .

Statistical tables are appended to the report of the Scientific Committee, to which the council desire to direct especial attention, as they exhibit a compendious summary of the extent of the epidemic, its duration, its comparative mortality in different districts, and at different ages.

In concluding our report, and thus bringing the duties of the Medical Council to termination, we most earnestly, but respectfully, urge upon the government the paramount importance of pursuing with unabated diligence that path of investigation which science sanctions, and into which the circumstances of the late epidemics had directed and guided us. That which has been so repeatedly and wisely urged regarding the removal of accumulating filth and the correction of nuisances during intervals comparatively free from disease, may be pleaded with equal truth as to the necessity of an uninterrupted continuance of scientific inquiries during the same seasons of immunity, from which alone can we reasonably expect to obtain the requisite data for a true theory of the causes, or a wise plan, for the cure of any future epidemic. . . .

26 July 1855 John Ayrton Paris, Chairman