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*Walter F. Wilson*

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THE  
LONDON WATER SUPPLY

ITS PAST, PRESENT, AND FUTURE

BY

G. PHILLIPS BEVAN, F.S.S.

With a Map showing the Districts of the Water Companies.

ELIZABETH  
DAVID

LONDON

EDWARD STANFORD, 55, CHARING CROSS, S.W.

1884

WARBURG INST



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## PREFACE.

NOTHING is more remarkable than the carelessness and apathy of Londoners concerning all that appertains to the organisation and arrangement of the sanitary machinery of their great city, and this is more especially the case with regard to the Water Supply, upon which the daily health of every family in the Metropolis depends.

I have endeavoured to place before my readers the principal facts of the question, and would fain hope that they may find the subject to be one of undeniable interest.

I have to thank Col. Sir Francis Bolton for the kind and valuable assistance which he has rendered me during the progress of my little work.

G. P. B.

1884.



# CONTENTS.

| CHAPTER  | PAGE |
|--|------|
| I. THE ANCIENT SUPPLY . . . . .                                  | 1    |
| II. THE MODERN SUPPLY . . . . .                                  | 14   |
| III. THE EXISTING WATER COMPANIES . . . . .                      | 42   |
| IV. THE INCREASE OF THE SUPPLY—THAMES BASIN<br>SCHEMES . . . . . | 89   |
| V. THE INCREASE OF THE SUPPLY—NORTH COUNTRY<br>SCHEMES . . . . . | 104  |
| INDEX . . . . .  | 113  |

CONTENTS

|    |  |
|----|--|
| 1  | Introduction                                       |
| 2  | The Author's Preface                               |
| 3  | The Editor's Preface                               |
| 4  | The Author's Acknowledgments                       |
| 5  | The Editor's Acknowledgments                       |
| 6  | The Author's Dedication                            |
| 7  | The Editor's Dedication                            |
| 8  | The Author's Introduction                          |
| 9  | The Editor's Introduction                          |
| 10 | The Author's Preface to the Second Edition         |
| 11 | The Editor's Preface to the Second Edition         |
| 12 | The Author's Acknowledgments to the Second Edition |
| 13 | The Editor's Acknowledgments to the Second Edition |
| 14 | The Author's Dedication to the Second Edition      |
| 15 | The Editor's Dedication to the Second Edition      |
| 16 | The Author's Introduction to the Second Edition    |
| 17 | The Editor's Introduction to the Second Edition    |
| 18 | The Author's Preface to the Third Edition          |
| 19 | The Editor's Preface to the Third Edition          |
| 20 | The Author's Acknowledgments to the Third Edition  |
| 21 | The Editor's Acknowledgments to the Third Edition  |
| 22 | The Author's Dedication to the Third Edition       |
| 23 | The Editor's Dedication to the Third Edition       |
| 24 | The Author's Introduction to the Third Edition     |
| 25 | The Editor's Introduction to the Third Edition     |



# THE LONDON WATER SUPPLY.

## CHAPTER I.

### THE ANCIENT SUPPLY.

IN no time in the history of the English nation has the progress of sanitary knowledge been so marked as at present, or the study of social hygiene assumed a position of so much importance. Our ancestors, of course, took no cognisance of these matters, though, if they had no scientific education, they had their full share of common sense; and they provided for their individual and collective requirements very satisfactorily to themselves, even if the means for doing so were primitive. The water supply of our cities and towns, now that our population is so rapidly increasing and has such a tendency to migrate to urban centres, has become a very anxious question, which is often more easily asked than answered; and in London especially, the giant arms of which are flung out far and wide, like the octopus, absorbing everything within their reach, it has become an exceedingly difficult problem how to provide for the daily wants of so many millions. With us legislation

on these points and on the requisite scale is terribly slow, and there are so many obstacles and vested interests to be grappled with, that by the time any great permanent improvement is effected a fresh call for it begins to loom in the distance. Before we enter into the discussion of the present water supply of London, its requirements and deficiencies, it will be interesting to take a brief retrospective survey of the means adopted by the earlier inhabitants to obtain the necessary supply of water, which, as a rule, was good and plentiful; the Thames, the principal source for a long time after the Norman conquest, being then pure river-water, innocent of sewage and other wicked pollutions. The Thames, however, was by no means the only available supply, for several wells and streams existed, of which, to Londoners of the present day, only the tradition or the name survives. The principal of these streams were the River of the Wells, the Wall Brook, and the Long Bourne, together with three chief wells or fountains, viz., Holy Well, Clement's Well, and Clerks' Well. There were also a few others of less note, such as Skinners', Fag's, Tode, Loder, and Lad Wells. The River of the Wells, which was apparently so called from receiving the overflow drainage of all these fountains, was better known by the name of the Fleet River, which rose amongst the Hampstead hills near the source of the Ty Bourne, and flowed south by Gospel Oak, Battle Bridge, Coldbath, and Clerkenwell, to empty itself into the Thames at Dowgate. Its course

was through a deep-cut bed in the London clay, which, according to some, obtained for it the name of Hole-Bourne, while, according to others, this latter was only one of its tributary brooklets, rising near Holborn Bars. The River of the Wells must have been a stream of considerable importance, from the fact that it was granted by William the Conqueror to the College of St. Martin-le-Grand, preserving its name up to, at all events, the time of Edward I., as we find in 1307 a complaint of Henry Lacy, Earl of Lincoln, respecting its condition. It was worded as follows: that "whereas in time past, the course of water running under Old Bourne Bridge and Fleet Bridge into the Thames, had been of such breadth and depth, that ten or twelve ships, navies at once with merchandise, were wont to come to the aforesaid Bridge of Fleet, and some of them under Old Bourne Bridge: now, the same course, by filth of Tanners and such others, was sore decayed; also by raising of wharfs, but especially by a division of the water made by them of the New Temple, for their mills standing without Baynard's Castle in the first year of King John, and by divers other impediments, so that the ships could not enter as they were wont and as they ought. Wherefore he desired that the Mayor of London with the sheriffs and other discreet aldermen, might be appointed to view the said course of the said water, and that, by the oaths of good men, all the aforesaid hindrances might be removed, and it be made as it was wont of old." It is clear, therefore, from this,

that the appointment of river-bailiffs and inspectors of nuisances is not a modern institution. The commission performed its work well, the river was cleaned, the mills removed, and everything done that could be done to bring the stream back into its old form ; but somehow or other, the flow of water had become permanently lessened, so that people gradually left off calling it a river, and it then became known as the Turnmill Brook, the name of which still exists in Turnmill Street, close to the Farringdon Street Station of the Metropolitan Railway. Things must have got worse rather rapidly, for, a little later on, the name had degenerated into the Fleet Dyke or Ditch. In Henry VII.'s time another attempt was made to utilise the brook by scouring it out, and it was so far successful that boats with fish and firewood again came up as far as Old Bourne and Fleet Bridges, very much to the convenience of the inhabitants. In 1589 a final effort took place to make the Fleet again navigable for large craft, and a grant of 1000 marks of silver was made by the common council for cleansing it, and improving the flow by concentrating the springs on Hampstead and directing them into the course of the Fleet. This, it was fondly hoped, would bring an additional supply of fresh drinking water to the city and suburbs, which had increased so rapidly that complaints of deficiency began to be heard. But it was all to no purpose. The stream was evidently doomed to extinction, for what with the extension of building, the encroachments on the banks, and

the now perpetual pollution by sewage, the once pleasant River of Wells became completely demoralised, and ended its days as a filthy sewer, only fit to be bricked over, and hid for ever from human ken.

Wall Brook was just such another stream, called the Running Water at the time of the Conquest. It rose in the fens beyond Moorgate, and flowed past Lothbury, underneath the Poultry, and to the west of the Mansion House, emptying itself into a creek at Dowgate. For a good many years it maintained its character as a rural, wholesome stream, notwithstanding the comparative density of city buildings, and the fact that it was crossed by so many bridges that it became necessary to appoint two bridge-keepers, whose names in 1300 were, William Jordan and John de Bever. Gradually, however, the bridges increased so, that they were almost continuous, and thus the little brook became at last vaulted over, as one of the subterranean mysteries of London. The Langbourne Water was a stream of some size, which flowed through Lombard Street, and at Sherborne Lane (Share-bourne) divided into several rivulets to join the Thames.

The wells played no inconsiderable part in the supply of London water, besides figuring pretty constantly in its history. Both Holy Well and Clerks' Well, we are told, were much frequented by scholars and youths of the city on summer evenings, when they walked forth to take the air. One can scarcely imagine the existence of a lover's idyll in the neighbourhood of

that, at one time, very unsavoury locality, Holywell Street, although, under its new name of Booksellers' Row, it has certainly regained a more decent reputation. Close to Clement's Inn was a very favourite well, "fair and carved square with hard stone," which always had an unfailing supply. Clerks' Well, of which the name only lives in Clerkenwell, the home of artizan jewellers and watchmakers, was a famous rendezvous for the parish clerks of London, who, in the time of Richard II. were in the habit of assembling here (there could not have been very many) to play interludes and enact a kind of mystery. These gatherings became almost as fashionable as the Ammergau Passion Plays, the performance sometimes lasting three days, and being more than once attended by the king, queen, and the whole court. Subsequently, the actors migrated to the Skinners' Well, when the subject of their drama was the Creation of the World, which took no less than eight days to get through. The Skinners themselves were also in the habit of acting miracle plays at their well, but either from a more demoralised taste, or because the religious element failed to draw, they eventually took to winding up the performance with a wrestling match. These sources of the water supply were still further supplemented by ponds or pools, several of which were scattered about in the suburbs. One of them went by the peculiar name of Dame-Annis-th'-Clear, of which the situation was somewhat vague, except that it lay east of Islington. In this quarter, too, was Perilous

Pool, so called from the number of youths that were annually drowned in it. This piece of water, however, remains where it was, and is utilised as a swimming bath at the present day under the corrupted name of Peerless Pool. Then there was Horse Pool in Smithfield, where the drovers congregated, but which, as may be imagined, was only a nasty, dirty water-hole, which was filled up after the great fire; while another large pond, near St. Giles, Cripplegate, was also filled up in consequence of a misadventure by drowning in 1244, the victim being a citizen's wife, named Ann of Lodbury (Lothbury).

For many years these sources of supply were sufficient; but as time went on, and both buildings and population increased very rapidly, it was found that the water ran short oftener than was pleasant or safe, and what with one well running dry and another showing traces of sewage pollution, a serious outcry arose. A great step was made in Henry III.'s reign, when an energetic speculator, one Gilbert Sandford, obtained a concession to bring water from the Ty Bourne to London in lead pipes. This stream rose in what was known as the Conduit Fields, near the Swiss Cottage, and had a southerly course through what are now Regent's Park, Marylebone Road, Marylebone Lane, Berkeley Square, and the Green Park to Buckingham Palace, where it divided—one branch to the Ornamental Water in St. James' Park, the other to flow into the Thames by Westminster Abbey buildings. As in those

days all the district between Marylebone and Edgeware Road was open country, it marked a new departure in social experiments. A large lead cistern, with a castellated stone front, the first of the kind erected in the city of London, was placed in Westchepe in 1285, and called the Great Conduit; and, within the next two or three hundred years, was followed by other water improvements in the following order:—

- 1405. The Tun in Cornhill was built.
- 1423. Conduits established in Billingsgate, Paul's Wharf, and Cripplegate.
- 1431. Water procured for the Standard in Westchepe.
- 1432. Water taken to the jails of Newgate and Ludgate.
- 1442. Building of the Little Conduit in Westchepe.
- 1471. Conduits made in Aldermanbury and Fleet Street.
- 1498. Conduits made at Holborn Cross.
- 1500. „ „ at Stock's Market.
- 1513. „ „ at Bishopsgate.
- 1535. „ „ at Aldgate.
- 1546. „ „ at Lothbury.
- 1577. Lamb's Conduit erected by the liberality of Mr. William Lamb, just as in modern days, a philanthropist puts up a drinking fountain. Once in the year the Conduit Heads at Tyburn were visited in state by the Lord Mayor and Aldermen, to see into their condition, and this visit was made the occasion of a regular



day's outing, in which the authorities enjoyed themselves in a truly cockneyfied manner. First of all, they hunted a hare, after which the City Chamberlain gave a banquet at the Conduit Head. The post-prandial proceedings consisted of a fox-hunt, the fox being usually headed towards London, so that by the time he was killed, the *Patres Conscripti* had not very far to ride home. This system fulfilled its requirements very well until 1620, when the completion of the New River rendered it unnecessary.

It must not be forgotten, however, that the Thames itself was a great stand-by for the water supply, and the people who used to live in its neighbourhood used to fetch the water from it, giving rise to a regular industry of water-carrying. As time went on, far-seeing citizens, who had acquired property in the lanes on the river side, laid claim to a wayleave, which was such a disagreeable form of water-rate, that a popular commotion took place in the time of Edward III., with the result that the abuse was remedied. This piece of sharp practice was not an unmixed evil, for it set inventors to work as to how to get the Thames water into the houses without its passing through the brigands of the lanes: and at last (in 1582) a Dutchman, named Peter Morrice, started a scheme for forcing the water into the houses by pipes, the "forcier" being placed under London Bridge. Indeed, this was the commencement of a mechanical supply of water to the city, although the experiment only extended as far as Gracechurch Street

or thereabouts. But though the radius of the invention was at first limited, Peter Morrice had no doubt whatever of his being able to do more; for he gave an exhibition before the Lord Mayor of his waterworks, and succeeded in squirting a fine jet of water over St. Magnus' Church steeple. This performance so pleased the City Fathers, that they granted the Dutchman a lease of the Thames water for 500 years, including the ground on which his forcier stood, and one of the arches of the bridge, wherein to erect more works. All this was granted at the very moderate rental of ten shillings a year, and it is quite certain that no inventor ever got such good terms out of the City either before or afterwards. Nor was this all, for, two years later, the knowing Peter obtained another arch also for 500 years, and probably would in time have monopolised the remaining ones, had not a rather pertinent question been put, as to the possibility of the hindrance of traffic before the 500 years had expired, which would have been an awkward contingency for the trade of the port. As it was, Peter Morrice did not do badly, for when the New River Scheme was first proposed in 1601, he, shrewdly suspecting that the time of his golden monopoly was drawing to a close, sold his rights to Richard Soane, citizen and goldsmith, for the modest sum of £38,000. On the strength of having paid so large a price, Soane applied to the City for a lease of one more arch of the bridge, which, after a good deal of demur, was granted at an annual rental of twenty shillings,

and an annual fine of £300 for as many of the 500 years as were unexpired. He then formed a company in 300 shares of £500 each, and, as these were in great request, he cleared out with the handsome profit of £150,000. It is evident, therefore, that waterworks, even in those days, were lucrative affairs, and it is no wonder that there arose a mania for speculating in this class of business. But a great revolution was impending, for Queen Elizabeth granted a liberty to the citizens of London to cut a river from any part of Middlesex or Hertfordshire to the City, limiting the time for its completion to ten years. For a considerable period the magnitude of the proposed operations kept people back, there being as yet no Brindleys or Brasseys, until Mr. (afterwards Sir Hugh) Myddleton grappled with the undertaking, and made the famous New River from Chadwell and Amwell near Ware to the cistern at Islington, a distance, on account of the windings, of sixty miles ; and what is more, he actually did it in five years. The inauguration took place on Michaelmas Day 1613, when, in the midst of a vast concourse of people, the floodgates were opened, and the cistern speedily filled. The cost of this great work was moderate enough at £500,000, but notwithstanding the sums advanced by the City, and the help rendered by King James I., Sir Hugh himself was beggared. The King held an interest in the concern, but voluntarily gave up all participation in the profits, with the exception of a royalty of £500 per annum. For all that, however, the expenses were so

great that, for more than thirty years, five pounds each was all that accrued to the shareholders, who were seventy-two in number ; and it must be confessed that £360 profit in thirty years made the New River anything but a golden river of Pactolus. Time has reversed this, and the shares are now, and have for long been, one of the most valuable properties in the metropolis. At first the pipes were made of wood, and placed so irregularly that they ran above or under each other in the most confusing manner, so that, when repairs were needed, the whole water supply had to be stopped for a time. In 1732 an expenditure of £10,000 was incurred in substituting lead pipes and arranging them in a better fashion. The venture must have been paying pretty well by this time, for another scheme was brought forward to supply London with water from the Coln, near Uxbridge, but it met with no response, and although it was revived in George I.'s reign, it never came to anything.

During the reign of Charles II. Westminster began to agitate for a second supply, and the York Buildings Waterworks were established, and a new machine, which attracted great attention at the time, for raising water by the power of fire, was placed about half-way between the forcing engine at London Bridge and Chelsea. But it was not very successful, and in 1723 the Chelsea Waterworks were set on foot to supply Westminster and "the new buildings by Hanover Square," having the sheet of water in Hyde Park, which was fed by the

West Bourne, and is now known as the Serpentine, as the reservoir. Besides these, there were also the Merchants' Waterworks, for supplying parts of the Strand and Long Acre. By this time the conduits were found to be unnecessary, and were gradually taken down, as interfering with the street traffic. The Tun in Cornhill, the Great Conduit in Gracechurch Street, the Small Conduit in Stock's Market, the one at Dowgate, and all the conduits in Cheapside, which had done good service to the citizens for so many years, fell, like Temple Bar, before the march of improvement, and their place knew them no more.

## CHAPTER II.

### THE MODERN SUPPLY.

Two undertakings form, as it were, the link between the London water supply of the past and that of the present systems, the magnitude of which has been gradually developing from the close of the last and the early part of the present century. These were the Hampstead Water Company, which obtained its first charter as far back as the time of Henry VIII., and the New River Company—although the latter was the only one that entered seriously into the metropolitan question. In 1723 the Chelsea Company commenced a competition with the existing corporations, and was followed after a considerable interval of time by the Lambeth Company, which began operations in 1785. As London and its surroundings increased with amazing rapidity, there was a quicker succession of new water corporations to supply the demand. In 1805 the Vauxhall Company was set on foot, to be followed in the next year by those of West Middlesex and East London, and in 1809 by the Kent Company. Finally, the Grand Junction entered the field in 1810, and the

Southwark Company in 1824, though it had not a very long independent existence before an amalgamation was effected with the older Vauxhall waterworks. Practically London is supplied to this day by the same companies, although the work is carried on under very different conditions.

I propose to trace, as briefly as possible, the history of these undertakings, which, as might be expected, have given rise at different periods to an immense mass of literature, though principally of an official and technical character. The supply of water, both as to quantity and quality, has been a vexed question from very early times, nobody dreaming that London growth would prove such a constantly recurring problem, and one presenting so many difficulties for solution. Though for the last seventy years or more these difficulties have been very sensibly felt, they have come to a head at a rather alarming rate; and the probability seems to point before long in the direction of a new supply independent of the present ones, well ordered and well conceived as are the existing arrangements. Few people, perhaps, are aware of the many schemes that have been proposed at various dates to increase the area of supply, some of them, of course, being brought forward by impracticable enthusiasts, while others failed from unexpected engineering or financial difficulties, accentuated by the natural opposition which the established companies would be sure to offer to rival schemes.

Without going into details of the many blue-books and *brochures* to which the water question has given birth, I will touch upon the leading events of the subject, as being not only interesting in themselves, but marking important eras in the growth and government of London. The antagonism of the public towards the water companies (who appear to be regarded more or less as its natural enemies) dates as far back as 1821, when a Select Committee of the Lords made inquiry into the income and expenditure of the companies, observing with considerable force that "the public is at present without any protection against a further indefinite extension of demand; in cases of dispute that there is no tribunal but the Boards of the Companies themselves to which individuals may appeal, and that, therefore, there are no regulations, but such as the companies may have voluntarily imposed upon themselves, and which may be withdrawn at any moment from the householders." The high-handed and arbitrary character of the rates was even then very strongly objected to, for the Report of 1821 showed that the increase of 25 per cent upon the rental of 1810 (which was considered sufficient to remunerate the companies at that period) was far outstepped, and that, in point of fact, the companies on the north of the Thames had gradually developed their extra charges to the amount of £44,000 per annum. In truth, the whole question was in a state of wild confusion, no two companies agreeing in their rating, but leaving the arrangements



entirely in the hands of their agents, who demanded whatever they thought they could get. In 1826, indeed, the Grand Junction Company obtained a private bill empowering it to levy an addition of from 50 to 300 per cent upon its customers, though when the inhabitants of the district petitioned, the chairman of the Company stated that the obnoxious clause had been introduced contrary to the wishes of the directors, and it was therefore promptly withdrawn. It is of course an open question whether the Company would have discovered the moral badness of the clause had not the public brought the pressure of agitation to bear upon it. In 1828 the discontent assumed a new phase—great complaints being made as to the quality of the water supplied—and this time a Select Committee of the Commons took the question in hand and satisfied itself that “the present state of the supply of water to the metropolis is susceptible of and requires improvement, that many of the complaints respecting the quality of the water are well founded, and that it ought to be supplied from other sources than those now resorted to.” With this conviction a Royal Commission was issued, and Mr. Telford, the eminent engineer, was directed to make surveys of the country round London with the object of substituting some other source instead of that of the Thames. The immediate cause that led to the appointment of this, the first Water Commission, was a pamphlet published by a Mr. Wright, in which he made a fierce onslaught upon the Grand Junction Company, and,

through it upon all the water companies of the metropolis, denouncing them as monopolists, while at the same time supplying a filthy and unwholesome article. There was then, opposite the Grand Junction works, which were situated at the mouth of a main sewer, a small wooden dolphin, placed over the spot from whence the water was obtained, and this became known as a conspicuous land-, or rather river-mark. Mr. Wright christened his pamphlet by the name of "The Dolphin," and it caused so much sensation that public meetings were held to ventilate the whole subject. Ultimately, Lord Wharncliffe in the Upper House, and Sir Francis Burdett in the Lower House, moved that a Royal Commission be appointed, which was agreed to, the members of it being Dr. Roget, Mr. W. T. Brand, and Mr. Telford. The range of the Commission was originally only intended to apply to the north of the Thames, but the Southwark and Lambeth inhabitants, who had suffered equally with the others, protested so strongly against being left out in the cold, that they also were included, as indeed was the whole area of the metropolis. Officially nothing very tangible came of the inquiry, for we find that a Select Committee of the House of Commons was engaged in "considering" the Report just six years afterwards, while the Select Committee of the House of Lords took another six years over the matter, and did not consider it until 1840. In reality, however, a great stimulus was given to improvement, for the nature of the evidence was so damning as to the insuffi-

ciency and the character of the water, that the companies themselves felt it absolutely necessary to commence a reform. Even at that time London was so rapidly increasing that a larger yield was imperatively called for. This is shown by the number of houses supplied in the years 1820 and 1827 by the several corporations:—

| Company.                          | Houses, 1820.  | Houses, 1827.  |
|-----------------------------------|----------------|----------------|
| West Middlesex . . . . .          | 10,350         | 14,500         |
| Grand Junction . . . . .          | 7,180          | 7,809          |
| Chelsea . . . . .                 | 8,631          | 12,409         |
| East London . . . . .             | 32,071         | 42,000         |
| New River . . . . .               | 52,082         | 66,600         |
| South London (Vauxhall) . . . . . | 5,200          | 10,000         |
| Lambeth . . . . .                 | 11,487         | 15,987         |
| Southwark . . . . .               | ...            | 6,900          |
|                                   | <hr/>          | <hr/>          |
| Total . . . . .                   | <u>127,001</u> | <u>174,205</u> |

The population of London in 1821 was estimated at 1,227,590. Considerable changes took place during the years succeeding the Report of the Royal Commission in the Companies' arrangements, in which filtration played a prominent part, though a change of residence was considered by some of them as indispensable to future peace and comfort. The Grand Junction made a clean sweep of the Dolphin and its works at the mouth of the Ranelagh sewer, and migrated to Kew Bridge; the Southwark and Vauxhall made a match of it, and left its old quarters for Battersea, which was then well in the country; while the East London took its water supply from a higher part of the river Lea

than before. The companies which remained where they were made extensive alterations in their plant, the Chelsea Company having a filter-bed of an acre in extent, by which the quality of the water was very greatly amended; the New River and the West Middlesex also constructed large settling reservoirs; while the Lambeth Company made reservoirs at Brixton and Streatham. In fact, the first great era in the recognition that better and more water must be furnished to Londoners, was the outcome of the Royal Commission of 1828. Doubtless, too, the movement was considerably hastened by a sharp attack of cholera which visited the metropolis and carried off 5275 persons out of the population of 1,681,641, or a proportion of 31·4 to every 10,000 inhabitants. The mortality was greatly accentuated by the impure and polluted state of the water supply from the Thames, and the shallow wells that contributed their quota; for even then the sewage difficulty was becoming a serious one, although the population on the banks of the river bore no proportion in those days to what it is at present. On the other hand, there was no main drainage system, and sanitary science was at a decidedly low ebb. In the Report of the Commons before alluded to, Dr. Bostock gives evidence "that the water of the Thames, when free from extraneous substances, is in a state of considerable purity, containing only a moderate quantity of saline contents, and those of a kind which cannot be supposed to render it unfit for domestic purposes, or

to be injurious to health; but as it approaches the metropolis it becomes loaded with a quantity of filth, which renders it improper to be employed in the preparation of food."

To the Lambeth Company (of the river companies) belongs the credit of first realising the unsatisfactory nature of the position, and of making up its mind that no amount of filtering or purification would make Thames water taken at Lambeth fit for consumption. It therefore determined, once for all, to incur a very large outlay, and to remove its source of supply to a considerable distance. A private Act was applied for in 1848 to enable it to bring water to London from a little above Kingston (where the influence of the tide had ceased), and convey it by pipes to its reservoir at Brixton. This was done with so much expedition that the new establishment was ready for work by 1851. The four years included between 1848 and 1852 were years of great importance for the water question, as it was the first time that any really trenchant legislation took place on the subject. In 1850 the position of the supply was this: Nine water companies were furnishing a gross daily supply, including watering the streets, flooding the sewers, fires, etc., of 44,383,332 gallons to 270,581 houses, a very great increase from the 174,205 dwellings of 1827. This was an average of 146 gallons for each house, or, including the public requirements, of 164 gallons. Under the income tax assessment there were in London 288,077 houses altogether, which

left 17,456, or about 6 per cent of the whole entirely unsupplied. A good many of these, however, depended for their water upon stand-pipes (of which there were scattered in the various districts 1181), and also upon shallow wells.

It was during this year that the Board of Health appeared on the scene, and took the water question in hand, *cum multis aliis*. Another very complete inquiry was held, so as to ascertain the physical and chemical conditions of the river, the arrangements of the various companies, and what fresh sources of supply should be looked for, for it was evident that Father Thames, as then utilised, was utterly unfit for the purpose. How unfit may be partly gathered from some evidence given by medical men in Bermondsey of the condition of affairs in 1849, when a much sharper epidemic of cholera attacked London than before, the total mortality being 14,137, or at the rate of 61·8 per 10,000. In fact, the very development of the drainage system, with all its sanitary advantages, proved in one sense a death trap to certain parts of the metropolis, seeing that, under the improved organisation and machinery, a vast quantity of house sewage was daily poured into the river, instead of being stowed away, as before, in cesspools and other contrivances. Unsavoury as is the subject, it is as well that it should not be forgotten, if only to show how grossly the conditions of civilised life may be neglected, and to serve as data for comparison with these present days of progressive sanitary enlightenment. Mr. Bowie,

a Bermondsey surgeon, speaking of a locality then called Jacob's Island, said, "That in this island may be seen at any time, women dipping water with pails, attached by ropes to the backs of the houses, from a foul fetid ditch, its banks coated with a compound of mud and filth, and strewed with offal and carrion ; the water to be used for every purpose, culinary ones not excepted, although, close to the place where it is drawn, filth and refuse of every kind are plentifully showered into it from the wooden houses overhanging the stream. During the summer, crowds of boys are to be seen bathing in these putrid ditches, where they come in contact with, and add to the highly injurious abominations." This was in the extreme east of London ; but, in many ways, things seemed to be nearly as bad in the west, and especially in the matter of water storage. Dr. Milroy thus spoke of it: "Amongst the most serious evils attending the present system of intermittent water to the dwellings of the poor, is the filthy and polluted state of the cisterns and butts into which it is received, and of the vessels in which it is generally kept ; whether the cistern or butt be in or out of doors, it is usually uncovered, and consequently exposed to all the dust and smut that are continually flying about even in the cleanest parts of a large city. But this is far from being the only or the worst source of impurity to which it is liable. Not unfrequently there is no tap at all, and it is generally so inconveniently placed that it is scarcely possible to make use of it ; hence the common

practice among the inmates of the house is to dip their vessels, no matter of what sort, and whether clean or otherwise, right into the cistern every time that they require to draw water. People have been seen rinsing utensils in the water which their neighbours drank and used for cooking ; when the cistern is outside of the house, it is liable to the same horrible pollution, from the common practice of parties who live in the upper rooms emptying everything out of their windows into the court below. In one case, near Covent Garden, the cistern was resorted to by boys in the street, the house-door being always open during the day, to wash their hands and play all sorts of pranks, such as dipping sprats or drowning mice in. Yet one of the occupiers of the house paid 4s. per week, or £10 per annum for her one room." Although matters are greatly improved at the present day as far as the quantity and quality of water supplied to even the poorest districts, it is much to be feared that the arrangements detailed in the last evidence are still often to be found ; although, of course, the landlords and owners of the abominable houses which we know to exist in such large numbers, are to be blamed rather than the water companies. One of the chief efforts made by the Board of Health at the date of its inquiry (1850), was to induce all the water companies to amalgamate, and thus bring the metropolis into one central organisation, in which everything should be identical and uniform. This scheme however failed ; but the Board succeeded in introducing



and getting passed the Act of 1852, entitled "An Act to make better provision respecting the Supply of Water to the Metropolis." This Act has been priceless in its value to the inhabitants of London, not only as being the first in which any real legislation was imported into the question, but as forming the basis of all future arrangements—the Magna Charta, so to speak, of the London Water Supply, under which, with certain modifications, we are still living. The first and foremost improvement insisted upon was, that no water was to be taken out of the Thames for the supply of the metropolis by any company, below Teddington Lock, or from any part of the tributary streams within tidal range. The other principal clauses were little less important, and provided that every storage reservoir within five miles of St. Paul's shall be covered; that all water supplied for domestic use shall be filtered, unless pumped direct from wells into covered reservoirs; and that a constant supply at high pressure should be given when demanded by four-fifths of the inhabitants of any district. This then was the pith of the whole, and we shall very soon see what a radical change it made in the organisation of the various companies by the beginning of 1855, which was the time specified by the Act, within which all new works should be completed and in operation. Of the companies that used the Thames water, the Lambeth had already taken the initiative and moved up to Thames Ditton, where it was soon joined by the Chelsea Company; the Grand

Junction, Southwark and Vauxhall, and West Middlesex Companies betook themselves higher up, to Hampton, as also did the East London to Sunbury, finding it a difficult matter to obtain a plentiful supply of good water from the Lea, as it became daily more and more contaminated with sewage and manufacturing refuse.

It was not long before an opportunity was given of proving the inestimable value of the changes, for even while a portion only of the London supply came from the new source, another epidemic of cholera arrived in 1854 and caused sad havoc, carrying off 10,738 of the inhabitants at the rate of 42·9 per 10,000. This was a decided improvement upon the previous attack of 1849 when, as we have seen, it was 61·8 ; and it was perfectly clear from the local evidence that the diminished mortality was almost entirely owing to a considerable portion of the water supply coming from Thames Ditton and Hampton, instead of, as before, the old polluted sources lower down. The influence of water purity as affecting the health of the metropolis was so marked, that it will be of great interest to study the remarks of the late Dr. Farr and Mr. Simon. Dr. Farr, to whose memory England in general, and the Registrar-General's Department in particular, owe a great debt of gratitude for his invaluable aid in diffusing sound knowledge on all vital statistics, wrote a letter, which was published in the Registrar-General's Report for 1854, respecting the two cholera epidemics of 1849 and 1853-54. The gist of this letter was to show that, in the

epidemic of 1849, the metropolitan population which was supplied by water taken at Kew (Grand Junction Company), suffered at the rate of 8 per 10,000; that those who were using the water from the river at Hammersmith, died at the rate of 17 per 10,000; the inhabitants of Belgravia, Chelsea, Westminster, who had to drink the water taken at Chelsea, at the rate of 47 per 10,000; while the districts between that and Waterloo Bridge suffered at the rate of 163 to the 10,000. The epidemic of 1854 showed even more conclusive facts, for by that date the Lambeth Company had removed to Thames Ditton, while the Southwark and Vauxhall still continued to take the water from the Thames at Battersea, near the entry of a great sewer. This latter Company supplied the Bermondsey district, which, in 1849, lost 734 inhabitants, and 829 in 1854, the river being undoubtedly more polluted between the two dates. The Lambeth district was supplied partly by the Lambeth, and partly by the Southwark and Vauxhall, and here we find that in 1854 there were 611 deaths in the 24,854 houses supplied by the former, and 3476 in the 39,726 houses supplied by the latter, the purer water population suffering at the rate of 37 per 10,000, the fouler water population at the rate of 130 per 10,000. There could be no clearer proof than this, as to one, at least, of the predisposing causes of cholera. The report of Mr. Simon carried the matter still farther, and is so full of interest that I cannot do better than quote the most salient points. Speak-

ing of the difficulties that surround such an inquiry as that which he was requested to make, he says that "commonly the inquirer is baffled by conditions which render exact conclusions impossible; for populations drinking different waters will often be living in different circumstances of wealth, comfort, cleanliness, occupation, soil, and climate. In the present case, however, there was a singular freedom from such causes of embarrassment. Throughout the investigated districts masses of similar population were dwelling side by side, and the exterior influences which affected them were, with a single exception, apparently identical. The one varying condition was the quality of water as consumed in different households. For throughout these southern districts of London, two great competing water companies had, in past times, canvassed house by house for customers; their rival mains were then branching within the same area, often running parallel in the same streets; and during the late invasion of cholera these two systems of pipes were respectively charged with very different water, in one case from the Thames at Battersea, in the other at Thames Ditton—the Southwark and Vauxhall pumping from the lower supply, and purveying perhaps the filthiest stuff ever drunk by a civilised community, the Lambeth furnishing as good water as any distributed in London. In the Report of the Committee for Scientific Inquiries, the contrast of these waters was shown, and microscopical and chemical observations adduced, as proving the almost incredible foulness of

that supplied by the Southwark and Vauxhall Company; how it was not only brackish with the influence of each tide, but contaminated with the outscouring of the metropolis, swarming with infusorial life, and containing unmistakable molecules of filth. It is worth notice that the materials for comparison were not on a small scale, not a village against a village, for the investigated districts comprised about a fifth of the entire population of London, containing in 1849 about 466,000 persons, and in 1854 about 511,000. In the 24,854 houses supplied by the Lambeth in 1854, comprising a population of 166,906, there occurred 611 cholera deaths, being at the rate of 37 to 10,000 living. In the 39,726 houses supplied by the Southwark and Vauxhall, comprising a population of 268,171, there occurred 3476 deaths, at the rate of 130 to every 10,000. But the Lambeth Company lost by the epidemic of 1848-49 consumers to the amount of 1925. The figures show conclusively that, first, their population suffered in 1853-54 not a third as much as its neighbours; and secondly, also that it suffered not a third as much as it did at the time of its unreformed water supply. On the other hand, the Southwark and Vauxhall Company—which pumped an impure water in 1848-49—pumped even a worse one in 1853-54, because the larger population and more extended drainage of London had given it a denser infusion of sewage and a more revolting unfitness for drinking. In short, the comparison of the two populations stood thus—In the one (notwithstanding a gene-

rally lighter invasion of disease) the cholera death-rate rose from 118 to 130, in the other it fell from 125 to 37. By this experiment it was rendered in the highest degree probable that, of the 3476 of the Southwark and Vauxhall Company who died of cholera in 1853-54, two-thirds would have escaped if their water supply had been as good as their neighbours; and that, of the much larger number—tenants of both Companies—who died in 1848-49, also two-thirds would have escaped if the Metropolis Water Act of 1852 had been enacted a few years earlier.”

So far we have been dealing with the history of the water supply as far as the water companies are concerned, and more particularly those which took their supplies from the river; but we must not omit reference to other sources of supply, such as wells, and particularly when they influenced the health of the community in any marked degree. Although we have seen that the epidemic of 1853-54 mainly affected the river-side inhabitants, these were not by any means the only ones who suffered; for there was a great outbreak, also at the same time, in the parish of St. James, Westminster, the focus of which was in Broad Street, Berwick Street, and Wardour Street, all crowded industrial thoroughfares in the Soho district, and the population of which, at the census of 1851, was 42,272. The houses, for the most part, though old and inconvenient, were let at high rents, and could not be called low-class; nor could the neighbourhood be called a very poor neighbourhood, inasmuch

as it contained great numbers of skilled artizans and people earning good wages. The peculiarity of the cholera attack was its extreme suddenness, and the rapidity with which it reached its intensity, and afterwards died away. A large number of individuals were attacked simultaneously, the maximum intensity being reached on the second, if not the very day of the outbreak, after which it remained stationary, and by the fifth day the mortality declined about 50 per cent. The total number of deaths was 609. What, then, was the cause of so fatal an epidemic? It all arose from the contamination of one well in Broad Street, a well which was so celebrated for the excellence of its water that people in the neighbourhood would drink nothing else. It was found that this pump was polluted by the leaking into it of a cesspool drain from the adjoining house, in which a fatal case of diarrhoea had taken place, and this was the origin of the mischief, which destroyed in a few days 609 lives. It seems surprising that water from a pump thus infected should have been in such good repute; but the fact was, that the cisterns of the neighbouring houses were generally foul and the water heated, while the well-water came up fresh, cool, and sparkling from the quantity of carbonic acid contained in it, the saline matter preventing its decomposition until after it had free access to the air. Dr. Snow was appointed by the Board of Health to inquire into the subject, and his observations were thus tabulated and published in the Report of the Rivers Pollution Commission: "1st.

That the outbreak, properly so-called, was principally confined to the area about the Broad Street pump. 2d. That 61 out of 73 persons who died during the first two days had been accustomed to drink the pump water either constantly or occasionally. 3d. That in the workhouse, where the well-water was not used, only five deaths occurred, whereas the ratio, in proportion to the numbers who died in the district, would have been 50. 4th. That in a factory employing 200 people, where the water was drunk daily, 18 people died. 5th. That 70 men employed in a brewery in Broad Street, who never drank the water, escaped the cholera. 6th. That in a particular street having 14 houses, in the only four which escaped death none of the well-water was used. 7th. That a lady living some distance away was so fond of this water that she used to send for it, but that she, as also her niece, died after drinking it." These facts, taken in connection with the river-side epidemics, are so plain as to the cause of a polluted water supply, and the effect of increased illness and mortality, that there never can be any excuse for the continuance of such evils.

A comparative table, issued in 1856, as to the general condition of the metropolitan water supply, shows an enormous increase, and a very great improvement as compared with 1850. The gross daily supply had been nearly doubled, it being 81,000,000 gallons furnished daily to 328,561 of the 340,000 houses in the Registrar-General's district, the average supply to each house



being 246 gallons. The distance traversed by the pipes conveying the water was 2086 miles, and the engine power used in pumping was equal to 7324 horses. The most noteworthy distinction was that, previous to the Metropolitan Water Act of 1852, considerably more than half the supply was unfiltered, subsiding reservoirs being the only means of clearing the water of impurities in suspension. But by 1856 upwards of 40 acres of filter-beds had been added, bringing the area of the whole of the reservoirs up to 141 acres. The cost of the new works was £2,282,824, which, with the previous and original expenditure, made the total outlay on water-works over £7,000,000, unmistakably showing a reasonable and satisfactory disposition on the part of the Companies to serve the public as well as they could. One of the most gratifying portions of the Report of the Board of Health for 1856 was a statement by the analysts, Messrs. Hofmann and Blyth, that there was a great diminution in the organic constituents of the water supplied, being nearly one-half less than it was in 1851, before the river Companies moved to their new quarters at Kingston and Hampton. The following short table will show at a glance the nature of the improvements during the six years:—

|  | 1850.              | 1856.            |
|--|--------------------|------------------|
| Gross daily supply .                   | 44,383,332 gals.   | 81,000,000 gals. |
| Houses supplied .                      | 270,581 „          | 328,561 „        |
| Average per house .                    | 146 „              | 246 „            |
| Filter and reservoir<br>arrangements . | } Very incomplete. | 141 acres.       |
| Organic matter .                       |                    | One-half less.   |

It is satisfactory to record that the improvement thus commenced was and has been very well maintained, with one or two exceptions. The chief of these was an outbreak of cholera in 1866, which proved very destructive during the (nearly) two months which it lasted, and which was said to have originated in the usual way—viz., the supplying of polluted water by the East London Company. It appears that this Company had two sources of supply, one of which was particularly liable to sewage contamination from the very dirty river Lea. It also possessed at Old Ford some uncovered reservoirs, from which it occasionally (though illegally) supplied unfiltered water to one part of their district. This reservoir was found, by Captain (now Sir Henry) Tyler, to be exposed to the spontaneous percolation of excessively foul water from the surrounding porous sewers, sodden ground, and from the neighbouring Lea, which was then little better than an open cesspool, receiving, as it did, the sewage of the large population inhabiting Old Ford, Bow, the greater portion of Bromley, and part of Mile-end. There were a good many locks upon the river, and a continuous stratum of gravel connected its bed, on the one hand, with the uncovered reservoirs, and on the other with the covered reservoirs, in which the filtered water was stored for distribution. It did not seem as if there was much supervision over the employés, for as soon as the Registrar-General sent a warning to the Company, the deaths, which at that date (August) were at the

rate of 170 a day, immediately declined, and by the end of the month the epidemic had well-nigh disappeared.

These, then, are the main incidents in the sanitary history of the London water supply, the subsequent events not being marked by any very radical changes, or by those unfortunate fatalities which have caused us to buy our experience so dearly. It may naturally be thought that, the onus of these fatalities lying so much upon the river water, the supplies from other sources could be anything but of the purest. But, though they are comparatively pure, it is difficult, if not impossible, to obtain the maximum of goodness even from a chalk well. Professor Frankland, in his evidence before the Water Supply Commission of 1868, tells us that sewage contamination is self-evident in the water of the Thames and the Lea, but not self-evident in the case of the chalk water supplied by the Kent Water Company, though chemical analysis reveals that it is present there also. The fact is, that the presence of nitrates and nitrites, even in the chalk water, shows that there has been previous contamination—that is, that sewage, which must necessarily be found on all cultivated land more or less, has soaked through the ground and found its way into the fissures of the chalk. At the same time, Professor Frankland considered these nitrates in the Kent Company's wells to be only the "skeleton," as it were, of the previous contamination, and that they do not exist in sufficient quantity to be

noxious to health. Broadly speaking, it is almost an impossibility to get any pure water from the Thames basin, as, that valley being highly cultivated and a great deal of manure being used, it stands to reason that there must always be a considerable amount of drainage into the river-springs and also directly into the river. Except, therefore, the supply comes from districts where there is little or no population, and a comparatively small amount of farming, it is hopeless to expect to obtain a very pure water, though the best guarantee perhaps is to get it from deep chalk sinkings, which are free from nitrates, as distinguished from the shallow ones in which they abound. It is not a very satisfactory reflection to the water-drinker to know that water which is perfectly transparent to the eye still contains germs of animalculæ, which afterwards develop in it, and it is difficult to see how far any kind of filtration can be relied upon to free the water perfectly from such germs. Professor Corfield to a certain extent, however, qualifies the presence of nitrates in water, and says "that if they are found in large quantities it must be regarded as a suspicious circumstance, unless we have good reason for knowing that the water comes from a source which is beyond the suspicion of contamination. There are quantities of nitrates in many soils, and the presence of nitrates in water obtained from such soils would not justify us in having the water condemned as a source of supply if there were no other reason."

One excellent result of the Rivers Pollution Com-

mission was the establishment, in 1868, of a system of inspection of the water supplied by the various Companies to the metropolis, which at that time was at the rate of 100,000,000 gallons per day. Up to this time examinations of the London waters had been pretty frequent by various well-known chemists and analysts, but they were rather of a perfunctory nature until 1865, when Professor Hofmann, and subsequently Professor Frankland, undertook the regular duty. The Metropolitan Water Act of 1852 was amended by the Waterworks Act of 1871, so far as the appointment of an official water examiner, who should take cognisance of the whole subject and make periodical reports to the Board of Trade. Colonel (now Sir Francis) Bolton, whose name is so familiar to Londoners in connection with the water question, is the official whose duty it is to supervise the water Companies, though his monthly reports, which are of such immense practical value, are made not to the Board of Trade but to the Local Government Board.

One of the most important movements that ever has taken place in the history of the London water supply occurred in 1879, when the then Home Secretary, Mr. (now Sir Richard) Cross, put forward a scheme with the object of buying up the interest of the water Companies. Though it was a rather gigantic proposal, it was based on sound policy, and probably would have come to a successful issue had not the demand of the Companies been out of all reason; and this, coupled with the fact

that the incoming ministry did not appear to be very favourable to any alteration, was the cause of the proposal being abortive. An inquiry was held by a Select Committee of the House of Commons in the succeeding year (1880) to discuss the undertakings of the water Companies generally and the basis of purchase, together with a few other points, such as the extent and powers of the Companies to levy water rates. Under Sir Richard Cross's scheme it was proposed to place the water supply under some public body and constitute it a water authority for the metropolis. It was to be of a representative character, and to include elements derived from the Corporation of London and the Metropolitan Board of Works, together with members from the districts supplied by the water Companies, but outside the jurisdiction of those two bodies. Putting aside for a moment the question of price, it was felt that enormous difficulties would supervene; for, in the first place, there was nobody to find the required capital. Generally speaking, if an agent is told to go and buy this, that, or the other, somebody undertakes to find the purchase money, but in this case there was nobody; and the paradox was, how to purchase the London waterworks without any purchase money passing between the respective parties, viz., the Companies and the public. It was proposed to arrange this by a conversion of Companies' stock into public water stock. The Corporation and Board of Works, however, did not consider the proposal a satisfactory one, on the ground that the price agreed to be

paid, viz. thirty-two millions sterling, was far too high, being nearly nine millions in excess of the market value of the property previous to the commencement of the negotiations.

Another difficulty was the question of back dividends claimed by the water Companies. The intention of the Waterworks Act of 1847 was to limit the dividend, so that all accruing after 10 per cent had been earned, should be applied to improving the water supply and lessening the price to the consumer. But the Companies had no idea of this interpretation, and asserted their right, under the title of back dividends, to escape from any such limitation ; and, moreover, that the claims of back dividends might be retrospective as far as the creation of the Company. The aggregate of these claims, upon whatever basis they rested, amounted to nearly twenty millions sterling ; the claims of the New River alone, which dates from James I.'s time, reaching the modest sum of fifteen millions. The Companies, according to these views, were evidently masters of the situation, and could pretty well demand their own terms and act in any way they chose, including possibly the undue raising of water rents, of which there had been many complaints ; or the putting forward of a right to increase their rates in proportion to the growth of the value of houses, the right having no legal relation to the augmentation in the quantity or improvement of quality of the water supplied.

The progress of the negotiations, as might naturally

be expected, caused a tremendous rise in the value of water stock, the prospect of the purchase by the Government on such favourable terms to the owners putting the latter in a fever of excitement. An equal rapid decline took place as soon as it became known that negotiations were at a standstill. The following table will be of interest as showing what a very nice little nest-egg would have fallen to the Companies by the possible back dividends, which, according to them, they could claim :—

| Name of Company.                 | Back Dividends possible. |
|----------------------------------|--------------------------|
| Chelsea . . . . .                | £650,000                 |
| East London . . . . .            | 1,250,000                |
| Grand Junction . . . . .         | 381,788                  |
| Kent . . . . .                   | 1,000,000                |
| Lambeth . . . . .                | 535,000                  |
| New River . . . . .              | 15,000,000               |
| Southwark and Vauxhall . . . . . | 613,675                  |
| West Middlesex . . . . .         | 432,000                  |
| Total . . . . .                  | <u>£19,862,463</u>       |

Such, then, briefly, was the episode of the unsuccessful Government undertaking to buy up the water interest of London; since which nothing of the kind has been again attempted, though what the municipal legislation of the next two or three years may bring forth in this direction nobody can foresee.<sup>1</sup> There can be no doubt but that the recent agitation as to the precise powers of the Companies and the basis on which they levy their rates, which agitation was commenced by

<sup>1</sup> See p. 87.



Mr. Dobbs and carried to a successful issue against the Grand Junction Company, will lead to considerable changes; the one which is most required being an uniform interpretation of the law on this point. Indeed, the special legislation (as distinguished from general legislation), which all the Companies have been so fortunate as to obtain, has not always been a blessing to the consumer, as, for instance, in the case of the Kent Company, which is not obliged by any specific mention to provide pure or wholesome water, although, as a matter of fact, its water is about the best that is provided. As regards the water assessment, nearly all the Companies differ in their claims, as well as in their rendering of the value of the property on which they assess. It will be well at this point to show how enormously the metropolis has increased, and, with the number of houses, the average daily supply of water. The comparison is given between 1871 and 1879:—

| Company.                    | No. of Houses. |         | Increase per cent. | Daily Supply in Gallons. |             |
|-----------------------------|----------------|---------|--------------------|--------------------------|-------------|
|                             | 1871.          | 1879.   |                    | 1871.                    | 1879.       |
| Chelsea . . . . .           | 27,809         | 29,727  | 6·90               | 8,363,242                | 8,333,192   |
| East London . . . . .       | 102,238        | 119,685 | 17·07              | 20,434,458               | 30,729,934  |
| Grand Junction . . . . .    | 31,623         | 39,589  | 25·19              | 11,125,555               | 11,755,912  |
| Kent . . . . .              | 40,259         | 47,638  | 18·33              | 7,071,657                | 8,162,762   |
| Lambeth . . . . .           | 46,494         | 61,530  | 32·34              | 10,427,603               | 13,576,217  |
| New River . . . . .         | 119,057        | 128,524 | 7·95               | 23,727,333               | 27,411,833  |
| Southwark and<br>Vauxhall ) | 77,967         | 85,529  | 9·70               | 16,427,386               | 24,034,252  |
| West Middlesex . . . . .    | 42,145         | 52,498  | 24·57              | 9,352,010                | 10,439,567  |
|                             |                |         |                    | 106,929,244              | 134,443,669 |

## CHAPTER III.

### THE EXISTING WATER COMPANIES.

I PROPOSE in this chapter to go a little more into detail as to the arrangements made by the present Water Companies for the supply of London, concerning which, as a rule, the metropolitan public is exceedingly ignorant. The number of persons who, if challenged to name the water district of any chance part of London, could answer satisfactorily, is probably very limited. This carelessness and apathy is the more extraordinary, as in the case of even the slightest failure in the supply, the fact is brought home most uncomfortably to every inhabitant of the Great City. Taking the various companies in the order of seniority, the first is, *The New River Company*, which, as we have seen in the remarks about the ancient water supply, is by far the oldest of all the corporations. Its first Act was passed in 1605, by which power was given to the Corporation of the City of London to carry out the undertaking. This, however, it failed to do from want of courage, and after the Act had thus lain dormant for a considerable time, Sir Hugh Myddleton applied for the transfer of these

powers under that particular Statute, and commenced the work on his own responsibility, and with money obtained on his own credit. It is a fair inference, therefore, that if the Corporation of that day had been as bold as it is now, the water supply of the metropolis would never have passed out of the hands of the central governing body. The sources from which the New River Company derives its supplies were originally from wells at Chadwell and Amwell near Ware, from whence the water was conveyed by a circuitous open conduit of about sixty-six miles in length, though in 1856 this channel was considerably straightened and the distance reduced. The Chadwell spring yielded, on an average, about 500 cubic feet per minute, and the Amwell well 274. As time went on and the number of houses increased, new sources had to be sought out and the area of the gathering grounds greatly enlarged, so that eventually the watershed of the Northaw district in Herts, the Spital Brook between Broxbourne and Hoddesdon, and the river Lea itself, were called upon to supply the demand. Later on, too, the absorption by the New River Company of the Hampstead waterworks gave an additional yield from the ponds at Highgate and Hampstead. At the present time a great number of streams and wells furnish the New River district with an average daily supply of 26,415,000 gallons. Of these, 3,924,458 gallons of water (afterwards filtered) are drawn from some nine wells and springs, and 19,888,294 (also filtered) from the Lea, while 2,602,158 gallons

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826.5

are unfiltered, of which 21,732 are obtained from the Hampstead and Highgate ponds. The filtered water is stored in seven covered reservoirs (as prescribed by the Act), holding altogether 36,000,000 gallons, these reservoirs being situated at Claremont Square (at the top of Pentonville Hill), Maiden Lane, Hornsey Lane, Highgate and Hampstead, Southgate and Crouch Hill. The subsiding and storage reservoirs for unfiltered water are of a capacity of 169,100,000 gallons, and are situated at New River Head, Stoke Newington (the scene of the terrible murder on New Year's morning last), Highgate, Hampstead, Camden Park Road, and Cheshunt. All these reservoirs are together over 100 acres in extent. No means of filtration existed prior to the Act of 1852; but that the character of the water was innately good, may be gathered from the fact that when the large Stoke Newington reservoir, which holds 90,000,000 gallons, was cleared out and deepened in 1856 (the first time for twenty years), only 10 inches of deposit were found. Of filter-beds there are twenty at New River Head, Stoke Newington, and Hornsey, with an area of  $16\frac{1}{2}$  acres, the filtering material being 5 feet 3 inches of sand and gravel, increasing in coarseness towards the bottom.

The district served by the New River Company is very extensive—the most extensive, indeed, in all London, though it is exceeded by its neighbour, the East London, in the number of houses contained, the former supplying 140,489 houses, the latter 142,839.

But though a great part of the New River district is of an old established character, and has probably not increased to any great extent for a number of years, the settlement of the population northwards has been continuous and rapid, as may be gathered from the fact that in 1847 the houses supplied by the Company numbered 83,206; in 1853 they had risen to 90,924; in 1856, to 95,083; in 1879, to 128,524; in 1884, to 140,489. The district may be said to extend north to south from Herts to the Thames, the boundary line that separates it from East London running from the Tower, through Bishopgate Street, Shoreditch, and Hackney Downs, nearly to Edmonton, where it turns abruptly eastward to the banks of the Lea, and thence follows the stream up. On the west the boundary is a little more erratic. Starting from Charing Cross, it runs through Soho, Gower Street, Hampstead Road, and Haverstock Hill to Hampstead Heath and North End, from whence it has a course due north to Colney Hatch. Roughly speaking, therefore, the New River Company supplies the City, the Strand, Holborn, Clerkenwell, Pentonville, Islington, Kingsland, Camden Town, Kentish Town, Stoke Newington, Holloway, Finsbury Park, Hornsey, Hampstead, Highgate, Crouch End, Muswell Hill, Colney Hatch, Southgate, parts of Hackney and Clapton, Wood Green, and Edmonton; and for the conveyance of the water to these districts there are 769 miles of service mains. The greatest head of pressure in the district is 260 feet, and the lowest 40 feet.

We must not omit at this point to mention that the Hampstead district was, up to 1856 or thereabouts, supplied by the Hampstead Water Company, which, though now extinct, is entitled to respectful memory, as being the oldest in the history of the London corporations, dating from the thirty-fifth year of the reign of Henry VIII. The early proceedings of this Company were rather hazy, as it existed before the days of Limited Liability, and when shareholders did what they liked with their money in a comfortable kind of way. In 1692 the city of London granted a lease (renewable every twenty-one years on payment of a fine of one year's improved value) for the exercise of the powers of their Act in the parishes of St. Pancras, Hampstead, and Hornsey, at a rental of £80 per annum ; and the lessees then formed a company and divided the undertaking into 600 shares, the first contribution being £20 per share. What became of subsequent calls, or whether there were any, nobody ever knew, as a fire broke out in 1763 and destroyed all the records, except a copy of the articles, though we hear later on that an action was brought by a Lord of the Manor of Hampstead against the Company, when it transpired that £60,000 had been spent on the works. Between that date and 1849 the total expenditure was believed to have amounted to about £121,000, a good part of which was laid out in substituting iron pipes for the old wooden ones, which had decayed. At the time of the Parliamentary Report of 1850, the Hampstead Water Company obtained their

supply (which was not filtered) from springs at Hampstead and Caen Wood ; also from two Artesian wells at Hampstead and Kentish Town ; and occasionally, when water ran short, from the New River. The districts supplied at that date were Kentish Town and Camden Town, the annual quantity furnished (though only thrice a week) being 718,013,000 gallons, supplied to 4490 houses. The Kentish Town Artesian well became a rather celebrated locality in water annals, the attention of geologists and engineers having been largely attracted to it. In 1854 the sinking had reached the base of the chalk at 886 feet, and it was fondly hoped that an inexhaustible supply of water would soon be at hand from the greensand. This, however, proved fallacious. For two years the sinking went on to 1302 feet, and yet there was no water, the bore having reached red sandstone, probably of Devonian (?) date ; and finally the undertaking was abandoned after an expenditure of £7500. This, however, is a trifle to the sums spent in similar efforts in other places, and notably at Richmond, alluded to at page 65. What with the ill-success of the Kentish Town well, and the evident fact that the whole district could be better supplied by the New River and West Middlesex Companies, the Hampstead Company took the wise course of disappearing from the scene and merging its whole concern with that of the New River.

As a property, the New River Company has been long and favourably known as a veritable Tom Tidler's

ground, from off which everybody who was in the slightest degree connected with it might pick up fabulous wealth. It was not so, however, at the early part of its career, for during the first thirty years there was only about £5 dividend for each of the £100 shares, which were seventy-two in number. But by the end of the last century, according to Pennant, these shares were selling for £10,000 apiece, and they have ever since been increasing in value. A note in Mr. Lass's admirable analysis of the London Water Companies, states that the New River Company's shares, as established by charter, are freehold, and are divided into moieties—one moiety or thirty-six parts being held by the incorporated "Adventurers," the other half being originally held by James I., and subsequently by persons who are now called "King's Shareholders," who are not incorporated with the Adventurers. Both these moieties are again subdivided and held by numerous persons, and, being real estate, are subject to entail and to trusts for minors. In 1880 a sale took place of a tenth of a King's Freehold Share in ten divisions, and the following shows the valuable character of the property from an auctioneer's point of view: "The purity of the water drawn from their own wells in the chalk; the first-rate character and complete order of all the appliances for supply; the great extent of territory over which the Company has the monopoly, including the City of London, part of Westminster, the wealthy parishes in the north and west of the town, and the in-



creasing suburbs of Middlesex and Hertfordshire, places the New River in a very different position to any other water company. It can supply the great want of the metropolis, namely, a pure supply for drinking purposes and high pressure for street hydrants, while the Thames water would meet all the other requirements of London. Should the New River not be taken over by the Government it has an illimitable future, of which its marvellous success and increase in the past are but an earnest. During the last fifteen years its income has doubled, and now amounts to the enormous sum of over £400,000 per annum; and there is no reason why, in the next decade, there should not even be a greater advance, as its income arises from its increase in the rating value of property within the districts over which it has the right of supply." Making allowances for an auctioneer's glamour, and the fact that the malign star of Dobbs had not risen as yet on the horizon, it is evident that a New River subdivided share is of very great value.

In 1834 the gross income of the Company from water rents, lands, and other sources, was £106,468, and the dividend £639. In 1882 the same sources yielded a gross income of £436,619, the dividend of 1879 being £2201. The total capital employed (1882) was £3,256,078. By the Company's Act of 1852 the amount expended by the Company on the works then in existence was declared to be £1,519,598 and upwards, that sum being deemed the capital. This Act,

however, did not create shares or a share capital, or alter or affect the nature, rights, or status of the property as existing under its charter. This Act also authorised the taking of certain lands for special improvements in its then existing works; and the Company was, by that and subsequent Acts in 1854, 1857, and 1879, authorised to raise on bond or debenture stock £1,500,000 for special improvements and general purposes. By the New River Company's Act of 1866 the Company was enabled to create a new description of shares, declared to be personal estate, to the amount of £500,000, the dividends on which were to be paid equally with the proprietors of the original shares.

The following table is one of the net water rates, working expenses (maintenance and management), and net profits from 1871 to 1882 :—

| Year. | Net Water Rates. | Working Expenses. | Net Profit. |
|-------|------------------|-------------------|-------------|
| 1871  | £273,523         | £115,413          | £123,178    |
| 1872  | 284,639          | 119,711           | 137,528     |
| 1873  | 300,288          | 124,694           | 145,432     |
| 1874  | 321,577          | 133,804           | 158,000     |
| 1875  | 334,676          | 130,511           | 173,511     |
| 1876  | 347,791          | 130,515           | 187,231     |
| 1877  | 362,828          | 131,983           | 202,197     |
| 1878  | 377,189          | 143,219           | 207,281     |
| 1879  | 388,399          | 146,687           | 211,486     |
| 1880  | 400,816          | 147,794           | 221,510     |
| 1881  | 416,848          | 155,763           | 226,298     |
| 1882  | 427,723          | 160,312           | 230,693     |

Amongst the items of maintenance are one or two under

the head of "Water Rights," which include sundry payments of an historic interest, such as London Bridge Water Works Annuities, Hampstead Water Works, and York Building Lessee Proprietors.

After all, the chief matter of importance to the customers and water consumers is the cost of water per house, which, like everything else in connection with water companies, has been steadily increasing for many years past. In 1820 the average cost per house was 25s., in 1827 it was 28s., and in 1879 it was 61s.; in this latter year the New River being exceeded by both the Chelsea and the Grand Junction Companies, which were 66s. and 68s. respectively. The Report of the Board of Health stated respecting the water charges, that at that time the New River Company charged houses of two rooms 6s. per annum; of three rooms, 9s.; of four rooms, 12s.; of eight rooms, 32s.; of ten rooms, 40s. Houses of a superior description were charged from four guineas, with 25 to 50 per cent for high service. Houses from one to four rooms were never charged extra for high service, while the poor, many of whom congregated together in one house, were charged 3s. per room when farmed. Baths and water-closets were not charged for separately. One of the greatest difficulties in the water arrangements is the want of uniformity of basis for assessment, each district doing as seems right in its own eyes, and undoubtedly creating a vast amount of confusion and dissatisfaction. The New River Company bases its charges on annual value, by which it

means the rental at which the premises would let if the landlord paid for repairs.

To follow the history of any Water Company through all its legal surroundings would be to bewilder the reader with very unnecessary knowledge. It is sufficient to say that, from the first start of the New River Company in James I.'s reign, it has had no less than fifteen special Acts, its chief and principal one being that of 15 and 16 Victoria. The pith of the rates that may be charged for water supplied to a dwelling-house is as follows :—

Where the annual value of the house does not exceed £200, at a rate per cent of such value not exceeding £4; and where the annual value does exceed £200, at a rate per cent not exceeding £3. The additional rates, in the case of water-closets, fixed baths, or high service, are : A rate not exceeding 4s. per annum for each single one, where the annual value of the house exceeds £30 but is under £50, and 2s. for each additional closet, bath, or high service. Where the annual value of the house exceeds £50 but is under £100, then the rate is 6s. per annum for each single one, and 3s. further for each additional one. Where the annual value exceeds £100, but is under £200, the rate is not exceeding 8s. for each single one, and 4s. for each additional one. Where the annual value exceeds £200, but is under £300, the rate is not exceeding 10s. for each single one, and 5s. for each additional. And where the annual value exceeds £300, the rate is not

exceeding 12s. for each single one, and 6s. for each additional. High service is defined as being a delivery of water at an elevation of more than 10 feet above the ground-floor of the house supplied ; but it is worth notice that when the services are given at an elevation of more than 160 feet above Trinity high-water mark, the Company claims a further sum, not exceeding £1 per cent on the annual value.

*The Chelsea Company* comes next in priority of date, having been established originally in 1723 (8th, George I.) under the title of "The Governors and Company of Chelsea Waterworks," to supply water to Westminster and the adjacent districts. The source of supply was the Thames, near the Red House, Battersea, by means of a conduit pipe laid across the bed of the river beyond mid-stream. To this Company belongs the honour and glory of having started the first filtering experiment, by the construction in 1829 of a filter-bed, one acre in extent, which was found to work remarkably well. By 1850 the arrangements of the Company had increased to four subsiding reservoirs of  $3\frac{1}{2}$  acres, 90,000 square feet of filter-beds, and two open service reservoirs in Hyde Park and Green Park. The annual supply at that date was 1,248,115,000 gallons to 20,996 houses. The Water Act of 1852 was the signal for the Chelsea Company to break up its establishment and betake itself to pastures new higher up the river, the localities fixed upon being West Molesey and Seething

Wells, between Thames Ditton and Kingston, with the Lambeth works as immediate neighbours. The total volume that may be taken from the river is 20,000,000 gallons per day, though the average quantity that is actually taken is 9,452,500 gallons. At West Molesey there are four subsiding and storage reservoirs for unfiltered water, occupying 40 acres, and having a capacity of 140,000,000 gallons, while the storage for filtered water consists of three covered reservoirs on Putney Heath, with a capacity of 11,000,000 gallons. There are also seven filter-beds at Seething Wells of about an acre each, the filtering medium being Thames sand, shells, and gravel, to the thickness of 8 feet. From the reservoirs on Putney Heath the filtered water is conveyed across the Thames close to Putney Bridge by an aqueduct well known to river travellers and boating men, and conspicuous from its exceeding ugliness. The possession of such large storage reservoirs at West Molesey gives the Company the power of falling back upon them when the river is in flood and consequently turbid, there being at least a fortnight's supply, during which time the river-water can be entirely cut off.

The Chelsea district is not a large one, and is indeed the smallest of all the Companies, containing but 32,636 houses, of which 3550 are on the constant system. The district is on the north side of the Thames, commencing a little below Hammersmith Bridge, and running eastward to Brompton, where a divergence to the north

takes place, so as to include Kensington Gardens and Hyde Park. From thence it follows the Green Park to St. James's Park, and at Charing Cross is conterminous with the district of the New River. The average daily supply is 9,452,500 gallons, that of 1853 (more than thirty years ago) having been 5,632,000 gallons to 22,725 houses. The increase of population, therefore, in the Chelsea district, has not been on the same scale as in others. The water rates, have, however, shown a satisfactory rate of increase, as shown by the following table :—

| Year. | Net Water Rates. | Working Expenses,<br>Maintenance, and<br>Management. | Net Profit. |
|-------|------------------|--|-------------|
| 1872  | £71,605          | £27,159  | £36,134     |
| 1873  | 76,721           | 29,558   | 40,866      |
| 1874  | 76,818           | 28,841   | 36,756      |
| 1875  | 79,679           | 29,364   | 38,478      |
| 1876  | 88,769           | 28,434   | 43,643      |
| 1877  | 89,178           | 31,826   | 40,763      |
| 1878  | 90,110           | 36,073   | 36,612      |
| 1879  | 92,493           | 33,248   | 35,496      |
| 1880  | 94,581           | ...  | 38,601      |
| 1881  | 95,830           | 36,000   | 37,189      |
| 1882  | 99,088           | 35,065   | 41,029      |
| 1883  | 101,583          | 33,865   | 46,288      |

The cost of water to the Chelsea consumer was in 1820 but 35s. per house, and in 1827 still less, only 30s. In 1833 it rose to 33s., and by 1879 it had doubled, the figures standing at 66s. Prior to 1852 the Company charged for one room 6s., for a large one 8s.; houses

400 to 600 superficial feet on plan at the rate of  $\cdot 875d.$  per foot; houses from 600 to 850 superficial feet, 1d. per foot; water-closets 15s.; for a second in the same house 10s.; baths from 5s. to 20s., according to size. At the present time the basis of assessment is determined by the annual value of the house. In the parish of St. George, Hanover Square, the rates are about 22 per cent under the gross value, according to the valuation list, and the average in the other parishes is 15 per cent below the annual value.

The Chelsea Company has had the benefit of about six special Acts, the one that fixes the rates being 15 and 16 Victoria. They are as follows:—

Where the annual value of the house does not exceed £200, the rate per cent not to exceed £4; but where the annual value exceeds £200, the rate per cent not to exceed £3. Where the annual value exceeds £30 but not £50, a rate of 4s. per annum for each single water-closet, fixed bath, or high service, and 2s. for each additional one. Where the annual value exceeds £50 but not £100, the rates not to exceed 6s. for each single one, and 3s. for each additional one. Where the annual value exceeds £100 but not £200, the rate is 8s. for each single one and 4s. for each additional one; between £200 and £300, a rate not exceeding 10s. for each single one, and 5s. for each additional one; where the annual value exceeds £300, the rates to be 12s. for each single one, and 6s. for each additional one.



*The Lambeth Waterworks*, which is next in order of date, is on a considerably larger scale, both as to works and district, than the Chelsea. It obtained its first Act in 1785 (25 Geo. III.), and for many years drew its supply from the Thames at Lambeth, and a very indifferent supply it was. The evils of river pollutions so rapidly increased about the middle of the present century that the Company applied in 1848 for a private Act to enable it to change its locality, and so rapidly were the arrangements for removal carried out that by 1851 the new works were ready for action, thus forestalling by three or four years the compulsory changes made necessary by the General Water Act of 1852. The same spot was fixed upon as that subsequently chosen by the Chelsea Company, the two works adjoining each other at Seething Wells, between Thames Ditton and Kingston. The only change that has been made since settling here has been the building of additional works at West Molesey, from whence the whole of the supply is now drawn, the filtering and pumping for distribution being carried on at Thames Ditton. The principal feature at the West Molesey establishment is the two large reservoirs (with one at Long Ditton), holding 125,000,000 and 3,000,000 gallons respectively, equivalent to a fortnight's supply, which is only drawn upon in any case of emergency, or of the river becoming turbid from flood, under which condition it is at once shut off, and not used again until it is clear. At Thames Ditton there are eight filter-beds of an area of

7½ acres, the filtering medium being Thames sand, coarse gravel and shells, to the thickness of 7 feet. Here also are ten engines of 1125 horse-power, one of which is used to pump filtered water to a reservoir on Kingston Hill (for local supply), the others for pumping to Brixton, whence it is subsequently continued to Streatham, Selhurst, Rockhill, Coombe, and Norwood, at each of which places are reservoirs, altogether nine in number, and holding in the aggregate 28,765,000 gallons. The immediate success that followed the change from Lambeth to Thames Ditton was most marked: for, during the cholera epidemic of 1854, the mortality in the 24,854 houses of the Lambeth district was 611, or 37 per 10,000 of the inhabitants, whereas in the 39,726 supplied by its late neighbours, the Southwark and Vauxhall Company, the deaths were 3476, or 130 per 10,000. The district served by the Lambeth Company may be more properly called South London, as, although it supplies that very closely packed area on the Thames side, extending from Vauxhall on the west to the Old Kent Road on the east, this same district is equally supplied by the Southwark and Vauxhall Company, illustrating the well-known absurdity of two people doing the work of one. Apart, however, from density of population, the largest area of the Lambeth, and one, too, that is very rapidly increasing in population and importance, is that between Kingston and Bromley (Kent), including Brixton, Clapham Common, Balham, Tooting, Merton, Kingston, Streatham, Norwood, Dul-

wich, Forest Hill, Sydenham, and Beckenham. Altogether there are 76,498 houses, with an estimated population of over half a million, the number of constant services being 27,639, in which particular the Lambeth Company exceeds all but the East London. The mains, which extended for 524 miles in 1853, are now 629 miles in length; and the total volume of water which may be supplied daily is 20,000,000 gallons, the average being 14,796,100.

The following are the statistics of the Lambeth Company for the last ten years or so:—

| Year. | Net Water Rates. | Working Expenses,<br>Maintenance, and<br>Management. | Net Profit. |
|-------|------------------|--|-------------|
| 1872  | £91,674          | £44,053  | £44,041     |
| 1873  | 98,883           | 48,113   | 44,434      |
| 1874  | 110,017          | 46,622   | 51,138      |
| 1875  | 114,354          | 48,613   | 56,375      |
| 1876  | 119,599          | 53,673   | 61,642      |
| 1877  | 126,782          | 51,841   | 64,443      |
| 1878  | 132,237          | 58,295   | 71,659      |
| 1879  | 138,054          | 58,616   | 70,805      |
| 1880  | 145,421          | ...  | 77,795      |
| 1881  | 154,356          | 65,858   | 79,727      |
| 1882  | 164,428          | 68,472   | 87,504      |
| 1883  | 174,862          | 71,179   | 96,153      |

The annual *gross* income of the Lambeth Company, which was £9335 in 1820, had risen by 1883 to £175,019. The cost of water per house has not risen to anything so high as in the case of other Companies. In 1820 it was 16s., in 1833 it had increased a little to

17s., and by 1879 it was 50s. 9d., which is certainly a contrast with the 66s. of the Chelsea district. Before the general Act of 1852 the Company had incorporated the Waterworks Clauses Act by their special Act of 1848. Their charges then were for houses :—

|                 |          |    |                        |
|-----------------|----------|----|------------------------|
| One room . . .  | 4s.      | to | 5s. according to size. |
| Two rooms . . . | 7s.      | „  | 8s. „                  |
| Three „ . . .   | 10s.     | „  | 12s. „                 |
| Four „ . . .    | 14s.     | „  | 16s. „                 |
| Five „ . . .    | 17s. 6d. | „  | 19s. „                 |
| Six „ . . .     | 21s.     | „  | 24s. „                 |

and for all above six, 5 per cent on the annual value. The Lambeth Company bases its present assessments on the opinion that annual value means rack rental. It levies its rates on the actual rent paid by a yearly tenant, and where this cannot be ascertained, its surveyor values the property to determine the probable rental. In cases of dispute, reference is made to the valuation lists, and it has usually been found that the value is considerably under the gross and very near the net ratable value. In consequence, very few changes have been made from alterations in valuation lists. The recent decision, therefore, is less likely to affect this Company than it does others. According to its special rating Act of 1848 (it has had seven altogether) the maximum rates chargeable are as follows :—

*Without Water-closets.*—Where the annual value of

the house does not exceed £20, the rate per cent not to exceed £7 : 10s. ; where the value exceeds £20 but not £40, the rate not to exceed £7 per cent ; where the value exceeds £40 but not £60, the rate per cent not to exceed £6 : 10s. ; where the value exceeds £60 but not £80, the rate per cent not to exceed £6 ; where the value exceeds £80 but not £100, the rate per cent not to exceed £5 : 10s. ; over £100 value, the rate not to exceed £5 per cent.

*With Water-closets.*—Where the value exceeds £20 but not £40, the rate not to exceed 10s. per annum for one closet, and 5s. for each additional one. From £40 to £60 value, the rate not to exceed 12s. per annum for one closet, and 6s. for each additional one. From £60 to £100 the rate not to exceed 15s. for one closet, and 7s. 6d. for each additional one. Where the value exceeds £100 the rate not to exceed 20s. for one closet, and 10s. for each additional one. It may be mentioned that the Lambeth is the only one of all the Companies which does not exempt itself from being bound to lay the communication pipes from the main to the dwelling-house.

In 1805 (Geo. III. 45) the fourth of the existing Waterworks was started under the name of *The Vauxhall Company*. Some thirty years afterwards, viz., in 1834 (William IV. 4), *The Southwark Company* also commenced its undertaking, and had a separate life until 1845 (8 Vict.), when the two Companies coalesced,

and have ever since carried on business under the title of *The Southwark and Vauxhall Water Company*. At the date of 1849 it owned 24 acres of land near the Red House, Battersea, the water being pumped during the ebb from the bed of the river below low-water. The appliances consisted of two depositing and two filtering reservoirs, the filtering medium being  $5\frac{1}{2}$  feet. The length of the mains and service pipes was 380 miles, and the district consisted of 34,864 houses, which were supplied during the year with 2,037,780,270 gallons. The water rents were then £33,639. The Southwark and Vauxhall Company was unfeignedly anxious to secure the best article that it could procure for its customers, and made a number of experiments to ascertain how soon after the ebb it would be safe to pump, so as to obtain immunity from the drainage element. The Company had a touching confidence in the purity of the Thames water, declaring that the impregnating ingredients were as harmless as the finest spring-water, and that there was not a spring in the country to equal it, except Malvern. A rude shock was given, however, to this belief by a report of the Registrar-General in 1850, who called attention to the different rates of mortality from the cholera in different parts of London, distinctly attributing the variation to the quality of the water supply. The rate, for instance, was 10 in 10,000 in the Grand Junction district, and 156 in the Southwark and Vauxhall district. The latter Company, however, with some show of justice, disputed

the inference, asserting that the water of the two Companies was precisely similar, but that the social differences of the districts were so great as to account for the mortality. It brought forward corroborating proof, in the shape of an analysis by Mr. Brande, to show that, while the solid contents per gallon in the Southwark and Vauxhall water were 21·5 and 20·1 respectively, those of the Grand Junction were 20·5 and 21,—certainly no great difference. After remarking on the poverty, bad drainage, and miserable sanitary arrangements of the Southwark district, it was stated that out of 14,000 tenants in the Grand Junction district, only 131 were supplied from spring-water wells, none from common taps, 142 from common tanks, while there were only 95 with no known supply; whereas in the Southwark district, out of 48,000 tenants, 4383 were supplied from common taps, 5231 from *tide* and other wells, while 1312 were without any supply whatever.

The Act of 1852 put an end to all disputes and the necessity for believing in Battersea water, by compelling the Company to migrate with the rest higher up the river, the point selected being Hampton, immediately opposite the racecourse, where its works stand cheek by jowl with those of the Grand Junction and West Middlesex. They consist at Hampton of three subsiding reservoirs for unfiltered water, with a capacity of 20,000,000 gallons, and three filter beds of an acre each; at Battersea, of three subsiding reservoirs for unfiltered water of 46,000,000 gallons, with nine filter-

beds, occupying altogether  $11\frac{1}{4}$  acres ; at Nunhead, of four storage covered reservoirs for filtered water, holding 18,000,000 gallons. Extensive works are in course of construction at Hampton for collecting underground waters that have been subject to natural filtration, so as to render the Company independent of the river in time of flood. A deep well is being also sunk at Streatham. There is an objection to the Battersea filter-beds, in the proximity of a large dust-sifting yard, to which the Board of Works for the Wandsworth District has called attention, but (according to the October report) the Company seem rather to like it than otherwise.

The district over which the Southwark and Vauxhall Company holds its sway is densely populated, extending from west to east, with a very irregular and straggling southern boundary, from Richmond to the Isle of Dogs, including Richmond, Sheen, Mortlake, Barnes, Putney, Wandsworth, Wimbledon, Battersea, Clapham, Kensington, Camberwell, Southwark, and Rotherhithe. The district between Vauxhall Bridge and Old Kent Road is, as mentioned before, common to it and the Lambeth Company, the two mains frequently occupying the same street. Incidentally in the history of the Southwark and Vauxhall Company, it may be stated that Richmond parted company with it some six or seven years ago, in consequence of some dispute, the Urban Sanitary Authority of that town, which takes the absurd name of a "Select" Vestry,



determining to sink a well in the chalk, and be its own water purveyor. Consent to this proposition was willingly given by the ratepayers, especially when coupled with the promise that the water-rate should be reduced one-half. But up to the present time the efforts of the Vestry Water Committee have been futile, and the promised well seems as distant as ever, as far as the water is concerned, the only thing that there is to show after an expenditure, directly and indirectly, of £60,000, being a hole bored down to the red sandstone (Devonian?) at a depth of 1334 feet, and a yield (15th March 1884) of  $5\frac{3}{4}$  gallons of water per minute. The Vestry is still boring away, with a happy ignorance as to whether the element ultimately reached will be fire or water. At any rate, a water scarcity during the summer of 1883 drove the ratepayers to the protection of the Local Government Board, and the Vestry, much against its will, was compelled to make terms once more with the Southwark and Vauxhall Company, whose vassals they are now.

The number of houses in the Company's district is now 101,009, with an estimated population of 750,496, the average daily quantity of supply being 20,575,317 gallons, and the number of constant supplies being 6488, exclusive of houses and factories supplied by meter. The following gives the particulars of the net water-rates, working expenses, and net profits:—

| Year. | Net Water Rates. | Working Expenses,<br>Maintenance, and<br>Management. | Net Profits. |
|-------|------------------|--|--------------|
| 1872  | £113,619         | £45,253  | £33,024      |
| 1873  | 119,912          | 54,726   | 26,390       |
| 1874  | 129,177          | 55,737   | 39,528       |
| 1875  | 135,032          | 55,980   | 44,404       |
| 1876  | 139,591          | 51,813   | 44,096       |
| 1877  | 142,952          | 59,477   | 29,338       |
| 1878  | 151,268          | 71,814   | 27,756       |
| 1879  | 167,488          | 64,331   | 51,707       |
| 1880  | 171,127          | 67,631   | 52,630       |
| 1881  | 177,424          | 79,166   | 55,248       |
| 1882  | 182,730          | 74,462   | 65,179       |
| 1883  | 189,765          | 70,292   | 76,583       |

The average cost per house appears to be much below that of other Companies, being stated at 40s. 9d. for 1879. Previous to 1852 the charge for domestic supply was 2s. per room, rising in cases where water-closets existed from 3s. to 5s. No separate charge was made for baths or high service. The Company has hitherto based its assessment on *gross* annual value, as shown by the valuation lists, considering that that term is meant by annual value. The Southwark and Vauxhall Company has had the benefit of nine Acts, its chief rating Act being that of 15 and 16 Vict., by which it charges on the annual value of the house not exceeding £5 per cent. Each single water-closet, bath, or high service is charged not exceeding 4s. per annum, and 2s. for each additional where the value exceeds £30 and not £50; 6s. per annum for each single, and 3s. for each additional, where the value is from £50 to £100;

8s. for each single, and 4s. for each additional, where the value is from £100 to £200 ; 10s. for each single, and 5s. for each additional, where the value is between £200 and £300 ; and above that value, 12s. for each single, and 6s. for each additional.

*The West Middlesex Company* commenced operations in 1806, its source of supply at that date being the Thames at Barnes, where it possessed two subsiding reservoirs. As the water passed into these through gravelly beds, no special filtration was necessary. From Barnes it was conveyed to a reservoir at Barrow Hill, near Primrose Hill. About the time of the removal compelled by the Act of 1852, when this Company settled itself at Hampton, side by side with the Grand Junction and the Southwark and Vauxhall establishments, the average daily supply was 5,000,606 gallons to 24,427 houses.

At the present time the Hampton works consist of the pumping arrangements, the intake from the river being separated from that of the adjoining works. As there is no subsiding reservoir, the water is pumped direct to Barnes, nearly nine miles, where are four reservoirs for unfiltered water, of the extent of 37 acres, holding 117,500,000 gallons. Here also are eight filter-beds of 12 acres, the filtering medium being  $5\frac{1}{2}$  feet of Harwich sand, Barnes sand, and gravel. The covered reservoirs for filtered water are at Campden Hill (3,672,000 gallons), the ornamental shafts of which are

conspicuous for miles to the west of London; Barrow Hill (4,750,000 gallons), and Finchley Road (2,500,000). The West Middlesex district is one of the most respectable in London, as far as the character of the dwellings is concerned. Geographically it ought to extend from the river at Hammersmith to Hendon, though practically the Grand Junction system cuts it in two, and completely dissevers the north and south portions. In the former are Wormwood Scrubs, Harlesden, Willesden, Neasden, Hendon, Child's Hill, Finchley Road, Kensal Green, and Edgware Road, from which a prolongation runs between the New River and Grand Junction systems to Primrose Hill, Regent's Park, Marylebone Road, and the north side of Oxford Street. The southern portion is smaller, and embraces Turnham Green, Hammersmith, Kensington (as far as the Gardens) and Brompton, as far as the Brompton Road, where the Chelsea Company takes up the running. The average daily supply is 12,225,785 gallons to 63,500 houses, with an estimated population of 476,250. The number of houses furnished with a constant supply is 14,120. The financial statistics of the West Middlesex Company are as follows:—

| Year. | Net Water Rates. | Working Expenses,<br>Maintenance, and<br>Management. | Net Profits. |
|-------|------------------|--|--------------|
| 1872  | £124,071         | £43,282  | ...          |
| 1873  | 125,435          | 42,752   | £82,577      |
| 1874  | 130,846          | 42,000   | 87,253       |
| 1875  | 135,179          | 42,398   | 92,629       |
| 1876  | 140,109          | 46,161   | 99,554       |
| 1877  | 147,117          | 54,626   | 102,028      |
| 1878  | 152,538          | 56,770   | 97,432       |
| 1879  | 154,662          | 51,891   | 98,166       |
| 1880  | 159,046          | ...  | 108,803      |
| 1881  | 166,023          | 53,806   | 113,591      |
| 1882  | 172,581          | 56,182   | 117,955      |
| 1883  | 179,690          | 60,420   | 121,227      |

The West Middlesex has always been rather costly to its customers, the average cost per house in 1820 having been 47s. ; in 1827 it was 51s., in 1833 it was 56s. 10d., while in 1879 it was 61s. 6d. Prior to 1852 the charges were regulated not so much by the number of rooms in a house as the general size and value of the premises, and also the level of the district. Detached houses or villas, with large frontages and gardens, in the higher parts of the district were charged more in proportion to their number of rooms than houses in streets at a lower level—a tax evidently put upon respectability—but to the present time the Company has based its assessment on the annual value of the premises, by which it means the yearly rent a tenant would pay, exclusive of rates and taxes, the landlord doing repairs. In cases of dispute, the gross value of the premises, as shown in the valuation lists, to be taken.

Of the seven West Middlesex Acts, the chief one, as fixing the rates, is 15 and 16 Vict., in which it is provided that where the annual value of the house does not exceed £200, the rate shall not exceed £4 per cent; and where the value is over £200, the rate is not to exceed £3 per cent. In the case of water-closets, baths, or high service, the rate is not to exceed 4s. per annum for each single one, and 2s. for each additional one, where the value is between £30 and £50; 6s. and 3s. respectively where the value is between £50 and £100; 8s. and 4s. respectively where the value is between £100 and £200; 10s. and 5s. where the value is between £200 and £300; and 12s. and 6s. where the value is above £300. High service is the usual elevation of 10 feet above the pavement, and £1 per cent may be charged in cases where the service is at an elevation of more than 200 feet above Trinity high-water mark.

*The East London Company* came into existence in the same year as the West Middlesex, though its history has not been quite so uneventful, as, from the nature of its geographical situation, it has had to contend with difficulties from which the wealthier and less crowded districts are free. The source of supply has always been more or less from the Lea, some two miles above the tide flow. Before the Act of 1852 the Company possessed six reservoirs at Old Ford, Stamford Hill, and Lea Bridge, holding altogether 35,400,000 gallons. No filtration was attempted at that date. The average daily

supply was then 11,990,989 gallons to 63,605 houses and manufactories. In 1856 the condition of the Lea became so unsatisfactory that the Company felt bound to improve its sources, and great alterations were made by cutting a large channel and drain to take off the dye-work and other refuse. Filter-beds were established, and the depositing reservoirs abandoned. The cholera epidemic of 1866 (to which allusion has been made in a previous chapter) was most severely felt in the East London district, and, from the inquiries made at the time, was apparently due to sewage contamination from the Lea. Soon after this, extensive alterations and additions were made by the Company with the view of supplementing its supply from the Thames, for which purpose a pumping establishment was fixed at Sunbury, at a higher point than any of the other Companies. The spot is conspicuous far and wide from the lofty water tower, overlooking Kempton Park race-ground. From this source, the amount that might be drawn daily was 10,000,000 gallons, though, as a matter of fact, but a small proportion is now being taken, the Lea and its branches furnishing the large daily yield of 35,132,648 gallons. The works of the East London consist of eight large reservoirs at Walthamstow for unfiltered water, of an area of 220 acres, and holding the enormous quantity of 600,000,000 gallons. There is also a reservoir at Hanworth, with a capacity of 5,000,000 gallons. The covered storage reservoirs for filtered water are six in number, and are situated respectively at Old Ford,

Woodford, Hanworth, and Hornsey Wood. At Lea Bridge are 22 acres of filter-beds, with a filtering medium of  $3\frac{1}{2}$  ft.

The East London district is the most densely built over and populated of any portion of the metropolis, extending from the New River boundary to the Lea, and including Whitechapel, Poplar, North Woolwich, East Ham, Plaistow, Stratford, Hackney, Bow, Bethnal Green, Stepney, Clapton, Leytonstone, Woodford, Walthamstow, and the Forest generally. The Tottenham people are also partly supplied from the East London mains, but only temporarily. Although the long supply main from the Thames is to a certain extent unutilised, a portion of it from Isleworth to Kew and Edgware Road is, by arrangement, placed at the service of the Grand Junction system, so that the two Companies can assist each other in cases of emergency. As may be imagined by anybody who knows the east end, the district contains more houses and people than any other. The former number 142,839 (a large increase from the 63,605 of 1853) and the latter (estimated) 1,071,292. A most creditable feature in the management is the constant supply to 106,043 of the houses, while a free flow of water is obtained in the most thickly-populated parts by means of stand pipes, a great number of which have been placed. According to the periodical official analysis, the water delivered by the East London appears to be equal to any of the London supplies, notwithstanding the very unpleasant condition of the Lea, as detailed by Dr. Hogg (page 92).



The following figures show the financial statistics of the East London Company :—

| Year. | Net Water Rates. | Working Expenses,<br>Maintenance, and<br>Management. | Net Profits. |
|-------|------------------|--|--------------|
| 1871  | £150,878         | £63,057  | £87,920      |
| 1872  | 155,848          | 63,244   | 89,826       |
| 1873  | 167,291          | 71,991   | 88,563       |
| 1874  | 174,010          | 71,449   | 95,050       |
| 1875  | 176,807          | 71,856   | 97,316       |
| 1876  | 184,989          | 74,418   | 102,199      |
| 1877  | 192,398          | 79,083   | 102,790      |
| 1878  | 202,042          | 81,914   | 108,678      |
| 1879  | 201,636          | 89,810   | 97,310       |
| 1881  | 211,975          | 92,423   | 105,390      |
| 1882  | 223,181          | 96,759   | 112,076      |
| 1883  | 230,452          | 91,919   | 124,708      |

The average cost of the water supply per house does not appear to have increased in East London at the same ratio as it has done in other systems. It was 22s. in 1820; during the next seven years it had risen 1s.; by 1833 it was 22s. 9d; and in 1879 it was 34s. 7d. Previous to the Act of 1852 the charges of the Company were 16s. for a four-roomed house, with 4s. for high service; 26s. for a six-roomed house, with 6s. for high service; 42s. for ten rooms, 21s. for high service; 52s. for twelve rooms, 26s. for high service; 62s. for sixteen rooms, 31s. for high service. On the other hand, no charge was made for water-closets or baths—a most excellent sanitary concession. According to the basis of assessment (after 1852) annual value is regarded as the rent where no premium has been paid or lease entered into. In

cases, however, of inquiry into the parochial assessment, it is as to the gross value and not the ratable value.

The East London Company has been the receptacle of more Acts than any other, no less than fourteen having guided its steps at different times since George III.'s reign. The Lea river, however, was the subject of legislation long before the Company was heard of, the earliest Act affecting this stream dating from the thirteenth year of the reign of Elizabeth. Its chief rating Act is 16 and 17 Vict. The rate for furnishing a domestic supply is not to exceed £5 per cent upon the annual value of the house. We find a falling off in the liberality of the Company previous to 1852, for an additional rate not exceeding 4s. per annum may be charged on every water-closet and bath where the annual value exceeds £30; 6s. per annum where the value is between £50 and £100; 8s. beyond £100 value. High service, which under this Company means water delivered at an elevation of 20 feet above the pavement, is charged at rates not exceeding 25 per cent on the foregoing. There are also scales of payment by meter; but as these are for the supply of water on a large scale, as in the case of manufactories, they need not be entered into here. Owners of houses, or parts of houses occupied as separate tenements, and not exceeding the annual value of £20, are liable to the payment of the rates instead of the occupiers.

*The Kent Water Company*, the youngest but one of all the London undertakings, differs materially from

them by depending in no way upon river supplies, although this was not always the case. It dates from 1809 (49 Geo. III.), and was originally set on foot to furnish the south-east of London with water taken from the Ravensbourne below Lewisham, a pretty Kentish stream that rises on Keston Common. In the report of 1850 it is stated that at that time the works consisted of a reservoir for unfiltered water, holding 4,845,410 gallons, and three others for filtered water to the amount of 3,865,344 gallons, situated in Greenwich Park, Woolwich Common, and near the Marine Barracks. This latter, however, was abandoned later on, and a new filter-bed constructed at Deptford, making a total filtration area of 12,880 square yards. The district, as then supplied, contained 16,077 houses, with a maximum daily supply of 3,500,000 gallons. But what with the enormous and rapid increase of the area to be supplied, and the deterioration of the Ravensbourne, it was felt that other and more reliable sources should be obtained; and it was determined, therefore, to discard the stream and sink wells into the chalk, which has never failed to meet the demands upon it, either in quantity or quality. The latter feature is so pronounced, that the Kent, of all the Companies, needs no filtration agent, but presents the water to its customers as it comes up—bright, cool, and sparkling. The area of the district over which the wells are scattered, is about 120 square miles. The storage reservoirs are as follows: three at Deptford, with an aggregate of 3,750,000 gallons; two at Woolwich

of 1,925,000 ; one at Plumstead of 750,000 ; one in Greenwich Park of 1,125,000 ; one at Chislehurst of 450,000 ; one at Farnborough of 1,400,000 ; one at Dartford of 370,000, the total capacity of storage being close upon 10,000,000 gallons. There are also pumping establishments at Bromley (close to the L. C. D. Railway), Crayford, and Dover Road. The district is one of the most homogeneous of any, the Southwark and Vauxhall and the Lambeth Companies bounding it on the west, while eastwards it stretches far into Kent, including Peckham, New Cross, Deptford, Lewisham, Greenwich, Blackheath, Lee, Bromley, Bickley, Chislehurst, Charlton, Woolwich, Plumstead, Eltham, Sidcup, and all the country extending to Dartford. The number of houses supplied is 60,211 (estimated population 361,266), of which 23,259 receive a constant supply, the daily average being 9,447,235 gallons. The rates and profits are thus :—

| Year. | Net Water Rates. | Working Expenses,<br>Maintenance, and<br>Management. | Net Profits. |
|-------|------------------|--|--------------|
| 1871  | £56,783          | £22,087  | £33,251      |
| 1872  | 60,002           | 25,119   | 33,110       |
| 1873  | 64,072           | 27,988   | 35,162       |
| 1874  | 67,437           | 20,238   | 37,911       |
| 1875  | 69,951           | 21,495   | 47,072       |
| 1876  | 74,143           | 23,809   | 49,014       |
| 1877  | 77,776           | 24,757   | 51,816       |
| 1878  | 81,283           | 25,738   | 55,087       |
| 1879  | 86,112           | 26,736   | 58,182       |
| 1881  | 90,225           | 26,707   | 62,467       |
| 1882  | 96,274           | 29,588   | 65,897       |
| 1883  | 100,463          | 28,689   | 71,192       |

The average cost of water per house in 1879 was 38s. 2d., which contrasts favourably with the cost of some of the other Companies. The charges of the Kent Company, before the Act of 1852, were, according to the class of house, from 4s. to 5s. per room on the low district, and 5s. to 7s. on the high district, delivered at any part of the premises, these rates including water-closets, baths, and, in fact, everything. Its rates after 1852 were based on the yearly value of the premises, the Company considering that the expression means the rent which a tenant would pay for the premises under an ordinary yearly tenancy, the landlord doing repairs and bearing all landlord's charges.

Of the eight Acts, the chief is that of 27 and 28 Vict., by which the Company amalgamated with the Woolwich and Plumstead Water Company. This Act gives the following scale of charges:—

|                                   |    |     |      | s. | d. |
|-----------------------------------|----|-----|------|----|----|
| Where the yearly value is between | £7 | and | £8   | 9  | 6  |
| "                                 | "  | 8   | " 9  | 10 | 6  |
| "                                 | "  | 9   | " 10 | 12 | 0  |
| "                                 | "  | 10  | " 11 | 13 | 0  |
| "                                 | "  | 11  | " 12 | 14 | 0  |
| "                                 | "  | 12  | " 13 | 15 | 6  |
| "                                 | "  | 13  | " 14 | 16 | 6  |
| "                                 | "  | 14  | " 15 | 18 | 0  |
| "                                 | "  | 15  | " 16 | 19 | 0  |
| "                                 | "  | 16  | " 17 | 20 | 0  |
| "                                 | "  | 17  | " 18 | 21 | 6  |
| "                                 | "  | 18  | " 19 | 22 | 6  |
| "                                 | "  | 19  | " 20 | 24 | 0  |
| "                                 | "  | 20  | " 25 | 28 | 0  |
| "                                 | "  | 25  | " 30 | 31 | 0  |
| "                                 | "  | 30  | " 35 | 35 | 0  |

|                                   |     |     |     | s. | d. |
|-----------------------------------|-----|-----|-----|----|----|
| Where the yearly value is between | £35 | and | £40 | 40 | 0  |
| ”                                 | ”   | 40  | ”   | 45 | 0  |
| ”                                 | ”   | 45  | ”   | 50 | 0  |
| ”                                 | ”   | 50  | ”   | 55 | 0  |
| ”                                 | ”   | 60  | ”   | 63 | 0  |
| ”                                 | ”   | 70  | ”   | 70 | 0  |
| ”                                 | ”   | 80  | ”   | 76 | 0  |

And, beyond this value, at a rate not exceeding £4 per cent per annum on the yearly value. In these rates one water-closet is included, but no bath, and additional rates are charged for the latter, as also for a second or third water-closet, according to the value of the house—for instance, where the yearly value does not exceed £9, the rate is 5s. for the second closet, and 6s. for the bath; where the value exceeds £80, the charge is 10s. for the second water-closet, 5s. for every additional one, 12s. for one bath, and 6s. for every additional one.

We now come to the youngest of all the London Water Companies, and the one which in its lifetime has gone through more stormy weather than any other. *The Grand Junction Company* was established in 1810 (51 Geo. III.), with the object of distributing to Londoners water taken from the Grand Junction Canal, which was derived mainly from the Colne; but this proving unsatisfactory, it changed its source of supply to the Thames, the intake being close to the mouth of the ancient stream of the West Bourne, which, however, was nothing more than the outlet of the Ranelagh sewer. The spot, where the Victoria Railway Bridge crosses the river, was in those days marked by the figure of a

dolphin, the same which afterwards became so notorious as the title of Mr. Wright's pamphlet (p. 17). The pamphlet, however, did its work, not only by attracting general attention to the bad management and abuses of the Water Companies, but by causing the Grand Junction Company to shift its quarters to a more sanitary locality. Previous to this outcry and its results in the Commission of Inquiry of 1828, a very ruinous struggle had been going on for a considerable time with the New River, Chelsea, and West Middlesex Companies; but in 1819 the opposing parties came to a mutual understanding, and agreed that each should restrict its service to a defined district, and that the rates should be raised 25 per cent all round above what had been charged before—the usual result of the termination of competition, and, of course, an eminently practical robbery of the inhabitants of London. In 1826, indeed, the Grand Junction Company brought in a bill in which a rate clause was introduced which would have enabled it to raise the charges somewhat indefinitely, but this was cancelled as being a little too strong. In 1834 a change of residence was made to a spot above Kew Bridge, at a cost of £170,000, the water passing through an iron pipe just opposite the eyot, thence into a well 22 feet deep, and afterwards pumped into a depositing reservoir. For several years afterwards there was little alteration, save an occasional enlargement of works; the establishment, prior to the passing of the Metropolitan Water Act of 1852, consisting of two reservoirs at Kew, holding

5,000,000 gallons, together with filter-beds with an area of 70,078 feet; there were also reservoirs at Campden Hill and Paddington, holding 6,000,000 and 3,400,000 gallons respectively. The number of houses supplied in 1850 was 14,058, of which 11,485 were rated under £5 per annum, and the quantity supplied in that year was 1,289,184,930 gallons.

The third move, viz. to Hampton, was made in 1854, extensive new works being erected by the side of the West Middlesex and the Southwark and Vauxhall buildings, and connection made with the district by a main to Kew, through Twickenham, Isleworth, and Brentford. At the present time the arrangements are as follows: At Hampton, three reservoirs of 12 acres, in the aggregate holding 51,000,000 gallons of unfiltered water, and a small reservoir of 2,500,000 gallons for filtered water; also three filter-beds. At Kew Bridge are two reservoirs of 5 acres, holding 13,500,000 gallons of unfiltered water, and  $8\frac{1}{2}$  acres of filter-beds, the filtering medium in both cases being Harwich sand, fine and coarse gravel and boulders,  $5\frac{1}{2}$  feet thick. At Campden Hill are three covered reservoirs for 18,000,000 gallons of filtered water, and another at Kilburn for 6,000,000 gallons. New works in progress at Hampton will increase the pumping and filtering power by one-third, and a reservoir, holding 3,000,000 gallons, has lately been completed on the summit of Hanger Hill, near Ealing.

The Grand Junction district is, in point of area, the



smallest in London, with the exception of Chelsea, though it is one that is increasing in population towards its western end. It includes Hampton and New Hampton, Teddington, Isleworth, Twickenham, Hounslow, Brentford, Acton, Ealing, Hanwell, Bedford Park, parts of Chiswick and Hammersmith. From this point it rapidly narrows, running in like an irregular wedge between the West Middlesex and Chelsea, and supplying Notting Hill, Westbourne Park, Maida Vale, Uxbridge Road, and the district between Oxford Street and Piccadilly. The total area comprises 48,255 houses, of which 27,223 are on the constant system. The population is estimated at 434,295, and the average daily supply is 13,819,557 gallons. The following is a statement of water rates, working expenses, and net profits of the Grand Junction Company :—

| Year. | Net Water Rates. | Working Expenses, Maintenance, and Management. | Net Profits. |
|-------|------------------|--|--------------|
| 1872  | £100,589         | £43,206  | £50,906      |
| 1873  | 104,666          | 45,375   | 49,360       |
| 1874  | 113,379          | 40,691   | 57,810       |
| 1875  | 114,548          | 38,711   | 63,907       |
| 1876  | 115,557          | 40,856   | 56,003       |
| 1877  | 121,361          | 40,778   | 45,694       |
| 1878  | 125,830          | 46,412   | 59,817       |
| 1879  | 129,642          | 52,502   | 69,213       |
| 1880  | 134,217          | ...  | 71,929       |
| 1881  | 144,221          | 50,542   | 84,312       |
| 1882  | 153,407          | 57,343   | 86,468       |
| 1883  | 157,270          | 57,310   | 89,909       |

The average cost per house of the Grand Junction

water supply has always been a high one, as compared with other Companies, being 57s. in 1820, and 61s. in 1827. In 1833 it underwent a considerable diminution, standing at 48s. 6d., while in 1879 it attained the supremacy in this item, having risen to 68s. As the Grand Junction is the last of the Companies on the list, it will be interesting to briefly compare the average cost per house of the water supply of all the Companies in the years 1820 and 1879:—

| Company.                         | 1820. | 1879.    |
|----------------------------------|-------|----------|
| New River . . . . .              | 25s.  | 61s. 3d. |
| Chelsea . . . . .                | 35s.  | 66s.     |
| West Middlesex . . . . .         | 47s.  | 61s. 6d. |
| Lambeth . . . . .                | 16s.  | 50s. 9d. |
| Southwark and Vauxhall . . . . . |       | 40s. 9d. |
| East London . . . . .            | 22s.  | 34s. 7d. |
| Kent . . . . .                   |       | 38s. 2d. |
| Grand Junction . . . . .         | 57s.  | 68s.     |

It would be interesting to know the reason for such divergences in the cost, or if there is any reason save the fact (which this little table seems to corroborate) that the poorer districts are served at a cheaper rate than the richer ones—which is certainly a fault on the right side.

Prior to the Act of 1852 the ordinary rates were calculated upon the mean rates of 1819, averaging from 4s. to 5s. per room throughout the district, with no separate charge for water-closets. High service, where the ordinary rate did not exceed £1:10s., was charged 18s. for the first floor, and 25s. for the second; but where the ordinary rate exceeded £2, the first floor high ser-

vice was 21s., the second floor 30s., the third floor 40s., etc. Subsequent to the Act of 1852, and up to the time that Mr. Dobbs obtained his memorable verdict last year from the House of Lords, the Grand Junction Company claimed to charge on the *gross* annual value, considering that annual value meant, "so much as a house will let for to a yearly tenant, when the landlord pays all expenses of repair," the valuation lists being the guide.

Of the fourteen Acts that the Grand Junction Company has had passed altogether, its chief rating Act is that of 15 and 16 Vict., although the Act of 7 Geo. IV. was also a rating Act, now in abeyance. By the former the charges were stated as follows:—

Where the annual value of the dwelling-house does not exceed £200, the rate per cent not to exceed £4, and where the value does exceed £200, the rate not to exceed £3 per cent. In the case of water-closets, baths, and high service (*i.e.* for water delivered at an elevation of 10 feet above the pavement), the rate not to exceed 4s. per annum for each single, and 2s. for each additional one, where the annual value is over £30 but does not exceed £50; 6s. for each single and 3s. for each additional one, where the annual value is between £50 and £100; 8s. for each single and 4s. for each additional between £100 and £200; 10s. for each single and 5s. for each additional between £200 and £300; 12s. for each single and 6s. for each additional where the annual value exceeds £300. Owners of all houses, or parts of houses, occupied as separate tenements, not exceeding

the annual value of £20, are liable to the payment of the rates chargeable for the water supplied instead of the occupiers; and the person receiving the rents from the occupiers, on his own account, or as agent, is to be considered the owner.

As the Grand Junction Company began its career in a somewhat stormy atmosphere, so it seems doomed to a similar lot in its later days. The most recent and most serious incident is the battle against illegal rating which has been so long waged by the persevering Mr. Dobbs, who carried his case through successive courts undismayed, and probably very much encouraged by the various readings of the legal powers as to the basis on which the water rate should be levied. As everybody now knows, a final appeal to the House of Lords procured a reversal of former verdicts. Mr. Dobbs reigns triumphant, and the claims of the Grand Junction, or of any other Company (it is to be presumed), to base the rates on the *gross* value of a dwelling are summarily extinguished. Mr. Dobbs, however, though the first successful litigant on record in this matter, was not the first who has entered the lists in protest against undue rating, for a Mr. Mather had a battle with the New River Company in 1875 on substantially the same question, but apparently did not make the desired impression.

In a few lines we may sum up the machinery by which Greater London and the immediate suburbs are

supplied with water, and may realise more easily how vast is the organisation that has to provide for the daily necessities of the metropolitan area.

|  |                     |
|--|---------------------|
| Number of Companies . . . . .                              | 8                   |
| Average daily supply (Jan. 1884)—                          |                     |
| From the Thames . . . . .                                  | 70,869,659 gallons. |
| From other sources . . . . .                               | 68,699,570 „        |
| Total . . . . .  | 139,569,229 „       |
| Estimated population . . . . .                             | 4,921,452           |
| Number of houses supplied . . . . .                        | 665,437             |
| Number of constant supplies . . . . .                      | 228,571             |
| Reservoirs for unfiltered water . . . . .                  | 54                  |
| Acreage of do. . . . .                                     | 465                 |
| Number of gallons held . . . . .                           | 1,290,100,000       |
| Reservoirs for filtered water . . . . .                    | 50                  |
| Number of gallons held . . . . .                           | 157,457,000         |
| Pumping engines . . . . .                                  | 144                 |
| Horse power of do. . . . .                                 | 16,610              |
| Filter-beds . . . . .                                      | 93                  |
| Acreage of do. . . . .                                     | 95                  |
| Number of miles of mains . . . . .                         | 4,025               |
| Number of street hydrants and private fire cocks . . . . . | 6,561               |

It is satisfactory to know that the system of constant supply is being rapidly extended, as shown by the number of houses thus supplied in the following table:—

| Company.                              | 1879.  | 1880.   | 1881.   | 1882.   | 1883.   |
|---------------------------------------|--------|---------|---------|---------|---------|
| Chelsea . . . . .                     | 941    | 1,573   | 2,191   | 2,824   | 3,550   |
| East London . . . . .                 | 98,745 | 106,043 | 106,043 | 106,043 | 106,043 |
| Grand Junction . . . . .              | none.  | 502     | 13,139  | 18,343  | 27,228  |
| Kent . . . . .                        | 12,884 | 13,777  | 15,859  | 20,533  | 23,259  |
| Lambeth . . . . .                     | 6,230  | 13,094  | 17,256  | 20,083  | 27,679  |
| New River . . . . .                   | 15,134 | 15,822  | 18,443  | 19,258  | 20,204  |
| Southwark and<br>Vauxhall } . . . . . | 610    | 2,615   | 3,024   | 3,162   | 6,488   |
| West Middlesex . . . . .              | 4,080  | 7,248   | 9,121   | 11,197  | 14,120  |

The number of mains kept constantly charged for this and for fire purposes is 927 miles, viz., New River district, 219; Chelsea, 70; Lambeth, 150; West Middlesex, 91; Southwark and Vauxhall, 130; East London, 120; Kent, 85; Grand Junction, 62. In houses supplied on the constant system all danger from drinking stale or contaminated water from cisterns may be avoided by attaching a small draw-off tap to the communication pipe which supplies the cistern from the main in the street. Water may be drawn from this at any hour of the day or night, and thus be obtained direct from the works.

The water rights paid by the different Companies depend upon the sources from which they get their supplies. In 1882-83 the Chelsea Company paid the Thames Conservancy, £2300; the Grand Junction the same sum; the Southwark and Vauxhall, £2305; the Lambeth, £2252; the West Middlesex, £2320; the East London paid to the Thames Conservancy and the Lea Conservancy, £5033; and the New River, £11,626, made up of the following items: London Bridge Waterworks annuities, £3750; Hampstead Waterworks Company, £3500; York Buildings Lessee Proprietors, £2000; River Lea Conservancy, £1776; Corporation of Hertford, £600.

It will be seen from the foregoing details respecting the London Water Companies, that the arrangements for supply in general keep pace, as far as possible, with the demand, though how long this can last is a question of

the future, and one, possibly, that is not very far off. It is unfortunate that the arrangements for payment are open to so much hostile criticism, for there is no doubt but that some of the Companies have for long proved themselves more than a little arbitrary and grasping. It may be said, and with justice, that they, as business firms, have only acted like every business firm in London, viz., got the best prices that they could for their wares, and made the best bargains possible; and, looking at it in that light, a good many hard things have no doubt been said by persons who were doing the same thing themselves every day of their lives. It is fair also to add, that to the negligence and slipshod way of conducting matters by Parliament, at various times, must be ascribed a large proportion of the hardship from which Londoners are suffering; for it is idle to suppose that the undue powers which the Companies possess could not have been easily controlled by the Legislature. As it is, the difficulties are greatly enhanced, and will be still more so, the longer that the abuses are allowed to remain unchecked. The recent effort made by the Corporation of London and the Metropolitan Board of Works to insert the thin end of their wedge into the Water Companies' affairs was ill-judged and impolitic; and the side-wind by which they attempted to establish a claim on the rents and profits that were derived from any landed estates or property belonging to the Companies was neither right nor creditable.

The objects of the Bill, which met with so decisive a defeat in the House of Commons on 11th March, were ostensibly to seek powers to regulate and reduce the profits now made by the Companies, to restrain the payment of back dividends within very narrow limits, to enforce the principle of the Dobbs' decision in all cases, and to compel the supply of water by meter. This sounds reasonable, especially when prefaced with virtuous indignation as to the great cost of water to the poor; but we can scarcely fail to observe that the compulsory sale of water by meter would simply result in the greatly decreased use of the water, very much to the detriment of cleanliness and godliness; while the City of London, in which are enormous warehouses and offices, using, comparatively speaking, very little water, would have correspondingly saved its pocket.

Constant supervision over the Companies as to supply, and especially as to charges, is required; and, as soon as opportunity offers, restriction of such charges and an uniformity of rating are urgently needed. Either from the operation of purchase, control, or competition, the water question will soon reach a fair and equitable level to both consumer and supplier; and we will see in the next chapter what attempts have hitherto been made on the side of competition, and the necessity which will soon exist for adopting it in some form or other.



## CHAPTER IV.

### THE INCREASE OF THE WATER SUPPLY—THE THAMES BASIN.

As we have seen in the preceding pages, the metropolitan water supply is on a gigantic scale, and one that is, generally speaking, admirably organised. Nevertheless, there is another side to the question, to which the attention, not only of sanitary reformers, but of all thinking people, may well be directed, and that is, the evident tendency of the supply to diminish, while the demand is daily becoming greater. The various schemes and proposals, which have at different times been brought forward to remedy the want, are proof that the evil is not a very recent one, but has been more or less felt throughout the century. The wonder is, not that such an abundant crop of suggestions has gradually accumulated, but that none of them have been acted upon ; for, allowing that a fair proportion of the schemes were impracticable, there have been many which deserved the highest consideration, both from their feasibility and the sanction of the eminent engineers whose names have appeared in conjunction with them. The vitality

of monopoly is always a characteristic feature in this country, and is as much marked in Water Companies as in other things. Although, as far back as 1824, the insufficiency of the London water supply was an acknowledged fact, and was then sought to be remedied, nothing has been done beyond increasing the capabilities of the existing sources. It is only giving their due to the Companies, to point to the constant endeavours that they have made to keep pace with the demand, and it must be admitted that, as far as in them lay, they have done their work remarkably well. For all that, we are confronted with the same difficulty as was the last generation, that London grows rapidly every day, while the water supply tends to diminish. It is not meant by this that the actual supply of this year is less than that of last, or that next year's will be smaller than that of 1884, but merely that it is impossible that the enormous drain upon the Thames can be kept up, without it showing signs of exhaustion, as is allowed to be the case. More than this, even supposing that the actual volume of the river remains the same, the increase of gathering grounds, which is carried out wherever possible, is fraught with considerably more danger than it used to be. Thirty years ago, schemes were brought forward for supplying London with water from other sources, which would then have been feasible enough, as far as its sanitary requirements go; but it is very doubtful whether these schemes would be admissible now, seeing that the conditions of life have altered

so much since the time that they were propounded. The growth of population throughout the river basin, the increase in the value of land, and especially agricultural land, would now be serious obstacles, as being almost certain to introduce into the water supply the perils of previous contamination. *A propos* of this danger, some letters have appeared within the last few months in the *Times*, from Mr. Jabez Hogg, which are certainly worth consideration. In one letter, speaking of the subsoil water, he says: "What more immediately concerns Londoners with regard to the subsoil water supply of the Lambeth Company is, that it is obtained from a very considerable area,—an area, according to the Company's engineer, of between 9 and 10,000 acres, extending to the southwards, the westwards, and the north-west of the Company's works at West Molesey, and even to the Bagshot sands. I must confess that this water is much better than the water of the Thames in flood. At this moment, however, it unfortunately happens that typhoid fever prevails to an alarming extent about Bagshot, and several deaths have been already reported. The houses which lie scattered about, the medical officer of health tells us, have been allowed to get into a very unsanitary state, and although he has repeatedly, and for the last eight years, drawn attention to the fact, nothing has been done to remedy the evil. This is, I fear, not the only place within a reasonable distance of the 10,000 acres of gathering ground of subsoil water that has been known to

suffer from typhoid. This, however, is only a part of the danger which environs a water supply drawn from a tidal river with half a million of human beings residing on its banks." On another occasion the same writer points to the watershed of the river Lea, and the filthy impurities that are daily poured into it by its tributaries, the Bean, Rib, Ash, and Stort. The population of this district exceeds half a million; much of the land is used for grazing, but a great deal more is converted into sewage farms, some eight or ten of which send millions of gallons of effluent water into the Lea, of such a character that it can be smelt for a considerable distance. Indeed the sanitary engineer of the Conservancy Board of the Lea describes the farms not as "sewage" but as "stink" farms; and as Mr. Hogg states it, "the residents of the Lea valley and the customers of the East London Waterworks are often reduced, during storm-water times, to drink diluted sewage." Mr. Hogg's own experiments were certainly sufficient to condemn any stream. After speaking of the odour and colour of the water, he says, "in shallow parts of the river a thick coating of mud was densely covered by the hair worms (*Gordiacæ*), while numerous other harmful organisms were seen to be moving about. On standing the bottles of water for a day or two, and then with a dipping-tube removing a few drops for microscopical examination, I was able to identify from sixteen to eighteen varieties of vegetable and animal life, amongst which I may enumerate bacteria, mycellium, fungus, muscular

fibre, and such like evidences of animal pollution. It would be difficult to picture a worse state of things, and conceive the possibility of London having to draw more than an eighth part of its water supply from so hopeful a source." It is evident from these and other descriptions, even allowing a considerable percentage of margin for descriptive purposes, that the future supply of the metropolis will be fraught with danger, unless it is obtained from a considerable distance and from spots where the water is of a purer quality.

Within what may be called the home radius, no less than nineteen different proposals have been at different times brought forward by persons of more or less authority and qualified to give an opinion. Some of them were plans for supplying water directly from the Thames at various points above Twickenham, some from tributaries of the same river, while others were for obtaining water from springs or Artesian wells. The first engineer of his day, Mr. Telford, proposed in 1834 to bring a supply to the Middlesex portion of London from the Verulam river in Hertfordshire, and to the Surrey portion from the Wandle river in Surrey. A great reservoir was to be constructed at Watford, from whence a double aqueduct would convey the water to Primrose Hill, thence to be distributed by the then existing River Companies on the north of the Thames, viz., the Grand Junction, West Middlesex, and Chelsea, who were at that time supplying 6,810,000 gallons per day. The South London inhabitants were receiving nearly

3,000,000 gallons from the Lambeth, South London, and Southwark Companies; and this supply Mr. Telford proposed to supplement by one from the Wandle at Beddington, from whence a similar aqueduct was to be made to Clapham Common. Instead, therefore, of a daily supply of 9,774,000 gallons to the metropolis, it would receive by the new scheme 23,220,000 at a cost of £1,177,840.

Mr. Robert Stephenson was the next to appear on the field in 1840, when he condemned Telford's proposals as being too costly and liable to be affected by surface drainage; but he endeavoured to demonstrate the feasibility of supplying London from chalk springs near Watford, and embodied his views in a report drawn up for a Company to be established under the name of the London and Westminster Waterworks Company. It did not come to maturity, though the scheme was revived later on (1849) by the London (Watford) Spring Water Company. A complete metropolitan supply was not contemplated, it being only proposed to bring 8,000,000 gallons per day from wells in Bushey Meadows by cast-iron pipes to reservoirs at Stanmore Heath, and from thence to another at Child's Hill. The estimated cost was £350,000. During the same year two other schemes were brought forward—one to obtain water from the Thames at Henley, the other at Mapledurham. The gist of the first was that an open canal, 40 feet wide, should be made from Medmenham Abbey to West Drayton, where the supply would be diverted—

100,000,000 gallons to be taken on to London by the Grand Junction Canal for flushing the sewers, while the same quantity would pass by a smaller canal to the Brent river, and thence by brick culverts to a reservoir at Hampstead, the whole to cost £2,000,000. The Mapledurham scheme was propounded by Messrs. Gordon and Liddell, 50,000,000 gallons to be brought by open canal to Caversham  $4\frac{1}{2}$  miles distant, where the water, which everywhere throughout the chalk districts is hard, was to be softened by Dr. Clark's process, and thence conveyed to London along the track of the Great Western Railway by three large iron pipes. The estimate of these works was £1,200,000. Mr. Quick, the engineer to two or three of the Water Companies, saw no reason why the Thames should be drawn upon so high up at a greatly increased cost, and suggested that Eel-Pie Island, near Twickenham, was quite far enough, the expense of obtaining 50,000,000 gallons from this point being only £300,000. He seems to have anticipated the present localisation of the Water Companies more nearly than any other promoter. In 1846 the "Aqueduct" Company was launched under the engineering auspices of Mr. Hawksley, who proposed to build at Bray, near Maidenhead, ten subsiding tanks of 5 acres each, and ten filter-beds of 2 acres, from which 50,000,000 gallons would be brought daily by tunnel or aqueduct to Hampstead, the total cost being £747,000.

Coming a little nearer to our own time, we find a scheme advanced by Mr. Bailey Denton, a well-known

drainage authority, which was more ambitious than the former ones, inasmuch as it proposed to seek the additional supply by tapping the tributaries of the Thames considerably higher up, at a cost of £5,320,000. He wished to include the streams of the Oolitic country (the Cotswolds) from Cricklade to Oxford, supplementing any deficiencies by the lower rivers of the Wey, Coln, Mole, and Wandle. Mr. Denton proposed also to purchase the two canals known as the Thames and Severn and the North Wiltshire, utilising them to bring the water to Lechlade, from whence a conduit of 127 miles would run to Hampton-on-Thames, collecting *en route* the water from the (Gloucestershire) Coln, Leash, Windrush, Evenlode, Cherwell, Ray, Ock, Thame, Loddon, and (Herts) Coln. At Hampton the supplies would be then given over for distribution to the Companies already settled there. Mr. Bailey Denton's scheme appears to be the only one which dealt somewhat exhaustively with the question of sewage, which he proposed to intercept for a certain distance up the course of each contributing stream. Open drains were the methods recommended, with, wherever it should seem to be an economy, compulsory powers to raise it and apply it to the hills, so as to favour a complete absorption of the sewage into the soil.

Mr. Bravender proposed a somewhat similar plan as regards the initiative supply, by tapping the springs of the head-waters of the Thames at Ampney Crucis, Bibury, Ablington, and other villages between Cheltenham



ham, Cirencester, and Fairford. These springs are certainly most prolific, yielding as follows per day :—

|                                   |            |          |
|-----------------------------------|------------|----------|
| Ablington . . . . .               | 2,000,000  | gallons. |
| Ampney Crucis . . . . .           | 12,000,000 | „        |
| Bibury . . . . .                  | 10,000,000 | „        |
| Bourton-on-the Windrush . . . . . | 25,000,000 | „        |
| Boxwell . . . . .                 | 1,200,000  | „        |
| Ewen . . . . .                    | 1,000,000  | „        |
| Seven Springs . . . . .           | 500,000    | „        |
| Seven Wells . . . . .             | 2,000,000  | „        |
| Syreford . . . . .                | 4,000,000  | „        |
|                                   | <hr/>      |          |
| Total . . . . .                   | 57,700,000 | „        |

Mr. Telford M'Neil proposed to bring 200,000,000 gallons daily from Teddington, raising it from 200 to 380 feet, and conveying it by an open channel to the Bagshot Sands for filtration. It was then to be brought back again in a closed conduit to Norwood and Hampstead, where large reservoirs would be formed. This scheme, which certainly to the inexperienced mind appears to be a rather roundabout one, was to cost £6,000,000.

These were the most noteworthy of the Thames valley schemes, although it does not exhaust them all, some being of rather an amateurish description. One of these schemes proposed to unite a supply from the Thames with one from the Colne, and to take it by what is known as the "Queen's River" to Feltham, and thence by pipes to London. An ingenious suggestion was also made by a Mr. Pym, that a series of shafts should be sunk down to the chalk at a certain distance

from and on each side of the river, every quarter of a mile. Each shaft was to have an aqueduct or canal communicating with the Thames between high and low water mark, through which a stream would flow for a given period, twice a day, to fill these shafts, and ultimately the chalk basin. At a convenient distance from each descending shaft another would be sunk, into which the filtered water would flow as in an inverted syphon, until it rose to the level of the water in the river.

A rather important scheme was apparently an offshoot from the South-Eastern Railway Company, as it was fathered by its engineer, Mr. Barlow. It consisted in intercepting the springs that flow from the chalk and discharge into the Thames between Greenwich and Strood. The late Professor Ansted held that this supply was practically inexhaustible, and in fact that the whole of the chalk between Erith and Gravesend is saturated with water, which might be tapped at a moderate cost. Mr. Barlow's idea was to construct a heading or small tunnel along the course of, and underneath the line of, the North Kent Railway, with borings every half mile, affording a supply of 100,000,000 gallons per day, at a cost of £150,000. If the conveyance of the water by the South-Eastern Company was on the same high tariff as that of the passengers overhead, it was, perhaps, fortunate for the inhabitants of London that this scheme did not take effect. Captain Vetch brought forward a comprehensive plan, which somewhat

resembled Telford's several years before, except that it was not limited to two streams only. He proposed to make a raid upon the waters of all the rivers within a certain distance of the metropolis, such as the Verulam, Chess, Colne, Gade, and Lea on the north side of the Thames, the Darent and Mole on the south side, the water to be brought by means of tunnels or adits in a direct line, to the amount of 100,000,000 gallons a day. South London was proposed by a Mr. Thompson to be supplied by the "Wandle Water Company," his scheme including a plan by which all the drainage between Croydon and Wandsworth would be intercepted and applied to the land.

There was also a somewhat ambitious Company started with a capital of £400,000, under the long-winded title of "The London and Medway Double Service Fresh and Salt Waterworks Company," the salt water to be brought to the metropolis from the Medway, the fresh water from the rainfall of the Tonbridge and Holmesdale Valleys, and also from the Darent and Cray rivers, under the impression that "the Company will enjoy a command of water sufficient for all the uses of a city twice the size of the existing metropolis." It is evident that a long and useful life was contemplated by the promoters, and it must have been a considerable shock to them that their pet scheme did not come to the birth.

Mr. Mylne has proposed the collecting of the streams and chalk springs into the London clay of the Enfield

Chase, and thus supplementing the New River and East London supplies by about 28,000,000 gallons at a cost of £1,250,000. Mr. Homersham, whose speciality consists in sinking chalk wells, is anxious to do away entirely with river water and trust to the chalk supplies, using Dr. Clark's softening process for correcting the hardness. Mr. Homersham is at present engaged in sinking the celebrated chalk well at Richmond. He is not, however, the first who advocates this source of supply, for, many years ago, the "Metropolitan Water Supply Association" was launched "on a self-supporting principle, through the medium of one public institution, directly responsible to the inhabitants." As this met with no response, it is clear that the Home-rule doctrines, so strenuously advocated and pandered to by the political authorities of the day, were in a disgraceful condition of obscurity.

The foregoing schemes, with the addition of one or two less important, such as that of Mr. Hennell, who advocated buying up the Basingstoke canal and making storage reservoirs to hold 840,000,000 gallons, which were to be brought to London by a conduit from Weybridge; and that of Mr. Ewens, who proposed to utilise the chalk springs near Emsworth and Bedhampton in Hampshire (now appropriated for the Portsmouth water supply), are all that bear reference to the Thames Valley, and I will now proceed to those of a different character. But before doing so, it will be well to bear in mind what has been said already respecting possible

sewage contamination, both direct and indirect, seeing that any future proposals will have to consider this branch of the question much more closely than was requisite in former days. It would be necessary, in the consideration of any suggestion for supplying the metropolis with water from the Thames or its tributaries, to carefully note (as far as can be done) the general increase of population throughout the basin, for it must be remembered that London, low down the river, cannot fail to be affected more or less, by the sewage of the population above it. The following table will give us some idea of what this population consists, taking the Registrar-General's district on the banks of the river and its tributaries throughout the basin, down to the point of junction with the river Lea, eliminating, however, the interval between Kingston and London, as not supplying potable water.

| County and District.             | On Thames. | On Tributaries. | Pop. 1881. | Pop. 1871. |
|----------------------------------|------------|-----------------|------------|------------|
| <b>SURREY—</b>                   |            |                 |            |            |
| Chertsey, Walton, and Chobham    | Thames     | ..              | 27,046     | 23,038     |
| Guildford, Godalming, and Woking |            | Wey             | 42,670     | 35,677     |
| Farnham and Aldershot            |            | Wey             | 40,275     | 39,867     |
| <b>HANTS—</b>                    |            |                 |            |            |
| Alton                            | ..         | Wey             | 15,199     | 15,099     |
| Basingstoke                      | ..         | Loddon          | ..         | ..         |
| Hartley Wintney and Farnborough  | ..         | Blackwater      | 21,324     | 20,601     |
| Kingsclere                       | ..         | Enborne         | 8,524      | 8,576      |
| <b>BERKS—</b>                    |            |                 |            |            |
| Newbury                          | ..         | Kennet          | 21,326     | 20,641     |
| Hungerford                       | ..         | Kennet          | 17,795     | 19,349     |
| Farringdon                       | Thames     | —               | 13,676     | 15,091     |
| Wantage                          |            | Ock             | 17,161     | 17,360     |
| Carry forward                    | ..         | ..              | 224,996    | 215,299    |

| County and District.                                 | On Thames. | On Tributaries. | Pop. 1881. | Pop. 1871. |
|--|------------|-----------------|------------|------------|
| Brought forward . . . . .                            | ..         | ..              | 224,996    | 215,299    |
| <b>BERKS, continued—</b>                             |            |                 |            |            |
| Wallingford . . . . .                                | Thames     | ..              | 14,493     | 14,648     |
| Bradfield . . . . .                                  | ..         | ..              | 17,972     | 15,691     |
| Abingdon . . . . .                                   | Thames     | ..              | 20,354     | 20,493     |
| Reading . . . . .                                    | Thames     | ..              | 43,485     | 33,340     |
| Wokingham . . . . .                                  | ..         | Blackwater .    | 20,005     | 16,195     |
| Cookham and Maidenhead . . . . .                     | Thames     | ..              | 16,934     | 14,873     |
| Easthampstead . . . . .                              | ..         | Loddon .        | 12,663     | 10,632     |
| Windsor and Egham . . . . .                          | Thames     | ..              | 32,064     | 26,725     |
| <b>MIDDLESEX—</b>                                    |            |                 |            |            |
| Staines and Sunbury . . . . .                        | Thames     | ..              | 23,782     | 20,199     |
| Uxbridge . . . . .                                   | ..         | Coln . . .      | 27,550     | 25,538     |
| Edmonton, Tottenham, }<br>Cheshunt, and Enfield }    | ..         | Lea . . .       | 139,188    | 84,853     |
| <b>HERTS—</b>  |            |                 |            |            |
| Ware . . . . .                                       | ..         | Lea . . .       | 18,624     | 17,460     |
| Bishops Stortford . . . . .                          | ..         | Stort . . .     | 21,799     | 21,620     |
| Hertford . . . . .                                   | ..         | Lea . . .       | 16,754     | 16,009     |
| Hatfield . . . . .                                   | ..         | Lea . . .       | 8,802      | 8,633      |
| St. Albans . . . . .                                 | ..         | Ver . . .       | 23,294     | 21,079     |
| Watford and Rickmansworth . . . . .                  | ..         | Coln . . .      | 31,276     | 27,172     |
| Hemel Hempstead . . . . .                            | ..         | Gade . . .      | 14,606     | 14,706     |
| Berkhampstead and Tring . . . . .                    | ..         | Gade . . .      | 15,090     | 14,099     |
| <b>BUCKS—</b>  |            |                 |            |            |
| Amersham . . . . .                                   | ..         | Chess . . .     | 18,314     | 18,511     |
| Eton . . . . .                                       | Thames     | ..              | 27,738     | 24,928     |
| Wycombe and Marlow . . . . .                         | Thames     | ..              | 40,284     | 38,366     |
| Aylesbury . . . . .                                  | ..         | Thame . . .     | 24,606     | 24,617     |
| <b>OXON—</b>   |            |                 |            |            |
| Henley . . . . .                                     | Thames     | ..              | 19,996     | 18,916     |
| Thame . . . . .                                      | ..         | Thame . . .     | 13,862     | 15,005     |
| Headington . . . . .                                 | Thames     | ..              | 28,717     | 22,756     |
| Oxford . . . . .                                     | Thames     | ..              | 21,900     | 21,016     |
| Bicester . . . . .                                   | ..         | Ray . . .       | 14,156     | 15,583     |
| Woodstock . . . . .                                  | ..         | Cherwell . .    | 13,320     | 14,070     |
| Witney . . . . .                                     | ..         | Windrush . .    | 21,534     | 22,905     |
| Chipping Norton . . . . .                            | ..         | Evenlode . .    | 17,958     | 17,938     |
| Banbury . . . . .                                    | ..         | Cherwell . .    | 30,121     | 31,208     |
| <b>BEDS—</b>   |            |                 |            |            |
| Luton and Dunstable . . . . .                        | ..         | Lea . . .       | 39,495     | 34,268     |
| <b>ESSEX—</b>  |            |                 |            |            |
| West Ham . . . . .                                   | ..         | Lea . . .       | 200,752    | 99,142     |
| Epping . . . . .                                     | ..         | Lea . . .       | 21,755     | 20,240     |
| <b>WILTS—</b>  |            |                 |            |            |
| Highworth and Swindon . . . . .                      | ..         | ..              | 35,736     | 25,679     |
| Cricklade . . . . .                                  | Thames     | ..              | 11,283     | 12,128     |
| Marlborough . . . . .                                | ..         | Kennet . . .    | 9,733      | 9,986      |
| <b>GLOUCESTER—</b>                                   |            |                 |            |            |
| Cirencester, Fairford, and }<br>Lechlade . . . . . } | Thames     | ..              | 21,310     | 21,314     |
| North Leach . . . . .                                | ..         | ..              | 9,884      | 10,584     |
| Total . . . . .                                      | ..         | ..              | 1,385,185  | 1,158,424  |

The gist of this long array of figures is, that the sewage

of nearly a million and a half of persons, and of a correspondingly large area of agricultural operations, drains more or less into the Thames. Mother Earth, doubtless, plays a great part in absorption, and there are occasional instances, such as Aylesbury, for instance, where the sewage is dealt with so as to leave a clear effluent water. But when all that is said and done, it stands to reason that a large proportion must eventually find its way into the river, and be a great bar to that purity of water which should be the birthright of every inhabitant of England. A collateral point worth notice in these figures is, that in every decade a constant migration is going on from the purely rural to the urban districts, and thus indirectly aggravates the difficulty by increasing the number of claimants for water.

## CHAPTER V.

### THE INCREASE OF THE WATER SUPPLY—

#### NORTH COUNTRY SCHEMES.

IT remains for us now to touch upon those schemes for increasing the water supply of London which are extraneous to, and have no connection with, the Thames basin. Such proposals are naturally of much more elaborate detail and greater magnitude, involving such considerable sums of money as would have taken the breath away of the earlier promoters and financiers of water schemes.

Vast as such undertakings would be to bring water to London from Wales or Cumberland, they must nevertheless be fairly looked in the face, more especially as they are not the suggestions of irresponsible enthusiasts, but the careful calculation of engineers who stand high in public estimation. I have endeavoured to show, in the last chapter, that whatever might be the quantity obtainable from the Thames, the quality must, from the very nature of things, be open to doubt. As regards chalk well sinkings, although a large extra supply would be yielded, it has never been satisfactorily shown that



the yield would be sufficient to supply all the demands made upon it. The inference seems to be, that, sooner or later, Londoners will have to go farther afield for their water requirements—and although ten or fifteen millions sterling is a large sum to disburse, it is a mere trifle to what we waste in other and less profitable ways. Water must be had, and it ought to be had of the very best quality possible. It does not become a great and wealthy community such as constitutes Greater London to haggle over the price for an article which is necessary to life and well-being, nor does it look well that prominent towns which do not possess a tithe of the population, or the riches of the metropolis, should willingly spend in obtaining pure water much vaster sums in proportion, than London would ever be called upon to disburse; and when we consider that there is an inexhaustible supply to be had, practically free from contamination, except that of nature's own preparing, and absolutely free from sewage pollution, it is a marvel that such apathy should exist on the part of London's inhabitants.

One of the most considerable of the proposed distant schemes was that of Mr. Bateman, who selected as his *venue* the mountainous districts on the boundaries of North and South Wales, for the reasons that the rocks are hard and impenetrable, that there is little or no cultivation, that the population is very small and scattered, that it would be easy to make storage reservoirs, and that, on account of the elevation, no pumping would be required. The particular district which

he advocated was, that large area on the eastern slopes of Plynlimmon, which supplies the head waters of the Severn, and forms also the gathering grounds of the Tylwch, Clywedog, Carno, Ceryst, and Tarannon rivers. The upper drainage ground of the Vyrnwy and the Banw would also be secured. There would be two separate areas of mountain draining ground, the northern embracing 104 square miles, and the southern 100, a total of 204; and should these not be sufficient, he proposed to include the head waters of the Wye, which would be an additional area of 180 square miles, believing that an available daily supply at the rate of 111,000,000 gallons for the north, and 108,000,000 for the south district, would be easily obtained, and that the amount might even be increased to 300,000,000 gallons. Mr. Bateman, indeed, thinks, and rightly, that no scheme of water supply to the metropolis should be entertained in which the estimate does not reach at least 200,000,000 gallons, and that the time is not far off when a still larger quantity will be needed. He proposed to build large reservoirs, viz., four in the north district, with a capacity of 3,494,000,000 cubic feet, and three in the south, with a capacity of 3,215,000,000. The rainfall of the district he calculated at 75 inches, but taking the mean of three consecutive years, he considered that 60 inches would be nearer the mark. A further deduction would have to be made for loss by evaporation and absorption, leaving an available rainfall of 48 inches.

From the reservoirs, separate conduits would converge to a central point at Marton Mere near Montgomery, from whence an aqueduct would cross the Severn at or near Bridgenorth, and pass near Stourbridge, Bromsgrove, Henley-in-Arden, Warwick, Banbury, Buckingham, Aylesbury, Tring, Berkhamstead, and Watford, discharging its contents into a large reservoir at Stanmore, 10 miles north-east of London. The total distance is 180 miles. The aqueduct should be an open canal, lined with masonry, tunnelling where necessary, and carried across the valleys by syphon pipes, and should be capable of conveying a daily quantity of 230,000,000 gallons. It would be quite possible to supply *en route* towns such as Birmingham, Wolverhampton, Dudley, Walsall, and the Black Country generally, which would contribute their quota to the standing expenditure. From Stanmore Mr. Bateman proposed to convey the water by large mains to the existing store reservoirs of the various Companies, though at the same time he would re-arrange the metropolitan districts, dividing them into four, so as to suit the levels of the smaller reservoirs. It would be necessary, as part of such an extensive scheme, that the interests of the existing corporations should be purchased, and that the whole water supply be vested in a public body, who should have power to levy compulsory rates. The cost for supplying a daily quantity of 130,000,000 gallons, he estimated at £19,000,000, and for an increased supply of 230,000,000 gallons, his estimate was £25,000,000. This

certainly is a startling sum at first blush, but it is not really more, or so much as Glasgow or Liverpool have proportionately incurred, or are incurring. He placed the water compensation to existing streams at one-fourth, and believed that sufficient water could also be impounded for this purpose, from the heavy floods that are so common in this part of the country, from 500 to 1000 times greater than the dry weather flow. Moreover, by so impounding, the destructiveness of the floods through the valleys would be greatly diminished, and a more serviceable volume of water obtained during the dry seasons, so that eventually the country of these watersheds would be greatly benefited. Considering the magnitude of the scheme, there were comparatively few objections to it—one being, that Mr. Bateman's estimate of the rainfall was too high—others, that mountain water is liable to be coloured by the peat; that being very soft, it would have a prejudicial action upon lead; that the opposition would be very severe on the part of the Severn fishery owners and other river interests; that an aqueduct of such length would be liable to injury from freezing, landslips, or malice; that the reservoirs might burst and cause terrible devastation, as happened at Sheffield when the Bradfield reservoir burst in 1864, etc. These objections would probably have been soon met—the real one being, that the outlay was considered too large.

The fact of the aqueduct being an exposed canal, seems to be one of the points most open to cavil; for,

however pure the water at the outset, no power on earth can prevent the careless, wilful, or accidental pollution in some part of its long course, and undoubtedly this source of mischief would be serious, though it might be prevented by the water being taken through closed conduits.

A second great scheme was that propounded by Messrs. Hemans and Hassard, and was still more ambitious, inasmuch as the distance of the water conveyance was greater, though the proposal involved the tampering with some of the finest scenery in the Lake district. The lakes of Thirlmere and Hawes Water were to be dammed, so as to raise the level of the one by 64 feet, and of the other by 42, in addition to which piece of profanity Ullswater was to be tapped at its upper or southern end, and the water taken from thence through a tunnel under Kirkstone Pass, and afterwards by gravitation to London. The area of supply would be—

|                                 |                  |
|---------------------------------|------------------|
| Thirlmere . . . .               | 44 square miles. |
| Hawes Water . . . .             | 38 „             |
| Ullswater . . . .               | 95 „             |
| The slopes of the hills . . . . | 53 „             |
|                                 | <hr/>            |
| Total . . . .                   | 230              |

The rainfall is estimated at from 83 to 100 inches; but the promoters only took 64 inches, less 14 for evaporation = 50 inches, for their standard, which would produce on the 177 square miles of the three lakes a daily supply of 350,000,000 gallons; of this quantity, 63,000,000 gallons were allowed for compensation purposes (equal

to 9 inches of rainfall), leaving an available yield of 287,000,000. The savage beauties of Ullswater were to be manipulated by raising the level of the lake 5 feet, and lowering it 20 feet at pleasure. The whole water storage would be 5,563,000,000 cubic feet, sufficient for 120 days' supply at 250,000,000 gallons, or 157 days at 200,000,000. The length of the water tunnels and conduits would be 270 miles, the tunnel through Kirkstone Pass being  $7\frac{1}{4}$  miles. The conduit was proposed to be equivalent to a river 30 feet in breadth and 10 in depth—and to have its course by Ambleside and Kendal through East Lancashire, avoiding the coalfields of Manchester and Wigan and the Potteries, which it would skirt near Stoke. At this point there was to be a reservoir, to which a large feeder was planned to bring the water from Bala Lake in North Wales—the reservoir to be capable of holding twenty-one days' supply, and thus increase the London delivery about 60,000,000 gallons per diem. The terminus of this great lake scheme was to be in a large regulating reservoir at Edgware, 12 miles from Hyde Park Corner, and 232 feet above Ordnance datum, this reservoir to contain fifteen days' supply, at the rate of 250,000,000 gallons consumption.

Notwithstanding the increased distance and the greater number of details, the estimated cost of the Ullswater scheme was not so large as that of Mr. Bateman. It was as follows :—

|   |             |
|---|-------------|
| Reservoirs and collecting water . . .   | £1,010,000  |
| Kirkstone Pass Tunnel . . . . .         | 360,000     |
| Aqueduct to London . . . . .            | 9,806,260   |
| Regulating reservoir at Edgware . . .   | 500,000     |
| Interest during construction of works . | 1,820,740   |
|   | <hr/>       |
| Total . . . . .                         | £13,497,000 |
|   | <hr/> <hr/> |

The objections raised to the scheme of Messrs. Heman and Hassard were of the same nature as in the previous case, with the rather important addition that the district might be claimed as more properly belonging to the northern towns, and that no town or city should assert the right to a geographical gathering ground, which, from its natural position, might be beneficial to another.

A third proposal emanated from Mr. Hamilton Fulton, whose idea was to secure the waters of the Wye in Mid-Wales, a district which was somewhat scantily populated, and which contained few or no manufacturing establishments to raise opposition. He mapped out his sources of supply into four areas, of 440 square miles in the aggregate, the first alone of which would yield (after 40,000,000 gallons were deducted for compensation) 130,000,000 gallons daily. The whole of the four districts would produce 393,000,000 gallons. Six reservoirs would be formed near Rhayader, and the water taken to London by a conduit of 180 miles in length, through Glasbury, Hay, Kington, Ludlow, Tenbury, Bewdley, Stourport, Bromsgrove, Warwick, Tring, and Watford, ending in a final reservoir at Barnet.

The cost for the daily supply of 130,000,000 gallons was estimated at only £7,000,000.

Finally, there was Mr. Remington's proposal to bring water from the Derbyshire hills, near Mill Dale on the Dove, by a conduit ending also at Barnet, a distance of 135 miles. The area of the gathering ground was estimated at 262 square miles, the daily supply delivered at Barnet at 100,000,000 gallons, and the cost at £5,000,000.

These, it must be confessed, form a tolerable crop of schemes, near home and far from home, to which the London water question has given rise. It is extremely likely that similar schemes will be proposed ere long, and that one of them will be adopted, for the very good reason that a change of some kind will eventually be necessary, and that it need not be looked upon as in any way superseding the arrangements of the present supply. It cannot be too strongly urged upon Londoners that it is to their vital interest to procure the very best supply that can be got, no matter at what price, and it would be unwise to tamper with such a momentous question for the sake of saving a few thousands a year. The old saying, *ἄριστον μὲν ὕδωρ*, will bear a double interpretation—that water is at once the best thing, and that the best only must be used.



## INDEX.

ANALYSIS of water supply, 37  
Ancient water supply, 1

BACK dividends, 39  
Bailey Denton scheme, 96  
Barlow scheme, 98  
Bateman scheme, 105  
Board of Health inquiry, 24  
Bostock, Dr., evidence, 10  
Bowie, Mr., evidence, 23  
Bravender scheme, 96  
Broad Street epidemic, 31

CHELSEA waterworks, 53  
— basis of rating, 56  
— charges, 56  
— district, 54  
— finances, 55  
— history, 53  
— working arrangements, 54

Cholera epidemic, 1828, 20  
— 1849, 22  
— 1854, 26  
— 1866, 34

Clerks' well, 6  
Companies' mains, 86  
Conduits in Old London, 8  
Constant supply table, 85  
Corfield, Prof., remarks, 36  
Corporation water bill, 87  
Cost of water per house, 82  
Cross, Sir R., proposals, 38

DANGER of gathering grounds, 90  
Dobbs' case, 83, 84  
Dolphin pamphlet, 18

EARLY legislation, 16  
East London waterworks, 70  
— basis of rating, 73  
— charges, 74  
— constant supply, 72  
— district, 72  
— finances, 73  
— history, 70  
— working arrangements, 71  
Ewens' scheme, 100  
Existing water companies, 42

FARR, Dr., report, 26  
Fleet Ditch, 4  
Frankland, Prof., on contamination,  
35  
Fulton's scheme, 111

GENERAL water supply, 85  
Grand Junction waterworks, 78  
— basis of rating, 83  
— charges, 83  
— district, 80  
— Dobbs' decision, 83, 84  
— finances, 81  
— history, 78  
— working arrangements, 80  
Growth of Thames population, 91

HAMPSTEAD waterworks, 46  
Hawksley's scheme, 95  
Hemans' and Hassard's scheme, 109  
Henley's scheme, 94  
Hennell's scheme, 100  
Hogg, Mr., on gathering grounds, 90  
— Lea Valley, 92

- Holy Well, 5  
 Homersham's proposals, 100  
 Houses, 1820-27, 19
- INSPECTION of Companies, 37
- KENT waterworks, 74  
 — basis of rating, 77  
 — Chalk wells, 76  
 — charges, 77  
 — district, 76  
 — finances, 76  
 — history, 75  
 — special acts, 77  
 — working arrangements, 75  
 Kentish Town well, 47
- LAKE scheme, 109  
 Lambeth waterworks, 56  
 — basis of rating, 60  
 — charges, 61  
 — district, 58  
 — finances, 59  
 — history, 21, 57  
 — working arrangements, 57  
 Langbourne water, 5  
 London and Medway scheme, 99
- MAPLEDURHAM scheme, 95  
 M'Neil's scheme, 97  
 Merchants' waterworks, 13  
 Metropolitan Association, 100  
 Milroy, Dr., evidence, 23  
 Morrice, Peter, 9  
 Myddleton, Sir Hugh, 11  
 Mylne's scheme, 99
- NECESSITY for increased supply, 104  
 New River Company, 11, 42  
 — basis of rating, 52  
 — capital, 49  
 — charges, 51  
 — district, 44  
 — finances, 50  
 — Hampstead waterworks, 46  
 — history, 11, 42  
 — Kentish Town well, 47  
 — King's shares, 48  
 — property, 47
- New sources, 43  
 — special Acts, 51  
 — working arrangements, 43
- PEERLESS Pool, 7  
 Ponds in Old London, 6  
 Population of Upper Thames, 100  
 Proposed purchase, 37  
 Pym's scheme, 97
- QUEEN'S River scheme, 97  
 Quick's scheme, 95
- REMINGTON'S scheme, 112  
 Report of 1821, 16  
 Richmond well, 65  
 River of the Wells, 2  
 River Pollution Commission, 36  
 Royal Water Supply Commission,  
 17
- SIMON, Mr., report, 27  
 Skinners' Well, 6  
 — miracle plays, 6  
 Soane, Richard, 10  
 Southwark and Vauxhall water-  
 works, 62  
 — basis of rating, 66  
 — charges, 66  
 — district, 64  
 — finances, 66  
 — history, 62  
 — Richmond well, 65  
 — working arrangements, 63  
 Stephenson's scheme, 94
- TELFORD'S scheme, 93  
 Thames basin scheme, 93  
 — population, 100  
 — springs, 97  
 Thompson's scheme, 99  
 Ty Bourne, 7  
 Tyburn Head conduit, 8
- UXBRIDGE water scheme, 12
- VAUXHALL waterworks, 61  
 Veitch, Capt., scheme, 98
- WALL Brook, 5

- Water Act 1852, 25  
— Companies, 14  
— rights, 86  
Water supply 1850, 22  
— 1856, 32  
— 1871-79, 41  
— 1884, 85  
Waterworks Act, 37  
Watford spring water scheme, 94  
Welsh scheme, 105
- West Middlesex waterworks, 67  
— basis of rating, 69  
— charges, 70  
— district, 68  
— finances, 69  
— history, 67  
— working arrangements, 67  
Wright's pamphlet, 112  
YORK Buildings' waterworks, 12

THE END.





