GEOLOGICAL SURVEY.

ENGLAND AND WALES.

THE WATER SUPPLY OF HAMPSHIRE

(INCLUDING THE ISLE OF WIGHT),

WITH RECORDS OF SINKINGS AND BORINGS.

BY

WILLIAM WHITAKER, B.A., F.R.S.,

WITH CONTRIBUTIONS BY

HUGH ROBERT MILL, D.Sc., LL.D.,
W. MATTHEWS, M.Inst. C.E.,
AND
J. C. THRESH, M.D., D.Sc., D.P.H.

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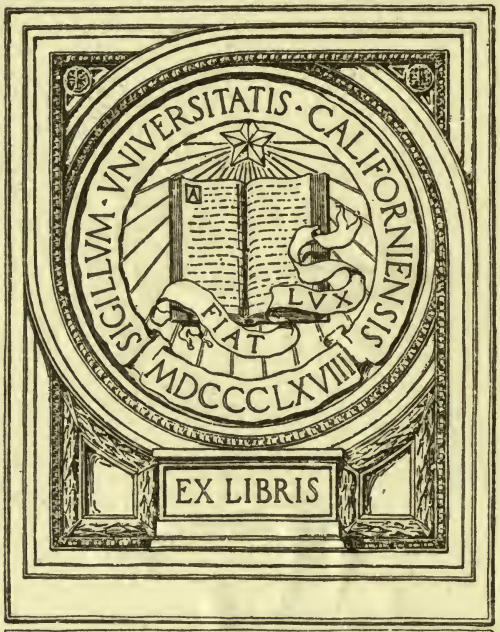
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PREFACE.

This is the eighth of the series of County Memoirs dealing with the water-supply derived from underground sources. We are indebted for its preparation mainly to Mr. Whitaker. Dr. Mill contributes a useful chapter and map illustrating the distribution of rainfall, Mr. Matthews furnishes a map of underground water-contours in the valleys of the Test and Itchen with an explanation, besides other notes, and Dr. Thresh has supplied us with a great number of detailed analyses of water.

In the preparation of the volume the various sources of published matter have been utilised, such as Geological Survey Memoirs, Reports of the Local Government Board, various books, papers in Scientific Journals, &c. By far the greater part of the description of springs and bournes has been derived from the papers of the late T. W. Shore.

A large amount of new matter also has been included, and in this engineers, well-sinkers and others have given much information. The assistance also rendered by chemists, medical officers, business-firms and private persons is duly acknowledged under various headings. To the Local Government Board through Dr. H. Franklin Parsons we are indebted for much information in the possession of that Board. Mr. H. L. Whitaker has helped greatly in the preparation of the MS. and the correction of proofs, and is chiefly responsible for the Index.

J. J. H. TEALL,
Director.

Geological Survey Office,
28, Jermyn Street, London,
19th February, 1910.

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General Remarks.

Hampshire is in a somewhat peculiar position amongst English counties, in that a large part of it, the Isle of Wight, is distinctly separated from the rest by a marked natural feature, a fairly broad and deep channel of tidal water, part of the sea, and not a mere river-estuary.

This natural division has led to a division for many administrative purposes, and it will be followed in this Memoir, as far as regards the detailed description of wells and waterworks, which are more or less of an administrative character.

On the other hand, the general remarks will refer to the county as a whole, for geologically the Isle of Wight is connected with the mainland (though the connection is an undersea one) and does not form a distinct area, except of course at the surface. Geology is not merely skin-deep, but deals with deep-seated connection, and markedly so in the case of underground water.

In another point also, I believe, Hampshire is unique amongst the counties. Some of its supply, though but a very small amount, is actually got from wells in the sea, the forts in the Spithead channel having deep borings for their supply. We have, therefore, a third territorial (or rather marine) division between the mainland and the Isle of Wight, and linking those two together, as far as water-supply is concerned.

In the matter of water-supply, Hampshire is notable for possessing the largest spring-supply in the kingdom, that of the Borough of Portsmouth Water Co. Although the springs are supplemented by borings, yet as these are in the basins from which the springs flow, or close to them, they are really only artificial enlargements of the springs. This supply is unique amongst large water-undertakings. As far as I know, there is no other case of a very large supply derived wholly from springs. It is, moreover, the largest in the county, and indeed in Southern England, with the exception of London and Bristol.

All other large supplies in the county are got by means of underground work; but from 1851 to 1888 Southampton, the second in size of Hampshire towns, got its supply from the River Itchen. Bournemouth, the third town, used to get its supply from shallow intakes close to the River Stour, which was practically a river-supply; but this town has now turned to a well-source in another county, though still keeping the older supply. Christchurch, however, takes its supply from the River Avon, though an attempt has been made to get a well-supply.

From the point of view of water-supply Portsmouth is the chief town of Hampshire, its population of over 211,000 placing it as the second of southern towns (after Bristol), of course leaving London and its contiguous boroughs out of consideration. Although the population of the three contiguous Devonshire towns, Plymouth, Devonport, and Stonehouse, slightly exceeds this figure (being over 218,000), the comparison is hardly fair, and to

make it so the population of Gosport should be added to that of Portsmouth, which gives a total of 243,000.

Southampton is the only other Hampshire place that comes in the list of what were lately known as "large towns," that is, towns with a population of over 100,000, its present record being over 122,000, or about 80 more than the record for Plymouth by itself. Here again, however, there is a populous area contiguous to but outside the borough. Brighton is the only other southern town (outside London, &c.) which exceeds Southampton in population, and so the latter ranks as fourth, though strictly it should give place to Plymouth, &c. and sink to the fifth place.

Bournemouth, with over 70,000 people, is the only other town in the county to reach a population of 50,000, so as to be placed amongst the "76 great towns" of which the weekly death-rate is regularly returned by the Registrar-General. It also has a large contiguous population just over the county-border, in Dorset.

Of towns with over 10,000 there are Aldershot (35,000), Gosport (over 31,000), Winchester (over 21,000), Itchen (=Woolston, &c., adjoining Southampton, over 16,000), Farnborough (14,000), Eastleigh (nearly 13,000), Basingstoke (11,000), and in the Isle of Wight, Newport (over 11,000), and Ryde (11,000).

The above figures have kindly been given by the Registrar-General. They are estimated for the middle of the year 1908, and so are probably slightly less than the present population. Of course estimates so far removed from a census must be taken with caution. I have omitted the odd hundreds, therefore.

Of course areas of population, such as those above given, are rarely coterminous with areas of water-supply. In some cases, as for instance Southampton, the whole town is not supplied by one water-authority; but this is not the usual difference, for generally the waterworks of a large place supply neighbouring tracts, as Portsmouth supplies Havant. Any town getting its supply from a distance is usually (and rightly) put under the obligation of supplying at a reasonable rate places through which its mains pass, or in which it has works, and by this means a supply is sometimes given to villages that are too small to get an independent supply.

We have in Hampshire a good example of a Company with widely extended limbs, giving a supply to towns and villages, including part of Southampton and the whole of the populated area round that town, with excellent results. This has led to the closure of many local wells, some of which may have been defective from a sanitary point of view, whilst others, though yielding good water, were troublesome or expensive to work and to keep in order. Reference is made, of course, to the South Hants. Water Co.

In another part of the county a large district is included in the area of supply of the Frimley and Farnborough Company.

Geological Formations.

Hampshire is based on two of the great series of sedimentary rocks, the Tertiary and the Cretaceous, the former comprising on the north a small part of the London Basin and in the central and southern parts a great tract of what is known as the Hampshire Basin

though it extends eastward and westward from the county. The Cretaceous beds rise up between the two basins, and also on the south of the Hampshire Basin, chiefly in the Isle of Wight.

Of the Tertiary beds, Hampshire has the most complete series of any county, being the only one in which the great Fluviomarine Series (above the Barton Beds) occurs. It fails only indeed in the absence of the highest beds, the Pliocene (Crag) of the Eastern Counties and of the lowest bed of all, the Thanet Sand: both of them, however, are comparatively thin, at the most.

The Cretaceous beds also are very well represented (although the base is not seen) and the county ranks among the highest in this respect, the coast-sections of the Lower Greensand in the Isle of Wight being the best display of that varying formation which we have.

Of course there are also sheets and scatterings of various surface-deposits resting irregularly on any of the Tertiary or Cretaceous beds; but amongst them the Glacial Drift does not figure, as far as we know. What age may some day be assigned to the patches of old gravel on the hills one cannot foresee. These may be Glacial or Pre-Glacial in age.

The following is a list of the geological formations of the county, from the top downward :—

Recent (Marine or Shore) ...		Blown Sand. Shingle.
Alluvial Beds		Tufa. Peat. Alluvium. Raised Beach (Portsdown).
River or Valley Drift		Brickearth. Gravel and Sand.
Deposits of doubtful age, on the Chalk		Clay with Flints, and Loam, or Tertiary Débris. Angular Gravel of the Downs (in I. Wight).
Older Drift, of doubtful age ...		Hill or Plateau Gravel and Sand (Brickearth above, rarely).
Oligocene Tertiaries.	Fluviomarine Series.	Hamstead or Hemstead Beds. Bembridge Beds, with Limestone. Osborne and Headon Beds, with Limestone.
Eocene Tertiaries.	Bagshot Series.	Upper Bagshot, or Barton, Sand. Barton Clay. Bracklesham Beds. Lower Bagshot Pebble Beds. " " Sands.
	Lower London Tertiaries.	London Clay. Pebble Beds [possibly Blackheath]. Woolwich and Reading Beds.
Upper Cretaceous.	Chalk.	Upper Chalk, with Chalk Rock at the base. Middle Chalk, with Melbourne Rock at the base. Lower Chalk. Chalk Marl, with Chloritic Marl at the base.
	Upper Greensand.	Chert Beds. Freestone and Soft Sands. Gault.
Lower Cretaceous.	Lower Greensand.	Folkestone Beds. Sandgate Beds. Hythe Beds. Wealden Beds, or Weald Clay and Hastings Sands.

Upper Greensand and Gault now grouped as Selbornian.

In the Isle of Wight the divisions of the Lower Cretaceous beds are as follows :—

Lower Greensand.	Carstone. Sandrock Beds. Ferruginous Sands. Atherfield Clay, with Perna Beds.
Wealden.	Shales. Sandstone. Variegated Clays.

The Wealden beds therefore are the oldest that come to the surface in Hampshire, and I do not know of any direct evidence to show what formation comes next beneath ; but there is little doubt that the Purbeck Beds range under the sea from Dorsetshire to the Isle of Wight.

In the north-western part of the county, whilst we may fairly assume that the Upper Greensand, the highest formation seen, will rest on Gault, we have little ground for speculation as to what would be found beneath the Gault.

As to the extension or otherwise of Lower Jurassic and of all older rocks under Hampshire we have no evidence, no ground for speculation : there is an absence of deep borings in those parts where (geologically) they are most wanted.

Water-bearing Formations.

Blown Sand and *Shingle.* Of these highly permeable beds there is no broad spread in the county ; so that they may be disregarded as a source of supply.

Drift. The various gravels and sands of this Series are also very permeable and sometimes they occur over large tracts ; but they are nowhere of great thickness and therefore do not afford storage on anything but a small scale. They are also liable to pollution from the surface. However, where a goodly area can be brought under contribution and can also be protected from pollution, a supply may be got, at all events enough for small local needs. Where these beds rest on another permeable formation, of course water goes through them and gets considerable filtration in so doing. Where they rest on clay, springs are often thrown out at the junction, if it is on a downward slope. I believe that West Cowes is the only town that gets a supply from a terrace of gravel, though now not exclusively. Bournemouth used to get its supply through gravel abutting on a river.

Fluviomarine Series. There are occasional sandy beds and limestones, from which small springs may flow and from which small local supplies may be got ; but the Series as a whole may be passed over as of no importance.

Bagshot Series. This is of more importance, from a water point of view. The top division, being mostly all sand, is permeable, and sometimes may yield a moderate amount of water. There are also sands in the Bracklesham Beds, sometimes of fair thickness, though hardly of constant occurrence. The bottom division, largely consisting of sand (and wholly so in many parts) forms a water-bearing bed : the pebbles at the top, which are of very local occurrence, going with the sand.

Lower London Tertiaries. Where there are sands or pebble-beds small supplies may be found; but as a whole the Series is clayey.

Chalk. This is the great water-yielding formation of this county, as of the whole south-eastern tract of England. From its general breadth of outcrop it is well adapted for collecting the rainfall in large quantity, and from its thickness it is well fitted for storage. In the northern half of Hampshire we have the broadest tract of bare Chalk in the Kingdom, right across the county, from the border of Wiltshire on the west to that of Surrey on the east. We have also the greatest thickness of the Chalk known (calculated at over 1700 feet); but this is in the Isle of Wight, where, from the high dip of the beds, the outcrop is in great part very narrow. The thickness elsewhere however is great, as may be seen from the one boring that nearly pierces the Chalk from top to bottom, at Southampton Common (*see* p. 127), where the thickness is over 850 feet, whilst at Portsmouth (*see* p. 118) a boring has passed through some 626 feet, apparently all belonging to the Upper Chalk.

The Chalk is not strictly a very permeable formation, that is to say, no very great amount of water filters through between the particles. The water is mainly distributed by means of the vertical or nearly vertical planes of jointing which cut across the rock in various directions: where these fissures open out at all there may be large quantities of water passing along them, and the way to ensure a large supply therefore is to carry out works in such way as to cut as many fissures as possible, that is by horizontal extension below the plane of saturation, or water-table; in other words to drive galleries. There is also sometimes a flow along planes of bedding, and where there are clayey layers, as is often the case at the base of the Middle Chalk and in the Lower Chalk, this may be considerable. As a rule, however, there seems to be communication throughout the formation, and the hindrance to downward percolation is more or less local.

Mr. W. R. Baldwin-Wiseman has lately given some interesting particulars as to the structure of various rocks in relation to the flow of water through them, and amongst these rocks Hampshire Chalk is included.

In his earlier paper[1] he deals with the flow of water through samples of the rocks under various pressures, and he finds that "with the chalk a peculiar phenomenon occurs: with the Mottisfont chalk there is a steady decrease of flow per unit pressure between 5 lbs. and 20 lbs. per square inch, succeeded by a steady increase between 20 lbs. and the pressure under which it failed; with the Micheldever chalk there is a small increase between 5 lbs. and 10 lbs. per square inch, followed by a decrease between 10 lbs. and 15 lbs. . . . succeeded by another small increase between 15 lbs. and 20 lbs. . . . which in turn gives place to a continuous decrease until the load of rupture is reached. The probable explanation of this phenomenon is that the flow increases with the pressure up to a critical velocity, beyond which any increase of pressure is expended in eddies and in the enlargement of the pores."

[1] *Proc. Inst. Civ. Eng.* 1906, vol. clxv.

The following is the loss of pressure in a six-inch block of Micheldever chalk under a surface-pressure of 40 lbs. per square inch, expressed as a percentage of the surface-pressure.

Between	surface	and	one inch	down		7
„	1 inch	and	2 inches	„		3·7
„	2 inches	„	3	„	„	5·3
„	3	„ „	4	„	„	5·2
„	4	„ „	5	„	„	8·
„	5	„ „	6	„	„	70·8

From this "it appears that water experiences little difficulty in obtaining ingress to chalk but considerable resistance to its egress. Disregarding the effect of cushioning air, which only operates when chalk is more or less thoroughly depleted of its water, the capillarity of the chalk appears to accelerate the inflow of water and to impede its discharge, although it assists in the desiccation of the chalk by evaporation when the chalk is more or less fully charged with water."

He found that "two upper chalk specimens, from Mottisfont and Micheldever, contained 2·86 and 2·92 gallons per cubic foot respectively," and he conducted experiments on immersion which resulted in "proving conclusively the obstructive action of air in the pores," against the passage of water. "Not only does the air in the interstices offer resistance to the inflow of water, but once in the rock mass it will cause or tend to cause instability of water-level, since it is much more susceptible to variations of pressure and temperature than the interstitial water."

The Mottisfont chalk was got at the Abbey, some distance below the surface; the Micheldever chalk from the eastern side of the line at the southern end of the railway-tunnel, about 100 feet below the surface.

The flow in gallons per hour per square foot of exposed surface, in specimens six inches thick, was as follows :—

Lbs. per square in.	Feet of Water.	Atmosphere.	Mottisfont.	Micheldever.
5	11·59	·34	·247	·277
10	23·08	·68	·43	·564
15	34·61	1·02	·613	·83
20	46·15	1·36	·795	1·117
25	57·69	1·7	1·01	1·341
30	69·23	2·04	1·268	1·596
35	89·77	2·38	1·655	1·851
40	92·31	2·72	—	2·085

The following figures are also from test-pieces six inches thick, the net volume of each being ·393 cubic feet, various other particulars being given.

	Mottisfont.	Micheldever.
Mean diameter of constituent particles, in inches	·0088	·0058
Total volume of pores, in cubic feet	·18	·184

Other tables are given, showing the quantity of absorption, the rate of drying, etc., and some particulars of the supplies for Ryde, Frimley and Southampton.

The following particulars are from Mr. BALDWIN-WISEMAN'S later paper.[1]

Rate of Absorption of Water by Chalk, the Water absorbed expressed as a Percentage of the volume of the stone. Continuous immersion in water at atmospheric pressure.

Hours immersion.	Mottisfont.		Micheldever.	
	1	2	1	2
·5	36·26	35·41	39·77	36·13
1·	36·53	35·81	40·23	36·49
4·5	36·96	36·61	40·29	36·99
47·	39·51	38·16	42·39	38·88
Maximum saturation	45·86	—	46·79	—
Weight of Chalk, dry	34·65	36·34	113·94	187·15

The following figures are for specimens of chalk six inches thick :—

Percentage porosity,	Mottisfont	45·86	Micheldever	46·79
Gallons stored when charged	„	1·43	„	1·46

Figures of discharge under various pressures are also given.

The plate is a sketch-map showing the sub-surface water-levels in the Chalk, chiefly in Dorset and Wilts., but also along the south-eastern border of Hants., from a little north of Fordingbridge, by Ringwood. The 50 and 100 feet underground contours are however barely extended into the county.

Information collected by Mr. C. E. HAWKINS and Mr. H. J. O. WHITE concerning the wells in the Chalk-area of sheet 284 of the Geological Survey Map goes to show that the underground water-plane "there lies generally between 270 and 300 feet above Ordnance Datum, but is rather higher (315 to 320 feet) beneath the summit of the southern range of downs, about Farleigh Wallop and Herriard. A comparison of the height of the water-table in the wells in the latter part of the Chalk country with the height of the nearest springs at the Eocene boundary to the north, shows that the (under) ground water surface has a northward gradient varying from 10 to 20 feet per mile" (Geology of Basingstoke, p. 105).

Upper Greensand.—This formation is not without importance in the matter of water in Hampshire, where it is ever present at the base of the Chalk, and, on the south (in the Isle of Wight) is of considerable thickness. It is from the water passing down through the sandstone and sand to the underlying impermeable clay of the Gault and then flowing out as springs along the cliffs that there has come about the great landslip, known as the Undercliff, at and near Ventnor. Here for a length of some miles along the coast and a breadth of sometimes about half a mile, the whole of the wonderfully irregular surface consists of slipped and fallen material, a witness to the power of underground water as an aid to the shifting of rocks in mass.

I do not know of any large supply that is got from the Upper Greensand, which is suited rather for a number of small supplies, its outcrop being narrow.

[1] *Quart. Journ. Geol. Soc.*, 1907, vol. lxiii., pp. 83, 88.

Lower Greensand.—This is the second water-bearing formation of Hampshire ; but it is of far more varying structure and changing character than the Chalk. In the mainland part of the county the Folkestone Beds at the top are mostly sand and very permeable. The next division, the Sandgate Beds, is either clayey or contains clayey beds, with others of a sandy nature, and therefore divides the water in the Folkestone Beds from that in the Hythe Beds beneath, which are also mainly sandy. The Atherfield Clay, at the base, for present purposes goes with the underlying Weald Clay.

The only outcrop on the mainland is at the eastern side of the county. In treating of this Mr. J. Lucas has remarked :—" At Lyss there is a dome of water in the Folkestone sands culminating at 238 feet, at Greatham another at 253 feet ; while a strong ridge shedding south-west to the Rother basin, and north-west to the Wey, runs north-west and south-east through Oakhanger, Blackmoor and Woolmer Pond to Weaver's Down, rising from 250 feet at Oakhanger to about 320 feet at Weaver's Down. The 250-feet contour [of underground water] sweeps round Oakhanger, and then runs as an artesian contour in a south-easterly direction for 3 miles to the Farnham Road at the northern boundary of Greatham parish . . . Woolmer Pond is in the anomalous position of being on the subterranean watershed ridge . . . In the Sandgate beds there are many shallow wells . . . The 250-feet contour [of underground water] of the Hythe beds water system is artesian under the Sandgate beds from Stanford for 3 miles south-west by south to a mile east of Lyss."[1]

Table 1 of this paper notes many wells in the tract described, but without any geologic information. The heights above Ordnance Datum, the depths of the wells and the water-levels above Ordnance Datum are given. The wells are entered under Greatham (3) Woolmer Forest (?2), Selborne (4), Bramshot and Liphook (6), Hogmoor, Headley (2), Arford (2), Greyshott (2), Hearn (8) and Kingsley. The plate is a map, with sites of wells and underground water-contours from 220 to 280 feet, at intervals of 10 feet, and at 300 feet.

In the Isle of Wight, where the whole Series varies from 400 to 800 feet in thickness, all the beds, down to the Atherfield Clay, form one great water-bearing deposit, being permeable, except for sundry local layers of clay.

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[1] *Proc. Inst. C. E.*, 1880, vol. lxi., pt. iii

RAINFALL.

(Plate 1.)

BY

HUGH ROBERT MILL, D.Sc., LL.D.

Director of the British Rainfall Organization.

The accompanying map, showing the average distribution of rainfall over Hampshire, has been prepared in the same manner as the maps of Kent and Sussex, which it continues towards the west. The data from which it has been compiled were collected annually from the observers and published in "British Rainfall" after being subjected to critical examination. In order that the map may be strictly comparable with those already published the same period of 35 years (1868–1902) has been adopted for the calculation of the average, although data down to 1907 computed to the longer period have been utilized in some instances of short records. Within Hampshire, or on its borders, there are continuous records of rainfall extending over 35 years at 14 stations. The mean values of these are of course available for placing on the map without modification; but in order to get the best possible distribution of stations it was necessary to make use of 148 shorter records in the county. The mean of the short records was in each case corrected to its probable value for 35 years by comparison with the long records running through the whole period.

For this purpose the total rainfall for each year for each of the long records was calculated as a percentage of the average of 35 years, and these were combined in four groups representing respectively the Southern Plain, the Valleys of the Test and Itchin, the Uplands, and the Northern Plain. Each group as given in Table I. represents the variation of rainfall from year to year in the part of the county to which it refers. The fifth column in the Table, giving the mean of the four preceding columns, is the best possible index of the variation of rainfall over Hampshire as a whole, and, for convenience, it is extended to include 1907.

It will be noticed that the seven years 1868–1874 had a mean rainfall exactly equal to the average of 35 years, though containing both the wettest and the driest year of the 35. For nine consecutive years, 1875 to 1883, the annual rainfall was never below the average and the mean of the nine years showed an excess of nearly 12 per cent. Finally it will be seen that from 1888 to 1905 there was a regular succession of one wet year followed by two dry years and for the 15 years 1888–1902 the mean annual rainfall was 5½ per cent. below the average. These periods occur fairly uniformly over the whole of the South East of England at least.

The wettest year of the 35 was, as in most parts of the country, 1872, when there was an excess of 36 per cent; but 1903, as in most parts of the South of England, proved still wetter with 43 per cent. excess. The driest year was 1870 when there was a deficiency of 24 per cent., although 1887, which was the driest year in most parts of the country, came very little behind, with a deficiency of 23 per cent.

The various short records were corrected to the long-period average by the ratios holding good for the group nearest them, or in some cases by the mean ratio of some stations in one group and

some in another. As the rainfall of any one year may be raised at any one station as much as 6 per cent. by a single very heavy thunder-shower, which might not reach adjacent stations, it is obvious that the computed average of a very short record cannot be viewed as of equal certainty with the computed average of a record of say 15 years or more, and consequently more weight was attached in constructing the map to the figures resulting from the longer records. As the rainfall of one period of 35 years probably does not differ by more than 2 per cent. from that of any other period of 35 years the figures as computed may be looked upon as expressing the normal rainfall of each station.

It is possible that some of the records may be affected by some error due to faulty construction or exposure of the rain-gauge employed, and several have not been utilized because this has been found to be the case; but taken as a whole I am satisfied that the records are trustworthy.

The distribution of the stations, dependent as that is on the position of the residences of those inhabitants whose tastes incline them to make meteorological observations, left something to desire; but it was at least as satisfactory as in Sussex, and more so than in many counties.

It was found most convenient to plot the figures and draw the isohyetal lines on a map on the scale of 4 miles to an inch, from which the map now published is reduced. The range of rainfall made it possible to draw isohyetals at intervals of 2½ inches of rain from 25 to 35 inches, and it is probable that in no part of the county is the average rainfall so low as 24 inches or so high as 38, in other words the range is probably not more than 14 inches.

The following Table gives separately the areas of the different zones of average annual rainfall in the Isle of Wight and in the mainland portion of the county :—

Isle of Wight.

Zone.	Square Miles.	Per Cent. of Total Area.	General Rainfall of Zone.
27·5 to 30 inches ...	37·4	25·4	29·1 inches.
30 „ 32·5 „ ...	78·6	53·3	31·2 „
Above 32·5 „ ...	31·5	21·3	33·0 „
Total ...	147·5		

This indicates a general average rainfall of 31·1 inches for the island.

Mainland portion of Hampshire.

Zone.	Square Miles.	Per Cent. of Total Area.	General Rainfall of Zone.
Below 25 inches ...	14·7	1·0	24·5 inches.
25 to 27·5 „ ...	115·9	7·6	26·6 „
27·5 „ 30 „ ...	331·2	21·9	29·2 „
30 „ 32·5 „ ...	665·8	44·0	31·1 „
32·5 „ 35 „ ...	280·6	18·5	33·4 „
Above 35 „ ...	106·4	7·0	35·3 „
Total ...	1,514·6		

This indicates a general average rainfall of 31·0 inches, practically the same as that of the Isle of Wight.

The figures may also be presented in a combined form to take account of the whole of Hampshire.

Hampshire (including Isle of Wight).

Zone.	Area. Square Miles.	Per Cent. of Area.	General Rainfall of Zone.
Below 25 inches ...	14·7	·9	24·5 inches.
25 to 27·5 „ ...	115·9	6·9	26·6 „
27·5 „ 30 „ ...	368·6	22·2	29·2 „
30 „ 32·5 „ ...	744·4	44·8	31·1 „
32·5 „ 35 „ ...	312·1	18·8	33·3 „
Above 35 „ ...	106·4	6·4	35·3 „
Total ...	1,662·1		

This corresponds to a general rainfall of 31·0 inches for the whole county. Applying to this figure the percentages of the extreme years as given in Table I. we have for the 35 years 1868–1902,

1868–1902.	Average general rainfall of Hampshire	31·0 inches.
1872.	Maximum general rainfall of Hampshire	42·16 „
1870.	Minimum general rainfall of Hampshire	23·56 „
1887–1889.	Driest 3 years mean general rainfall of Hampshire	27·37 „

In 1903, outside the period for which the averages are calculated, the rainfall was greater than in 1872 and the highest general rainfall on record took place, the value being 44·33 inches.

The distribution of rainfall in the Isle of Wight is exactly what might be expected from its position and configuration. The rainfall is least round the coast and greatest on the high land which occupies the southern half of the island. Few records exist within the area with more than 32·5 inches of rain; but it does not seem probable that the fall reaches 35 inches at any point.

The mainland portion of the county presents some peculiarities which give rise to a little anxiety as to the character of a few of the records; but the most careful enquiry fails to show any reason for distrusting the observations and the lines have been drawn on the map in conformity with them even where they differ from the figures suggested by the general configuration of the land.

The driest part of Hampshire is, as might be expected, the extreme north-east, where a small portion in the low-lying valley of the Loddon, draining to the Thames, has less than 25 inches. This is followed on the south by a strip of country reaching as far as Basingstoke with less than 27·5 inches, and a narrow belt in the valley of the Test with less than 30 inches reaches as far as Romsey. It would naturally be expected that this low rainfall should prevail down the river valley to Southampton Water and join that of the coastal plain, but this does not appear to be the case. It is true that the strip with over 30 inches which runs across

Southampton Water from the New Forest to the South Downs has really very little more than 30 inches in its driest part, and the dry strip running from the north very little less than 30 inches in any part, so that the contrast produced by the lines on the map is much more decided than it is in nature. There seems to be no doubt that a lower rainfall prevails along the shores of the Solent and Spithead, and this dry belt is widest to the east of Southampton Water. Both on the west, from Bournemouth to Hurst Castle, and on the east, from Gosport to Hayling Island, the rainfall is less than 27·5 inches; but does not appear to be anywhere so low as 25 inches.

The isohyetal line of 32·5 inches calls attention to three separate areas of relatively high rainfall situated respectively in the north, in the south-west and in the east of the county. The northern area is part of a small patch on the high land surrounding Wallbury Hill. The south-western area practically includes the whole of the New Forest, and it is somewhat remarkable to find that it extends as far to the south-east as the Beaulieu River on ground that is considerably less than 100 feet above sea-level.

The very moderate elevation of the greater part of the area of the New Forest raises the question as to whether the high rainfall may be to some extent a result of the large area of tree-clad country directly exposed to the south-westerly wind. On the eastern side of Southampton Water, sheltered from the prevailing wind by the New Forest, the rainfall is just over 30 inches, and where the sheltering effect of the Isle of Wight comes into play it is markedly less.

The eastern area of high rainfall includes the whole of the high land which unites the North and South Downs, and the area with more than 35 inches is continuous with that which extends along the South Downs eastward to the Arun. The number of stations is not sufficient to allow the exact adjustment of rainfall to configuration to be ascertained, but speaking generally the 32·5-inch isohyetal keeps close to the contour-line of 200 feet in the south, from Rowlands Castle to Droxford; thence it runs at first north-westward then eastward and northward approximately along the contour-line of 400 feet, but although the ridge continues with a higher elevation as a well-marked feature to Aldershot, the isohyetal turns across it abruptly (as does the 30 inch isohyetal about 3 miles farther on) and sweeps back to the boundary of the county at an altitude sometimes less than 250 feet on the eastern margin of the ridge. This appears to show that where the prevailing wind blows approximately along the axis of the high ground the maximum precipitation takes place in a comparatively short distance, leaving the more distant hills drier than those of lower elevation to windward. There is obviously not room for this effect to appear when the ridge runs transversely to the prevailing wind as in the case of the South Downs.

The 35 inch isohyetal inside this is nearly parallel to it at a distance of about 2 or 3 miles. It is interesting to notice that while rainfall of more than 35 inches does not extend along the high ground to the north-west beyond Alton, it extends over a considerable area of low ground on the east, to and beyond Petersfield,

where the elevation is only 200 feet. It is possible that the area on the South Downs in Sussex, with 37·5 inches or more, may extend across the boundary into Hampshire, but there is no direct evidence, and the indications which exist point the other way.

The highest rainfall, as a rule, occurs on the outcrops of the Chalk or of the Greensand, the Tertiary deposits have, as a rule, the lowest rainfall, except in the case of the New Forest, to which attention has already been drawn.

Table 2 gives the total annual rainfall at a number of representative stations selected from those used in compiling the map. The data given are the height of the receiving surface of the rain-gauge above ground, the height of the station above sea-level, the period during which the observations were carried on, the length of the record, the arithmetical mean rainfall for the actual record, the group in Table 1 by the ratios in which the reduction of short records to the 35 years' average was made, the computed average and the computed average corrected for the height of the rain-gauge above ground. The correction last mentioned is only important when the rain-gauge, in addition to being high, is also exposed to the wind, and in one case the correction is not applied, as the position of the gauge was considered too sheltered to justify it.

Table 3 gives the monthly rainfall at five representative stations. In selecting these it is necessary to consider length of record in the first place, as the range of rainfall in a month may be very great. Months have occurred in England when no rain was measured, and in the 35 years under consideration the rainfall of a particular month at one or other of the five stations has been more than three times the average fall, and it might conceivably be still greater. Hence it is evident that to secure the same degree of stability in an average for monthly rainfall as the 35-year period gives for annual rainfall, it would be necessary to utilise a much longer record, perhaps as much as a century. To secure a fair representation of the west of Hampshire it was found necessary to make use of Landford, a station in the extreme east of Wiltshire.

The month with absolutely least rainfall was February, 1891, when at one of the five stations there was no rain, and the average for the five was only ·05 inch. Curiously enough, the month with absolutely the most rainfall in the period was October in the same year, when at one station 10·56 inches of rain fell, and the average for the five stations was 9·23 inches. For the sake of comparison the average rainfall for each month at each of the five stations is set out as a percentage of the annual total, and the mean of the five presents the best view of the proportion of the annual rainfall which falls in Hampshire for each month. It is at once apparent that the three driest months are those of Spring (March, April and May) with practically 6·2 per cent. of the annual fall each. Of these three April is the driest by a shade. The last three months of the year are the wettest, being the only ones with more than 10 per cent., and October is easily the wettest with 11·5 per cent. of the annual fall. In the six driest months (February to July

inclusive) 41 per cent. of the annual rain falls, and in the six wettest months (August to January) 59 per cent.

Hampshire, in common with the greater part of England and Wales, has October as the wettest month; but it is interesting to observe that it occupies an intermediate position between the East Coast counties, like Lincolnshire, which have a second maximum of rainfall in July or August, and the West Coast counties, where there is a second maximum of rainfall in December or January. In extreme instances of both types the summer or the winter maximum may be greater than the autumnal maximum which is common to the three types.

TABLE 1.

Hampshire Rainfall Average for 35 years, 1868–1902 = 100.

Year.	Group A. Southern Plain.	Group B. Valleys of Test and Itchin.	Group C. Uplands.	Group D. Northern Plain.	Mean for Hampshire.
1868	111	110	111	112	111
1869	101	99	101	100	100
1870	77	80	79	70	76
1871	99	99	96	88	96
1872	137	141	137	131	136
1873	93	93	88	88	91
1874	96	96	92	84	92
1875	111	115	117	126	117
1876	112	113	115	123	116
1877	124	123	125	120	123
1878	97	102	97	103	100
1879	120	118	120	130	122
1880	108	106	111	121	111
1881	103	99	101	100	101
1882	111	113	118	117	115
1883	99	101	100	99	100
1884	84	82	83	84	83
1885	99	100	101	104	101
1886	114	113	110	113	113
1887	76	75	79	80	77
1888	101	105	102	101	102
1889	87	83	87	88	86
1890	86	86	82	82	84
1891	126	126	122	122	124
1892	82	80	81	86	82
1893	80	78	80	77	79
1894	122	117	120	123	121
1895	95	93	93	95	94
1896	91	90	94	91	91
1897	105	106	102	97	103
1898	86	85	84	84	85
1899	88	91	92	88	90
1900	103	106	107	98	103
1901	87	88	87	85	87
1902	89	88	86	90	88
1903	136	140	143	153	143
1904	100	102	97	95	99
1905	84	87	89	94	88
1906	107	107	105	103	106
1907	98	102	104	106	102

TABLE 2.

Average Rainfall—Hampshire.

Station.	Height above Ground.	Height above Sea level.	Period of Observation.	No. of years.	Arithmetical Mean.	Group in Table 1.	Computed Mean for 35 years, 1868–1902.	Computed Mean corrected for height above ground.
Isle of Wight.	Ft. in.	Ft.			In.		In.	In.
Ventnor Consumption Hospital	3 0 / 1 0	81	1872—1907	36	29·48	A.	29·2	29·2†
Carisbrook, Rowborough ..	1 0	193	1898—1905	8	31·76	A.	32·9	32·9
Totland Bay	1 0	85 / 145	1890—1907	18	27·48	A.	28·0	28·0
Osborne	0 8	172	1868—1902	35	28·22	—	28·2	28·2
Mainland.								
Bournemouth, Bath Road ..	1 0	121	1898—1907	10	29·97	A.	30·6	30·6
Christchurch, Mudeford ..	0 3	15	1879—1900	22	26·63	A.	27·0	27·0
Lymington, Wainsford ..	1 0	58	1868—1883	16	30·13	A.	28·4	28·4
Hayling Island	1 0	10	1890—1904	15	24·85	A.	25·3	25·3
Porchester	1 0	—	1890—1907	18	25·95	A.	26·5	26·5
Emsworth, Redlands	1 0	90	1884—1907	24	28·45	A.	29·4	29·4
Burley	1 0	200	1901—1907	7	33·76	A.	33·7	33·7
Cadland	4 6	52	1868—1902	35	32·46	—	32·5	32·5†
Lyndhurst, Cuffnells	0 9	200	1891—1896 / 1903—1907	11	34·11	A.	33·5	33·5
Southampton, Ordnance Survey Office.	1 0	79	1868—1902	35	30·56	—	30·6	30·6
Bishops Waltham, Swanmore House.	1 0	390	1868—1902	35	31·10	—	31·1	31·1
Horndean, St. Catherines ..	1 7	417	1883—1904	22	33·04	A.	34·0	34·0
Fordingbridge, Wood Green	1 2	140	1875—1900	26	31·06	A.	30·9	30·9
Otterbourne W. W., Shawford.	1 0	113	1892—1907	16	26·50	B.	27·2	27·2
East Meon, Westbury House	5 8 / 2 6	296	1895—1907	13	33·85	C.	34·3	35·3
West Dean	1 0	137	1868—1879 / 1886—1907	34	28·96	*	28·9	28·9
Liss	0 7	250	1868—1898	31	34·70	C.	34·4	34·4
Winchester, Harestock ..	1 0	304	1880—1903	24	31·27	B.	31·9	31·9
Swarraton	1 0	310	1876—1907	32	30·84	B.	30·8	30·8
Grayshott	1 0	660	1898—1907	10	32·61	C.	32·8	32·8
Alton, Ashdell	3 6	396 / 433	1868—1902	35	33·09	—	33·1	33·9
Farnham, The Bourne Vicarage (Surrey).	1 0	308	1878—1906	29	27·25	C, D.	27·4	27·4
Andover, Red Rice	0 7	277	1868—1885	18	31·06	B.	29·6	29·6
Longparish	1 2	210	1883—1906	24	27·98	B.	28·8	28·3
Tidworth House	1 8	357	1886—1907	22	29·83	C.	30·6	30·6
Basingstoke, Chapel Hill ..	1 0	328	1870—1906	37	27·78	C.	27·6	27·6
Hartley Wintney	1 2	222	1887—1907	21	25·26	D.	26·0	26·0
Kingsclere	3 0	327	1897—1907	11	30·38	C.	30·5	31·1
Buttermere (Wilts)	4 9 / 3 0	847	1882—1907	26	32·01	C.	32·7	34·0
Heckfield, Park Corner ..	1 2	257	1868—1902	35	24·31	—	24·3	24·3

* Alderbury only.
† Not corrected for height above ground.

TABLE 3.

Average Monthly Rainfall.

Months.	Osborne.					Landford.					Swarraton.*				
	Average Monthly Fall.	Maximum.		Minimum.		Average Monthly Fall.	Maximum.		Minimum.		Average Monthly Fall.	Maximum.		Minimum.	
	in.	in.	Year.	in.	Year.	in.	in.	Year.	in.	Year.	in.	in.	Year.	in.	Year.
January ...	2·70	6·54	1877	·28	1880	2·69	6·95	1872	·47	1898	2·83	7·28	1872	·56	1880
February ...	2·13	5·33	1900	·05	1891	2·29	5·12	1900	·04	1891	2·41	6·58	1900	·06	1891
March ...	1·72	4·81	1897	·37	1898	1·85	5·35	1897	·40	1893	1·99	5·30	1897	·64	1893
April ...	1·63	4·12	1871	·02	1893	1·93	3·91	1871	·14	1893	1·85	4·23	1871	·03	1893
May ...	1·59	4·38	1869	·15	1876	2·07	4·65	1878	·21	1876	1·97	4·36	1878	·26	1896
June ...	1·73	4·00	1879	·18	1870	1·90	4·70	1879	·31	1870	2·14	5·65	1879	·25	1877
July ...	2·08	4·72	1893	·23	1898	2·31	5·42	1888	·10	1885	2·61	6·14	1888	·15	1885
August ...	2·39	5·89	1891	·45	1885	2·59	6·67	1891	·70	1869	2·72	6·42	1881	·76	1883
September ...	2·66	8·09	1896	·15	1895	2·67	6·34	1896	·46	1895	2·73	7·46	1896	·78	1895
October ...	3·41	8·69	1891	·48	1897	3·49	10·39	1891	·86	1884	3·47	10·56	1891	·91	1897
November ...	3·15	7·06	1877	·30	1879	3·19	6·54	1877	·34	1879	3·21	6·99	1877	·49	1879
December ...	3 03	7·82	1868	·74	1873	3·17	8·25	1876	·73	1873	3·15	8·83	1868	·74	1873
Year ...	28·22	39·38	1872	21·96	1870	30·15	43·74	1872	20·03	1887	31·08	46·73	1872	23·61	1887

* Values for 1868—1875 taken from the record at a neighbouring station.

AVERAGE MONTHLY RAINFALL—*continued.*

Months.	Alton.					Heckfield.*					Average Monthly Fall expressed as Percentages of Annual Average.					
	Average Monthly Fall.	Maximum.		Minimum.		Average Monthly Fall.	Maximum.		Minimum.		Osborne.	Landford.	Swarraton.	Alton.	Heckfield.	Mean.
	in.	in.	Year.	in.	Year.	in.	in.	Year.	in.	Year.						
January ...	3·05	7·41	1872	·57	1898	1·97	4·55	1872	·47	1880, 1896	9·6	8·9	9·1	9·2	8·1	9·0
February ...	2·57	6·61	1883	·11	1891, 1895	1·73	3·94	1900	·00	1891	7·5	7·6	7·8	7·8	7·1	7·6
March ...	2·18	6·04	1897	·42	1893	1·43	3·61	1897	·22	1893	6·1	6·1	6·4	6·6	5·9	6·2
April ...	1 96	4·65	1871	·06	1893	1·59	3·27	1879	·03	1893	5·8	6·4	6·0	5·9	6·5	6·1
May ...	2·06	4·92	1885	·19	1880	1·62	3·79	1886	·19	1896	5·6	6·9	6·3	6·2	6·7	6·3
June ...	2·16	6·40	1879	·38	1870	1·90	4·51	1879	·42	1893	6·1	6·3	6·9	6·5	7·8	6·7
July ...	2·51	6·00	1875	·22	1885	2·16	6·12	1875	·32	1885	7·4	7·7	8·4	7·6	8·9	8·0
August ...	2·86	6·02	1891	1·14	1883	2·14	5·31	1879	·49	1899	8·5	8·6	8·7	8·6	8·8	8·6
September ...	2·94	8·24	1896	·86	1890	2·27	4·97	1896	·53	1900	9·4	8·8	8·8	8·9	9·3	9·1
October ...	3·70	9·07	1891	·76	1897	2·79	7·45	1891	·84	1879	12·1	11·6	11·2	11·2	11·5	11·5
November ...	3·59	7·36	1877	·50	1871	2·49	4·85	1894	·35	1871	11·2	10·6	10·3	10·9	10·3	10·7
December ...	3·51	8·33	1876	·67	1873	2·22	5·06	1876	·59	1873	10·7	10·5	10·1	10·6	9·1	10·2
Year ...	33·09	48·05	1872	24·98	1870	24·31	32·77	1875	18·01	1893	100·0	100·0	100·0	100·0	100·0	100·0

* 1868–1870 computed from the record at a neighbouring station.

SPRINGS.

We are dealing with a county that abounds in springs. Very many of these are of considerable volume, and groups of them give rise to the chief rivers. So intimately connected, indeed, are the springs and streams, that most of the former are more conveniently noticed in connection with the bournes, or intermittent streams, in which Hampshire is so rich.

To describe all the various other springs would involve so much work as seriously to delay this Memoir. The following pages must therefore be taken merely as samples, and those chiefly from published sources, notably from papers by Mr. T. W. SHORE, who spent much time along our Hampshire rivers and in antiquarian research over the county.

The great springs, of course, rise from the Chalk, and most of these will be described further on (pp. 24–37). Of the bourne-springs we have a full account; but various sandy formations also have their springs. In the following pages, however, no stratigraphic classification is attempted, and we start with some general remarks by MR. SHORE on the subject of holy wells.

In the concluding part of his paper, "Springs and Streams of Hampshire,"[1] MR. SHORE says, "I wish to draw attention to several considerations connected with springs and streams of some antiquarian and scientific interest. First, reverence was anciently paid to springs and wells in both Pagan and Christian times. Well worship can be traced from the most remote antiquity . . It appears to have been common both to the pagan Celts and Saxons. After the Saxon Christian conversion, it was difficult to put down this well worship . . What could not be suppressed in regard to the worship or reverence for springs and wells, appears at last to have been sanctioned under the patronage of the saints, and we have St. Clare's well, St. Mary's well, St. Boniface's well, and St. Lawrence's well . . and others remaining as examples of such holy wells. Secondly, we have traces in Hampshire of the ancient reverence of the Romans for springs and wells." But I doubt whether the frequent occurrence of the remains of Roman buildings near springs goes to prove this: rather does it show that the Romans, like other people, saw the advantage of a water-supply near at hand. "Another consideration worthy of note is that the sites of some of our ancient Hampshire churches appear to have been selected in reference to the sources of streams," and this is a pity, as many a stream has been polluted at its source by the establishment of a graveyard. Not a few holy wells are in this position.

The subject is further referred to in a paper on "Wishing Wells," in which MR. T. W. SHORE has made the following remarks[2]:—"There can be little doubt that the wishing wells are survivals of the mediæval holy wells. In Hampshire and the Isle of Wight we have a considerable number of wells and springs

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[1] *Papers Hants. Field Club*, 1891, vol. ii, pt. i, pp. 56, 57.

[2] Shore Memorial Volume, pt. i. *Hants. Field Club*, 1908 (from Hants. Independent, 1887), pp. 99–101.

which had a sanctity in previous centuries, and which have, or had, a 'Folk-lore' of their own down to this century. First in point of interest among these is St. Boniface well, at Bonchurch . . Another ancient holy well in the Isle of Wight is St. Lawrence well . ."

"On the mainland we have St. Clare's well, near Soberton, St. Mary's well, at Sheet, near Petersfield, and the holy bourn and spring at Holybourn, near Alton. These I take to be genuine examples of the mediæval holy well . ."

"It is not possible to fully understand the hold which the holy wells of the middle ages had in the popular imagination, without going back to pre-Christian days, when the ancients, far and wide, paid divine honour to certain springs and sources of great rivers."

"Besides these wells and springs . . whose ancient names still survive, we have in Hampshire and the Isle of Wight many other springs which were much frequented down to the end of last century for curative purposes in certain disorders. These were probably reputed holy wells in the middle ages, certainly 'Wishing wells' as far as those who frequented them were concerned. Among these were Irons well, or the Lepers' well, at Fritham, in the New Forest, a chalybeate spring at Shanklin, Sandrock spring, near Chale, Tatter's well at Stanpit, near Christchurch, said to have been noted for its efficacy in weakness of sight, one of the springs at Bedhampton, the strongly chalybeate spring on the north of the old church at Botley, formerly in much repute, a spring near Buckland Rings, Lymington, and a mineral spring at Swathling, near Southampton, formerly resorted to for disorders of the eyes, but now gone for ever, through the necessary excavation made many years ago for the main service pipes of the Southampton Water Works."

"About half-a-mile south of Tangley, on the north-west border of Hampshire, is the hamlet of Waterswell Cross, a name probably derived from a cross in ancient days placed over a well in a dry chalk country . ."

"Our modern investigation of these springs shows us that they are all, or nearly all, chalybeate . . and that they issue from the tertiary or greensand geological formations."

"The water from . . the Lepers' well . . Fritham was . . analysed by Mr. Brierly . . and it was found that the small proportion of iron which it contained, and which is rapidly deposited by oxidation close to the spring, is the only special chemical character the water possesses."

The following two paragraphs, by Mr. C. Reid, are from the Memoir on the Geology of Ringwood (1902):—

"Though powerful springs are thrown out at points where Chalk at a low level is overlapped by impervious Eocene strata, these springs have not been utilised for the supply of the towns, wells being dug everywhere. Taking the springs in order, the most copious will be found at Burgate, where the Avon finally passes from Chalk to Tertiary strata. Then following the escarpment towards the south-west we find Sagles Spring, in a similar position in the small valley below Rockbourne. The next valley shows similar springs below South Damerham."

"Throughout the Tertiary area, though there is a great deal of swampy and boggy land, the water is generally given out as a 'soak' over a considerable area, not as clearly defined springs. There are some good springs, however, one of the best being given out in the valley north of Rockford Common, apparently from a sand which rests on the impervious glauconitic clay near the base of the Bracklesham Series. About this level a good deal of water oozes out in other places. Nearly all the springs from the Tertiary strata are more or less ferruginous; those from the Chalk are hard from the dissolved carbonate of lime; the gravel springs vary considerably in quality, and tend to fail in dry seasons."

In 1897 Mr. H. Guillaume gave me the following information about a spring that once flowed in Bitterne Park, near Southampton:—The spring was in an old gravel-pit in Middenbury Lane, opposite Middenbury Castle, and about 200 feet above sea-level. It ran perpetually and the water was very chalybeate. When the new road was made the spring was buried, but pipes were laid to give exit to the water. Analysis showed that the water contained over 5 grains of iron soluble, per gallon, 4½ grains insoluble, and a large amount of sodium-chloride. He believed that the spring did not come from the gravel, but from the clay beneath. He sunk several shallow wells and amongst them one near to and above the spring, which passed through the following beds, the water from the lowest of which was said to come out warm:—

Ordinary clay	12	30 feet.
Blue impervious clay	12	
Brown irony clay, with a little white sand	6	

After describing the springs and bournes of the Test, down to Mottisfont (*see* post), Mr. Shore goes on to say[1] "The remaining tributaries of the Test are . . . chiefly fed by springs in the Tertiary beds . . . The water from the Tertiary springs is not so clear and sparkling as that from the chalk springs," and it "also in many instances contains some little trace of iron, which that from the chalk does not."

Of Tadbourne Lake (p. 29), he adds that "another source of this stream is from the springs at Ampfield . . . about 230 feet above the sea." These are from Tertiary beds. "On the west slope of Toot-hill (north-eastward of Nursling) a spring occurs at 150 feet in elevation, which sends out a stream which flows past Ashfield to the Test."

"The Ouse or Blackwater, which has its source in Wiltshire, near Whiteparish, at the junction of the chalk with the lower Tertiary beds, enters the county at" Plaitford. "It is increased by springs along its course, and also by the Cadnam water which . . . has one of its sources in the wet wood, full of springs on the slope north of Castle Malwood . . ."

"Another stream, which gives Millbrook its name, has its sources above Shirley, one branch, the Hollybrook, being supplied by rather fitful springs near Chilworth, the highest source being about

[1] *Papers Hants. Field Club*, 1891, vol. ii., pt. 1, pp. 41, 42, 44.

240 feet, and another branch, the Tanner's brook, having one of its sources at the Bedwell spring 100 feet above the sea, a little south of Rownhams."

"A permanent spring about a mile south of Hursley is at Ladwell 209 feet above the sea . . . The water from it now supplies the mansion in Hursley Park."

At Huntbourn, 2¼ miles S.S.E. of Soberton, there is a spring, just within the border of the Reading Beds, the water of which probably rises up from the Chalk. It was sluggish when I saw it, in August 1903.

In the main valley, just above Spurlings (and about a mile north-north-eastward of St. Peter and St. Paul's Church, Fareham) there seemed to be a spring, in the water (June, 1903).

At Offwell Farm, Southwick, there is a well-marked spring close to the outcrop of the Chalk. Of course, all the farm-buildings have been placed above it. I believe that the flow fluctuates very much.

There is a moated enclosure (? and old fish-pond) a little north-eastward, the western and southern ditches of which were dry when I was there (June 9, 1903); but there was a spring at the south-eastern corner and there was a strong flow along the ditch through the little wood eastward; however, Mr. HILDRED told me that this was dry some time after. It seemed as if there was some slight outburst from the top of the Reading Beds and the base of the London Clay.

I was told that there was sometimes an outbreak of water at Newbarn, nearly three quarters of a mile south-eastward of Southwick church, in two places, north and east of the house.

There is a spring near the outcrop of the Reading Beds south-east of the church (? Widley) over 1½ miles eastward.

At Rowlands Castle there seems to be a swallow-hole just S.W. of Stansted Cottage, and at the south-eastern corner of "The Forest," there is a spring, the water of which speedily sinks into a swallow-hole, a very short way to the N.E. North-westward of this is a line of swallow-holes, marked as such on the Ordnance Map (Hants. 68, S.E.).

The great quantity of water flowing out from the Chalk, at its junction with the Tertiary beds, from Bedhampton through Havant and Warblington, eastward to the county-boundary at Emsworth, and thence further eastward in Sussex has long been commented on. The springs at the first place are taken for the supply of Portsmouth, as also some of those at Havant (*see* pp. 38–40); but there are still others at the latter place, which are used for other purposes.

The quantity and the origin of this large outflow of water have given rise to some speculation, and whilst great exaggeration has not been wanting as to the amount, views of a still wilder kind have been brought forward as to the source from which the water comes.

Mr. G. W. EWENS[1] gave the total flow of the Bedhampton springs as no less than 87,450,000 gallons a day, the Havant town-springs as 9,000,000 (apparently not the whole of the springs here), the Langbourne springs as the same, two springs at Warblington as 4,500,000, and the whole available quantity of the springs in this district as 134,850,000 gallons a day! No wonder then that he

[1] Royal Commission on Water Supply. Report, 1869, pp. 224–228.

suggested this, at that time, as a supply for London! There must have been some mistake in these gaugings.

With figures like these before us (and they have been repeated, if not exceeded) it is no wonder, perhaps, that suggestions of a very distant source for the water have been brought forward, and I have seen one to the effect that it must have come from somewhere in France!

Whilst however the above figures are beyond the facts there is no doubt that a very large amount of water flows out from this long set of springs, many millions of gallons a day, and there is at first sight some difficulty in accounting for it. Clearly the eastern part of Portsdown is not a large enough gathering ground to account for all the water of the neighbouring springs at Bedhampton, and the western part of that comparatively small outcrop of Chalk would not contribute. All the other springs are away from Portsdown.

Clearly we must look to some greater source, and there is really only one available, that is the much broader outcrop of the Chalk northward of the Tertiary area. That the water is not derived from the various creeks &c. southward of the line of springs is shown by two facts, that it is not salt and that the outflows are above the level of the sea.

The wonderful thing is that the water should find its way through deep-seated Chalk, below a trough of Tertiary beds. That trough however is both narrower and shallower than is the case westward of Havant and we must suppose that there are sets of marked fissures or channels giving a fairly free communication from north to south.

The following notes, on springs not elsewhere mentioned in this Memoir, are by Mr. H. J. O. White (Geology of Basingstoke, pp. 104–107):—From the Upper Greensand near Bentley there are a few springs, mostly small. The principal seems to be the one a quarter of a mile west of Froyle Mill. "North of Froyle a strong spring from the Lower Chalk forms the Ryebridge-Brook," eastward of the village. There are springs from the top of the Chalk at Wolverton and Ewhurst (feeding the Enborne) and at Sherborne St. John (feeding the Loddon). The basement-bed of the London Clay has inconsiderable springs. Many small springs occur at the edge of the Bagshot Sand. The Bracklesham Beds furnish few marked springs, but water leaks out in boggy ground on the slopes.

The following four paragraphs, by Dr. A. Strahan, on springs in the Isle of Wight, are from the Memoir on that tract (1889).

One of the most noticeable features in connection with the outcrop of the Gault, is the copious supply of water which it throws out nearly all round the southern Downs of the Island. The greater part of the strata over-lying this clay being of a permeable nature, the rainfall is absorbed by them, and is thrown out in a line of springs along the top of the first impermeable bed it encounters. The springs are of course most copious along the hill-sides where the Gault is at the lowest level, the underground water naturally moving down the dip-slope of the beds; but, the dip being very gentle, there are springs along nearly the whole Gault outcrop. The most copious occur at Wydcombe, Bierley (utilised for the Niton and Whitwell Water-works), Niton, Whitwell, south and south-east of Wroxall, and in Greatwood Copse

near Shanklin. The natural spring which formerly issued at the last-mentioned locality was utilised for the Shanklin Water-works, the supply of water having been somewhat increased by driving a heading into the hill along the junction of the Upper Greensand and Gault. Ventnor is supplied by a spring issuing from the same strata, and met with in driving the railway tunnel. Several springs take their rise in the same neighbourhood, and were formerly used to drive a mill in Ventnor Cove.

Along the central chain of hills the springs are less frequent, owing to the steep inward dip of the strata. But a fine spring issues at Bottlehole Well near Brixton, and another, issuing, however, in the Upper Greensand, gives its name to the village of Shorwell. About Chillerton and Gatcombe, where the dip is very gentle, numerous springs rise along the sides, and particularly at the heads of, the valleys.

At Knighton there are good springs [from the base of the Chalk and from the Upper Greensand], which, supplemented by a well, are used for the supply of Ryde.

On the very steep slope of chalk over Ventnor a small spring rises, known as St. Boniface's Well. It was remarked by Sir H. Englefield that "a spring at this height, is a most remarkable circumstance, and the only instance of the kind in the whole island. It indicates some stratum within the hill differing from the chalk, which certainly would let the water sink through its substance here, as it does everywhere else." This spring occurs at about the height at which it may be calculated that the Melbourn Rock and Belemnitella Marl should occur.

A Report by Mr. F. Newman to the Public Works Committee of the Ryde Corporation gives the following figures of guagings:—

Upper spring at Chillerton	...	30,000	gallons a day.
Spring at Wroxhall ...	...	120,000	„ „
Spring near Span ...	...	110,000	„ „

By collecting all the springs at Chillerton about three times the quantity above noted could be got.

To these may be added the following:—

Mr. W. Topley has noted a spring from the Upper Greensand nearly half a mile south of Luccomb Farm, north of Bonchurch, which is 339 feet above Ordnance Datum; whilst another, in the garden at the farm and 321 feet above Ordnance Datum seems to be from near the top of the Gault. A third, in the parish of Shanklin, nearly half a mile north of the farm, is from Upper Greensand.

In the wood just westward of the Ashey Waterworks (Ryde) there used to be a spring from the Chalk, probably intermittent; but this has ceased to exist, presumably as a result of the pumping.

A chalybeate spring is marked on the Ordnance Map (Hants. Sheet 100), about halfway between Blackgang Chine and Rocken End. It is in the parish of Chale, and was described by Dr. Berger to Dr. Marcet.[1] It is about 130 feet above the sea, and was said to flow at the rate of two or three hogsheads a day (? 100 to 150 gallons). It issues from a bed of loose sandstone, and is of interest only from its highly ferruginous character (*see* p. 185).

[1] *Trans. Geol. Soc.*, 1811, vol. i, pp. 215–217.

INTERMITTENT STREAMS.

General Remarks.

The phenomena of bournes, or intermittent streams, are now well understood, and attention has lately been drawn to them in a Geological Survey Memoir.[1] Hampshire abounds in them and Mr. T. W. Shore did much good work in recording these flows in the county; so that I am able to use his words in this general description. My old friend had a keen interest in the subject of springs and streams, not only from a scientific but also from an antiquarian stand-point. The first of his papers to be quoted has only lately been published in a permanent form and is concerned with Prehistoric Earthworks and Tumuli.[2] The publication in question is a well-deserved tribute from the Hampshire Field Club to its founder, who was also its Organizing Secretary for many years. Of the three others associated with Mr. Shore in starting this successful Society I am proud to be one.

"In the situation of some of the Celtic tumuli in this county I think we may find a trace of the reverence of the Celts for water sources."

"In Hampshire, Celtic tumuli are found in some instances just above the permanent water sources, and in others just above the occasional water sources. The occasional water sources are those which give rise to chalk bourns, which are a marked feature in the physical geology of chalk districts. The bourn is a stream which does not always flow. Usually it is dry during the summer and autumn months, depending on the rainfall. When the rainfall has been great the line (plane) of saturation in the chalk rises higher than at other times, and the bourn springs then begin to flow. If the rainfall has only been moderate in amount the lower springs only flow, but if it has been great, the line (plane) of saturation rises and causes the water to flow out from springs higher up the bourn, and in very wet seasons much higher up. These phenomena in our Hampshire valleys must have been as well-known to the Celts as to ourselves. Whatever their opinions may have been on the origin of these springs, and whether they reasoned about them or not, they must have known the facts. Some of the occasional springs flow only once in ten or even in twenty years, and in some instances the sites of these remarkable springs . . were chosen by the Celts for the burial places of those whose remains they wished to honour by rearing tumuli over them. This is the case at the Seven Barrows between Whitchurch and Newbury. For many years in succession you may pass through the little village of Litchfield near these barrows, and see that the water course along the village street is quite dry, but occasionally after long intervals, it is a roaring little torrent, and its highest occasional source is close to the Seven Barrows . . . Many other instances exist in the county of barrows near occasional bourn springs, such as the case of a barrow at Penton Mewsey, and in other instances where groups of barrows

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[1] The Water Supply of Kent, 1908, pp. 54–63.

[2] Shore Memorial Volume, pt. i. *Hants. Field Club*, 1908, p. 109. Pages quoted 111–113. Paper reprinted from the *Hampshire Observer*, 1892.

exist. There is another group of Seven Barrows about two miles west of Stockbridge, near the head of one of the small lateral valleys of the Wallop stream, a branch of the Test and near an occasional water source. Another group of a similar kind exists at South Tidworth, also near the head or watershed of a lateral valley from which water must flow in very wet seasons into the Bourn rivulet close by, which is one of the most remarkable bourns in England. The remains of another group of barrows exists near Bramdean and Hinton Ampner, near the site of a bourn spring, which is one of the occasional sources of the Itchen."

"The custom of burial near springs both occasional and permanent has survived in some instances in this county until our time . . . Hambledon affords a good example. The village is situated at the head of a dry chalk valley and is the occasional source of a bourn." One or more of the springs "rises quite close to or from the churchyard itself . . . At Itchenswell and Mapledurwell springs rise close to the churchyard. . . . A sluggish spring which in ancient times had a reputed curative property . . . is situated close to the old church of Botley, and the stream at Holybourn near Alton rises in considerable volume from the church yard itself."

This partnership of springs and churchyard is however not to be commended from a utilitarian point of view.

It is the Chalk which is most noted for the phenomena of intermittent springs, and the following descriptions are almost wholly confined to the Chalk-streams. The details to be given are chiefly from another paper by Mr. SHORE, which gives an elaborate account of the Hampshire streams, based on observations extending over several years of his life in Hampshire.[1]

His remarks refer to both springs and bournes; and it is convenient now to keep them together, as in the original, as far as regards the Chalk. It will be noticed that Mr. SHORE uses the apt term "occasional sources" for the parts where streams break out only at comparatively rare intervals.

His accounts are now reproduced, nearly always in his own words, but in a rearranged form and with some additions, mere verbal ones being put in brackets.

The rearrangement consists chiefly in putting the streams in a certain order, taking firstly those which flow southward, to the sea, and then those which flow northward, to the Thames, in each case working from west to east. Tributaries are arranged from above downward.

I had the pleasure of visiting many of the places mentioned in the following pages with Mr. SHORE, and am the more glad to make use of his work.

RIVERS FLOWING SOUTHWARD, TO THE SEA.

There are eight of these and they include all the chief Hampshire streams. All but three are wholly in Hampshire, the Avon starting as a Wiltshire stream, the Test having some tributaries from that

[1] *Papers Hants. Field Club*, 1891, vol. ii., pt. i., pp. 33–58. The quotations from this paper run on to p. 37.

county (though the main stream is all in Hampshire) and the Rother having only its head-waters in the county, whence it flows through Sussex.

The Avon and its Tributaries.

On pp. 44–46 of Mr. Shore's paper we have the following remarks, partly referring to the neighbouring county of Wilts, and to a tract not covered by a Geological Survey Memoir :—

"The Avon is but partly a Hampshire stream. . . . Of its three main branches . . . one, the Collingbourn, enters this county at the Hampshire Cross, South Tidworth. . . . This stream is very fitful, and is, perhaps, more peculiar than any of the chalk streams I have mentioned. Beyond the limit of Hampshire, at Collingbourn Ducis, the stream may always be seen flowing, not usually of great volume. . . . Its source appears to be further north, towards the Upper Greensand outcrop . . . and it flows over some drift or alluvium, or other bed impervious to water (or water-logged ?), until it reaches some bare (or gravel-capped) part of the chalk south of Collingbourn Ducis. There in ordinary seasons the Collingbourn takes its leave of the upper world and disappears below. You may follow its course . . . for miles. There you may see just beyond the Hampshire border a dry water-course . . with footbridges, and sluices, and all other conveniences for a flow of water, but the water level is usually far below. Some surface water may not unfrequently be seen under the bridge at North Tidworth, but the stream only comes up in wet seasons. At the Hampshire Cross the water in the wells is often 60 feet below the surface, which is the level (of the surface) at Cholderton," some four miles southward.

Mr. F. J. Bennett has remarked of a short dry tributary-valley, on the west :—[nearly] "two miles south of Sidbury Hill and south of the Seven Barrows there is a well-marked bourne-hole."[1]

Continuing from Mr. Shore's paper :—"Between South Tidworth and Shipton Bellinger the bed of the stream is commonly a green sward, and it may be mown or grazed, for grass and wild flowers grow in it. The village road at Shipton is the course of the stream . . . and near the church the dry watercourse is bridged over. . . . Just where the course of the stream leaves Hampshire at Cholderton, at an elevation of 299 feet, the water rises in considerable volume, and the Collingbourn further on flows above ground," and in Wiltshire. "The Avon enters Hampshire . . . south of Downton, and the smaller streams it receives from our county are, with one exception, from the Tertiary formations. . The exception is the Sweetford water, which . . . flows through Rockbourne."

"The usual sources of this stream are from springs at about 186 feet. The level in the village is about 169 feet, and the stream is occasionally so great in volume as to flood the road, so that a high pathway has been constructed at its side below the village."

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[1] The Geology of the Country south and east of Devizes (Sheet 282), 1905, p. 54.

An error seems to have crept into Mr. SHORE's paper, when he speaks of the Ashford Water as a New Forest stream from Tertiary beds, for, unless the name has been wrongly marked on the Ordnance Map (Sheet 314), it joins the Avon on the west, with the Sweetford Water, at Fordingbridge. Moreover, its source, under the name of Allen River, is from the Chalk at Martin, across the border, in Wiltshire.

The Test and its Tributaries.

This, the chief of Hampshire rivers, is described on pp. 36–41 of Mr. SHORE's paper.

"The main stream of the Test flows from Polhampton, and its highest permanent spring is at Ashe, about 300 feet above the sea level. . . . The watercourse at Church Oakley is an example of one of the peculiarities of our Hampshire streams. Some of these streams are shy, for after flowing a little way above ground in a rather undecided manner, they simply disappear into the chalk beneath and flow underground. This is the case at Church Oakley. In very wet seasons indeed a stream flows all the way from Oakley, past Dean Church to Polhampton, but commonly, although it may be seen at Oakley, it disappears, and the water swells the great springs at Polhampton. Oakley is 365 feet and Polhampton 300 feet above the sea level . . . and there are many springs along the line of the Test below it, past Overton, Laverstoke, and Freefolk."

In speaking of the Test, Mr. H. J. O. WHITE says, "In the wet year of 1881 it rose at Spring Pond . . three furlongs south-west of Clarken Green. Mr. C. E. Hawkins ascertained that the ground-water was approximately 20 feet below the surface when he visited the spot (? summer of 1891).[1]"

"These springs usually 'rise' either in November or in December, and it has been noticed that if they rise in November they flow stronger in May . . . than they otherwise do. The Laverstoke springs are at elevations of from about 245 to 274 feet. At Southington the springs are about 268 feet in height. The course of the river seems to be along a continuous line of springs. This course through Laverstoke Park was diverted, but the line of springs remains, and the land which formed the bottom of the ancient stream course is always wet from this cause." . . .

"A small stream from the north of Whitchurch rises near Cold Henley at about 280 feet, and higher up is St. Paul's Wood, which must be an occasional source when the chalk is much saturated" (Paul=the Celtic pwl probably).

"The St. Mary Bourne stream, which joins the Test at Hurstbourn Priors, has its usual source at Upton, about 368 feet in elevation, and at Hurstbourn Tarrant, 325 feet. In very wet seasons the Swift river, as it is here called from its rapid flow, rises at Vernham Dean, 433 feet above the sea. These springs about Hurstbourn Tarrant arrested the attention of Cobbett, who mentions them in his 'Rural Rides,' and describes them as dry from August

[1] The Geology of the Country around Basingstoke, page 105.

to nearly March 'when the water boils up in thousands of places in the meadows.' . . If you visit the village of St. Mary Bourne late in the summer the stream there will usually be found almost stagnant."

"In the low lying meadows at Longparish and Wherwell are great springs. Wherwell, locally pronounced Horrel or Horwell, derives its name from its hoar, or ancient springs or wells. The springs here rise at about 152 feet . . ."

"The Micheldever stream, which joins the Test before the junction with the Anton (near Bransbury), is supplied by springs which may be seen among the watercress beds near Northbrook, a little north of Micheldever village, and by the footpath to East Stratton. These springs in very rainy seasons produce great volumes of water, which flood the road. The name Miceldever in Doomsday Book means 'much water.' The highest occasional source of the stream is at the south of Stratton Park (near the Tertiary outlier). It receives a branch which is fed by the springs about Bullington, the highest of which is near the Stockbridge and Basingstoke road, at an elevation of about 217 feet."

"The Anton (tributary), which flows past Andover, rises near that town in various springs, those near Water-lane towards East Anton, being about 200 feet above the sea. The springs at Charlton have about the same elevation, and those at Penton Mewsey about 234 feet. This is the highest visible source of the Anton, but there can be little doubt that the Penton Mewsey springs are connected with the phenomenon which occurs in wet seasons at Appleshaw. When the chalk is much saturated a stream rises at Redenham about 308 feet in elevation, and flows through Appleshaw village 300 feet, where you may see water-courses, generally dry, alongside of the village road. The stream flows south towards Wey Hill, to a level of 283 feet, where the road begins to rise, and here the water is absorbed by the chalk and disappears, flowing below Ramridge Park, and probably east of Wey Hill, but underground, until it reaches the water course at or near Penton Mewsey. The Pill brook, which joins the Anton . . a mile below Andover, has its source near Kimpton 274 feet . . receiving a branch from the Thrunton springs 260 feet in elevation." Whether anything in the nature of intermittence occurs in this stream is not said however; but it is likely.

"Near Horsebridge (Bossington) the Test is joined by the Wallop stream . . The highest source of the Wallop stream is above the village of Over Wallop, where springs occur in the fields, but in the latter part of the summer the brook which is seen along the roadside is dry. The highest occasional source of the stream is near Castle Farm . . 300 feet in elevation . . Springs occur along the course of this stream, through Broughton to Bossington."

"The Sombourn . . has its source usually in and near Tanner's Pond, east of King's Sombourn, 119 feet in elevation. The springs are flowing in April, but the stream above the village is dry in September. In very wet seasons this stream rises at Ashley a mile and a half to the east, and on higher ground. This has happened on three occasions since 1851."

"The Dean . . stream, which flows into the Test near Mottisfont, is fed by springs from the chalk in the valley of West Dean (just in Wiltshire), at about 126 feet in elevation. Its occasional sources are in Wiltshire further to the west, and it receives smaller streams from occasional sources about East and West Tytherley (at the northern outcrop of the Chalk) . . Near Dembridge farm there are springs at about 86 feet in elevation . . On the line of junction of the chalk with the Reading beds at Mottisfont occurs a spring of remarkable interest. It is undoubtedly the 'font' which partly gives the village its name, and is one of the most beautiful springs in the county. This . . 'font' is on the lawn of Mottisfont House; it is a well, perhaps, 10 feet deep and 4 or 5 feet wide, full of water as clear as crystal, ever flowing and yielding, perhaps, two million gallons of water daily . . ."

"Tadbourne Lake, a stream which joins the Test at Romsey, has one of its sources in a spring near Pucknall (by Braishfield), 113 feet in elevation, where the chalk crops out."

The Itchen and its Tributaries.

The Itchen is of course a tributary of the Test; but in tidal water, and therefore for present purposes, which are of a distinctly freshwater character, may be treated as a separate river.

Continuing from Mr. Shore's paper (pp. 42–44) we come to what may be called the three-headed Chalk-stream of the Itchen, the northern part from the Candover valley, the eastern being the Alre, and the southern the name-stream. Of this last Mr. Shore says:—"A little to the north of Kelmeston is a pool in a little field by the road side, where you may drink at the head-water of the Itchen. This spring head is about 247 feet above the sea, and is the usual highest source of the stream, but its occasional source in very wet seasons is higher up at an elevation of about 300 feet, not far from Kilmeston church . . A little stream . . rises at Bramdean at about 260 feet in elevation. Springs and wells, which sometimes overflow, occur along its course to Cheriton."

The following three paragraphs which go into more details are from a later paper by Mr. Shore.[1]

"Cheriton is a place of springs . . East, south, and west of these water sources for eight or more miles, no permanent springs are found. On the east, the long valley in which Bramdean is situated may be traversed until the water parting of the river basin of the Itchen and that of the Rother, is met with . . This valley is one of those dry upper valleys above the permanent springs which commonly occur in chalk and limestone districts."

"The system of water drainage in the dry valleys near Cheriton is a system of soakage and swallow holes. In wet seasons, and particularly in rainy winters, plenty of water may be seen flowing down the little channels from the higher ground to the hollows where the porous chalk absorbs it. It is not often that much of

[1] The Physical Geology . . of the Neighbourhood of Cheriton. *Papers Hampsh. Field Club*, 1900, vol. iv, pt. ii, p. 137.

this water may be observed flowing along the usually dry water courses, but the water goes, as certainly as if it flowed above ground, to feed the springs at and near Cheriton. At rare intervals the water flowing beneath the surface down the Bramdean valley rises in a great spring a little west of the village (of Bramdean), and flows along the bourn channel. Some springs in very wet seasons have been known to burst out not far from Woodcote (just above Bramdean). The bourn spring west of Bramdean, is one of the most interesting of Hampshire springs. Only sometimes is it a spring; much more often it is a swallow hole. It is easy to understand that the underground channel from which the water rises when the chalk is saturated with water and the water level consequently high, is capable of forming a channel through which the water can sink when the chalk is dry and the water level is low . . ."

"The water of these (Cheriton) springs being derived from the chalk is of a temperature of about 50° Fah., and this is the normal temperature, both in summer and winter . . It is owing to this that the water above such springs never freezes. These springs usually flow the strongest at the latter part of the winter or in the early spring, depending on the period of the autumn or winter rain. They do not rise the strongest just after the rain, but some weeks after a rainy period. This is owing to the slow action of the chalk in first absorbing, and afterwards giving out the water which falls upon it."

Turning again to the older paper of Mr. Shore's, in speaking of the Alre branch of the Itchen he says:—

"The stream from Bishop's Sutton flows from springs at Waterlane, 264 feet above the sea. This stream is also increased in volume by an occasional supply from the lower part of Ropley, which is 70 to 120 feet above the level of the springs at Bishop's Sutton . . A stream from Bighton rises near Drayton farm at about 280 feet above the sea . . Its occasional highest source is in Well Copse . . 350 feet in elevation."

An older observer, Col. G. Greenwood, noted in 1864, in a letter to the Hampshire Chronicle,[1] that "the springs about Bishop's Sutton, Bighton, and Hinton, which are among the earliest sources of the Itchen, have been for some time dying off; and I imagine we must expect this dying off of springs to progress down the valley."

Returning to Mr. Shore, "Alresford pond, made by Bishop de Lucy, in the twelfth century . . was constructed by a great embankment being projected across the valley . . In some parts of this valley the chalk is covered only by a few inches of soil, and so as the water was made to rise in the pond the action of the chalk at the western part of it made it difficult to keep all the water in, except when the chalk in very wet seasons was saturated. Consequently a swallow hole limits the holding capacity of the pond, and it has been calculated that more water leaves the pond by the swallowing action of the chalk beneath than by the natural overflow. The level of the embankment is 233 feet, while the river about

[1] Reprinted in his "River Terraces," 1864, 8° *Lond.* p. 61.

one mile below is only 185 feet in elevation; so that there is a considerable fall to allow this underground drainage to act."

The following later note is by Mr. H. J. O. White (Geology of Basingstoke, 1909, p. 105):—"At long intervals the Candover branch of the Itchen rises near Preston House, south of Axford. Both syllables of the name of the latter place indicate the former presence of a stream still higher up the Axford valley, but the writer was assured by an old resident in the neighbourhood that no bourne had flowed at Axford for at least sixty years, though melting snow had been known to cause floods there. The average level of the ground-water at Preston Candover and Axford is said to be about 30 feet below the surface in the bottom of the valley." And now we again take up Mr. Shore's paper.

"The Candover stream, the longest of the tributaries of the Itchen, rises from a spring at Chilton Candover 300 feet above the sea. . . In wet seasons the stream rises at Preston Candover at an elevation of 324 feet. There can be little doubt, also, that it receives an underground supply occasionally from a higher source still, for Anton, 361 feet above the sea, lies higher up the valley. . . Several old roads converge here, more or less water tracks in wet seasons, and the chalk lies so near the surface (with still more permeable gravel along the bottom of the valley) that the drainage of this part of the valley is easily absorbed, and no doubt helps to swell the stream below."

"After leaving the neighbourhood of Alresford the Itchen receives no considerable tributary, except that from Headbourn Worthy, until it reaches the Tertiary country . . . but many springs occur along the course of the stream. . . . One of these springs near Wharf Mill, Winchester, has been utilized for centuries for a water supply to Winchester College, and it still supplies the Warden's house, the Brewery, and the inner quadrangle of the College. A little rivulet formerly flowed past Fulflood farm to the east part of the city ditch at Winchester, and thence along the south wall to the Itchen. The deep railway cutting east of the barracks marks the line of this ditch, but goes much below its former level, and the rivulet has consequently ceased to flow. North of Brambridge springs may be observed in the bed of the water courses near the river. . . . The Otterbourn has its source in the Poleshole spring, which has been lately utilized for watercress growing. About half a mile to the west of this spring is the Otterbourn swallow hole, which receives the water that flows from the direction of Hursley, along the channels by the side of the lane past Silkstead farm. This swallow hole, as well as the Poleshole spring, occurs at the junction of the Reading beds with the chalk. The volume of water from the direction of Hursley is sometimes very great. In 1775 this village was flooded through the bursting out of chalk springs after a very wet season." The Poleshole springs usually break out in the higher part of the Watercress Bed and just above.

"Bow Lake stream, which joins the Itchen north of Bishopstoke, has its main source in the chalk springs near Upham, 200 feet above the sea. Another branch of this stream rises north of Hensting, when the springs flow there, which they do not always. Water

channels may be seen along the roadway at Hensting, 109 feet above the sea, from which the water flows to Fisher's pond, the springs near the upper end of which are always active. The highest occasional source of the stream is in Water lane, near Owlsbury, 306 feet."

The Hamble.

Of this stream Mr. SHORE speaks on pp. 55, 56 of his paper. "The Hamble has its chief sources near Bishop's Waltham. The springs to the north of the town are in the chalk at an elevation of about 128 feet. Those near Waterlane farm are about 134 feet. A branch stream joins the Hamble south of Bishop's Waltham from Stokes lane, south of Upham, the water source being about 150 feet" (above the sea). Other streams flow from The Moors, south-east of the town, "the elevation . . . being about 100 feet. Another stream flows to the river from the direction of Swanmore," but this is mainly the drainage of the Tertiary tract, as also are other tributaries lower down. "The Lower Bagshot . . . has a number of springs at its base, which supply rivulets."

I examined the springs at the Moors in October 1898 and again in August 1903. They are within the area of the Reading Beds; but the water must come up from the Chalk. The springs can mostly be seen by following the edge of the marshland. At its western end, close to the footpath, there is a large collection of bubbling springs or "sand-boils," so called from the rapid throwing up of the sand at the bottom of the water. There are springs at the re-entering angles of the northern border of the marsh, and in a small basin in the middle of its eastern border is another set of bubbling springs. Nearly a quarter of a mile eastward (a little south of Suetts Farm) are other springs, once used for a watercress-bed, and still further east by Newlands Lane are some fluctuating outflows. Most of these springs are practically shown on the six-inch Ordnance Map (58, S.E. and 59 S.W., Revised 1895), though the word spring is nowhere engraved.

In the main valley, in October 1898, the channel of the westerly branch was dry from Waterlane Farm to just below Northbrook Farm; but there was water in the other branch by the road a little east of Northbrook Farm, and it supplied a watercress-bed.

The Meon or Titchfield River.

Continuing from Mr. Shore's paper (p. 55), this stream "is in some respects unlike any other in Hampshire. It has its highest permanent sources about a mile south of East Meon, where its spring head may be seen in the chalk, about 400 feet above the sea. About half-a-mile to the east is another spring at about the same elevation, which gives off a stream called the Oxenbourn. . . . These are our highest chalk springs in Hampshire."

Here one may interpose an older notice of this stream and its temporary disappearance, by COL. G. GREENWOOD.[1]

"The stream which usually runs through Westmeon . . . has for many weeks entirely disappeared, so that there is no running water between Westbury Pond and Warnford Pond. Though

[1] Letter to the *Hampshire Chronicle*, 1864. Reprinted in his "River Terraces," of the same year, pp. 69, 70.

above Westmeon three mills are worked . . . these mills are worked 'by spells,' as they say—that is as often as they can get water enough. . . . But below Drayton the water sinks away into 'swallow-holes.' I have observed two of these swallow-holes just below Westbury Ponds. Probably the water reappears at Warnford Pond, around and just below which the springs are strong enough to form a river at once. . . . The two highest springs above Eastmeon are the Oxenbourne spring, and the other 'Spring-head,' above Fairfield Mill. . . . I imagine, however, that both these springs are just dying off, and all the *springs* and wells above Warnford and Westmeon may probably go dry."

"There is a common belief that wind makes the springs rise. But . . . the springs are strong or weak directly as the quantity of rain. . . . As the past drought has caused our present low springs, so after very rainy seasons, what we call our *Lavants* (*Labens*) run. . . . That is, springs burst forth in the valleys many miles above what are considered as the perenniel springs. This happened here last after the very rainy winter of 1852–3."

Mr. H. W. TRINDER, writing of West Meon, says: "The river here is small and intermittent in summer. Hence it is called . . . 'The Bourne.'" (*Papers Hants Field Club*, 1907, Vol. vi, pt. i, p. 74).

Much lower down the valley, to return to MR. SHORE, "south of Soberton, not far from the stream, is a pool or well called St. Clare's well (? a spring just above St. Clair's Farm) which was probably in ancient time one of our holy wells. The springs near Wickham are caused by the London clay outcrop from beneath the Lower Bagshot sands. . . . Further on, the Meon again meets with . . . another chalk outcrop, the western part of the Portsdown ridge. . . . Here the stream is increased in volume by great springs about 35 feet above the sea at Great Fontley, and near Little Fontley farm. These old place names have been derived from the springs."

The Wallington River.

Mr. SHORE, on pp. 54, 55 of his paper says of this stream: "It derives its supply chiefly from the Tertiary formations . . . on the north of Portsdown hill, and you may stand on the bridge at Southwick, and see the stream either in great volume or at other times almost dry, depending on the period of the year and the season," as would be expected with a stream largely dependent on the drainage of a clay-country. "A branch . . . has its sources . . . a few miles north of . . . Southwick . . . Its highest occasional source in wet seasons is at Hambledon (in the Chalk-tract). In 1879 a great 'lavant' occurred at Hambledon; the water rose in all the low-lying parts of the little town, and springs broke out in all directions . . . as high up the village as the churchyard."

I was at Hambledon in May 1905 and then found a dribble of water through the village from above Fairfield House (the north-eastern end of the village) down to the Smithy (at its south-western end, about half a mile from the church), the water being more pronounced from below Hambledon House to the fork of the roads. Below the Smithy there was no water for some way.

The Havant Stream.

On page 54 of his paper Mr. Shore says: "No permanent stream flows through this valley, but eastward of the village (of Chalton) a remarkable 'lavant' occurs. This lavant is a flow of water from springs in the chalk of an uncertain and intermittent nature, which occur in the winter or early spring, depending on the time and degree of the winter rainfall and the consequent saturation of the chalk. The lavant springs occur at varying elevations, depending on the nature of the season; the higher the lavant, the greater is the flow of water;" but there seems to be some slip in saying that it "finds its way into Chichester harbour, near Emsworth," it would seem to flow rather to Havant than to the Ems River.

The head of this stream, that is the highest part of the bourne-rise, is at the north-western corner of Idsworth Old Park.

The Rother.

The following remarks are from pp. 52–54 of Mr. Shore's paper.

"In the eastern part of Hampshire, north of Petersfield, . . . the high, well-wooded hills or hangers are partly those of the Upper Greensand, and the vales at their feet are chiefly formed of the Gault clay. It is on the lower slopes of these Upper Greensand hills that the springs which feed some of the branches of the Rother occur . . . In very wet seasons, when the Upper Greensand hills are saturated, the Gault . . . becomes slippery from the great flow of water, so that landslips have occasionally occurred . . . One of the branches of the Rother has its sources near Empshott and Hawkley. The springs near here have an elevation of about 300 feet . . . The Ashford stream, another of the tributaries of the Rother, has its source on the slopes of Ashford hill . . . . 400 feet above the sea."

"The Criddle stream . . . has its sources in springs near the Upper Greensand outcrop to the east of East Meon."

"South of Petersfield the streams which flow to the Rother are fed by springs from the chalk . . . One of these streams has its sources in the springs about Buriton . . . from 255 to 300 feet in elevation."

Where the Rother leaves Hampshire "the springs have an elevation of about 170 feet. Near here, in St. Mary's Well Hanger, is St. Mary's well (spring?) 172 feet above the sea."

Streams flowing northward to the Thames.

Of these three streams the upper parts only are in Hampshire, except in the case of the short Enborne, which however passes out of the county before it flows into the Kennet.

The Enborne.

This, which for the greater part of its course is the border between Hampshire and Berkshire, is chiefly a Tertiary stream; but it is partly of Cretaceous origin, and Mr. Shore says of it (on p. 50 of the paper quoted): "From the vale of Kingsclere the

Enborne receives two lesser streams which rise from springs of much interest. One of these, the Kingsclere stream, rises at the spring head a short distance south of Kingsclere, at an elevation of about 350 feet, and close to the Upper Greensand outcrop. Occasional springs also occur up to 372 feet, or higher." This then is an Upper Greensand stream at its start.

"The Itchingswell spring (Ecchinswell of the newer map), from which the other stream is chiefly supplied, occurs at the junction of the chalk with the Reading beds. This spring has an elevation of 335 feet, and is near to the site of the old church and graveyard . . . The occasional sources of water . . . are higher up towards Ladle Hill, from the northern slopes of which the water course is either through Sidmonton Park to Itchingswell, or along the road at the western extremity of the park, where a very deep channel, dry in summer, may be seen near the Burghclere road. The Itchenswell spring forms a small rivulet of considerable volume at its source."

The course from the west of Sydmonton Park, above alluded to, would seem to lead northward to the Chalk-spring named Hockley's Hole, at the junction with the Reading Beds a little east of the railway, which source of the Enborne has escaped notice in the above-quoted paper.

The Loddon and its Tributaries.

Mr. H. J. O. White records the highest rising point of this river, saying "the Loddon occasionally rises in a field east of Crossway Farm, near Worting," (Geology of Basingstoke).

Of this river Mr. Shore treats on pp. 48, 49 of his paper. I add some notes from visits of my own, in later years :—

"The main stream rises about a mile west of Basingstoke, at an elevation of about 265 feet." This is at West Ham House, whence, for three-quarters of a mile or so the stream is very small, but increases as it passes through the town, below which "it is largely increased in volume . . by the great flow of water from the springs, which may be seen near the upper road between Basingstoke and Old Basing. These springs are in the chalk, and have an elevation of about 263 feet. An occasional source of water flowing down to the level of these springs is in Spring Wood, Hackwood Park, 330 feet in elevation."

The chief springs are in the small side-valley of Basingstoke Common, and, in the parish of Basing, in another small side-valley just to the east, and in the main valley at and below the combined junctions of these side-valleys.

"The Lyde . . tributary stream, has its chief source in the great springs at Andwell Moor at an elevation of about 237 feet," as well as from springs in the marsh a little westward, between the two main roads. But this group of springs is not the head of the stream, one branch of which seems to rise at Moorham's Farm, in the valley to the south-west, whilst the other "branch of this stream has its source at Maplederwell. . . The spring is in the chalk close to the churchyard, about 242 feet in elevation, but the flow is very uncertain. In wet seasons the stream rises half a mile

higher up, and the water makes a channel for itself across the fields. Some years ago . . it was stated . . that the Maplederwell stream yielded 1,800,000 gallons of water a day. This perhaps it does in March, but in the latter part of a fairly dry summer it does not yield a pint, and the watercress at the spring head is barely kept alive." But "the Lyde at Andwell carries away some millions of gallons of water daily."

"The Weybrook, which is one of its (the Loddon's) tributaries, has its spring head at the junction of the chalk and Reading beds, a little west of the church at Sherborne St. John, the elevation of the spring being about 256 feet. It flows at once in considerable volume." The longer branch of this tributary starting from Ramsdell, further westward, seems to consist only of the drainage from the Tertiary beds.

"The Whitewater springs (probably the chief tributary from the Chalk) are at Bidden Water about a mile south of Greywell, the elevation being 268 feet. Its highest occasional source is . . towards Upton Grey. The springs . . yield many million gallons of water a day." I examined this watercourse early in the spring of 1908; but unfortunately have lost my notes. Springs can be seen at various places from Bidden Water downward to Greywell.

A branch, not alluded to by Mr. SHORE, starts in the valley by Hill Side Farm, just E.S.E. of Odiham.

"A branch of the Whitewater rises at Ashley head spring, close to Crondall, about 273 feet above the sea. It flows north, joining another stream from near Itchel (also in Crondall parish), 265 feet. These streams have their sources at or near the outcrop of the chalk." The first spring is in a small basin in the Chalk; the second set of springs, named Itchell Mill Springs on the six-inch Ordnance Map, is about a third of a mile north of Itchell House.

On a visit to Crondall in August, 1889, I was told that in winter water breaks out in the valley to the south-west.

The Wey and its Tributaries.

Continuing from Mr. SHORE's paper (pp. 50–52): "The highest geological formation which supplies the Wey is the Chalk, and the lowest is the Lower Greensand." The high springs of the Alton branch, from the Lower and Middle Chalk, just west of Alton "at Willhall [? Wellhall] have an elevation of about 360 feet. King's Pond, near the railway station, is supplied by springs south of the town. . . The Alton springs yield a very great volume of water."

By the eastern end of Alton this branch "receives an occasional source in a stream which in wet seasons flows from the Upper Greensand at West Worldham (a little S.W. of West Worldham, but not on the newer Ordnance Map), down one of the most interesting waterways in the county, called Water Lane, which is at times both a lane and a water-course."

At Holybourne is another Lower Chalk spring and very short water-course. "The spring has an elevation of about 350 feet, and is close to the churchyard. Formerly, the water issued from its

natural spring almost opposite the west door of the church, and about 20 yards from it; but when the churchyard was enlarged, the spring head and stream were culverted for about 30 or 40 yards to the pond, which adjoins the churchyard wall, and in which the . . Holybourne now rises."

"The southern branch of the Wey . . enters our county from Sussex, and it forms the boundary of the two counties in Hammer bottom (west of Haslemere). . . The springs in Hammer bottom (from Hythe Beds) have an elevation of 400 feet." The neighbourhood of Bramshott "is a country of springs, the most interesting of which are in the beautiful glen scenery of Wagner's (Waggoners) Wells, at an elevation of from 400 to 500 feet," in a tributary-valley on the right, also in the Hythe Beds. On the left, at Lindford, other tributaries, forming the Hollywater, join, and "one of these streams flows, except in dry seasons, from Woolmer pond."

The short tributary from Headley, where there is "at the part called Arford, plenty of water and springs at an elevation of about 255 feet," joins the main stream on the right bank just north of the village.

"Another branch of the southern Wey is the Oakhanger, which has its source at the well head (spring) at Selborne, 415 feet above the sea, at the outcrop of the Upper Greensand."

It is to be wished that the streams of the Isle of Wight may be as carefully chronicled as those of the mainland have been by Mr. Shore.

Mr. T. Hennell has given the following gaugings of springs feeding the Loddon and the Whitewater, made in the autumn of 1866: Greywell, 2,500,000 gallons a day; Mapledurwell, 1,980,000; Newram (a name given on the old Ordnance Map, sheet 12, to the springs half-way between Basingstoke and Basing), 4,500,000.*

* Royal Commission on Water Supply. Minutes of Evidence, p. 117. Fol. *Lond.*, 1869.

SUPPLIES FROM SPRINGS.

Water is of course taken from springs for small local supplies in many places; but there are also public supplies which get their water from springs or by development of springs, either in part or wholly. Though there are not many such yet amongst them is the largest supply in the county, that of the Portsmouth Company, which is moreover the largest spring-supply in the kingdom.

Portsmouth and District Supply.

So important are the Portsmouth Waterworks, on which the great dockyard, as well as other naval and military establishments depend for their supply, that they may well be described before passing on to the smaller works.

The following account is based on a pamphlet printed by the Company in 1889, on the Report of Dr. T. Thomson (L.G.B. 1897), from which several quotations are made, on later information given by the Engineer, Mr. H. Ashley and on some other sources, besides my own personal knowledge.

The first step for a public supply was taken in 1741 by Mr. T. Smith, who got power to use springs in Farlington Marshes; but nothing was done for 30 or 40 years, when Mr. P. Taylor took the first practical step by digging a well in Crookhorn Copse, about five miles north-eastward of Portsmouth and by driving a tunnel into Portsdown Hill in the same neighbourhood. Enough water however was not got and the scheme was abandoned.

In 1809 the Farlington Waterworks Co. was established, taking over the powers got by Mr. Smith, and it made a pumping station in the Farlington Marshes, from the springs in which a supply was started in 1811.

In 1809 the Portsea Island Waterworks Co. was also established and started a competing supply, from a well at Brunswick Road, Landport, even then a populous place.

In 1840 the two companies combined, as the Portsmouth and Farlington Waterworks Co.; but their long rivalry had impaired their resources and they failed in sufficiently extending the works.

In 1857 the old company was bought up by the present one, the Borough of Portsmouth Waterworks Co. The population of Portsmouth and its immediate surroundings, not then included in the borough, was about 98,000 and the total supply about 500,000 gallons a day; many houses getting water from wells in their back-yards, often dangerously near to cess-pits and other possible sources of pollution.

The new Company continued to use the Farlington springs (a little northward of the railway about half a mile south-westward of the church); but the Landport well was not used. Soon after its establishment the Company purchased some of the springs at Havant and then supplied the borough from this source in 1860.

The Havant works (close to the springs) were enlarged and from time to time other springs were purchased, at Havant and at Bedhampton. In 1889 a second pumping station was established

at the latter place, close to the additional springs that had been acquired, and various additional works have been done since, including short cylinders or borings in some of the springs. Thus at the Railway Spring, just within the southern border of the London Brighton and South Coast line, westward of the Bedhampton Works, a cylinder was driven down, in gravel, to a depth of about 18 feet; whilst at East Bidbury Spring, just to the north, a boring was made, in the middle of the spring-pond, through gravel (below the water), to a depth of 7 feet below the surface of the water, then through 29 feet of "chalk marl and stones" (the reconstructed material at the top of the Chalk which often occurs hereabout), and then through 82 feet of chalk and flints, or 118 feet in all. I have seen the water flowing over the top of the bore-pipe, some inches above the level of the water in the spring-pond, and a like thing occurs in other cases.

The following is a description of the works as they were in 1896, 7. (From Dr. Thomson's Report, L. G. B.)

At the Havant Works there are several springs within the Company's property of about seven acres. "As they rise many of these springs are impounded in open collecting basins, through the floor of which they bubble up, while others are conveyed in open conduits from their point of origin to these collecting basins. Collecting basins as well as conduits are lined at the sides with stones, set in cement. Their bases are formed by the Chalk and Chalk-gravel. . . All the springs, conduits, and collecting basins within the enclosure are surrounded by a trench of puddled clay. . . This puddle trench is constructed of . . . a red clay of impervious character derived from the Reading Beds." With an average breadth of three feet the trench "is said to have been everywhere carried down into the hard Chalk or into clay, which is stated to have been encountered at some points. . . The depth . . . is said to range between 10 and 30 feet."

Two other springs, outside the puddle-trench and south-west of the enclosure are also used. In one, about 150 yards from the enclosure, the water "is received as it comes to the surface in a small collecting basin, of which the sides are lined with brick and stone set in cement. The second, really a group of springs is a little eastward and rather nearer than the enclosure, and its water is received in a small collecting basin through the floor of which the springs bubble up. The walls . . . are formed by brick and stone in cement, and . . . are surrounded on all sides by a trench of puddled clay some 3 feet in thickness, and carried down . . . 8 or 10 feet from the surface of the ground into the Chalk."

The Bedhampton Works, by the Hermitage Stream "take their supply from the St. Chads Well, Blue Hole, and Bedhampton Springs. These springs have been opened out; while the channels along which they flow have been cleared out and the water in them dammed back by weirs, so as to form collecting basins. These basins are unlined and unprotected."

Though the two Works are each complete in themselves, they are so connected that water from either can be pumped by the engines at the other.

Other springs then owned by the Company but not used have since been brought into use.

The Havant and Bedhampton Springs belonging to the Company "are estimated as yielding about 15,000,000 gallons per day. Of these . . . probably about 9,000,000 are furnished by the springs utilised by the Company" (in 1897). Pumping from both or either of the works "goes on daily . . and the average supply drawn from the combined source amounts to about 7,000,000 gallons daily."

At the Farlington Works is a set of springs, mostly eastward of the engine-house, over ground a quarter of a mile or more in length. The water has no exit at the surface but flows into a pumping well, about 15 feet deep. The amount formerly taken from these springs, by the Farlington Water Co., is said to have been 500,000 gallons daily. (Mr. H. Ashley gives it as only from 150,000 to 200,000.) This supply has been given up.

The following springs were taken in later:—North or East Bidbury in August, 1898, South or West Bidbury in the month after, Little Blue Hole in August, 1901, and the Railway Spring in August, 1902. The total minimum yield of the four being nearly 3,000,000 gallons a day. There are also the Church springs (2 sets), south of the engine-house, and Wyatt's spring, in the Upper Bedhampton Mill Pond.

The winter of 1879, 1880 is said to have given the lowest gaugings of the springs.

A table of gaugings of the Company's springs, at Havant and Bedhampton, taken once a week, from 4th April, 1905, to 20th March, 1906, shows that the amount varied from 11,800,000 gallons on 4th December, 1905, to 21,000,000 on 20th February, 1906. Only twice was the amount below 12,000,000, and six times it was 20 or more.

The level of the springs is about 18 feet above Ordnance Datum.

From a table showing periods of great consumption, from 16th January, 1901, to 3rd September, 1902, we learn that in the week ending 12th July, 1901, the supply reached a daily average of 9,113,000 gallons.

The following particulars are gleaned from the Water Works Directory, 1909. Besides the Borough of Portsmouth (equal the whole of Portsea) the following places are in the area of supply:—Bedhampton, Cosham, Drayton, Emsworth, Farlington, Havant, New Brighton, Purbrook, Red Hill, Warblington, Waterloo and Wymering. The yearly supply is 2,866,930,121 gallons and the average daily consumption is 24½ gallons a head (for domestic purposes only).

For analyses of the waters of these springs *see* pp. 179–184.

Aldershot Camp.

The former supply of this great military station was from a set of springs flowing into Bourley Bottom. These springs are for the most part just within the county-boundary and two only start some yards across it, in Surrey. The water comes from the gravel of the hill-top and from the underlying Upper Bagshot Sand, being thrown out by the clayey Bracklesham Beds beneath. Collected by a great number of channels it is led into reservoirs, the highest just below the 500 feet contour on the map and the lowest a little below the 400 feet contour.

The scheme is a good example of the collection of water from surface-beds in an uninhabited area; but the collecting ground is comparatively small, and with the increase of the demand for water it became needful to look for another supply. Now the Camp depends for its water on the Aldershot and Farnborough Companies.

From a Report made by Lord Belhaven (then Lt.-Col. A. C. Hamilton, R.E.) in 1884 we learn that the supply was uncertain because in dry seasons it was inadequate to the requirements and that the water was of inferior quality, as being unfit for use unless filtered. At the time the Permanent Barracks and the South Camp were wholly supplied from this source and it had been lately extended to part of the North Camp. Except for this the North Camp was dependent on wells, some of which had been reported as unfit for use; but others apparently yielded wholesome water. The five reservoirs have a total capacity of 41,727,585 gallons; it was impossible to prevent an accumulation of vegetable débris from collecting in them.

The following particulars as to the character of the Bourley waters are taken from an Appendix to this Report, by the Professor of Hygiene at Netley (De Chaumont). The samples were taken from the reservoirs on 5th July, 1883.

Reservoir No. 2.

Slightly coloured; clear; slight sediment; good lustre; good taste; no smell;

Microscopic characters. A desmid, a few particles of soot, minute infusoria, vegetable débris.

Remarks. Unfit for drinking without filtration.

Reservoir No. 5.

Slightly coloured; clear; slight sediment; good lustre; good taste; no smell.

Microscopic characters. Mineral grit.

Remarks. Usable, but would be improved by filtration.

Aldershot Town.

At first the supply here seems to have been somewhat of the nature of a spring-supply, being derived from a very shallow source. According to Dr. Reece, in his Report on the Urban District (L.G.B. 1889). "At one time, some years ago, the company procured their supply of water from the gravel strata at the southern part of the district, but owing to the increase of the Town, and, to a certain extent, the difficulty of ensuring the gathering ground from pollution" this was given up and the well-supply was established.

Bournemouth.

In its early days, when this was but a small place, the water-supply was got from springs. *See* p. 68.

Hartley Wintney.

The public supply, according to Dr. Low (Report, L.G.B. 1907) is "derived from upland springs and upland surface water in an unpopulated part of the district. . . Some of the water is peaty." For an analysis of the water *see* p. 179.

Lymington.

Particulars from the Water Works Directory, 1907.

Works established 1883.

Surface-springs, from gravel (? near Ampress).

Yearly supply 28,500,000 gallons. Maximum days' consumption 90,000.

According to the same work, 1909, the yearly supply was 27,769,500 in 1908, and the maximum day's consumption (August) was 102,000 gallons.

An analysis of the water is given on p. 179, and an account of a well here on p. 105.

Southampton.

In early days an approach to a public supply was got from springs from the gravel. Of these there are two remaining, small medieval buildings from which the supply was taken; one is on the west of Hill Lane, near Spring Hill, and the other on the northern side of Commercial Road, by the footpath east of the church, north-eastward of Southampton West Station.

The following particulars are from a paper by Mr. W. Matthews:—[1]

"The Waterworks of Southampton have a history going back to a more remote date than can probably be ascribed to any other such undertaking in this country, it being recorded that on June 16th, 1290 (Edward I.), one Nicholas de Shislee granted to the Friars Minor the right to take water from a spring at Colwell (= Spring Hill) to Achard's Bridge, and thence by the King's highway to their church in the town of Southampton. It is further recorded that upon the Feast of the Purification, 1310 (Edward II.) the Friars granted the use of the water to the town. On October 3rd, 1420 (Henry V.) they conveyed to the Mayor and Community of Southampton all their rights and title in the springs, conduit, and pipes, and the waterworks of the town have ever since, for a period of 478 years, remained in their possession."

"On June 1st, 1515 (Henry VIII.), another spring at Lobery Mead (now Grosvenor-square) was presented to the town by John Flemynge. The water

[1] *Trans. Brit. Assoc. Waterworks, Eng.*, 1899, vol. iii., pp. 180, 181.

was led to a water-house (which until recently could be seen in Waterhouse-lane), and thence to the still existing house, which was quite close to it. From this water-house lead pipes conveyed the water to the town, and, together with sundry wells of a purely local character, including the Houndwell Well . . . constituted the water supply until 1803."

Later the supply was got from springs on the Common, by drains cut across that place, and of varying depth (from 10 to 20 feet), the water being collected into reservoirs, two of which still remain, as ornamental ponds. Mr. Matthews tells us, in the paper above quoted, that No. 1 reservoir was made about 1804, the water being collected by earthenware pipes and conveyed to the town by a line of elm-pipes. The reservoir has been abandoned and the banks have been levelled down. No. 2 reservoir was made about 1811 and No. 3 about 1832. This water was used till 1852.

In the Isle of Wight there are also some public supplies that are or were taken from springs to some extent, and probably many springs are used privately.

Carisbrook.

Part of the Newport supply was got from springs, near by the wells at the works at the eastern end of the village (see p. 150). The following information is taken from Dr. T. Thomson's Report to the Local Government Board on Newport, 1895.

The springs that form the low level service rise (from the Chalk) through a "thin layer of soil to the ground surface and are with one exception impounded at the points where they rise in a reservoir. . . . The one exception . . . consists of a spring which rises to the surface in an adjacent field at a point some 60 feet to the east of the reservoir, to which its waters are conducted." The amount got is unknown.

East Cowes.

In 1891 I found that the supply was practically from springs, being got by drains cut through the gravel of the high ground, supplemented from a well, in the Osborne and Headon Beds, between 40 and 50 feet deep, at Mr. Brading's (Clarence Road ?) over a quarter of a mile south of the Floating Bridge. At that time I recommended an extension of the gravel-supply.

Newchurch.

Knighton. Ryde Waterworks.

Geol. Map 331, new ser.

At the Knighton Works springs from the base of the Chalk and from the Upper Greensand are taken. The chief spring is from the Chalk at the northern end of the reservoir, and there are probably others at various places round that reservoir. Mr. W. Matthews tells me that this supply is to be increased by means of headings driven into the hill.

Lord Alverstone's Waterworks get their supply from Lower Greensand springs. *See* p. 185.

Shanklin.

These works get their supply partly from springs. *See* pp. 163, 164.

Totland. Water Co., 1883.

From the Water Works Directory, 1909.

The source of supply is springs at Headon. The water is of moderate hardness and great organic purity. It is filtered through gravel beds.

Ventnor. Water Co., 1886.

From the Water Works Directory, 1909.

The source of supply is springs from the Chalk (by the railway-station) The water is excellent, and its hardness, after treatment 4·4°. The places in the area supplied are Bonchurch, St. Lawrence and Ventnor.

West Cowes.

Geol. Map 330, new ser.

Some time ago the whole supply was got from what may be called artificial springs. The gravel-tract of Broadfields, southward of the town, from Moor Green to the cross roads west of Northwood Cottage, is trenched across, and the water drawn off to the reservoir.

The following particulars are from the Water Works Directory, 1909, p. 88.—Estimated quantity available in a year 16 million gallons. Estimated daily discharge at points of collection, maximum 400,000 gallons, minimum 5,000, average 50,000.

There is also a well-supply. *See* pp. 164–166.

SUPPLIES FROM WELLS.

By far the greater number of the public supplies of the county is got by means of wells, and the same is the case with supplies for manufactories of all kinds, for institutions and for houses.

The tendency, too, is for the well-supplies to increase, at the expense of other sources; thus Southampton was once supplied from a stream, and Aldershot camp from a set of springs. Whilst the former place has now the largest well-supply in the county, the latter has had to go to local companies to cope with its greatly increased needs. Bournemouth is another case in point, and Poole, just across the border, in Dorset, is following suit.

All the large towns get their supply from the Chalk, either wholly or in part, the chief supply from other sources being that of Ryde, and in this case the Chalk contributes.

Dr. BULSTRODE, in a Report upon the Isle of Wight (L.G.B. 1905), makes the following remarks, which it is very satisfactory to note: "In the matter of water supply . . . the Rural District Council has merited . . . the gratitude of the public. It is true that the fact that many of the villages are well supplied with water is due in no small measure to the facilities afforded by Nature and to the public-spirited action of certain of the large landowners. But when allowance has been made for these two factors there still remains much which must be placed unreservedly to the credit of the District Council."

He then draws attention to the fact that places in the northern part of the island get their supply from the southern or central parts (where the water-bearing formations crop out), giving as examples Ryde and St. Helens, Newport, Shalfleet and Newbridge (these two getting their supply from the Chalk at Shalcombe), Yarmouth and Freshwater.

"The water supply of Newchurch is derived from the private supply of Lord Alverstone," and the mains of the Newport and Ryde supplies have been extended to various villages.

"But . . . there are still many places . . . in need of an adequate supply of wholesome water . . . mention may be made of Brading, Godshill, and Rookley . . . of Chillerton, Gatcombe, Shorwell, Atherfield, Thorley and Yaverland."

"In each of these places the water supply is eminently unsatisfactory, being derived from shallow wells in objectionable positions, and altogether imperfectly protected against surface washings and soakings. In some instances . . . the inhabitants are compelled, especially in summer, to go long distances for their drinking water; and . . . there are still places where the inhabitants drink from streams which are obviously liable to pollution."

NOTABLE WELLS.

The following wells are of note from the geologic considerations appended to each. Besides those mentioned there are many which show the depth, through Tertiary beds, to the Chalk. Those of the mainland are noticed first.

Bentley. Shows a great thickness of Gault, ? over 370 feet.

Boldre. Lady Cross. Gives details of the Headon Beds in the New Forest.

Christchurch. Proves the depth through Drift and Bracklesham and Bagshot Beds, to the London Clay (? 380 feet) and then, through London Clay and Reading Beds, to the Chalk (824 feet).

Dibden. Shows a great thickness of Barton Clay (349 feet).

Farnborough. Passes through Upper Bagshot Sand, Bracklesham Beds and Lower Bagshot Sand, to London Clay, 228 feet.

Fordingbridge. The gasworks-well shows a thinning of the London Clay (? to 124 feet).

Gosport. Haslar. Details of Tertiary beds. (Hard to classify the beds). The Victualling Yard well proves the thickness of the Bagshot Sand and of the London Clay (31 and over 336 feet). Bury Cross, Waterworks, No. 1 Well, gives details of the Bracklesham Beds (294 feet thick) and shows that the Bagshot Sand is only 26 feet thick (in No. 2 apparently it is only 17). No. 3 passes through Bracklesham Beds, Bagshot Sand (25 feet), London Clay (327 feet) and Reading Beds (100 feet), not reaching the Chalk at 747 feet.

Havant. Wells show the varying depth to Chalk, resulting from the northerly dip, whilst those of *Hayling Island* show the like from the southerly dip, on the other side of the rise.

Hythe. Gives details of Barton and Bracklesham Beds.

Lymington. Shows the thickness of the Barton Sand and of the Barton Clay.

Milton, near Lymington. Gives details of Headon Beds and Barton Beds.

Netley. Gives details of the Bracklesham Beds.

Portsmouth. The deep boring at the Dockyard goes through 288 feet of London Clay and 119 of Reading Beds, to the Chalk, and then over 626 feet into the last. Other wells show the varying nature of the Tertiary beds in different parts of the town and the varying depth to the Chalk, owing to the southerly dip.

Southampton. The boring on the Common is the deepest in the county, beginning in Bracklesham Beds, it passes through Bagshot Sand (32 feet), London Clay (301 feet) and Reading Beds (85 feet), reaching the Chalk at 464 feet and then going down more than 850 into that rock. As with Portsmouth, though to a less extent, other wells show the variations in the Tertiary beds and in the depth to the Chalk at different places.

Steep Mill. Shows the Gault to be 236 feet thick.

Swanwick. One of the borings shows that the depth to the Chalk is very much greater than had been expected, and that therefore there must be an error in the Geological Survey Map, 315, new series. According to this map there should be but little London Clay here, instead of about the full thickness, and the depth to the Chalk should not be more than 150 feet, instead of 425. Probably there is some fault or other local disturbance.

Upham. A very peculiar section. Can it be on the line of some disturbance?

In the Isle of Wight the following may be noted as of geologic interest :—

Bembridge. The boring at Steyne goes through the Bembridge Marls and Limestone (? 145 feet), the Osborne and Upper Headon, the Middle and Lower Headon Beds (in all 311 feet) and the Barton Sands (244 feet), to the Barton Clay.

Brading. The Harbour Farm boring also gives details of the Osborne and Headon Beds.

Newport. The wells at Mews' Brewery, the Gasworks and the West Medina Cement Works, pass from the Hamstead through the Bembridge Beds and the Upper Headon Beds into the Middle Headon Beds. The well at the Isle of Wight Union passes through all these beds and the Lower Headon Beds to the Barton Sand.

St. Helens. No. 2, goes from the Hamstead Beds through the Bembridge Marls and Limestone (134 feet) to the Osborne Beds.

Ventnor. Isolation Hospital. Seems to be an example of a well made in a slipped mass of rock.

West Cowes. The Waterworks Well starts in Hamstead Beds and passes through Bembridge Marls and Limestone (125 feet), Osborne Beds (103 feet) and Upper and Middle Headon Beds (to 169 feet).

Wootton. The Beach Lane well ranges from the Hamstead Beds, through Bembridge Marls and Limestone (118 feet) and Osborne Beds (about 117 feet) into Headon Beds.

The Spithead Defences Wells are notable as showing a considerable thickness of Recent Marine Deposits (70 and 90 feet) and of Bracklesham Beds (471 and 451 feet).

Turning now to wells that are specially important as regards their supply we have the following on the mainland :—

Aldershot. Waterworks. An example of a large supply from a set of wells and borings through some thickness of Tertiary beds into the Chalk.

Alton. A well getting its supply apparently from Lower Chalk and Upper Greensand.

Alverstoke. The Foxbury Works of the Gosport Company are of interest from the fact that over-pumping resulted in the drawing in of salt water (*see* pp. 48–50).

Braishfield. Cases of overflow from borings driven through Tertiary beds into the Chalk.

Christchurch. The West Hants well is a case of overflow from the Chalk beneath a very great depth (824 feet) of Tertiary beds.

Farnborough. An example of a public supply got from the Bagshot Beds.

Gosport. Bury Cross Waterworks. An example of a public supply from Bracklesham and Bagshot Beds, probably with some addition (in one boring) from very deep-seated Chalk. Other Gosport wells also get a supply from the former source.

Herriard. An illustration of change of water-level brought about by pumping.

Hursley. A private supply, to an estate, extended to a village.

Netley. The hospital gets a supply from Bracklesham and Bagshot Beds.

Otterbourne. Southampton Waterworks. Notable as getting a very large supply from the Chalk and also for perhaps the largest and most up-to-date softening works in the kingdom.

Petersfield. Supply from Lower Greensand. Waterworks and others.

Portsmouth. Some of the wells get a supply from Bracklesham and Bagshot Beds ; some from the Chalk. In most cases I believe the yield is small. Some wells reach Chalk at a great depth.

Soberton. The Gosport Company get a large supply from a well sunk through a small amount of Gravel and Reading Beds (51 feet) into the Chalk.

Southampton. Various wells get water from Bracklesham and Bagshot Beds ; others are continued downward into the Chalk, but without satisfactory results.

Timsbury and *Twyford.* The South Hants Water Company get a large supply from the Chalk, for a wide-spread district. With softening works.

Wimborne. The Waterworks for Bournemouth get a large supply from the Chalk, in Dorsetshire, replacing the old supply.

The Isle of Wight wells that are notable in the matter of supply are as follows :—

Carisbrook. Newport Waterworks get a good supply from the Chalk.

Knighton. The Ryde Waterworks get a large supply from the Lower Greensand (borings), with some addition from the Upper Greensand and the base of the Chalk (springs).

Newport. Four deep borings seem to get their water from the Headon Beds ; but that at the Gasworks goes through to the Barton Sand.

West Cowes. The old supply is of interest as an illustration of getting water from a spread of gravel. The waterworks-well taps Bembridge Beds, and Osborne and Headon Beds, as also does the Woodvale well.

At the Spithead Defences the borings at the Horse Sand and Noman Forts get their supply from Bracklesham Beds.

New Wells.

The following wells on the mainland are now noticed in detail for the first time and so may be described as new :—

Aldershot (Nos. 8, 9), Alton (No. 2), Andover (3 wells), Basing (2 wells), Basingstoke (Nos. 2, 4), Bentley (both), Bishopstoke, Bishops Waltham (Nos. 2, 3), Blendworth, Boldre (2 wells), Botley, Bournemouth (Nos. 1, 2, 3, 4, 8), Catherington (all three), Cheriton, Christchurch, Cliddesden, Cranbourne, Crondall (all 4), Droxford (2 wells), East Meon, East Tisted, Eastleigh, East Worldham, Ellisfield, Emsworth (all), Ewhurst (No. 1), Fareham Asylum, Fawley, Fordingbridge (No. 4), Frensham, Froyle, Fyfield, Gosport (Nos. 3, 5, 6, 7), Greywell, Hambledon (3 wells), Havant (Nos. 4, 5), Hayling Island (Nos. 4, 5, 7,), Herriard (4 wells), Hursley, Kingsclere (No. 4), Lockerley (Nos. 1, 2), Lymington, Marchwood, Odiham, Owslebury, Petersfield (Nos. 1, 3, 4, 6, 7, 8, 9, 12, and 2 borings of No. 2), Pilcot (No. 2), Porchester, Portsmouth or Portsea (Nos. 2, 3, 4, 5, 6, 7, 9, 12), Ramsdell, Ringwood (2 wells), Romsey, Ropley, Rotherwick (No. 2), Selborne, Sherfield (No. 3), Shidfield, Soberton (2 wells), Southampton (Nos. 4, 7), South Stoneham, Steep (Nos. 1, 3), Stratfield Saye (Nos. 1, 2), Swanwick (all three), Sway (both), Twyford (South Hants Works), Weston, Weyhill, Wickham (No. 2), Winchfield (Nos. 2, 3), Wootton St. Lawrence, Yately, also Daneshill.

Also, in Addenda, Alverstoke, Hambledon (2), Titchfield.

The following wells in the Isle of Wight are also new :—

Bembridge (No. 2), Brading, Chale, Freshwater, Newport (Nos. 2, 3), Newtown, Ryde (No. 1), Shalfleet, Shanklin, Ventnor (Hospital), West Cowes (No. 2), Wootton (No. 9).

Also, in Addenda, East Cowes.

CONTAMINATION OF WATER.

Various notes on this subject will be found in the accounts of some of the wells (*see* Index); but there is one kind of contamination of water common to all coastal counties. It is often found that wells near to the sea or tidal waters are liable to draw in salt water. Such wells may yield good water, even though its level varies with the rise and fall of the tide, until pumping takes out more fresh water than Nature is bringing to the site, and so makes room for the incoming of salt water.

The Rev. J. C. Clutterbuck, speaking of infiltration of sea-water at Haslar, said: "After carefully examining the water in the surface gravel, into which some of the wells of the hospital were sunk, he ascertained, that the salt water came through a bed of sand beneath the subjacent clay, into which the tidal water found its way, from an artificial, and not from a natural, cause. Many of the wells in Portsmouth were tidal." [1]

One of the most interesting cases of infiltration that I know of occurred at the Foxbury Works of the Gosport Water Company (*see* pp. 60, 189–191).

That site was selected for new works as being perhaps the only one, within the Company's then district, at which it was likely that success would attend the sinking of a well into the Chalk, though at the time it was foreseen that excessive pumping might result in drawing in salt water.

The result of the work justified the selection of the site, a good supply being got; but salt water was drawn in after a time, far sooner indeed than had been thought for, and in the end a new source of supply, far outside the Company's district, had to be got.

Directly the evil became manifest a careful watch was kept, and from the records supplied we have a full account of the case, with its various unexpected and sometimes apparently contradictory occurrences.

In the first place we have a Report by Mr. E. T. Hildred, the engineer, on November 4th, 1902, published in the *Portsmouth Times*, August 29th, 1903, with the following information (somewhat rearranged).

On October 15th he made a verbal report to a special committee of the Company, and, having made the needful arrangements, on the afternoon of that day he went along the whole length of the headings, so as to take samples of water for analysis, from each of the fissures contributing to the supply.

The analyses that had been made show the gradual but unmistakable change for the worse in the water, as below:—

1897.	Chlorine,	in grains	per gallon,	23.	Hardness	20°
1898.	"	"	"	26	"	18·8°
1899.	"	"	"	26·6	"	21°
1900.	"	"	"	31	"	26°
1901.	"	"	"	33·9	"	24°
1902.	"	"	"	45	"	35°

[1] In discussion, *Proc. Inst. C. E.*, 1860, vol. xix., pp. 32, 33.

The samples taken on October 15th (1902) were tested by Dr. J. C. THRESH, with the following general results :—

Water in Bulk.

Eastern Heading.	Chlorine, in grains per gallon,	62.	Hardness	52·5°
Western "	" " "	26·6	"	25·2°
Rising Main	" " "	45·6	"	35°

These figures fairly agree with those of similar samples taken in August, 1902

Water from Fissures.

Eastern Heading, from the well eastward.

Fissures 1, 2, 3, 4.	Chlorine, in grains per gallon,	48.	Hardness	33°
Fissure 5	" " "	50	"	37·5°
" 6	" " "	86	"	67·2°

Western Heading, from the well westward.

Fissure 1 omitted, its yield being very small.

" 2.	Chlorine, in grains per gallon,	36·4.	Hardness	29·4°
" 3	" " "	27·7	"	25·8°

These results show that the waters from the western heading were of better quality than those from the eastern (the chlorine and hardness of the former not being greater than in some deep-seated Chalk-supplies) and that the easterly waters contain chlorine in excess and are very hard, those from fissures 5 and 6 certainly pointing to infiltration of salt water. MR. HILDRED therefore advised that the eastern supply should be cut off by dams, and that the western heading should be extended, in the hope of getting better water : advice that was agreed with by DR. THRESH, and later on by myself, in consultation with MR. HILDRED, as afterwards noted in a Report on March 27, 1903, in which I advised that borings should be made in the western heading.

On April 16, 1903, I went down with MR. HILDRED and walked along the galleries. I noticed that one spring in the western gallery was the most effective in adding to the supply. The water came in partly from the bottom of the gallery, with a rise so strong as to force up the water above the level of that flowing along the floor, but partly also by an issue from the roof and side. The two flows seemed to come from one and the same fissure, extending across the gallery, and consequently they had been taken as one spring, the combined water being tested for chlorine. It occurred to me that it might be worth while to test the waters of the top and bottom flows separately, but without expecting any appreciable difference. The result, however, was that the difference was great, to our astonishment. If the infiltration of brackish water came from above, as would have been expected, it would seem that the top flow should have been more salt than the bottom one, which rose from below ; but the reverse was the case. Details of this, from MR. HILDRED, are given further on, with other evidence of increase of saltness with increase of depth.

The public, not unnaturally, got somewhat alarmed by the increase in the saltness of the supply. Meetings were held in 1903, and the local newspapers had frequent references to the subject, of course with some needless alarms thrown in.

In the later part of 1902 I had a set of letters from Mr. E. T. Hildred on the subject, from which the following facts are noted :—

It was not until the installation (in 1902) of new pumping plant that he was able to exhaust the water to below the headings, and on doing this he found that the supplies from the eastern and western adits were very unlike in character, there being a difference of 36 grains of chlorine per gallon and of 27·3° of hardness.

When first enabled to lower the water-level in the well to any extent the chlorine rapidly decreased ; but this was not maintained with more continuous exhaustion.

In April 1903 Mr. Hildred took six samples of water from the two springs at the end of the western heading (which I had examined with him the day before), at low, mid and high tide, with the following remarkable results as to the quantity of chlorine, in grains per gallon :—

Low tide ...	Bottom spring ...	38·4 ...	Side spring ...	31·4
Mid tide ...	" ...	39·2 ...	" ...	24·8
High tide ...	" ...	40·8 ...	" ...	24·4

Showing a contrary effect of the rise of the tide on the two contiguous springs.

A few days later, the headings having been driven further (in all 90 feet of extension), in dry chalk, and a boring having been made to 50 feet below the heading, at 49 feet a large flow of water was tapped, but this was still worse as regards chlorine, which reached 60 grains a gallon.

Early in May the gallery had been pushed still further westward (130 feet of extension), but only two very small flows were found, and the water was good.

Later a second boring was made to 85 feet below the heading. This tapped a small flow at 60 feet, or a little below the level at which the earlier boring yielded bad water, and the water was fairly good, with only 17 grains of chlorine to the gallon, but with a good deal of sediment (sand and chalk).

The variations in the waters from different parts of the works, and even from contiguous outflows, that have been described are very perplexing, nor is it easy to understand how the salt water gets into the well in such quantity, the tidal channel in the neighbourhood being in Reading Beds and London Clay. The fact however remains that the supply is contaminated by salt water and so it has had to be abandoned, being replaced from the inland works near Wickham (see p. 126).

I had also the advantage of examining a curious case of pollution, at the Freshwater Waterworks, for details of which I have to thank Mr. E. T. Hildred and Dr. Groves.

In October 1901 the employees of the Rural District Council threw from buckets a large quantity of weed-destroyer along the road that goes in front of the works. "After the heavy rains which followed, a quantity of the solution, which contained a noxious matter, percolated through the soil and chalk fissures into the springs from which the Company derives its supply . . A report by Drs. Attfield and Thresh . . . on a sample of water taken on the 11th inst. from the well . . shows that the water was

of the highest purity before the weed-destroyer was used" (Letters from the Company to the Council in the Isle of Wight County Press, 2 Nov., 1901). The slightest possible trace of arsenic was found in the water by DR. GROVES, who thought that the weed-killer found its way into the main and not into the well. I visited the site soon after and found that the well was unprotected from such an assault.

There was also some infiltration of salt water into the well; but this seems not to have been noticed until after the episode of the weed-killer. From the position of the well it is clear that heavy pumping might draw in salt water.

MR. G. W. LONG, the Secretary of the Company, drew my attention to the fact that there seemed to be two different waters in the well, at top and at bottom, and on Feb. 8th, 1902, MR. HILDRED had 3 samples of water taken, A from the bottom of the well, B from the water-level ($5\frac{1}{4}$ feet above the bottom of the well while pumping) and C from a ditch in the marsh, with the following curious result, in grains per gallon:—

—	A.	B.	C.
Chlorine	86·1	10·1	52·7
Common salt	143	16·8	88
Hardness	23°	9·8°	22°

The difference between the waters from the top and bottom of the well is surprising, and the bottom-water is worse than the water from the marsh.

MR. HILDRED believed that "through many years the samples taken for analysis have given misleading results because they have always been taken from the top water-level in the well" and he thought "that with the pump-section at the bottom of the well a great proportion of sea-water is drawn in." He advocated the driving of a gallery into the hill, eastward, which has been done, and in May, 1903, I heard from him that the water had got right again, the chlorine never exceeding 8 grains a gallon, as against from 60 to 80 before the extension had been carried out.

In November 1909 MR. HILDRED again wrote to me and said that continuous pumping since 1903 had resulted in the character of the water getting gradually worse, until in August 1909 the chlorine had risen to about 85 grains to the gallon. In September the new supply, from a well at Shalcombe, came into work, and in November 1909 the water at Freshwater Gate was again good; showing that the trouble was owing to the exhaustion of the water, by pumping.

UNDERGROUND WATER-LEVELS IN THE CHALK IN THE VALLEYS OF THE TEST AND OF THE ITCHEN.

(Plate II.)

By W. Matthews, M.Inst. C.E.

The data from which the Table and Map have been compiled were collected between 1884 and 1899, many of the wells having been gauged throughout that period. The number increased as time went on, and the observations were reduced to a system of monthly records of those in the more accessible places, and of bi-monthly records of those more remote. The gaugings have been continued down to the present time; but a fair average of the seasonal variations is obtainable from the data collected between 1884 and 1899. These variations range from about 5 feet, in wells in the low ground, to as much as 63 feet in the case of wells sunk at the higher elevations. The maxima were recorded in December 1891, and the minima in November 1893. The primary object of the observations has been to observe the effect produced by pumping large quantities of water at the pumping-stations of the Southampton Corporation and of the South Hants. Water Company. The positions of both are indicated on the map.

Some wells, notably those near Kings Somborne, were only under observation for a short period in 1899 for special purposes; hence the levels in February of that year have been tabulated as giving the largest possible number of records. At this date the wells were within 15 per cent. of their maxima, taking the whole range as being 100.

The map showing the probable contours of the water-levels in the Chalk was partly compiled in 1897, and extended up the Test Valley in 1899. In its compilation use was made of the gaugings of a large number of wells not shown thereon and only observed for a short time. Where the gaps were great the contour-lines have been plotted by enclosing the area between three or four wells in a semi-rectangle or triangle, and computing the levels on the cross-lines connecting the wells. At the same time regard was paid to the surface-contours of the land, which, although not coinciding with the water-contours, have, in general, a distinct relation to them. It will be found that the well-levels do not in all cases correspond with the positions of the contours, which were plotted rather from average-levels than from those obtained at the date named in the Table. For it was found that the variations in rise and fall are by no means synchronous, even over comparatively short distances, especially near the outcrop, where the Chalk in places appears to be somewhat puddled by the infiltration of clay from the Tertiary beds. The contours will obviously be moving with the seasonal and other variations in the water-levels and those represented on the map can only be taken as showing average and approximate levels.

Explanation of Plate II.

The Tertiary area is shewn by stippling. The remainder of the map is mainly occupied by Chalk.

Reference.

No. of Well.	Surface Level above Ordnance Datum.	Water Level, Feb. 1899, above Ordnance Datum.	No. of Well.	Surface Level above Ordnance Datum.	Water Level, Feb. 1899, above Ordnance Datum.	No. of Well.	Surface Level above Ordnance Datum.	Water Level, Feb. 1899, above Ordnance Datum.
	Feet.	Feet.		Feet.	Feet.		Feet.	Feet.
1	187·9	147·7	30	196·5	122·2	59	123·8	87·3
2	192·9	131·1	31	346·3	119·5	60	158·3	94·3
3	157·9	120·5	32	250·3	124·6	61	244·3	97·7
4	144·7	89·5	33	292·0	157·4	62	126·0	85·6
5	119·0	90·9	34	192·5	127·3	63	122·0	81·9
6	82·7	78·4	35	172·7	121·1	64	210·4	91·5
7	108·6	81·9	36	136·3	117·9	65	312·2	173·9
8	158·3	88·9	37	325·8	141·7	66	227·2	186·8
9	120·8	107·5	38	326·9	177·2	67	318·0	229·1
10	146·1	136·3	39	184·2	144·7	68	189·8	146·2
11	140·6	128·5	40	314·4	129·6	69	156·6	121·1
12	131·9	102·5	41	196·9	116·9	70	175·3	131·1
13	166·2	129·3	42	167·5	134·6	71	114·6	107·4
14	241·5	132·1	43	188·9	128·4	72	309·7	180·3
15	171·3	131·6	44	158·6	115·6	73	245·5	191·3
16	114·9	111·7	45	375·2	211·5	74	405·0	254·3
17	131·3	108·1	46	449·3	282·8	75	333·8	223·0
18	122·2	111·3	47	308·0	211·3	76	297·6	235·4
19	110·0	105·1	48	260·5	181·9	77	415·6	315·0
20	146·2	114·8	49	240·3	112·0	78	331·3	247·6
21	137·1	106·5	50	153·3	93·4	79	331·6	252·3
22	101·7	95·5	51	114·3	104·3	80	327·0	258·7
23	292·5	135·2	52	159·3	99·7	81	378·0	265·3
24	144·6	91·2	53	136·9	94·0	82	517·0	255·7
25	95·2	88·4	54	126·6	90·5	83	291·4	243·7
26	90·1	77·7	55	105·2	84·8	84	283·3	222·8
27	82·0	66·2	56	215·2	89·8			
28	211·4	113·4	57	154·3	88·2	85	129·3	Gaugings ceased before 1899.
29	280·8	128·5	58	81·0	78·3	86	278·3	

WELLS AND BORINGS FOR WATER, MAINLAND.

Aldershot.

Ordn. Map 285 new ser. Geol. Map 8*l*

1. D. LINES, SOUTH CAMP. 1856.

Communicated by the War Office.

Partly published by CAPT. H. G. LYONS, *Quart. Journ. Geol. Soc.*, Vol. xliii, p. 434.

About 320 feet above Ordnance Datum.

Shaft about 34 feet, the rest bored. Water rose to 48½ feet from the surface.

		Thickness. Feet.	Depth. Feet.
[Bracklesham Beds]	Yellow loam	15½	15½
	Green sand	12½	28
	Grey sand...	10	38
	Mixed green sand	6½	44½
	Dark green sand	1½	46
	Streaky blue clay	3	49
	Blue clay	4	53
[? Bracklesham or Lower Bagshot]	Black sand	15	68
	Blue clay	20	88
[Lower Bagshot Beds]	Mixed sand	22	110
	Stone [? only at bottom of bed] ...	4	114
	Mixed sand	1	115
	Mixed clay and sand	8	123
	Blue clay	6	129
	Yellow clay	1	130
	Sand and rock	5	135
	Mixed sand	1	136
	Blue clay	1	137
	Green sand	5	142
	Red sand	1	143
	Mixed sand	5	148
	Light-coloured sand	2	150
	Blue clay	4	154
	Mixed clay	2	156
	Mixed sand	6	162
	Mixed clay and sand	6	168
[London Clay]	Blue clay	7	175
	Stone [? only at bottom of bed] ...	17	192
	Blue clay	14	206
	Pebbles	1	207
	Blue clay	15	222
	Pebbles	1	223
	Blue clay	2	225
	Pebbles	2	227
	Blue clay	22	249
	Yellow stone	2	251
	Blue clay, streaked	67	318
	Blue clay	17	335
	Blue clay, streaked	8	343
	Blue clay	89	432
	Pebbles	1	433
	Blue clay [? sand at bottom] with water	67⅓	500⅓

There is a difficulty in defining the formations, and the occurrence of pebbles in the London Clay of this district is peculiar.

Another boring of the like depth at the Commissariat Supply Depot. Both were unsuccessful in getting a supply.

Aldershot—*cont.*

2. High Street, Messrs. Gale and Polden, about 100 yards W. of the Railway Station, adjoining the Goods Yard. 1897.

Made and communicated by Messrs. Le Grand and Sutcliff.

Some signs of water in the last few feet of the Chalk. Water only rose to about 70 feet down.

The old boring was made with gas-pipes of 4 inches diameter, which were damaged some 200 feet down and had to be cut through.

		Thickness. Feet.	Depth. Feet.
Old borehole	... ...	—	217
[London Clay]	Shelling out { Blue clay	33	250
	Shelling out { Black pebbles and clay	20	270
	Blue clay	68½	338½
	Blue sandy clay	2½	341
	Green and grey sandy clay	4	345
[Reading Beds, 76½ feet.]	Mottled clay	23½	368½
	Grey sandstone	1½	370
	Mottled clay	½	370½
	Buff clayey sand...	10	380½
	Fine grey blowing sand [specimen from 380½ feet, sharp buff sand]	4½	385
	Dark sandy clay	1½	386½
	Hard grey sand	2½	389
	Hard grey sandy clay	2½	391½
	Dark clay...	6½	398
	Tough greyish sandy clay	4¾	402¾
	Blue clay	½	403
	Blue sandy clay	3½	406½
	Green and grey sand	5½	412
	Green sandy clay	2½	414½
	Green sandy clay and pebbles	2	416½
	Green sandy clay	5	421½
[Upper Chalk, 52½ feet.]	Chalk and flints	½	422
	Soft clay-like chalk	16	438
	Soft chalk and occasional small flints, 6 inches of flint at the base	23	461
	Soft clay-like chalk and occasional flints	13	474

3. Aldershot Place.

Communicated by Mr. J. F. Fairbank, C.E.

No. 1. Less than a quarter of a mile a little E. of N. of the house.

About 260 feet above Ordnance Datum.

		Thickness. Feet.	Depth. Feet.
Soil, &c.	... ...	4	4
[London Clay, 151 feet]	Yellow clay	4	8
	Blue clay	142	150
	Green sand [basement-bed?]	5	155
[Reading Beds, 39 feet.]	Blue clay	12	167
	Mottled blue and red clay		
	Mottled white and red clay		
	Mottled blue red and white clay ...		
	Mottled dark blue and red clay ...		
	Mottled blue and white clay		
	Mottled blue clay		
	Yellow red and blue clay	5	172
	Yellow and red clay	1	173
	Yellow and dark red clay	1	174
	Mottled clay	20	194

Aldershot—*cont.*

No. 2. About a sixth of a mile a little N. of E. of the house.

245 feet above Ordnance Datum.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Soil		1	0	1	0
Gravel. Flint and clay mixed		5	0	6	0
[London Clay, about 66 feet.]	Blue clay	61	0	67	0
	Blue sandy clay, rather green [basement-bed ?]	4	10	71	10
[Reading Beds, about 76 feet.]	Dark brown and blue clay	7	4	79	2
	Blue and red clay, the red rather sandy	7	3	86	5
	Light-blue clay, mixed with lilac-coloured	2	6	88	11
	Blue and pink clay	2	6	91	5
	Yellow clay	8	2	99	7
	Blue and red clay	4	11	104	6
	Blue and brown mottled clay	7	4	111	10
	Red clay	1	0	112	10
	Brown clay	3	0	115	10
	Light-blue and brown clay	6	9	122	7
	Blue clay	2	9	125	4
	Dark clay	3	1	128	5
	Black smutty earth	1	8	130	1
	Dark clay	1	10	131	11
	Blue clay	4	3	136	2
	Blue and red clay	1	0	137	2
	Blue clay	1	1	138	3
	Dark sandy clay	1	5	139	8
	Green sand	5	3	144	11
	Dark sand	1	5	146	4
	Light-green clay mixed with chalk ...	1	8	148	0
[Upper Chalk, about 69½ feet.]	Chalk and flints	12	8	160	8
	Chalk	56	11	217	7

4. WATERWORKS. Southern side of Boxall's Lane, half a mile S.W. of St. Michael's Church. 1878.

About 250 feet above Ordnance Datum.

Communicated by the Aldershot Gas and Water Company.

A second boring about 16 feet off. The water-level the same in both (14 feet 2 inches and 16 feet 3 inches below the surface), and not lowered by 24 hours pumping. Daily yield about 220,000 gallons (? more).

		Thickness. Feet.	Depth. Feet.
Gravel and yellow clay [? weathered London clay] ...		17	17
[London Clay]	Blue clay	110	127
	Red and yellow dirty clay, with soft iron [basement-bed ?]	7	134
[Reading Beds, 59 feet.]	Pot clay	5	139
	(*a*) Light-red dirty clay with sand ...	7	146
	(*a*) Light-red clay with sand	23	169
	(*b*) Light-coloured pure sand ...	5	174
	(*b*) Dark clay, with thin beds of sand	6	180
	(*c*) Light and dark sandy clay ...	13	193
Chalk with flints. Water at a depth of 211 feet		46½	239½

Another account differs in some details, thus—

(*a*) Grouped as light-red dirty clay, with soft iron...	30
(*b*) Grouped as pure white clay	10½
(*c*) Grouped as dark sandy clay	13½

Aldershot—*cont.*

5. WATERWORKS. SECOND BORING. 1881. (? 8 or 10 feet of shaft.)

		Thickness. Feet.	Depth. Feet.
Loam and red-grey gravel		25	25
[London Clay, 107 feet.]	Blue clay, with claystone, from 84 to 85 feet down...	95	120
	[Basement-bed] Sand	6	126
	[Basement-bed] Sand and shells ...	6	132
[Reading Beds, 65½ feet.]	Mottled clay	18	150
	Coloured [mottled] sandy clays ...	5	155
	Grey loamy sand	8	163
	Grey and brown sand	1	164
	White sand	13	177
	Blue clay	9	186
	Black sandy clay	2	188
	Live green sand	8½	196½
	Pebbles	1	197½
Chalk with flints		152	350

6. WATERWORKS. On the Eastern side of the Railway and the Southern side of Boxhall's Lane, South of the Town. Borings 3—6; 1884, and later.

Made and communicated by Messrs. LE GRAND and SUTCLIFF.

	3	4	5	6
	Feet.	Feet.	Feet.	Feet.
Gravel and sand	14½	13½	14	16½
London Clay	103½	94½	92	105
Woolwich and Reading Beds ...	68	72	63	68
Thanet Sand [?]	9	7	10	9
To Chalk	195	187	179	198½
Chalk and flints	45	38	101	52½
Total	240	225	280	251

Water-level 23 feet down in 3; 15 feet in 4; 14 feet in 5; 22 feet in 6.

Messrs. LE GRAND and SUTCLIFF make the figures of Borings 1 and 2 slightly different from those of the more detailed versions already published, and they are said to enter Thanet Sand, the presence of which formation here is unlikely.

7. WATERWORKS. 1896. ?

Made and communicated by Messrs. ISLER & Co.

Two boreholes of 8½ inches diameter, within 40 feet of each other, give precisely the same section.

Water-level 30½ feet down. Supply 10,000 gallons an hour.

		Thickness. Feet.	Depth. Feet.
[Drift]	Dug well ...	—	8
	Ballast ...	10	18
Blue [London] clay		126	144
[Reading Beds, 60 feet.]	Mottled clay ...	25	169
	Claystone ...	2	171
	Sandstone ...	4	175
	Sand	8	183
	Black clay ...	9	192
	Mottled clay ...	4	196
	Stone	½	196½
	Green sand ...	6½	203
	Sandstone ...	1	204
Chalk and flints		52	256

At a visit to Aldershot in May, 1898, I learnt that there are 9 wells and borings at these works. Also that the original water-level was 11 feet down, that it was lowered by pumping to 36 feet down, and that a gallery connects all the wells, its bottom being 50 feet down. The supply in 1898 was at the rate of 1,100,000 gallons a day.

Aldershot—*cont.*

8. WATERWORKS. Later date.

Made and communicated by Messrs. ISLER and Co.

40 feet of 11½ inch tubes, 6 feet down, and 200 feet of 10 inch tubes level with the surface.

Water-level, 28 feet down.

		Thickness. Feet.	Depth. Feet.
Mould ...		2	2
Gravel and a little clay		8	10
[London Clay.]	Blue clay	43	53
	Blue clay, claystones, and sandstones	15	68
	Blue clay	52	120
	[? Basement-bed] Dead sand	5	125
	[? Basement-bed] Conglomerate	1	126
	[? Basement-bed] Dead sand	2½	128½
[Reading Beds, 65½ feet.]	Mottled clay	23	151½
	Mottled clay and dead green sand	8½	160
	Dead green sand	11	171
	Light-green sand	3	174
	Dark grey sand and fossil wood	3	177
	Black clay	8	185
	Hard green sand	9	194
[Upper]	Chalk and flints	106	300

For an analysis of the water, *see* p. 189.

9. Messrs. SIMMONDS, Millers.

Made and communicated by Messrs. ISLER and Co.

20 feet of 10 inch tubes, 4 feet down. 160 feet of 8½ inch tubes, 3 feet down. 415 feet of 7¼ inch tubes level with the surface.

Water-level, 54 feet down. Supply, 1,400 gallons an hour.

		Thickness. Feet.	Depth. Feet.
Made ground ...		3	3
[Drift]	Loamy sand and ballast [gravel]	9	12
[London Clay.]	Blue clay and claystones. Pebbles and shells	221	233
	Sandy clay	40	273
	Blue clay and claystones	64	337
	Green loamy sand [? Basement-bed]	2	339
[Reading Beds, 84 feet.]	Red mottled clay	12	351
	Grey mottled clay	10	361
	Red mottled clay and stones	15	376
	Green loamy sand	16	392
	Dark clay and peat	11	403
	Mottled clay	4	407
	Green loamy sand	2	409
	Sand stone	4	413
	Loamy sand and shells	10	423
[Upper]	Chalk and flints	257	680

Dr. REECE, in his Report on the Urban District of Aldershot (L.G.B. 1899), says :—

"It is said that even after heavy pumping the water has never been known to sink below 38 feet from the surface."

"The number of houses supplied from (private) wells is becoming insignificant . . Such private wells as came under inspection are all constructed after the same principle, and differed only in depth and in the degree to which they are liable to pollution. They are dry-steined surface wells . . Most of them were imperfectly protected against surface drainage . . and often the well was so surrounded with organically polluted soil as to render the water almost certainly liable to gross pollution." Of this sort of thing examples are noted, and many of the wells have been condemned by the Council.

According to the Water Works Directory, 1907, the town, camp, and the village of Tongham are supplied, and the yearly supply was 364,420,000 gallons, or practically a million gallons a day. The same work for 1909 gives the yearly supply as 378,032,000 gallons.

Alton.

Geol. Map 300, new ser.

1. Local Board Well, near the Stables at Ashdell. 1882.

From a memorandum of the late Mr. W. Curtis, communicated by Mr. F. Crowley, and from specimens and notes from the latter (1885).

Shaft 160 feet, bored 400.

Before boring there was often 32 to 33 feet of water in the well ; but this was soon pumped out, and the quantity gradually decreased. Now (1882?) there is 17 feet of water, which is not lowered much by pumping, and very soon fills up again.

Information from Mr. J. Mansergh (1889) gives the following particulars :— Surface 457 feet above Ordnance Datum. Water-level 321½ feet [? above O.D.]. 60,000 gallons a day pumped, from the Chalk, without lowering the level of the water. No water got in the bore-hole, which was carried to the depth of 570 feet. Shaft 146½ feet.

	Thickness. Feet.	Depth. Feet.
Well dug [chalk]	—	140
Lower chalk / Grey chalk	68	208
Chalk marl ... ... 50 or perhaps	80	258?
Chloritic marl ... ... 10 ,,	15	268?
Malm rock [Upper Greensand]	80	348
Gault	150	498
Gault (? partly hard Lower Greensand) ...	42	540

A specimen, marked 185 (meaning 185 feet down the bore), is grey hard sandy marl, like Malm rock.

A specimen marked 360 in grey clay (Gault).

According to the Water Works Directory, 1907, the area supplied is Alton only and the Princess Louise Hospital. (In the same work for 1909, Cripples' Home and College is the name given.) The yearly supply is 60 million gallons.

According to Mr. J. H. Spicer (*Land*, March, 1881), there is "at the Alton Paper Mills, an artesian well, 249 feet deep, which has for the last twenty years produced an unfailing supply of water."

2. Beechmount. 1905.

Boring, made and communicated by Messrs. Duke and Ockenden.

Water-level, 116 feet down. Yield 360 gallons an hour.

Lower Chalk, 150 feet.

Alverstoke.

Geol. Maps 316, 331, new ser.

1. Fort Elson.

From information given by Major Lovell, R.E., to the late Mr. Bristow

Well in the brickfield.

Sea-water broke in at the depth of 40 feet below high water mark, and the stopping-out of it gave much trouble.

		Thickness. Feet.	Depth Feet.
[London Clay, ? part Reading Beds.]	London clay and hard black silt (with water)	112	112
	[Not accounted for] ... ... about	18	130
[Reading Beds.]	Red and white mottled clay ... ,,	10	140
	Pale blue clay, slightly mottled with red	1	141
	Very sandy and ? laminated yellow clay	6	147
	Ditto, gradually getting more sandy ...	21	168
	Sand (or sand and clay), with water [thickness not stated ; but this, ? with other beds, must be]...	62	230

Chalk with a good supply of water.

Alverstoke—*cont.*

ELSON FORT. No. 3 Well.

Shaft 40 feet, the rest bored.

Water came in sparingly the first week, in consequence of the pipes having much sand in them, but it came in more freely after the sand had been pumped away.

		Thickness. Ft.	Thickness. In.	Depth. Ft.	Depth. In.
Mould	... ...	1	0	1	0
[London Clay.]	Yellow clay	6	0	7	0
	Hard blue clay	65	6	72	6
	Light-brown soft sandstone... ...	1	2	73	8
	Hard blue clay	26	4	100	0
	Shelly rock	0	10	100	10
[Reading Beds.]	Dirty brown sand	4	0	104	10
	Dark blue sand	5	2	110	0

Mr. C. E. HAWKINS suggests that the sand in the second section may belong to the basement-bed of the London Clay, and that the 18 feet not accounted for in the first section, or, at all events, some of it, is probably similar sand.

2. FOXBURY, about 1½ miles S.S.W. of the Point.

For GOSPORT WATERWORKS, 1897.

Communicated by Mr. P. SMITH, Engineer to the Waterworks Co.

28 feet above Ordnance Datum.

Shaft of 9 feet diameter, lined with brickwork for about 52 feet, and with iron cylinders from the depth of 24 feet 4 inches to 82 feet 7 inches. Then of 11 feet diameter, lined with brickwork to the depth of 168 feet 4 inches. Headings, 6 feet high by 4 broad, with their bases at the depth of 214 feet, one to the N.E. for 523 feet, another to the S.W. for 564 feet. These were extended later.

		Thickness. Feet.	Depth. Feet
Soil	... ...	1	1
[London Clay, 64 feet.]	Clay with race	8	9
	Stiff brown clay...	7	16
	Stiff black clay, with a bed of stone, at 22 to 22½ feet down	33	49
	Clay, loam and water	16	65
[Reading Beds, 97 feet.]	Light-brown sand	5	70
	Grey sand, pyrites and peat	10	80
	Stamshaw [mottled] clay	78	158
	Clay, flints and very hard stone ...	6	164
Chalk	... ...	59¾	223¾

A full description of these works has been given by Mr. E. T. HILDRED, in the *Trans. Assoc. Waterworks Engineers*, 1898, vol. iii., pp. 127–155, from which we learn that the yield is at the rate of 1,000,000 gallons a day, that the chalk throughout was dense and hard, with but few flints, and that the joint-fissures are at irregular and long distances apart.

Water in the Chalk first met with at the depth of 198 feet; but the bulk comes from the headings.

For analyses of the water *see* pp. 189–191. Also pp. 48–50.

Andover.

Geol. Map 283, new ser.

1. RAILWAY STATION (Junction?).

For Messrs. WATSON and Co. 1881?

Made and communicated by Messrs. LE GRAND and SUTCLIFF.

Water-level 52 feet down (July).

Chalk and flints, 92 feet.

Andover—*cont.*

2. WATERWORKS. 1891?

Communicated by Messrs. G. ISLER and Co.

Shaft 93 feet, the rest bored.
Water-level 68 feet down. Supply abundant.

Chalk and flints (flints for 3 feet at top part of boring), 157 feet.

The Water Works Directory, 1909, gives the yearly supply as 30 million gallons.

According to Mr. CRAWFORD, a well here has been carried to the depth of 920 feet in chalk and flints, the water-level being 52 feet down. [? Some mistake.]

For an analysis of the water, *see* p. 192.

3. BORING (? site).

Made and communicated by Mr. F. W. OCKENDEN, 1905.

210 feet above Ordnance Datum.
Water-level, 3 feet above the surface. A good supply.

Sand, gravel, and chalk ...	30	89 feet.
Soft chalk, very few flints	59	

Ashmansworth.

Geol. Map 283, new ser.

LOWER MANOR FARM.

Sunk and communicated by Mr. BROADHURST (*Memoir on the Geology of Andover*).

650 feet above Ordnance Datum. 12 feet of water.

(Upper and Middle Chalk.) Soft chalk 360 feet.

Basing.

Geol. Map 284, new ser.

1. GRANGE. Mr. H. BARTON.

Made and communicated by Mr. F. W. OCKENDEN.

Water-level, 2 feet down.

Well sunk	22	98 feet.
Bored. Very soft chalk	76	

2. HODD'S FARM. Mr. E. WIGG.

Made and communicated by Mr. F. W. OCKENDEN.

No water.

	Thickness. Feet.	Depth. Feet.
Well sunk in sand and clay (the rest bored)	30	30
Sand	40	70
Mottled clay	6	76
Dark green sand	5	81
Soft chalk	84	165

Basingstoke.

Geol. Map 284, new ser.

WATERWORKS.

1. The old Pumping Station is in the north-eastern part of the town, just south of the railway. Top of coping ($2\frac{1}{3}$ feet above ground) being 268 feet above Ordnance Datum. The following notes are from Dr. FARRAR's Report to the Local Government Board, 1905.

Made to supply a Seed Mill and taken over by a Water Company, which worked both the mill and the town-supply. Abandoned by the Corporation on the completion of the West Ham Works.

Basingstoke—*cont.*

Well, in chalk with flints, of 4 feet diameter for 12 feet, then belled out, for a further depth of 6 feet, to a diameter of 10 feet, in which it continues through open chalk for 12 feet (= 30 feet in all). Heading at the bottom 9½ feet by 6, for 54 feet in a northerly direction, when it branches, one branch running 45 feet in a westerly, the other 75 feet in a north-easterly direction.

The great bulk of the water comes through a fissure (? bedding-plane) round the well about 25 feet below the ground-level.

This well was sunk in 1860. Before 1894 it was connected with a second well, 33 feet to the south, which did not reach the water-bearing plane of the older well, its principal supply coming through a fissure (? bedding-plane) corresponding to a flint-layer in the older well. The heading continues 15 feet further south.

It was found that surface-water frequently, especially in wet weather, came in through this southern heading, and that the water in the original well was at times discoloured and turbid. Analysis showed that the water was then highly polluted with organic matter, much of animal origin, and the water was pronounced dangerous. In 1894, therefore, the supply from the second well was cut off by a brick wall 3 feet thick, built across the heading and reaching 4 feet on either side and up to the ground. After this disconnection the supply in the older well recovered its good quality. Dr. Farrar found, however, that a considerable volume of water was pouring into the older well through two pipes in the chalk, with diameters of nearly three inches, one on each side of the southern heading and near the disconnecting wall. These opened out of a fissure 7 feet above the bottom of the well, and the water from them left the chalk brown and discoloured, whilst that from the main fissure below was unstained; from which he concludes that subsoil water of a contaminating character may reach this well.

The water-level here rose to 251 feet above Ordnance Datum. After 6 hours pumping it fell to within a foot of the bottom of the well. When pumping ceased the level rose at the rate of 2 feet an hour.

(In 1900 the average daily supply was 363,000 gallons.)

2. Trial well in Sherborne Bottom, north of the town, a little W.N.W. of North Ham, 294 feet above Ordnance Datum. I believe that this has since been taken for the supply of a large public institution near by.

Water-level nearly 261 feet above Ordnance Datum.

Square shaft, 63 feet? Particulars taken on the spot, 1895.

Loamy wash, to 7 feet or so.

Chalk, broken up a long way down.

At about 20 feet down a marked layer of flints on both E. and W. showing a northerly dip of over 5°.

On October 30, 1894, there were 26 feet of water in the well; on January 10, 1895, 35¼ feet; on August 17, 25¾ feet; and on October 8, 24 feet.

3. Trial works S.S.W. of the town. *See* **Cliddesden**, p. 73.

4. West Ham Works. Between the Alton Light Railway and the London and South Western Railway, north-westward of the town. 1906.

From Report by F. R. Phipps, the Borough Engineer.

310 feet above Ordnance Datum.

A well, 60 feet deep, in chalk, and 11 feet in diameter in the clear, the top 32 feet being lined with blue bricks in cement, with 1 inch cement-backing.

The tests below were made from February 22 to March 7, 1905.

Yield, in 14 days' pumping, 12,662,720 gallons, giving an average of 904,480 a day.

Rest-level of water at starting, 38¼ feet down.

Level of water at finish, 50⅕ feet down. (Water lowered about 12 feet.)

Level of water 1 hour after pumping stopped, 42 feet down. (Recovery = about 8⅕ feet.)

Level of water 24 hours after pumping stopped, 40⅕ feet down. (Recovery = about 10 feet.)

Level of water 8 days after pumping stopped, 38¼ feet down. (Recovery complete.)

According to Dr. Farrar's Report there are two headings, 6 by 5½ feet, each reaching 49 feet in a north-easterly and in a south-westerly direction. It is proposed to use the Cliddesden well as supplementary to this.

The Water Works Directory, 1909, gives the yearly supply as 162,055,000 gallons.

For analyses of the waters of 1 and 4, *see* pp. 192, 193.

Bentley.

Geol. Map 284, new ser.

1. Bury Court. 1901.

Made and communicated by Messrs. Duke and Ockenden.

Inflow, 249 gallons an hour. Rest water-level about 220 feet above Ordnance Datum.

		Thickness. Feet.	Depth. Feet.
Dug well [? old, the rest bored]		—	60
[Gault.]	Clay. Traces of greensand at 428 feet	373	433
[Lower Greensand.]	Running sand	7	440
	Blue clay...	2	442
	Running sand and clay...	8	450
	Running sand	11	461

The old well is probably for the most part in Upper Greensand, but some little way into the Gault. The thickness of the latter is about the highest record.

2. Holt Hatch. 1901.

Made and communicated by Messrs. Duke and Ockenden.

Shaft 100 feet, the rest bored.
Water-level 128½ feet down.
Gault and Lower Greensand, 261½ feet.

Bishopstoke.

Geol. Map 315, new ser.

Brambridge Lodge.

Made and communicated by Messrs. Isler and Co.

Lined with 160 feet of tubes 5 inches in diameter from 24 feet down.
Water-level 41 feet 2 inches down.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Dug well				71	6
Black clay		10	0	81	6
[Reading Beds, 99½ feet.]	Red mottled clay	32	0	113	6
	Brown clay ...	6	0	119	6
	Red mottled clay	7	0	126	6
	Light brown clay	4	0	130	6
	Black Clay ...	10	0	140	6
	Red mottled clay	2	0	142	6
	Light-blue clay...	16	0	158	6
	Light-brown clay	21	0	179	6
	Blue clay ...	1	0	180	6
	Red flints ...	0	6	181	0
[Upper Chalk, 92¾ feet.]	Chalk and flints	20	0	201	0
	Chalk	0	10	201	10
	Flints	1	0	202	10
	Chalk	40	0	242	10
	Flints	1	0	243	10
	Grey chalk ...	30	0	273	10

Bishops Waltham.

Geol. Map 316, new ser.

1. Oaklands. On the western side of the road, and just S. of Lockham Wood, over a mile N.E. of Botley Station. 1894.

Made and communicated by Messrs. Duke and Ockenden.

Water stands 77 feet down.

		Thickness. Feet.	Depth. Feet.
[Drift.]	Gravel and loam	4	4
[Bracklesham Beds.]	Sand with clay, mixed ...	40	44
	Hard black clay	56	100
Black [Bagshot] sand		14	114

Bishops Waltham—*cont.*

2. SWANMORE PARK, E.S.E. of the town. 1877.

Sunk and communicated by Mr. R. B. PATEN.

Shaft 250 feet, the rest bored. Chalk and flints 462 feet.

3. WATERWORKS. In a Chalk-pit about a third of a mile northward of the Church. 1863.

From information on the spot, 1899.

Supply 12 or 13 million gallons a year.

Two wells, about 20 feet apart, joined by a gallery, in Chalk.

Under the engine it is about 28 feet to water, and there is 7½ feet of water, which is pumped down 1½ feet.

Engine pumps about 60,000 gallons in 10 hours.

Blendworth.

Geol. Map 316, new ser.

Idworth Waterworks. Western side of Dirty Lane close to its junction with Woodhouse Lane, N.W. of Rowlands Castle Station, 1897.

About 200 feet above Ordnance Datum.

Made and communicated by Messrs. DUKE and OCKENDEN.

Well of 6 feet diameter, to 250 feet. Boring of 12 inches diameter to 50 feet deeper. Two headings each 65 feet long, 6 high and 5 broad, at 240 feet.

Water-level 105 feet down. Yield 4,000 gallons an hour.

Upper Chalk, 300 feet.

Boldre.

Geol. Map 330, new ser.

1. LADYCROSS LODGE, NEW FOREST. Just N. of N.W. part of Beaulieu Heath, 1899.

Made and communicated by Messrs. MERRYWEATHER and SONS. Notes in brackets by C. REID, from specimens.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Plateau Gravel.	Made earth	2	0	2	0
	Gravel with water	7	0	9	0
Headon Beds.	Blue marl	13	0	22	0
	Cherry-coloured marl [red and brown mottled]	2	0	24	0
	Marl and shell	21	0	45	0
	White rock [earthy limestone, smooth-grained]	1	0	46	0
	Marl and shell	38	0	84	0
	Black mud	0	3	84	3
	Sand with water	2	0	86	3
	Marl and shell	34	9	121	0
	Sand with water	0	3	121	3
	Marl and shell [green and brown marl at 152; grey loamy sand with *Ostrea vectensis* at 157; black unctuous clay with *Cytherea incrassata* at 162. Shells, no depth marked, *C. incrassata*, *Cardita*, *Cyrena obovata*, *Voluta geminata*, *Pl. hantonensis*, *Cer. concavum.*]	44	3	165	6
	Loam and shells with water	1	6	167	0
	Marl and sand [mottled green and brown marl and streaks of white sand]	9	0	176	0
	Black sooty loam, or carbonaceous wood	1	0	177	0
Barton Sands.	Sand with water	14	0	191	0

Boldre—*cont.*

2. Loyal (or Lisle) Court Farm (E. of Lymington). ? 1900.

Made and communicated by Messrs. Le Grand and Sutcliff.

Water-level varies from 27 to 32 feet down.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Soil	... ...	1	0	1	0
[Drift.]	Gravel	2	3	3	3
	Sandy gravel	15	9	19	0
[Headon Beds, 35¾ feet.]	Light-blue clay and shells	10	6	29	6
	Fine grey sand	2	0	31	6
	Fine grey sand and bands of mottled clay	8	6	40	0
	Mottled sandy clay	12	6	52	6
	Dark blue sandy clay	2	3	54	9
[Barton Sands, 87¾ feet.]	Grey sand	7	3	62	0
	Fine grey blowing sand and shell ...	23	6	85	6
	Fine grey sand and bands of sandy clay (1–2 inches thick, 6–10 inches apart)	5	0	90	6
	Fine grey blowing sand	14	6	105	0
	Fine grey sand and bands of blue sandy clay	5	0	110	0
	Fine grey blowing sand	26	5	136	5
	Grey sandstone	0	3	136	8
	Fine grey blowing sand	5	10	142	6

For an analysis of the water, *see* p. 193.

? Botley.

Geol. Map 316, new ser.

Kitnocks. ? 1898.

? About 130 feet above Ordnance Datum.

Communicated by Mr. C. Conway.

Shaft, of 6 feet diameter, 28 feet. The rest bored, 3 inches diameter.

		Thickness. Ft.	Depth. Ft.
Soil	... ...	3	3
[Bracklesham Beds.]	Yellow clay	20	23
	Dark red clay	2	25
	Blue clay	58	83
	Dark green or black sand, very hard but fine (drying to light-grey)	6	89

Bournemouth.

Geol. Map 329, new ser.

1. Boscombe. Messrs. Parsons Dairy Co.

Made and communicated (1901) by Messrs. Isler and Co.

125 feet of tubes, of 4 inches diameter, 5 feet down.

Water-level, 110 feet down.

		Thickness. Feet.	Depth. Feet.
Made ground		3	3
[Gravel.]	Ballast	27	30
[Bagshot Beds.]	Red sand	10	40
	Very fine red sand	10	50
	Grey marl	10	60
	Dead grey sand ...	16	76
	Fine grey sand ...	4	80
	Fine red sand ...	20	100
	Dead grey sand ...	3	103
	Live grey sand ...	14	117
	Dead grey sand ...	8	125
	Live grey sand ...	32	157

Bournemouth—*cont.*

2. Boscombe. For Messrs. Isaac and Co., Dairymen, Christchurch Road.

Made and communicated by Messrs. Isler and Co.

Lined with 100 feet of 5-inch tubes from 6 feet down; 300 feet of 4-inch tubes from 5 feet down; and 15 feet of 3-inch tubes from 300 feet down.

Water-level, 104 feet down. Supply, 1,200 gallons per hour.

		Thickness. Feet.	Depth. Feet.
[Gravel.]	Ballast	13	13
[? All Bagshot Beds.]	Light-coloured sands	6	19
	Light-coloured running sands ...	7	26
	Light-coloured sands	22	48
	Gravel and sands...	13	61
	Light-coloured sands	9	70
	Brown sandy clay	42	112
	Light-coloured clay	16	128
	Light-coloured sands	8	136
	Brown clay	12½	148½
	Light-coloured sands	7	155½
	Light-coloured clay	1	156½
	Light-coloured sands	18½	175
	Light-coloured clay	11	186
	Running sands	24	210
	Light-coloured sandy clay ...	11	221
	Running sands	37½	258½
	Brown clay	24½	283
	Running sands	32	315
	Brown clay	1	316

3. Boscombe. Boscombe and Bournemouth Laundries Co.

Made and communicated by Messrs. Isler and Co.

Lined with 10 feet of 10-inch tubes from 7 feet down.
260 „ 5 „ „ 3 „
53 „ 3 „ „ 226 „

Water-level 108 feet down. Supply 2,844 gallons per hour.

		Thickness. Feet.	Depth. Feet.
Made ground	... ...	2	2
[Gravel.]	Ballast	9	11
[? All Bagshot Beds.]	Yellow sand	4	15
	Hard dark clay	23	38
	Light-coloured sand and clay	10	48
	Light-coloured coarse sand	6	54
	Light-coloured hard clay	1	55
	Light-coloured coarse sand	14	69
	Light-coloured coarse sand and pebbles	6	75
	Light-coloured clay	3	78
	Light-coloured sand	47	125
	Dark fine sand and wood	2	127
	Dark sand	8	135
	Dark sand and clay	1	136
	Dark fine running sand...	6	142
	Dark sand and clay	3	145
	Dark sand	5	150
	Fine running sand	20	170
	Fine running sand, dark	8	178
	Sand and clay	1	179
	Light-coloured running sand	21	200
	Sandy clay	15	215
	Light-coloured sand	25	240
	Fine light-coloured running sand ...	9	249
	Dark clay	17	266
	Sand	1	267
	Sand, light-coloured	18	285
	Dark sand and clay	1	286
	Light-coloured sand	2	288

Bournemouth—*cont.*

4. Electric Power Station.

Made and communicated by Messrs. Isler and Co.

Lined with 40 feet of 10-inch tubes.
270 „ 7¼ „
and 43 „ 6 „ of which 30 feet are perforated.
Water-level 100 feet down.

		Thickness. Feet.	Depth. Feet.
[Gravel.]	Ballast	7	7
[? All Bagshot Beds.]	Light-coloured sand	6	13
	Yellow sand	5	18
	Light-coloured sand and clay	4	22
	Running sand	8	30
	Light-coloured clay and sand	12	42
	Dark clay and sand	15	57
	Dark grey sand	7	64
	Hard light-coloured sand	21	85
	Light-coloured coarse sand	15	100
	Dark fine sand and wood	7	107
	Dark fine sand	52	159
	Dark running sand	51	210
	Sand and clay	15	225
	Running sand	13	238
	Sand and clay	5	243
	Coarse light-coloured sand	16½	259½
	Light-coloured hard clay	12½	272
	Light-coloured sand	10	282
	Light-coloured running sand	17	299
	Hard dark clay	3	302
	Light-coloured running sand	2	304

5. Mont Dore. 1888.

Made and communicated by Mr. J. M'William.

Shaft, the last 25 feet with iron cylinders.

The well holds about 9,900 gallons of water, and it took two steam-pumps, working night and day, to keep the water down.

		Thickness. Feet.	Depth. Feet.
[Bagshot Beds.]	Loam and sand mixed	4	4
	Light-yellow or buff, compact clean sand, with layers of dark red sand or fine gravel	20	24
	Loose yellow sand	4	28
	Hard blue clay, with here and there a layer of light-yellow sand	10	38
	Sand	2 or 2½	40+
	Blue clay ... ... about	5	45+
	Hard sand, overlying the water-stratum... ... ... nearly	10	55

For an analysis of the water *see* p. 194.

6. A few hundred yards west of Moredown Church. Boring. 1896.

Made and communicated by Messrs. Duke and Ockenden.

Abandoned. No water.

		Thickness. Feet.	Depth. Feet.
[Drift.]	Flints, sand and gravel	19	19
[Bagshot Beds.]	Running sand	15	34
	Clay	11	45
	Sand and hard rock	36	81

Bournemouth—*cont.*

7. Water Works. 1876.

Sunk and communicated by Messrs. S. F. Baker and Sons.

		Thickness. Feet.	Depth. Feet.
[? Drift.]	White sand	1½	1½
	Yellow loam	3	4½
	Yellow gravel	8	12½
	Yellow loam	1½	14
	Coarse gravel and stone	½	14½
[Upper part of the Bournemouth Marine Series (Bagshot), of Mr. J. S. Gardner.]	Bright red sand	2	16½
	Yellow sand	2½	19
	Mottled clay	1	20
	Yellow sand (water-bearing)	5½	25½
	Fine grey sand	2½	28
	Tough clay	5	33
	Grey loam and sand	4	37
	Grey sand (water-bearing)	9½	46½
	Sharp grey sand	2½	49
	Veins of loam and sand	2	51
	Sharp grey sand (water-bearing) ...	3½	54½
	Fine grey sand	6½	61
	Sharp grey sand	5	66
	Coarse grey sand (much water) ...	1	67
	Clay, very compact	8	75
	Dark clay, close and tough	5	80

This well, however, is but a small part of the works (? now abandoned).

Mr. F. S. Cripps has given a short history of the works here, from which the following three paragraphs are taken.*

"In the early days all water was obtained from the springs to the north of the Bourne Valley, and conveyed by culverts and open water-courses to the filters and reservoirs situated at the gasworks near by, from whence it was pumped direct to the town."

"Another supply was obtained from wells close to the river, near Christchurch. This, however, proved unsatisfactory and was eventually abandoned, chiefly owing to trouble with sand."

"Later on, the water supply to Bournemouth was . . obtained from the gathering grounds adjacent to the river, near Longham Bridge. These gathering grounds consisted of underground adits, shallow tunnels running for a considerable distance a little below the surface of the meadows. The water was collected and delivered into a common sump, from which it was lifted partly by turbines, but chiefly by Worthington pumping engines, to the filters and reservoirs at Alderney, a distance of over two miles. . . Here the water, after passing through sand filters, found its way by gravity to Bournemouth—a distance of another five miles."

The new works at Wimborne were finished in 1900, after a Report by Mr. C. Reid in 1894. Although these are in the neighbouring county of Dorset, it seems well to give an account of them here (*see* pp. 144, 145).

According to the Water Works Directory, 1907, the district of supply includes Bournemouth, Kinson, and parts of Canford Magna, of Hamphreston, of Holdenhurst, and of Poole. The estimated quantity of water available in a year is 728 million gallons from shallow wells or subsoil, and 1,092 million from deep wells. The yearly supply was 785 million gallons, the average daily supply 2 million, and the maximum day's consumption (in July) 3 million. The same work, of 1909, makes the yearly supply 805 million gallons, the average day's supply 2¼ million, the maximum day's 3 million.

For an analysis of the water *see* p. 194.

8. Mr. Joys. 1895. No water.

Boring, made and communicated by Messrs. Duke and Ockenden.

[Drift.]	Flints, sand and gravel ...	19	81 feet.
[Bagshot Beds.]	Running sand ...	15	
	Clay	11	
	Sand	36	

* *Water*, vol. vii., 1906, p. 265.

Braishfield.

Geol. Map 299, new ser.

Three borings close together on the eastern side of the road, a little northward of LEAD BRIDGE.

Made and communicated by Mr. J. GRACE.

	Beach Ho. Feet.	Oak Villa. Feet.	Just N. Feet.
London Clay, with some pebbles in the bottom part	35	33?	31
[Reading Beds] Mottled clay	100	100?	100
Chalk	167½	127	259
Total ...	302½	260	390
Water rose above ground	10	7?	4

In the third no water was found in the bottom 50 feet, which was through hard chalk. The yield of this boring is 8 gallons a minute.

The interesting point in these borings is that the sand which crops out from beneath the London Clay just N. is absent. The place where the sand thins out is precisely marked by some other wells a little northward; thus at the cottage on the western side of the road, just N.E. of Farburn Farm, sand was reached at the depth of 50 feet, whilst 60 feet southward there is none. Again, on the eastern side of the road, a little further north-eastward, a well, by the hedge on the northern side of the track, was also 50 feet to sand; whilst in another, a few yards to the south, there was none. On the same side of the road, further northward, at the cottages, about 1,000 feet from the Wheatsheaf, pebbles and sand were found at the depth of 36 feet. This information was also given by Mr. GRACE.

Bramley.

Geol. Map 284, new ser.

Information got by Mr. J. H. BLAKE (two wells).

1. CHURCH FARM, Lower Bagshot Beds, 20 feet.
2. A quarter of a mile N. of the church. About 12 feet of water.

Lower Bagshot Beds.	Brown loamy clay	10	23 feet.
	Grey sandy loam...	13	

Bramshaw.

Geol. Map 315, new ser.

Mr. EYRE'S ESTATE. By pond S. of Bramshaw Hill.

		Thickness. Feet.	Depth. Feet.
Soil		1	1
[Bracklesham Beds.]	Clay	3	4
	Dense grey sandy loam	7	11
	Wet sand, with a six-inch band of ironstone full of good water	9	20
	Very hard sand, in parts nearly black with vegetable matter. No water ...	3	23
	Greenish sand crust	¼	23¼
	Soft sand ... ... (ferruginous water)	4	27¼
	Crust, as above, but harder ... ... (ferruginous water)	¾	28
	Sand ... ... (ferruginous water)	3	31
	Dingy blue clay reached		

Bramshott.

Ordn. Map 301, new ser. Geol. Map, 8.

GRAYSHOTT DOWN. [? Ludshott Common of new map.] Shaft in which Fullers' earth was found.

Communicated by Mr. J. M. PEAKE, who got the section from the well-sinker in 1890. Well made some years before.

		Thickness. Feet.	Depth. Feet.
[Lower Greensand ? Hythe Beds.]	White sand	3	3
	Strong loam	15	18
	White sand-rock	40	58
	Veins of red sand	4	62
	Sand-rock	1½	63½
	Ragged rock	7	70½
	Sharp rocky sand or sandstone	5	75½
	Hard solid sand-rock	7	82½
	Fullers' earth	2	84½
	Green rock	20	104½
	Green sand (to water) ...	6	110½

Breamore.

Geol. Map 314, new ser.

DAIRY FARM at UPPER STREET.

Sunk and communicated by Mr. JOHN WEEKS. 4 feet of water.

Gravel, 16 } 50 feet.
Chalk, 34 }

Burghclere.

Geol. Map 283, new ser.

Made and communicated by Mr. BROADHURST, except 2 and 3, which are from Mr. C. ALDERMAN.

From the Memoir on the *Geology of Andover*, 1908. With some additions as to sites.

1. DOWN FARM, about a mile south of the Church.

450 feet above Ordnance Datum. 4 to 10 feet of water.
(Middle) Chalk, without flints, 100 feet.
Judging by the position it must be partly in Lower Chalk.—W.W.

2. DUNCROFT FARM, Cottages near (N.N.E. of the Church. This and the following entered as Hockley Hole in the Andover Memoir).

373½ feet above Ordnance Datum
Blue (London) Clay, 40 feet.

3. FARM an eighth of a mile N.W. of Duncroft Farm.

(Lower Bagshot Beds.) Clayey sand to rock, on piercing which water rose to the surface. 30 feet.

4. MANOR HOUSE. 415 feet above Ordnance Datum.

(Upper Greensand.) Sand and rock, 130 feet.

5. NORMAN'S COURT FARM. ? Norman's Farm of the map, 1¾ miles north of the Church.

411 feet above Ordnance Datum.
Water not good.
(Bagshot Beds, Lower), Dark clay, 45 feet.

Burghclere—*cont.*

6. Ox Drove Lane. House. 450 feet above Ordnance Datum.

[Plateau] Gravel	...	10	40 feet.
(Bracklesham Beds.) Sand		30	

7. Palmer's Court Farm, more than 2 miles E. of N. from the Church.

380 feet above Ordnance Datum.
Water not good.
(Lower Bagshot Beds.) Loamy sand, 20 feet.

8. On the Common near the last. 430 feet above Ordnance Datum.

[Plateau] Gravel	...	20	30 feet.
(Lower Bagshot) Sand		10	

9. Post Office. 480 feet above Ordnance Datum.

[Plateau Gravel]	... ...	20	40 feet.
(Bracklesham Beds) Sand	... ...	20	

10. Near the School. 443 feet above Ordnance Datum.

[Plateau] Gravel	...	15	22 feet.
(Lower Bagshot) Sand		7	

Catherington.

Geol. Map 316, new ser.

1. Horndean.—The Good Intent. 1904.

Made and communicated by Messrs. Duke and Ockenden.

Water-level 174 feet down. Lowers to 206 feet when pumping at the rate of 1,200 gallons an hour.

Clay	... ...	23	350 feet.
Clay and gravel	...	5	
Chalk	... ...	322	

2. On the western side of the high road from Blendworth to Waterloo near the 9th milestone. From information on the ground.

Well for four houses, with independent pumps.

To Chalk [through Reading Beds]		90	160 feet.
Chalk	... ...	70	

Near by, to the west, was a boring to the Chalk, for the reception of the sewage, after it had passed through a septic tank.

3. On the western side of the same road a little to the S.W. (about half a mile S.W. of Merchistoun Hall). 1904.

Three borings, made and communicated by Messrs. Duke and Ockenden. Dug to 12 feet. No water.

Reading clay	...	68	117 feet.
Chalk	... ...	49	

Cheriton.

Geol. Map. 300, new ser.

Tube-well, where the first springs rise. 1898.

Communicated by the owner, Mr. T. B. Grinham.

240 feet above sea-level.
Water rose to within about 3 feet of the ground.

Gravel	... ...	5	105 feet.
Chalk, with occasional thin layers of flint		100	

An excavation was made for 3 feet, to allow the water to run, the top of the pipe being driven down that distance. The water overflowed for about a week, and then sunk lower down the pipe.

Christchurch.

Geol. Map 329, new ser.

1. The following particulars of the water-supply of this town are taken from Dr. St. G. MIVART's Report to the Local Government Board, 1899. Interesting as a record of former evils.

It was believed that out of 900 inhabited houses 575 were supplied from wells, public or private, while 319 were connected with the mains of the West Hants. Water Co., a number that was increasing.

Five wells were used for public supply, a sixth, in that part of the main street called Bargates, having been closed as contaminated. None of these wells are over 20 feet deep ; they are as follows :—

RAILWAY INN WELL.—Beneath the roadway of the main thoroughfare ; about 16 feet deep.

HIGH STREET WELL.—Probably about 14 feet deep. For analysis, *see* p. 195.

CHURCH STREET WELL.—Beneath the main roadway ; said to be about 20 feet deep.

PIT WELL.—In the centre of a small unpaved square down to which the ground slopes from the roadway, said to be about 9 feet deep. A sewer is said to pass close by.

TUTTON'S WELL.—In the suburban quarter, Stanpit, in a little open patch of grass-land sloping down to a creek : 45 feet above high-water mark ; said to be fed by a strong spring.

"But though the public wells are unsatisfactory, the private shallow dry-steined wells are still more so. Sunk in gravel or alluvial soil, it is difficult to see how they can fail to become contaminated. The ground around them, or in their neighbourhood, has for years been polluted by leakage from cesspools (now nearly all abolished), while filth of all kinds thrown upon or dug into the surrounding ground undoubtedly soaks into them." A few notable examples are given.

The West Hants. Co. was then giving a supply from the River Avon, with filtration. Several analyses of this water are given in the Report.

2. WEST HANTS. WATER COMPANY. 1906 ?

Boring made and communicated by Messrs. ISLER and Co. Combined from two accounts.

40 feet of 15½-inch pipes level with the surface ; 405 feet of 10-inch pipes, 3 feet down ; 830 of 7¼-inch pipes, 4 feet above the surface.

Very strong springs 209 feet down. Pumped at the rate of over 25,000 gallons an hour (from bore of 10 inches diameter) ; but the water contained iron and so had to be shut off. Overflows during the night.

		Thickness. Feet.	Depth. Feet.
Made ground ...	... ...	5	5
[Drift]	Ballast [gravel]	17	22
	Red running sand	6	28
	Grey sand and ballast [gravel] ...	3	31
[Bracklesham and Bagshot Beds.]	Sandy clay	4	35
	Grey running sand	14	49
	Sandy clay	3	52
	Running sand and layers of clay ...	28	80
	Grey running sand and lignite ...	18	98
	Sandy clay	10	108
	Fine running sand	39	147
	Clay and peat	2	149
	Running sand and lignite	51	200
	Sandy clay	5	205
	Running sand and lignite	2	207
	Soft sandstone	3	210
	Running sand and lignite	7	217
	Sandy clay	4	221

Christchurch—*cont.*

		Thickness. Feet.	Depth. Feet.
[Bracklesham and Bagshot Beds]—*cont.*	Running sand, lignite and sandstone...	8	229
	Hard, dry sandy clay (? and sandstone)	11	240
	Running sand, layers of lignite and sandstone	38	278
	Soft sandy clay (? and stone)... ...	15	293
	Hard sandy clay	9	302
	Running sand, layers of clay, stone and lignite	10	312
	Clay, layers of coarse sand and sandstone	28	340
	Running sand and lignite	12	352
	Mottled sandy clay	8	360
	Running sand and lignite	21	381
	Sandy clay	10	391
	Running sand and lignite	10	401
[London Clay, 325 feet.]	Sandy clay	13	414
	Hard rock	3	417
	Sandy clay, stone and lignite	6	423
	Sandy clay	7	430
	Sandy clay and stone	8	438
	Loamy sand	12	450
	Fine running sand and lignite... ...	32	482
	Sandy clay	7	489
	Hard brown clay	20	509
	Fine running sand and lignite ...	27	536
	Soft sandy clay	11	547
	Running sand, clay and pebbles ...	13½	560½
	Hard rock	1½	562
	Loamy sand	37	599
	Clay, claystones, shells and pebbles ...	112	711
	Green sandy clay	15	726
[Reading Beds, 98 feet.]	Red mottled clay	3	729
	Soft sandstone	4	733
	Sandy clay, mottled, with clay-stones...	49	782
	Sand	21	803
	Sandy clay	21	824
Chalk and layers of sand		97	921

Another account differs as to the lowest four layers of the Reading Beds, giving them as follows :—

	Feet.
Sandy mottled clay, &c.	47
Sandy clay and sand ...	5
Sand	12
Sandy clay	27

According to the Water Works Directory, 1907, the supply was then got from the River Avon. The places supplied were Bournemouth (? small part), Burton, Christchurch, Everton, Highcliffe Milton, Hordle, Iford, Jumpers, Keyhaven, Milford, Mudeford, New Milton, Pennington, Southbourne and Ward ; and the quantity supplied was 78 million gallons a year. In the same work of 1909 this last has risen to 85 millions.

Cliddesden.

Geol. Map 284, new ser.

1. Works for Basingstoke Water-supply, about half-a-mile south-westward of the church. 1903.

Over 474 feet above Ordnance Datum.

Information chiefly from Mr. F. S. Courtney.

Shaft and galleries, total length of the latter, 200 yards : one gallery at 228 feet down (apparently 460 feet long), one at 250 (77½ feet), one at 264 (50 feet), and one at 270 (12 feet).

Cliddesden—*cont.*

Water (little) began at 200 feet. Most water at 225. Water-level about 286½ feet above Ordnance Datum.

In the Chalk throughout. Total depth 275 feet.

Chalk, with flints down to about 245 feet, when there was hard semi-crystalline chalk.

At 249 feet, a thin clayey bed.

At 264 feet, a gray clayey bed, 6 or 8 inches thick.

In November 1903, with the galleries finished, the yield was only a little over 5,000 gallons an hour, practically the whole of which was got within 120 feet of the well.

2. Old Swallick House. About a third of a mile N.W. of Winslade Church Information got by Mr. C. E. Hawkins.

Almost 420 feet above Ordnance Datum.

About 14 feet of water. The water-level does not vary much and there is plenty of water when other wells are nearly dry. A later gauging, by Mr. F. S. Courtney, makes the water-level about 137½ feet down.

Chalk 156 feet.

Combe.

Geol. Map 283, new ser.

Village Well.

From the *Memoir on the Geology of Andover*, 1908.

Chalk (Middle and Lower), 201 feet.

Cranbourne.

Geol. Map 314, new ser.

Boring of 6 inches diameter, made and communicated by Mr. F. W. Ockenden

157 feet above Ordnance Datum. Water-level, 3 feet above surface. Yield, good.

Soft chalk, the top part almost like sand	50	111 feet.
Chalk a little harder with few flints ...	61	

Crondall.

Geol. Map 284, new ser.

1. Frimley Farnborough and Wey Valley Waterworks. Itchell Pumping Station.

About 261 feet above Ordnance Datum.

Two borings. Made and communicated by Messrs. Isler and Co.

No. 1. Lined with 80 feet of tubes, of 6 inches diameter, 45 feet down.

No. 2. Lined with 120 feet of tubes, of 6 inches diameter, 48 feet down.

Water-level 5¼ feet down. Supply 4,000 gallons an hour [? from No. 1 only].

	Thickness. Feet.	Depth. Feet.
Dug well [chiefly London Clay] —		50
[Reading Beds.] Mottled clay	48	98
[Reading Beds.] Blue clay ...	12	110
Chalk	54 (No. 1), 185 (No. 2).	164 (No. 1), 295 (No. 2).

The trial-boring showed rock at the base of the London Clay, which reached to 47 feet down, giving a thickness of 63 feet to the Reading Beds.

A tracing, communicated by Mr. A. C. Pain (1901) shows 3 bore-holes with the following depths:—No. 1, 157 feet 10 inches. No. 2, 194 feet 6 inches. No. 3, 126 feet.

The lowest 5 feet of the shaft is shown as an iron cylinder and the bore-pipes rise to about 3, 7 and 4 feet up in the well.

There was a fissure at 150 feet.

From Mr. R. Nunn I learn that there was very little increase in water below 185 feet.

Crondall—*cont.*

2. Trial-boring near Mill Lane,, a sixth of a mile S. of Bowerhurst Farm. Information from Mr. A. C. Pain.

Nearly 278 feet above Ordnance Datum.

London Clay ...	32	164 feet.
Reading Beds ...	75	
Chalk	57	

3. Redfields, nearly three-quarters of a mile east of north from the church. 1899.

About 300 feet (or a little more) above Ordnance Datum ?

Made and communicated by Messrs. LeGrand and Sutcliff.

Water-level varied in working from 50 to 80 feet or more. No supply.

		Thickness. Feet.	Depth. Feet.
[London Clay.]	Red clay	20	20
	Gravel	½	20½
	Red clay	7½	28
	Blue clay	137½	165½
	Clay and pebbles	2½	168
	Blue clay	68	236
	[Basement-bed.] Blueclay, green sand and shells	1	237
	[Basement-bed.] Blue sandy clay	7	244
	[Basement-bed.] Grey sand	1	245
	[Basement-bed.] Sandstone	2½	247½
[Reading Beds, 68½ feet.]	Mottled clay	37½	285
	Yellow sand	3	288
	Blue clay	7	295
	Mottled clay	13	308
	Mottled clay, and sand and shells [? oysters]	8	316
[Upper Chalk.]	Grey chalk (no flints)	25	341
	Chalk and flints...	191	532

There being no gravel mapped here, one must conclude that the six inches of that material near the top is either in a pipe or is a pebbly bed in the London Clay, of which latter an example occurs lower down.

4. Trial-well for the War Department, Heath Lane, E. of the village. A little S. of the lane, and nearly a sixth of a mile westward of the pottery.

Reading Beds ...	17	147 feet.
Chalk	130	

On going down this well in 1888, after the water had been pumped down to within about three feet of the bottom, I found that below the steining (carried into the looser chalk at top) the whole of the chalk was compact and not broken up by joints, so that there was no definite outflow of water, only a gentle oozing out through the body of the rock. There were but few flints.

At a visit in the beginning of August, 1889, after a long season of dry weather, the water in some of the wells in the village, above the level of the spring (*see* p. 36), stood at about 20 feet down, and I was told that in winter it rose close to the surface, so that it could be got by dipping.

Dibden.

Geol. Map 315.

Windmill House. A little south-westward of Langdown Windmill and southward of Baker's Farm. 1892.

Over 100 feet above Ordnance Datum (? 105 or more).

Made and communicated by Messrs. A. Williams and Co. (notes from specimens in brackets).

Shaft 13 feet, the rest bored. Unsuccessful.

Dibden—*cont.*

Before getting through the rock, at 445 feet, the water-level was 172 feet down. Later on it rose slightly, to 160 and then to 150.

		Thickness. Feet.	Depth. Feet.
[Drift.]	Gravel	19	19
	Gravel and sand	5	24
[Barton Sand, 72 feet.]	Sand (at 44 feet, fine buff sand, with some bits of greenish grey sand). Water at 44 feet	33	57
	Running sand	5	62
	Blue sand. A little water, exhausted by 4 hours' pumping at the rate of 300 gallons an hour; brackish and of bad smell	34	96
[Barton Clay, 349 feet.]	Blue sandy clay	10	106
	Blue clay (some greenish-grey clay, with bits of shell. Stiff grey clay, with bits of shell at 138 feet. The like at 154, but a trifle sandy) ...	81	187
	Sandy clay	21	208
	Black sand (specimen of greenish sandy clay or clayey sand)	6	214
	Green loamy clay and black sand ...	12	226
	Dark green sand	2	228
	Dark green loamy clay. (At 347 grey clay, with a few small bits of shell. At 350 grey and slightly greenish-grey clay and sandy clay. At 390–400 grey slightly sandy clay, with broken shells and some green sand. At 444 brownish-grey clay with bits of shells. Hard sandstone at the bottom 5 feet.)	217	445
[? Barton or Bracklesham Beds.]	Light-green loamy clay (greenish sand slightly clayey, with broken shell, top 10 feet)	25	470
	Light-green loamy clay with rock ...	4	474
	Dark green loamy clay	26	500

There is an older well at Langdown Mill, about 45 feet deep, with the water-level about 39 feet down, which was the same as in the above boring in June, 1891. This water is also slightly brackish, and with a disagreeable smell and taste.

Droxford.

Geol. Map 316, new ser.

1. Holywell. 1902.

Made and communicated by Messrs. Duke and Ockenden.

Well 82 feet, the rest bored. Lined with 103 feet of tubes of 4½ inches diameter.

Water-level 80 feet down.

Reading Beds	82	182 feet.
[Upper] Chalk and flints	100	

2. Railway Station.

Well 64 feet in chalk.

Dunley, near Litchfield.

Geol. Map 283, new ser.

Made and communicated by Mr. Broadhurst. From the Memoir on the Geology of Andover, 1908.

1. At Cottages, 400 feet above Ordnance Datum.

(Upper and Middle) Chalk and few flints, 129 feet.

Dunley—*cont.*

2. Manor House. 12 feet of water.

(Upper and Middle) Chalk, with hard bed and Chalk Rock 12 feet down, 210 feet.

East Dean.

Geol. Map 299, new ser.

Holbury Mill. In the garden between the buildings and the road.

Probably about 110 feet above Ordnance Datum.

Made and communicated by Mr. James Grace. Bored throughout.

	Thickness. Feet.	Depth. Feet.
London Clay ...	43	43
Clay [Reading Beds]	77	120
Chalk	60	180

I was told that oyster-shells were found at the base of the Reading Beds.

Eastleigh.

Geol. Map 315, new ser.

For Mr. Pember, Eastleigh Park.

Made and communicated by Messrs. Isler and Co.

Lined with 340 feet of 4-inch tubes from 8 feet down.
Water level 95 feet down.

		Thickness. Feet.	Depth Feet.
Dug Well		—	12
[London Clay.]	Clay	168	180
	Sand and clay ...	36	216
	Clay	25	241
[Reading Beds, 98 feet.]	Sand and clay ...	55	296
	Mottled clay ...	9	305
	Sand	11	316
	Sand and clay ...	17	333
	Sand	6	339
[Upper Chalk.]	Chalk and flints ...	3	342
	Chalk	156	498

The division between the London Clay and the Reading Beds is doubtful.

East Meon.

Geol. Map 316, new ser.

Coombe Bottom, south-west of the village.

From Messrs. Duke and Ockenden, August, 1896.

Well in the Chalk, 50 feet deep, with 6 feet of water.

East Tisted.

Geol. Map 300, new ser.

Rotherfield Park.

Boring made and communicated (1901) by Messrs. Isler and Co.

		Thickness. Feet.	Depth Feet
Old well [? Upper and Middle Chalk] ...		—	284
[? Middle Chalk.]	Chalk	18	302
	Grey chalk ...	39	341
	Chalk and rock ...	27	368

The last two depths are given as 365 and 392, so, perhaps, the grey chalk is 63 feet thick.

East Wellow.

Geol. Map 315, new ser.

EMBLEY PARK.

Made and communicated by Mr. J. GRACE.

Water, at 180 feet, rose 8 feet above the ground.

		Thickness. Feet.	Depth. Feet.
Soil		2	2
Gravel		6	8
[? Bagshot.]	Loamy sand	14	22
[London Clay.]	London Clay	158	180
	Pebbles [? Basement Bed]	1	181
[? Reading Beds.]	Sand with water	46	227

If the above interpretation of the beds is right, the London Clay is thinner than one would have expected.

East Worldham ?

Geol. Map 300, new ser.

Mr. JOHN BAIGENT'S. 1905. Communicated by him.

[Upper Greensand.]	Soft rock	10	85 feet.
	Alternate layers of hard and soft rock	60 ?	
	Black rock	15 ?	

About 28 feet of water (January, 1905), which was increasing at the rate of about 20 inches a day.

Eling.

Geol. Map 315, new ser.

1. LANGLEY MANOR, HUNTER'S HILL. 1887.

Bored and communicated by Messrs. ISLER. Notes from specimens and from Mr. T. LLOYD (of Winchester).

Water-level about 80 feet down. After pumping for 9 hours could not be lowered below 100, quickly returning to the natural level. Yield, 300 gallons an hour.

		Thickness. Feet.	Depth. Feet.
Old dug well (cylinders since carried down to 96 feet, by Mr. JAMES GRACE)		—	28
[Barton and Bracklesham Beds.]	Clay	7	35
	Blue sandy marl [specimen of grey clay, with greenish sand]	39	74
	Stiff blue clay	8	82
	Sandy blue clay...	4	86
	Stiff clay	12	98
	Sandy marl [specimens of green-grey clayey sand or sandy clay]	27	125
	Stone [specimen of hard calcareous clay]	1	126
	Sand [specimens of green-grey clayey sand or sandy clay, with bits of shell at 136 and 148 ; then specimen of green-grey clay]	31	157
	Sandy clay	1	158
	Sand	7	165
	Stiff sandy clay [specimen of fine greenish-grey clayey sand at 178 ; of green sandy clay at 200 ; of brown-grey clay at 204 ; and of dull brownish clay, with a little greenish sand, at 205]	40	205
	Stiff clay	6	211
	Stiff sandy clay [specimens of brown-grey clay, with shells, at 213 and 218 ; of greenish-grey sand, with shells, at 223 ; and of brown clay, with shells, at 226 and 231, the latter tough]...	23	234

Eling—*cont.*

		Thickness. Feet.	Depth. Feet.
[Barton and Bracklesham Beds]—*cont.*	Stiff green sand [specimens of brownish and greenish sandy clay, clayey sand and sand, often with shells, down to 300. A four-inch bed of sandstone at 285]	76	310

Mr. T. Lloyd told me that after the slight earthquake-shock felt here on May 31st, 1889, large quantities of sand came up with the water, so as to cut out the leathers, which had to be replaced, and then to stop the supply. Before this the water had been free from sand for months.

2. Oakhurst, close to Woodlands (described as Bartley in paper on Hampshire Wells). Communicated by Mr. Blatch.

Over 60 feet in hard clay ; yellowish at top, the rest blue.

Ellisfield.

Geol. Map 284, new ser.

Widmoor (Rectory), about a third of a mile E.S.E. of the church.

635½ feet above Ordnance Datum.
Well 317 feet. Boring 70.
Water-level 378¼ feet above Ordnance Datum (August, 1903) ; unusually high.
When the well was first made it is said that there was only 35 feet of water in it. Amount drawn about 1,000 gallons a day, with a maximum, on a hot summer's day, of between 2,000 and 3,000.
The first 20 feet clay, the rest chalk.
The above information from Mr. A. P. Morris.
I have seen the following specimens, August, 1903 :—

White chalk (5 specimens) from 30 to 190 feet.
Layer of brown clay at 200.
White chalk, (?) gritty, rather hard, at 230.
" " partly pale greyish. gritty, at 264.
" " in lumps, with pale grey between, at 290.
Grey chalk, with very little white and hard, at 320.

The specimen from 290 feet is suggestive of Melbourn Rock.

Emsworth.

Geol. Map 316, new ser.

1. For Mr. J. Hales. 1898.

Made and communicated by Messrs. Duke and Ockenden.

Shaft 30 feet. Boring to 170. 144¼ feet of tube standing 22 feet up in the well.
Water-level 7 feet down.
Rock at 152 feet, with water underneath.

2. Mount Pleasant. 1898.

Made and communicated by Messrs. Duke and Ockenden

Shaft 33 feet. Bored to 75. Water-level 39 feet down.

3. The Laundry, New Brighton, N. of the town. 1906.

Boring, made and communicated by Messrs. Duke and Ockenden.

Water-level 20 feet down.

		Thickness. Feet.	Depth. Feet.
Blue London Clay, with layers of rock 26 and 28 feet down, and one 6 inches thick at the base		75½	75½
Reading Beds.	Mottled clay	29½	105
	Clay and sand	34	139
	Red clay	11	150
	Mottled clay	28	178
	Clay and gravel	7	185
Chalk and flints		73	258

Ewhurst, north-westward of Basingstoke.

Geol. Map 284, new ser.

1. Foscott Farm, north-west of the church.

Information got by Mr. J. H. Blake.

Well dry at Christmas, 1890. No water until after the melting of the heavy fall of snow in March, 1891.

London Clay, Reading Beds and Chalk, 135 feet?

2. Farm near the Church.

Section given to Sir J. Prestwich, "from recollection by the man who had made it a few years previously." (*Quart. Journ. Geol. Soc.*, vol. x., pp. 96, 97) and MS. He adds that "there is apparently some mistake in the measurements, although I believe the order of succession and the occurrence of lignite to be correct."

		Thickness. Feet.	Depth. Feet.
[Reading Beds.]	Red and blue mottled clay	20	20
	Blue clay with pebbles	15	35
	Black clay with small oyster-shells ...	15	50
	A bright ore (iron-pyrites)	3	53
	Coal (lignite)	7	60
	Green sand and gravel (flint-pebbles)	2	62
Chalk...	... ...	17	79

Eyeworth.

Geol. Map 314, new ser.

Schultze Gunpowder Co.'s Works, about 6 miles N.W. of Lyndhurst. 1888.

From specimens taken at every 10 feet of depth, and from information from Mr. R. W. S. Griffith, Manager.

Shallow pit and then a boring to 200 feet. Very small supply of water, which rose some 60 feet (? more), but was pumped down in a few hours. A little later about 6 feet was silted up.

1. Blackish-brown loamy earth (alluvial wash).

[? All Bracklesham Beds.]

2. Pale brownish or buff clay, slightly sandy.
3. Dull brown (greyish) clay, or sandy clay.
4. Fine clayey green sand.
5. Brownish-grey sandy clay.
6. Greenish-grey sandy clay or clayey sand.
7. Calcareous stone (2 to 3 feet) and impure pyrites [? in sand or clay].
8. Fine green sandy clay or clayey sand.
9. Light-grey sandy clay.
10. " " more sandy.
11. Pale brownish-grey clay.
12. Light-grey clean sand, blowing; gave water at first.
13. Dark grey sand, drying compact.
14. Pale brownish-grey sandy clay, with vegetable matter.
15. Sand, like 13, but of a lighter colour.
16. Sandy clay, like 14.
17. Sand, like 15.
18. Pale clay, almost a pipe-clay.
19. Light-brownish-grey sand, with pieces of vegetable matter (lignite).
20. Said to be like 19. A heap, by the boring, full of pieces of lignite.

Faccombe.

Geol. Map 283, new ser.

From the Memoir on the *Geology of Andover*, 1908.

1. In the Village.

750 feet above Ordnance Datum.
(Upper and Middle Chalk, 314 feet.)

Faccombe—*cont.*

2. Netherton.

447 feet above Ordnance Datum.
Water rose 50 feet.
(Upper and Middle) Chalk, 240 feet.

Fareham.

Geol. Map 316, new ser.

1. Fort Fareham. Five wells.

From information at the Royal Engineers' Office, Milldam, Portsmouth.
All the water from a bed of greenish sand [at bottom]. Chalk not touched.

1. 200 feet deep. The sand 16 feet thick.
2. 188½ " " 6½ "
3. 210 " " 8 "
4. 220 " " 7 "
   Carried 2 feet into red clay beneath the sand.
5. 229 feet deep. The sand 5½ feet thick.
   Carried 1½ feet into red clay beneath the sand.

It looks as if the sand were either the bottom of the London Clay or the top of the Reading Beds, the red clay being probably red mottled plastic clay.

2. Lower Quay. Fareham Mill Co.

A few feet above high water.

Mr. E. T. Hildred tells me that there is a shaft of 30 feet, the rest being bored, and that the supply has greatly fallen (November, 1898). He believes that the water comes chiefly from sand of the Reading Beds, as a great deal of sand was being pumped. A slight subsidence had occurred close by.

To Chalk ...	141	441 feet.
Chalk ...	300	

3. Knowle. Hampshire Lunatic Asylum.

The former supply was from a well 120 feet deep, in Chalk, at the Asylum. Pumps 100 feet down. Heading never finished, because of the inflow of water.

3,000 gallons an hour pumped, for 12 hours; and 6,000 gallons an hour for 6 hours.

Water has once risen above the pumps. There is generally 6 feet or so of water, which is pumped down to about 3 feet.

Newer Works. On the left bank of the valley, about half-a-mile S.S.W. of the Asylum, and a little S.E. of Fontley Farm.

Communicated by Mr. W. Matthews.

108 feet above Ordnance Datum.

Rest-level of the water 84 feet above Ordnance Datum.

Well 62 feet deep, 7 feet diameter and lined with brickwork for 31 feet, the rest of 6 feet diameter and unlined.

Heading 40 feet long, from the bottom of the well, giving a yield of 6,090 gallons an hour. An additional heading, 50 feet long, made in 1891, increased the yield to 7,000 gallons an hour.

		Thickness. Feet.	Depth. Feet.
Soil		2	2
[Reading Beds.]	Reading clay	18	20
	Grey clay	1	21
	Flints and stones	2	23
[Upper Chalk.]	Grey chalk, with veins of clay and flints	4	27
	Chalk	35	62

4. Waterworks.

Wells 50 feet deep, with adits in chalk. At foot of Portsdown Hills.
Yield 18,000 gallons an hour.

The Water Works Directory, 1909, gives the yearly supply as 97,235,000 gallons, and the maximum day's supply (June 1908), as 314,500 gallons.

For an analysis of the water, *see* p. 196.

Farnborough.

Ordn. Map 285, new ser. Geol. Map 8.

WATERWORKS. Western side of Alexandra Road, just S.E. of Alma Cottages. 1884.

About 260 feet above Ordnance Datum.

Sunk and communicated by Messrs. TILLEY & SONS, and from specimens (to 185 feet).

Water-level 23 feet down, until 29th July, 1884, when it was pumped down to 41 feet, and the fixed level was then reduced to 29 feet.

		Thickness. Feet.	Depth. Feet.
Gravel (8 feet and iron-bound, in a trial-boring)		7	7
[Upper Bagshot Sand, 128½ feet.]	Brown loamy sand, rather coarse ...	33	40
	Buff sand rather coarse and water ...	33	73
	Yellow clayey sand, fine	8	81
	Green loam (turning grey when drier)	12	93
	Fine green sand and water (turning grey when drier)	29	122
	Light-grey fine sand and water ...	13½	135½
[Bracklesham Beds, 31¼ feet.]	Dark grey clay, with some large flint pebbles	¾	136¼
	Green-grey loam	17	153¼
	Flint pebbles, in green-grey clayey sand	3½	156¾
	Green-grey loam and sand, with pebbles...	10	166¾
[Lower Bagshot Sand, 62 feet.]	Fine grey sand, with water (? and loam)	22	188¾
	Green sand and water	22	210¾
	Green sand, with thin layers of clay ...	3	213¾
	Strong green loam, with layers of clay	12	225¾
	Green sand and water	3	228¾
London Clay		31	259¾

The divisions of the Bagshot Series are hard to make out, and the thickness given to the Upper division is more than one would expect; but some of the specimens looked like Bracklesham Beds, the green being an evanescent colour, from dampness. The Lower Bagshot Sand, on the other hand, is thinner than one would expect. Whether the bed described as London Clay is all truly so may also be a question, and some of it may turn out to belong to the loamy passage-beds from the sand into the clay.

According to a MS. note left by Sir J. PRESTWICH, a well at the railway-station passed through 30 feet of fine white sand and 60 feet of dark blue sand, to green sand.

Fawley.

Geol. Map 330, new ser.

STONE POINT, by the Solent.

From a note by Mr. H. W. BRISTOW.

9 feet above Datum.

Shingle	21½	137½ feet.
Various coloured clays...	110	
Sand	6	

Fordingbridge.

Geol. Map 314, new ser.

1. BOWER WOOD.

Sunk and communicated by Mr. HOBBS.

[Plateau.]	Gravel	4	70 feet
[Bagshot Beds.]	Yellow clay	20	
	Light-coloured sand ...	36	
[London Clay.]	Black clay	8	
	Yellow sand	2	

Fordingbridge—*cont.*

2. GASWORKS. By the stream at the western end of the town. 1887.

Bored by Messrs. TILLEY. From E. Westlake's 'Geology of Fordingbridge,' p. 28.

88 feet above Ordnance Datum.

Water from the sand at 125 feet rose to 13 feet above the ground.

		Thickness. Feet.	Depth. Feet.
Soil.	Black mould	2	2
River Gravel.	Broken subangular gravel in a good deal of sand	12	14
Bagshot.	Fine grey quartz-sand, clayey in places	6	20
London Clay, 118½ feet.	Grey sandy clay...	8	28
	Sand and pebbles	2	30
	Hard stiff clay	10	40
	Sand, with pebbles at the base ...	4	44
	Sandy clay	6	50
	Septaria, containing fossils, *Turritella imbricataria*, &c.	1	51
	Clay	8	59
	Hard stone	1	60
	Dark clay	7	67
	Dark clay with shells, probably *Pholadomya*	3	70
	Dark bluish clay	14	84
	Hard stone	½	84½
	Dark bluish clay, with a few small pebbles, *Cardita planicosta*, *Rostellaria lucida*, *Turritella imbricataria*	7	91½
	Hard stone	½	92
	Clay	8	100
	Brown clay, very hard and compact ...	4	104
	Septaria	1½	105½
	Sand and clay, with water under the stone	20	125½
	Sand and water	3	128½
	Sandy clay	7	135½
	Sand, shale, and pebbles (basement-bed?)	3	138½
Reading Beds, 73½ feet.	Light-grey clay laminated with grey sand	6	144½
	Greenish-brown loam with a little glauconitic sand and lignite	11½	156
	Buff-coloured calcareous stone, 4 inches	¼	156¼
	Light-brown clay	3¾	160
	Brown clay	2	162
	Mottled clays, 31 feet. — Whitish-grey or pale green clay, with occasional streaks of red	14	176
	Light-grey pipe-clay ...	1	177
	Red clay	3	180
	Yellow clay, greyer towards the base	8	181
	Dark brown or chocolate-coloured clay	2	190
	Purple clay streaked with ochre	3	193
	Marl, 9 feet. — Pale buff-coloured marl ...	3	196
	White highly calcareous marl	4	200
	Pale green or olive-coloured marl with calcareous lumps	2	202
	Greensand (glauconitic quartz and iron grains with oyster-shells)	10	212
Chalk	... ...	7	219

On this section Mr. C. REID has made the following remarks:—"Mr. E. Westlake's classification gives to the London Clay a thickness of 118 feet; but it is possible that strata both higher and lower should be included in that

Fordingbridge—*cont.*

division. I should be inclined to class the beds marked as doubtful with the Basement-bed, making the London Clay 136 feet thick. Pebble-beds in this district occur at so many horizons that they cannot be taken as marking lines of division ; in this section at least four are found. Glauconitic sand, also, in the Reading Series of this area seems to be confined to the base of the deposit, though it is common throughout the London Clay." (*Memoir on the Geology of Ringwood*, p. 16.)

There seems, however, to be some misapprehension ; the beds marked by Mr. WESTLAKE as doubtful are included by him in the London Clay. To give the London Clay the thickness suggested that formation must be carried two steps lower, to the depth of 156 feet, and this would make the Reading Beds only about 53 feet thick, which seems too small for this neighbourhood.

Mr. WESTLAKE's classification agrees in that matter with the one previously given by me in my paper on Hampshire Wells (with less detail than above). But the account of the section that I had did not suggest Bagshot Sand, and so the London Clay was given six feet more at top.

3. 1¼ miles north of the town.

Sunk and communicated by Mr. HOBBS. Water, 2 feet.

Gravel	9	35 feet.
Black clay full of oyster-shells [Reading Beds]	26	

4. SANDLE HEATH [? Sandhill, W. of the town].

Boring made and communicated by Mr. F. W. OCKENDEN.

200 feet above Ordnance Datum.

Water-level, 75 feet down. Yield plentiful.

Mixed sands and clays. Some of the sands very deep green	140	285 feet.
Chalk, very soft, with a few flints	145	

Frensham, near.

Ordn. Map 301, new ser. Geol. Map 8.

Near BATT'S CORNER, S.W. of Dockenfields Farm. Mr. G. C. A. Jonson's. 1899.

Made and communicated by Messrs. LE GRAND and SUTCLIFF.

Water-level 85 feet down (February).

		Thickness. Feet.	Depth. Feet.
[Gault.]	Brown clay	11	11
	Gault	61	72
[Folkestone Beds.]	Brown loamy sand ...	5	77
	Brown sand	12½	89½
	Live sand	18	107½

Frimley and Farnborough Company.

The following particulars are taken from the Water Works Directory, 1907 :—

Hampshire places within the area of control (besides Frimley and other places in Surrey and others in Berkshire) Blackwater, Cove, Crondall, Crookham, Farnborough, Fleet, Hawley Minley, Odiham, Winchfield, and Yately.

The sources of supply included surface-springs from the Bagshot Sand at Frimley (? Surrey) and the yield from these in 1906 was 96,516,356 gallons, that from wells being 183,832 000. The same work of 1909 gives these figures as 105,035,000 and 169,368,000 in 1908, and the average day's consumption as 751,789 gallons. The spring-water is about 3½° of hardness, and the well-water from 18° to 21°.

See also **Crondall** and **Farnborough.**

Froyle.

Geol. Map 284, new ser.

Lower Froyle, north of the main village. Mr. Burningham's. 1908.
Bored and communicated by Messrs. DUKE and OCKENDEN.

Chalk (marl)	33	141 feet.
Grey chalk	63	
Grey chalk (plastic) ...	45	

Fyfield. 1881.

Geol. Map 283, new ser.

Water-level, 55 feet down. Chalk and flints, 90 feet.

Gosport.

Geol. Map 331, new ser.

1. BLOCKHOUSE FORT. 1848.

Information from the Contractor's notes, made when doing the work, communicated with other notes by Mr. J. CARRUTHERS (then of Haslar).

About 13 feet above Ordnance Datum.
Shaft 19 feet, the rest bored.
Good water found in the bottom sand.
In 1884 the bore was sounded to 247 feet and cleaned down to 287, but it again filled up to 281.

		Thickness. Feet.	Depth. Feet.
[Shore Deposits.]	Shingle	40	40
	Brown and greenish-blue sand, and oyster-shells	9	49
	Fine shingle	21	70
[Bracklesham Beds.]	Sand and alternate layers of clay and gravel (in the upper part), and blue clay and green sand (in the lower and main part)	46	116
	Stiff blue clay	22	138
	Blackish-green sand, with slightly brackish water	20	158
	Stiff blue clay	66	224
	Clay and sand	52	276
[? Bracklesham or Bagshot Beds.]	Clean sand	24	300

The account given by Major-Gen. PORTLOCK, in 1850 (*Journ. Geol. Soc. Dublin*, vol. iv., p. 247), differs much from the above. He makes the oyster-shells 50 feet down and, very naturally, classes the clays beneath the later deposits as London Clay, Bracklesham Beds not having been then invented.

2. GOSPORT BREWERY CO., HASLAR STREET. 1896.

Boring made and communicated by Messrs. LE GRAND and SUTCLIFF.

Water-level, 17½ feet down.

		Thickness. Feet.	Depth. Feet.
Soil		2	2
[River Drift.]	Gravel and sand	7	9
[? All Bracklesham Beds.]	Brown loamy clay	9½	18½
	Blue sandy clay	4½	23
	Sand and clay	50	73
	Running sand	20	93
	Sandy clay	17	110
	Sandy clay with stones	26	136
	Sandy clay	27	163
	Sand, pebbles and lignite	17	180
	Sand	40	220
	Live sand with peat and wood [lignite]	22	242
	Clay	1	243

Gosport—*cont.*

3. Haslar Hospital. Well and boring at the wash-house. 1858. Communicated by Messrs. Easton and Amos (and from specimens, from a larger well, from 138½ feet down) ? later extension.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Mould	... ...	2	6	2	6
[River Drift.]	Clay	2	0	4	6
	Gravel, the lowest 9 feet red	27	0	31	6
[Bracklesham Beds, 284½ feet.]	Rock	2	0	33	6
	Light-coloured clay	6	0	39	6
	Light blue clay	4	0	43	6
	Dark silty soil	8	0	51	6
	Running silty soil	5	0	56	6
	Yellow sand	4	0	60	6
	Grey sand	6	0	66	6
	Iron-grey sand, to bottom of old bore, a mixed sort of silty soil	71	6	138	0
	Sand (138½ buff; 139¾ rather darker; 142½ greenish-grey, all fine and full of dark grains; 145½ greenish-grey sandy clay)	10	3	148	3
	Sandy clay and shale (148¾ greenish sand; 151 greenish sand, a little darker, partly clayey)	3	3	151	6
	Green sand (153 feet 10 inches greenish sand; 155 feet 2 inches brownish-grey clay with greenish sand; 156 brownish-grey clay, laminated; 158 brownish clay; 159 buff clayey sand)	8	4	159	10
	Clay (160 brownish sandy clay, with grey sand; 161 grey sandy clay, with sand; 162 brownish and greenish clayey sand and sandy clay, ? with traces of decomposed shells; 163 greenish-grey sandy clay, ? traces of shells; 164 and 166 grey sandy clay, traces of shells; 167 brownish sandy clay; 168½ and 169½ brownish clay; 172 brownish-grey clay; 175 brownish-grey and greenish-grey sandy clay, with shells; 178 greenish-grey sandy clay, with shells; 179 grey sandy clay, ? with decomposed shells; 180 greenish-grey sandy clay; 182½ grey clayey sand; 183½ brownish clay; 184½ greenish-grey clayey sand, a bit of shell)	25	2	185	0
	Sandy clay (186¾ greenish-grey clayey sand; 188 grey sandy clay; 190 greenish-grey clay, with brown specks; 192 greenish-grey sandy clay)	7	9	192	9
	Clay (194, 195, 196 greenish-grey sandy clay, the last with vegetable remains, and with many white acicular crystals weathered out on the surface) ...	3	3	196	0
	Sandy clay (197 grey; 199 greenish grey; 200 grey, all with traces of vegetable remains and a few crystals, as above)	5	0	201	0
	Sandy clay, peaty (201½ and 202½ grey, the former with a few crystals, as above; 203½ and 204½ greenish-grey, with traces of plants)	4	0	205	0

Gosport—*cont.*

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
[Bracklesham Beds, 284½ feet]—*cont.*	Sandy clay (206½ greenish-grey; 208, 209, 210, 212 sands all fine and greenish-grey, some slightly clayey)	7	6	212	6
	Hard sand (215 and 218 grey and clayey). First spring	5	6	218	0
	Sandy clay	3	0	221	0
	Hard sand	3	0	224	0
	Greensand (225 green-grey; 228 grey; 233 green-grey; 234 and 237 brownish clay)	15	0	239	0
	Stiff clay (240 brownish clay, with greenish sand)	7	0	246	0
	Sandy clay (250 grey; 255 brownish clay)	10	0	256	0
	Stiff clay (260 and 265 brownish and partly sandy; 270 alternations of grey sandy clay and brown clay; 275 grey sandy clay; 279 brown sandy clay, with green-grey sand)	25	0	281	0
	Sandy clay (283 green-grey sand and brown clay; 284 and 285 brownish clay, partly sandy)	5	0	286	0
	Clay and green sand	3	0	289	0
	Clay (290 brown, with green-grey sand)	2	0	291	0
	Clay and green sand (292 and 295 brownish clay, or with a little sand or partly sandy)	5	0	296	0
	Clay (300 and 302 brownish, partly sandy)	12	0	308	0
	Clay and pebbles (310 brownish sandy clay, with flint pebbles; 311½, 314, 316 fine buff sand, slightly clayey; the last compacted, with a flint pebble; also brown clay)	8	0	316	0
[Bagshot Sand.]	Water strata (318 fine buff sand, compacted, ? slightly clayey, with a flint pebble; 319 like above, with flint pebbles)	8	0	324	0
	Green sand and black [flint] pebbles ...	1	0	325	0
	Greensand (326 fine buff sand; ? 328 and 331½ buff compacted sand, the latter clayey)	7	0	332	0
	Peat [lignite] mixed with pyrites ...	0	6	332	6
	Loamy sand (334½ buff compacted sand; 336 dark sandy earth, with bits of lignite, crystals (? from decomposed pyrites) and strong smell)	8	0	340	6

4. Messrs. Mumby & Co., Mineral Water Works.
Communicated by Messrs. W. Hill & Co.

		Thickness. Feet.	Depth. Feet.
[Bracklesham Beds.]	Clays and sand	55	55
	Green sand and water	12	67
	Clay	1	68
	Green sand	4	72
	Light-coloured sand	4	76
	Blue clay	11	87
	Sandy clay	22	109
	Blue clay	16	125
	Blue clay and pyrites	14	139

Gosport—*cont.*

		Thickness. Feet.	Depth. Feet.
[Lower Bagshot Beds, 34 ft.]	Black pebbles	1	140
	Green sand and water	8	148
	Black pebbles and sand	3	151
	Green sand and water	11	162
	Sand and water	11	173
[London Clay.]	Sandy clay	15	188
	Stiff sandy clay	8	196
	Stiff clay and pebbles, with some pyrites	1	197
	Shale	1	198
	Light-coloured sand and water (ferruginous)	21	219
	Stiff clay	30	249
	Clay and shells	1	250
	Stiff clay	27	277
	Dark sand, with shells and clay ...	4	281
	Clay	18	299
	Clay-stone	1	300
	Blue sandy clay	12	312
	Stiff blue clay, with a layer of pyrites at 330 feet	48	360

Messrs. Hill classed the beds down to 281 feet as Bracklesham and Lower Bagshot, but the sandy London Clay clearly ranges up to 173 feet.

For an analysis of the water, *see* p. 197.

5. New Barracks.

		Thickness. Feet.	Depth. Feet.
[River Drift.]	Gravel and sand...	28	28
[Bracklesham Beds.]	Blue clay	18	46
	Black sand	1½	47½
	Sandy blue clay	72½	120
[? Bagshot.]	Light-coloured sand, with pebbles and water	20	140
[? London.]	Blue clay (? to sand and pebbles, and springs)	80	220

6. Royal Clarence Victualling Yard. From a section at Haslar Hospital (and from specimens).

Shaft about 50 feet, plugged for about 6 feet, the rest bored.

Measurements from the floor-level of the engine-house.

Major-Gen. Portlock gave an account of this section in 1850 (*Journ. Geol. Soc. Dublin*, vol. iv., p. 245), in much less detail. He says that an abundant spring was met with at a depth of 312 feet.

		Thickness. Feet.	Depth. Feet.
[River Drift.]	Gravel	4	4
[Bracklesham Beds, 35¾ feet.]	Yellow clay	11¾	15¾
	Silty clay (?)	16	31¾
	Silt, &c.	6	37¾
	Pebbles	2	39¾
[Bagshot.]	Sand	31	70¾
[London Clay, 336¾ feet.]	Silt, &c.	1¼	72
	Yellow clay	7	79
	Clay and sand	15	94
	Sand, with water	3	97
	Clay	77	174

Gosport—*cont.*

		Thickness. Feet.	Depth. Feet.
[London Clay, 336¾ feet]—*cont.*	Shells, &c.	3	177
	Clay and sand	16	193
	Clay	100	293
	Sand (fine buff loose sand, with bits of shell, at 309)	16	309
	Clay and sand (brown-grey clayey sand and sandy clay at 312. Brown-grey or grey sand at 315, 317, 320, 323, 326, 329, 331 (with bits of fossiliferous stone); all these fine compacted, to some extent clayey, and much alike)	22	331
	Clay (brown-grey compact sand at 337; brown clay, often with bits of shell or of stone or with pyrites, at 343, 351, 352½, 355, 357, 371, 375, 377, 379 (six inches of stone), 381, 385, 389; brown sandy clay at 390; brown-grey clay at 406 and 407)	76½	407½
[Reading Beds.]	Stamshaw clay (red and grey mottled clay at 408 and 410)	2½	410

7. Sea Horse Brewery. 1909.

Made and communicated by Messrs. Le Grand and Sutcliff and from Messrs. Biden and Co.

When the boring had reached 312½ feet down the water-level varied between 14 to 18 feet down.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
[River Drift.]	Gravel	10	0	10	0
	Sand, gravel and clay ...	6	0	16	0
	Sand and gravel ...	19	0	35	0
[Bracklesham Beds.]	Sandy clay	16	0	51	0
	Light-blue sandy clay ...	9	0	60	0
	Sandy clay	9	10	69	10
	Stone	0	2	70	0
	Blue sandy clay	55	0	125	0
	Sandy clay and pebbles...	2	0	127	0
[Bracklesham and Bagshot Beds.]	Sand	12	0	139	0
	Pebbles and clay ...	1	0	140	0
	Sand	11	0	151	0
	Hard sand	20	0	171	0
	Sandy clay	14	0	185	0
	Sand and water	23	0	208	0
[London Clay.]	Clay	2	0	210	0
	Blue clay	14	0	224	0
	Hard sandy clay ...	20	9	244	9
	Clay stone (?)	0	11	245	8
	Sandy clay	23	4	269	0
	Clay stone (?)	5	10	274	10
	Dark greenish loamy sand	8	4	283	2
	Clay stone (?)	0	7	283	9
	Grey sandy clay... ...	17	0	301	9
	Loamy sand	1	6	303	3
	Sandy clay	10	0	313	3

An analysis of the water is given on p. 197.

An old well here is said to be 164 feet deep. The water in it became brackish.

Gosport—*cont.*

8. Gosport Waterworks. Bury Cross.

There are four wells here. No. 1 is the most easterly, in the eastern Engine House. No. 2 is close by, to the N.W., just outside the Engine House. No. 3 is merely a pumping shaft, by the western Engine House. No. 4 is further west, by the north-western corner of the field beyond the works. The water from No. 2 flows into No. 1 by a pipe. Nos. 1, 3 and 4 are connected by a conduit at the base of the shafts.

Total supply, in 1885, about 300,000 gallons a day.

A brick shaft, 100 feet deep and 40 feet in diameter, was sunk later (1889 ?), so that 400,000 gallons would collect in it during the night, then enough for the next day's wants.

For analysis of the water *see* p. 198.

No. 1 Well.

J. Pilbrow, *Quart. Journ. Geol. Soc.*, vol. xvi., pp. 447–449 (1860). Corrections and additions from the Waterworks Company, and from specimens kept in their office.

Shaft 10 feet. Large cylinders to a depth of 83 feet, smaller to about 110 (? rather less). The rest bored.

Water originally rose to 9 feet below the surface. Would rise to about 25 feet from the surface when the supply was got from here ; but was pumped down to about 80 feet, and never left to rise higher than to about 35. Quality good.

Yield only tested to about 500,000 gallons a day, at about 70 feet from the the surface. In 1885 about 7,000 gallons an hour pumped.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
[River Drift, 9½ feet.]	Soil (specimen of brown loam) ...	1	6	1	6
	Gravel	8	0	9	6
[Bracklesham Beds, about 294 feet.]	Mottled clay (specimen brown and grey, and sandy)	2	3	11	9
	Blue clay, with sand and pyrites. Water at a depth of 25 feet. (Specimens of brown laminated sandy clay, of dark grey ditto, and of brownish sandy clay)	15	6	27	3
	Light-coloured sand, with pyrites and small shells (specimen of grey clayey sand with small *Ostrea*)	5	10	33	1
	Sand and shells. At 52 feet more loamy and full of shells. List of fossils by Prof. Morris, given. Water increasing just below 45 feet. (Specimen of sand with green grains and *Nummulites*)	34	2	67	3
	Greensand (specimen with shells) ...	2	9	70	0
	Greensand, lighter in colour (specimen finer and with shells)	5	0	75	0
	Light-green sand (specimen of compact clayey grey sand)	5	0	80	0
	Light-coloured sand (specimen of green-grey sand with shells)	3	0	83	0
	Clay and sand	1	0	84	0
	Sand and shells, compact and full of shells at 86 feet (specimens of grey sand, with *Cardita* and *Turritella*) ...	11	0	95	0
	Sand, shingle and shells (specimen of grey sand with *Cardita*)	9	0	104	0
	Laminated clay (specimen, marked 104, of brown-grey clay with sand-partings)	2	9	106	9

Gosport—*cont.*

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
[Bracklesham Beds about 294 feet]—*cont.*	Blue clay and sand (specimen of brown-grey laminated clay at 108, and of brown clay below)	11	6	118	3
	Black peat, woody (specimens of peat with brown clay)	4	6	122	9
	Stiff blue and green clay (specimen brown)...	16	0	138	9
	Blue clay and sand (specimen brown)	12	6	151	3
	Dark sand and water (specimen of grey sand, coarser than any other, the rest being all fine)	2	0	153	3
	Blue clay and sand (specimen brown)	8	1	161	4
	Green sand (specimen with bits of clay)	1	0	162	4
	Stiff blue clay (specimen brown, with a little sand, ? trace of shell) ...	21	5	183	9
	Dark green sand, with peat clay and pyrites (specimen of brown-grey compact sand with peaty streaks) ...	18	0	201	9
	Green sand and water (specimen of fine light-coloured sand with dark grains)...	20	6	222	3
	*Blue[light-coloured]clay and sand[48]	49	3	271	6
	Clay, sand and shells	1	0	272	6
	Blue [light-brown] clay and [green] sand. At 290½ feet hard blue clay	27	6	300	0
	Blue clay and black [flint] pebbles ...	3	0	303	0
	Blue clay, crusty [no record of this in another account]	0	9	303	9
[Lower Bagshot.]	Light-coloured sand [clayey at the bottom] and water	26	0	329	9
[London Clay.]	Sandy clay and black pebbles	1	3	331	0
	Hard clay [these two together, in specimens, as clay, the depth being made 331¼ feet]	2	3	333	3

*From this point the specimens differ slightly from the published account, and the version in square brackets is taken from them; but of course it does not follow that the whole of each bed was like the specimen.

It should be noted that specimens of bluish-grey clays, &c., are liable to turn brown after long exposure. Hence, probably, some of the differences in the above account.

The Rev. O. Fisher (*Quart. Journ. Geol. Soc.*, vol. xviii, p. 76), from an examination of the specimens, when fairly fresh, gave the following abstract:—

Laminated clay, weathered, at a depth of 11 feet 9 inches.
Laminated clay and dark sand, at 37 feet 3 inches.
Nummulina lævigata bed at 67 feet 3 inches.
Very green sand, with a few specimens of *N. lævigata*, at 75 feet.
Turritella bed, a conglomerate of shells, with *Cardita planicosta*, at 95 feet.
Cardita bed; shells rather smaller at 104 feet.
Shaly and peaty clays at 109 feet.

He remarked: "I should say that the water was obtained in the London Clay series, and that the Bracklesham Beds ended at a depth of 201 feet 9 inches. The green sand (with water), 20 feet 6 inches thick, would then belong to the Lower Bagshot sands."

I think, however, that the Bracklesham Beds reach further down, their base being shown by the pebbles of the specimen from below 300 feet. In this case the 26 feet of sand below is Lower Bagshot, as is most likely from the fact that it is the chief water-bearing bed. The London Clay, therefore, would be only just touched. The specimens from the latest well (No. 4) agree with this classification, and so does the account of the well at the Royal Clarence Yard.

Gosport—*cont.*

No. 4 Well.

? Shaft about 40 feet (with bores to 120, 220, and 330 feet).

From specimens in the Company's office.

It must, of course, be understood that the whole of the thicker beds are not likely to follow the character of a single specimen taken from one part; thus specimens of sand may come from a bed largely composed of clay.

		Thickness. Feet.	Depth. Feet.
[River Drift, 12 feet.]	Brown loam	3	3
	Gravel	9	12
[Bracklesham Beds, 291 feet.]	Brown and grey (discoloured) clay ...	1	13
	Grey clay and sand, laminated, with pyrites	10	23
	Light-grey and greenish sand, partly clay; small shells	57	80
	Green-grey sand and shells	22	102
	Brown clay	15	117
	Sand and peat	3½	120½
	Clay and sand	19	139½
	Light-coloured sand	4½	144
	Clay with sand (specimen mashed up)	22	166
	Hard clay	35	201
	Light-grey sand...	22	223
	Clay and sand, laminated	16	239
	Clay with a little sand...	59	298
	Sandy clay and flint pebbles	5	303
[Bagshot Sand.]	Light-coloured sand with small flint pebbles	4	307
	Light-coloured sand	13	320
[Bagshot, and London Clay?]	Clay, sandy clay, and iron-pyrites ...	14	334

The base of the Bracklesham Beds was, therefore, struck at exactly the same depth as in No. 1 Well; but in the later well there may be a less thickness of the Lower Bagshot Sand, and there is less water found. The sand, from 20 to 22 feet thick, below the depth of 201 feet, may be the same bed that occurs, in a like position, near Southampton.

At the more northerly well of the Royal Clarence Victualling Yard (there is apparently no record of the southerly one), the base of the Bracklesham Beds is not quite 40 feet down, so that we have the means of calculating the fall of the beds between the two sites (about 1 in 25).

A newer boring (decreasing from 8 to 4 inches diameter) in this well, from the base of one of the old borings, made and communicated by Mr. W. Hill, of Gosport.

The water found at the bottom, which they were only just able to reach, rose to the surface.

		Thickness. Feet.	Depth. Feet.
Old shaft, about 40 feet, and boring (9 inches diameter) ...		—	218
[Bracklesham Beds.]	Sand, with a little clay	8	226
	Stiff brown clay	2	228
	Brown sandy clay	21	249
	Stiff brown clay	34	283
	Sand and clay, with water	12	295
[Bagshot Sand.]	More sand; water	8	303
	Darker sand, with more water ...	17	320
[London Clay, 327 feet.]	Sandy clay	10	330
	Clay	7	337
	Sandy clay, with a few black [flint] pebbles	11	348
	Clay	1	349

Gosport—*cont.*

		Thickness. Feet.	Depth. Feet.
[London Clay, 327 feet]—*cont.*	Dark sandy clay	10	359
	Hard yellowish clay...	3	362
	Sand, with a little clay and pebbles	6	368
	Clay, with a little coarse grey sand, a few pebbles, and some water ...	61	429
	Sandy clay, much easier to work ...	25	454
	Hard clay	102	556
	Sand and water (which rose to within 19 feet of the surface)	18	574
	Very hard stone	2½	576½
	Sandy clay, getting harder	12½	589
	Strong brown clay, with 8-inch stone, at about 517 feet	58	647
[Reading Beds, 100 feet.]	Pure Stamshaw [mottled] clay ...	43	690
	Light-brown clay	6	696
	Sandy clay, Stamshaw, [mottled]. Specimen of brecciated-looking mottled sandy clay, grey, red, and whitish, at 700 feet	5	701
	Stamshaw [mottled] clay and sand in about equal parts	4	705
	Ditto milder, light-brown, with deep red veins. Specimen, grey-and-brown, at 730 feet...	25	730
	Very fine close bluish and black clay	11	741
	Stamshaw [mottled] clay, very bright red. Vein of snuff-coloured sand at 745. Some water. Specimen of red clay, with but little light-grey mottling, at 745 feet	6	747

Deepened later, to Chalk ... 777 feet.
In Chalk ... ... to 786 ,,

For other Pumping Stations of the Gosport Waterworks Co., *see* ALVERSTOKE and SOBERTON, pp. 60, 126.

The following places are in the district of supply:—Alverstoke (which includes Anglesey, Bridgemary, Brockhurst, Elson, Forton, Gosport and Hardway), Crofton, Rowner, Shedfield, Swanmore, and Wickham (Water Works Directories, 1907, 1909).

Greywell.

Geol. Map 284, new ser.

FRIMLEY and FARNBOROUGH DISTRICT WATERWORKS. 1908.

Information from Mr. A. C. PAIN and Mr. R. NUNN.

		Thickness. Feet.	Depth. Feet.
Soil (peaty)		½	½
[River Gravel, 30½ feet.]	Yellow gravel	4½	5
	Brownish gravel	4	9
	Whitish gravel and flints	5	14
	Fine gravel, flints and chalk	5	19
	Gravel, flints and chalk	12	31
[Upper Chalk.]	Very soft white chalk (disintegrated) ...	17	48
	Chalk, blocky but flinty and loose ...	12	60
	Chalk, tough with brownish seams ...	19	79
	Chalk, firm and blocky with flints in layers	6	85
	Chalk, compact and blocky with layers of flints, 3 to 4 feet apart	11	96
	Chalk, more or less hard, with flints at times	86	182

Greywell—*cont.*

When the well was 60 feet deep about 700,000 gallons a day were pumped. The back of the cast iron lining was grouted and this water was shut out, so that when sinking was begun again there was no pumping.

At 110 feet the pumping was at the rate of 44,000 gallons a day.
" 121 " " " 113,000 "
" 127 " " " 144,000 "
" 132 " " " 182,000 "

Hale.

Geol. Map 314, new ser.

1. Manor House, in kitchen garden.

Sunk and communicated by Mr. Hobbs.

Gravel	3	40 feet.
Sharp yellow sand [Bagshot] ...	37	

2. Home Farm.

Sunk and communicated by Mr. Hobbs. 3 feet of water.

Yellow loam [London Clay ?], 27 feet.

Hambledon.

Geol. Map 316, new ser.

Dr. H. F. Parsons, in a Report on Hambledon (1884), says :—

"The water supply is derived from deep wells in the chalk. . . . The level of the underground water fluctuates greatly, so that the water in a well may at one time be 60 or 70 feet from the surface, and at another may overflow in a stream, and the water level in a well has been observed to rise 23 feet in 12 hours. This overflow of the underground water is spoken of as 'high springs.'" *See also* p. 33.

1. Alliance Brewery.

Bored and communicated by Messrs. A. Williams and Co.

Boring lined with 10 feet of pipe, 7½ inches in diameter.
Water-level, 52½ feet down. Good supply.

Well (old ?)	53	106 feet.
Boring in Chalk and flints ...	53	

2. Denmead Schools. 1899.

Bored and communicated by Messrs. A. Williams and Co.

Lined with 45 feet of pipes of 4 inches diameter and 10 feet of guide-pipe of 6 inches diameter.
Good supply of water.

		Thickness. Feet.	Depth. Feet.
[Reading Beds.]	Mottled clay ...	8	8
	Light-blue clay ...	28	36
	Black flints ...	3	39
[Upper.]	Chalk and flints...	69	108

3. Boring at Mr. Wilson's Farm. 1909.

Made and communicated by Messrs. Duke and Ockenden.

Water found at 167, 180 and 218 feet ; rest-level 136 feet down.
Chalk (with soft veins 72 and 138 feet down) 250 feet.

Hatchet Green.

Geol. Map 314, new ser.

Sunk and communicated by Mr. Hobbs.

Gravel	2	44 feet.
Soft light-coloured sand [Bagshot ?]	42	

Havant.

Geol. Map 316, new ser.

1. BELGRAVIA DAIRY, on the southern side of the road, a little south-eastward of the Railway Station. 1896.

Made and communicated by Messrs. DUKE and OCKENDEN (and from specimens).

Water rose to within 5 feet of the surface. Tested with a surface-pump at 348 feet and the yield found to be 2,700 gallons an hour. At 373 feet it was 3,000, till the level was lowered 30 feet.

		Thickness. Feet.	Depth. Feet.
[River Drift ?]	Ballast and stones	8	8
	Sand	9	17
[London Clay, ? 118 feet.]	Sand and clay	8	25
	Clay with a few stones (specimens of brown sandy clay at 25 and of brown stone at 28 feet)	15	40
	Dark blue clay (specimens of dark grey and brown clay at 75, 100, and 110 feet, the last browner)	74	114
	Dark blue clay, rather harder (specimen of dark brown clay at 120 feet)	13	127
	Clay, gravel and sand (large flint pebble at 128, septaria at 129, and dark brown rather sandy clay at 130 feet) ...	5	132
	Sand and gravel (specimen of brown fine clayey sand at 135 feet)	3	135
[Reading Beds, 109 feet or more.]	Sand and clay (specimen of grey and red mottled clay at 141 feet)	7	142
	Coloured [mottled] clay (specimens of grey and red, red and grey mottled clays at 145 and 150, and of brown and grey streaked sandy clays at 152, 156, 159, and 161 feet, middle two light-coloured, the rest more sandy)...	19	161
	Clay with a little sand (specimen of light-brown sandy clay or clayey sand at 163, of light-brown and grey streaked sandy clay at 165 and 170, of brown sandy clay at 174, of light-grey sandy clay at 178, of brown-grey clay at 181, of brown-grey sandy clay at 187, of grey sandy clay at 188; the last four with lignite mostly in patches or streaks. Some loose specimens of bits of stone, with pyrites, "appear to come from the black formation, 185 to 187 feet," and of light-grey sandy clay with blackish streaks at 190 feet)	33	194
	Stiff variegated clay (many specimens of variously coloured clays, mostly streaked or mottled, down to 240 feet)	57	251
[Reading Beds and Chalk.]	Clay, chalk and flints	13	264
Chalk and flints		109	373

An older well is 15 feet deep, in gravel, with running sand at the base.

2. BREWERY. On the northern side of the main road, a little east of Hermitage Bridge. 1878.

Information (in 1896) from Mr. A. SUTTON, the former owner, from memory of samples that he had taken and kept for some time.

Shaft 20 feet, the rest bored. Surface-water kept out by iron cylinders. Boring of 8 inches diameter to 60 feet down, when the work was stopped by accident. Boring continued of 4 inches diameter. The flow of water was very

Havant—*cont.*

strong, to 6 feet above the ground, with force enough to work a turbine. The only time it falls below that is in November, and for two or three months.

		Thickness. Feet.	Depth. Feet.
[River Drift.]	Gravel	4	4
	Marl	5	9
[Reading Beds, 91 feet.]	Red Stamshaw clay [mottled]	30	39
	Black clay	5	44
	Mottled red and yellow clay	10	54
	Blue clay, very tough 60 feet down ...	46	100
[Upper Chalk.]	Chalk	40	140
	Harder chalk with water	10	150

Messrs. Duke and Ockenden, who did the work below 60 feet, give the following account, but say that they cannot find an exact record. Of course, they are not answerable for the top 60 feet.

	Thickness. Feet.	Depth. Feet.
Sand and ballast, with water	10	10
Clay beds	115	125
Running sand	9	134
Chalk	11	145

This version would bring in London Clay, which is, I think, unlikely to occur, and Mr. Sutton notes nothing of the sort.

3. 103 West Street, southern side, a little west of the Union Workhouse, and near the Portsmouth Waterworks. 1883.

Made and communicated by Messrs. Le Grand and Sutcliff.

Water-level, 1½ feet down.

[River Drift.]	Gravel and marl ...	20	50 feet.
Soft chalk and flints	... ...	30	

4. Messrs. A. Stent and Sons. 1904.

Made and communicated by Messrs. Duke and Ockenden.

Lined from the bottom with 98 feet of tubes, of 3 inches diameter, and from 15 feet below the surface with 63 feet of 4½ inches diameter.

Water-level 2½ feet down

Gravel and sand ...	21	150 feet.
Soft chalk... ...	129	

5. For Mr. F. Stent. 1898.

Boring, made and communicated by Messrs. Duke and Ockenden.

150 feet. Lined 45 feet with tube of 6 inches diameter.

Water overflowed.

Surface-beds and Reading clays	110	150 feet.
Chalk	40	

Hayling Island.

Geol. Map 331, new ser.

1. About half a mile N.E. of South Hayling Station. 1896.

Made and communicated by Messrs. Duke and Ockenden.

In January, 1896, the yield was only about a gallon a minute, apparently from the depth of 630 feet, the water rising to within 15 feet of the surface.

		Thickness. Feet.	Depth. Feet.
Sand ballast, with water		57	57
[London Clay, 221 feet.]	London Clay	97	154
	Running clay and sand	22	176
	London Clay	102	278
Reading Clay		120	398

Hayling—*cont.*

		Thickness. Feet.	Depth. Feet.
[? All Upper Chalk.]	Brown chalk, without flints. No water	62	460
	White chalk, with layers of black flint, from 3 to 6 inches thick, about 10 feet apart. At 640 the thickest bed of flint, whence about 1 gallon of water comes in a minute	200	660
	Very hard brown chalk, without flints. No water	30	690
	Very hard limestone-rock, the last four feet still harder	10	700

2. Copse Cottage, about a mile east of Hayling Station ?.

Made and communicated by Messrs. Duke and Ockenden.

No water.

Reading Clay	42	218
Chalk and layers of hard flints	176	

3. Lawn Cottage, about half a mile south of North Hayling Station.

Made and communicated by Messrs. Duke and Ockenden.

Water stands 10 feet down.

[Reading Beds.]	Reading Bed clay	70	178 feet.
	Rock [flints ?] ...	12	
Chalk and flints		96	

4. South Hayling Station.

Made and communicated by Messrs. Duke and Ockenden.

Well 83 feet deep, still in clay.

5. South Hayling Waterworks. 1899.

Made and communicated by Messrs. Duke and Ockenden.

Lined from the surface with 69 feet of tubes of 7 inches diameter, and 150 feet of 6 inches diameter.

Water-level when at rest 12 feet down.

[? Reading Beds.]	Clay ...	68	250 feet.
	Flints ...	1	
	Rock ...	2	
Chalk		179	

6. Dr. Townshend's, southward of South Hayling Railway Station.

Made and communicated by Messrs. Duke and Ockenden.

No water got.

		Thickness. Feet.	Depth. Feet.
Shingle		16	16
[Bracklesham Beds.]	Sand and clay	15	31
	Blue clay, very hard	25	56
[Bagshot Beds ?]	Running sand	23	79
	Clay	1	80
	Running sand	2	82
	Gravel and sand mixed with clay	12	94
[London Clay.]	Sandy clay	51	145
	Blue clay, very hard	34	179
	Brown clay, very hard	8	187
	Blue clay, very hard	21	208
	Green sandy clay	4	212

There is much difficulty in classifying the beds.

Hayling—*cont.*

7. Stoke. Near North Hayling Station. 1905.

Made and communicated by Messrs. Duke and Ockenden.

Shaft 14 feet, the rest bored. Water-level 10 feet down.

Clay and gravel ...	14	65 feet.
Soft chalk and flints	6	
Hard chalk ...	45	

Headley.

Ordn. Map 301, new ser. Geol. Map 8.

1–3 Headley Park. Borings.

Made and communicated by Messrs. Legrand and Sutcliff. (Remarks in brackets, in the first, from an account given by Mr. E. E. Berry.) With some additional information from Sir R. S. Wright.

1. A boring of 5 inches diameter. (About 30 feet S.S.E. of Park Mill ; about 1¼ miles N. of Headley Church. About 200 feet above Ordnance Datum.) 1888. Water overflowed.

		Thickness. Feet.	Depth Feet.
Top ground ...	... ...	1	1
[Folkestone Beds.]	Yellow loamy sandstone	2	3
	Grey sand	2	5
	Peat (peaty sand)	3	8
[Sandgate Beds.]	Very green sand, and a little clay ...	5	13
	Blue sandy clay (tenacious, watertight), and layers of sandstone (a layer, very hard, green, about 3 inches thick) ...	21	34
[? Hythe Beds.]	(Loose blowing) grey sand	16	50

2. A boring of 16 inches diameter, 10 feet S.S.E. of No. 1. 1889. Water-level a foot down, June.

		Thickness. Ft.	In.	Depth. Ft.	In.
Top ground ...	... ...	1	0	1	0
[? Drift.]	Brown sand	1	0	2	0
	Gravel	3	0	5	0
[Folkestone Beds.]	Brown and green sand, mixed	5	0	10	0
[Sandgate Beds.]	Dark clay and sand	6	0	16	0
	Sandstone and clay ...	8	0	24	0
	Sandstone rock	2	2	26	2
	Green sand and stone ...	11	10	38	0
	Green sand with water ...	7	0	45	0
[? Hythe Beds.]	Hard rock	0	10	45	10

3. A boring of 16 inches diameter, about 40 feet N.E. of No. 1. 1889. Water-level a foot down, August.

		Thickness. Feet.	Depth. Feet.
[? Drift.]	Peat and sand	5	5
	Sand, clay and stones ...	13	18
[Folkestone Beds.]	Hard, dead sand	2	20
	Sandstone-rock ...	3	23
	Grey sand and stone ...	7½	30½
	Green sand and water ...	3½	34
	Hard green sand and water	5⅓	39⅓
	Hard sandstone-rock ...	3⅔	43
	Blowing sand, to rock ...	3	46

No. 1 is now stopped. No. 2 is in constant use, and in 7 or 8 years (always running free) has varied very slightly in yield, giving 50 gallons in about 52 or 53 seconds, with a nearly constant temperature of about 51°. No. 3 runs wholly to waste, and seems to yield about the same as No. 2. (1895.)

Headley—*cont.*

According to a note in the *Daily News*, 20th July, 1888, at the first, water rose to 9 feet above the surface, which is 210 feet above Ordnance Datum, at first at the rate of about 200 tons a day, but increasing to that of 290. Upon the tube being cut down 2½ feet the overflow increased to 480 tons, or 110,000 gallons, daily. The water has been analysed and found to be of the finest quality.

4. 170 yards north of the church tower. For Mr. Delamotte. 1888.
Communicated by Prof. T. R. Jones.

Shaft throughout, with 3 feet of water when digging was left off.

		Thickness. Feet.	Depth. Feet.
Brickwork		—	8
[Lower Greensand (Hythe Beds).]	White sand	16	24
	Rock	2	26
	White sand	8	34
	Rock	3	37
	White sand	12	49
	Three pieces [? beds] of rock	7	56
	White sand, with water...	19	75

The sand between the layers of stone is so hard as to be a soft stone.

Herriard.

Geol. Map 284, new ser.

Four wells on the estate. All in Chalk.

1. Hurst Well.

561 feet above Ordnance Datum.
Water-level 227 feet down (? 1899) 274 feet deep.

2. Lee Farm Well.

510½ feet above Ordnance Datum.
Water-level 228 feet down (? 1899). 234 feet deep.

3. Park Farm Well.

500 feet above Ordnance Datum.
Water-level 210 feet down. 220 feet deep.

4. Stables Well.

592½ feet above Ordnance Datum.

Water-level 290 feet down.

Originally only 314 feet deep. Before 1892 water drawn up by bucket. In 1893 pumps set up. In seasons of drought the supply was inadequate (for house, gardens, stables, farm and cottages dependent on this well). In 1895 the shaft was deepened 26 feet (to 340) and a boring of 82 feet was made, giving a total depth of 422 feet.

Said to be about 250 feet in Upper Chalk, the rest in Middle.

After the deepening and regular pumping the wells at Lee Farm and Park Farm gave out, and had to be deepened (to above figures?). Later Weston Corbett well gave similar evidence of the lowering of the water-level, and also had to be deepened. More recently no less than eight wells at Tunworth had to be sunk deeper into the Chalk for the same reason. Two of the above wells are within a mile of the Herriard well.

The above information is from a Report made for the purpose of an arbitration between the Estate and the Basingstoke and Alton Light Railway Co. in 1899, and communicated to me.

In my own Report on the subject I remarked that Herriard is on the watershed between the Loddon, on the north, and the Itchen and the Wey, on the south. It is on the high ground of the Chalk and on a tract from which water flows, chiefly perhaps northward or north-eastward (to the springs of Basing,

Herriard—*cont.*

Nately and Greywell). In such a position a well is more likely to be affected by other wells than in the lower tracts, where there is more water; and it is likely to be affected from a greater distance.

Highclere.

Geol. Map 283, new ser.

From the Memoir on the Geology of Andover, 1908.

Nos. 1–4, 7–22 made and communicated by Mr. Broadhurst.

1. Balls Cottages.

420 feet above Ordnance Datum.
(Bracklesham Beds.) Sand, 30 feet.

2. Bottle Row.

401 feet above Ordnance Datum.
(Bagshot Beds, Lower.) Blue clay, 45 feet.

3. Caernarvon Arms, opposite to.

550 feet above Ordnance Datum. Water rose 15 feet.

(Bagshot Beds, Lower.)	Red clay	10	100 feet.
	Sand ...	90	

4. Carpenter's Arms, near.

476 feet above Ordnance Datum. Good water.
(Bracklesham Beds.) Loamy sand, 45 feet.

5. Church Lane Lodge.

Chalk with flints, 130 feet.

6. Dod's Farm.

370 feet above Ordnance Datum. Water rose to the surface.

(Bagshot Beds, Lower.)	Brown clay ...	3	20 feet.
	Sand	10	
	Dark clay, to sand	7	

7. Highclere Farm.

430 feet above Ordnance Datum.
(Bagshot Beds, Lower.) Brown and red clay, 15 feet.

8. Highclere Park. Headstock Lodge.

380 feet above Ordnance Datum.
(Bagshot Beds, Lower.) Blue clay, 45 feet.

9, 10. Highclere Park. Keeper's House and London Lodge.

450 feet and 506 feet above Ordnance Datum.
(Bracklesham Beds.) Sand, 50 feet and 100 feet.

11. Pound Street, at cross-roads.

397 feet above Ordnance Datum.
Gravel.
Clayey, boggy soil (Bagshot Beds, Lower) 20 feet.

12. Pound Street, Treasurer's Hill.

458 feet above Ordnance Datum.

	Gravel	5	30 feet.
(Bracklesham Beds.)	Sand	25	

13. Ridgemoor Farm.

450 feet above Ordnance Datum (?).
(Bagshot Beds, Lower.) Sand, 30 feet.

Highclere—*cont.*

14. Spring Lane.

(Lower Bagshot.) Blue clay, 40 feet.

15. Close by the last, near Wellhouse Farm.

376 feet above Ordnance Datum. Water not good.

(Bagshot Beds.) { Black clay, Sand } 30 feet.

16. Tot Hill Farm.

430 feet above Ordnance Datum.

Gravel, 15 feet.

17. Close by the last.

Gravel	10	25 feet.
Sand (Bracklesham Beds)	15	

18, 19. West Street and West Street Farm.

(?) 430 feet and 450 feet above Ordnance Datum.

(Bracklesham Beds.) Sand, 30 feet and 350 feet.

[There must be some error in the latter (?) 35 feet.]

20. Cottage half-way between Tot Hill Bridge and the Railway Station.

Gravel	10	45 feet.
Sand (Bracklesham Beds)	35	

21. House a quarter of a mile north of the Church.

(Lower Bagshot.) Sand, 45 feet.

22. Between Maple House and Highclere Street Farm.

482 feet above Ordnance Datum.

Gravel	10	130 feet.
(Bagshot Beds, Lower.) Blue clay	20	
(Bagshot Beds and London Clay.) Black clay and shells	100	

Hursley.

Geol. Map 299, new ser.

The Park.

Communicated by Mr. W. Matthews.

	House. Feet.	Home Farm. 1908. Feet.
Surface above Ordnance Datum	200	210
Depth of well (all in Chalk)	144	500
Rest-level of water, below the ground	100	110
Gallons pumped per hour, practically without drop in the water-level	1,500	2,500

The water is used for the house, farms and the bulk of the houses in the village.

Messrs. Duke and Ockenden describe the farm-well as a shaft of 118 feet and the rest bored (1908). Beds of flints occurred at 395 and 494 feet down. The boring is lined with 8-inch tubes to the depth of 159 feet. The water-level is 100 feet down.

Hurstbourne Tarrant.

Geol. Map 283, new ser. (From Memoir thereon.)

Cowdown Farm, N.E. of Upton.

450 feet above Ordnance Datum.

(Upper and Middle Chalk.) Soft chalk with flints, 165 feet.

Hythe.

Geol. Map 315, new ser.

WINTERTON HALL, N.W. of house (in field). 1885.

Communicated by Mr. G. F. L. GILES, and from specimens.

Field overflowed by high water spring tides (reclaimed land ?).

Water, from the last bed but one, rises to the top of the bore-pipe and cannot be lowered more than 40 feet.

		Thickness. Feet.	Depth. Feet.
[Alluvium.]	Yellow clay	8	8
[Drift.]	Yellow gravel, very compact	10	18
[Barton Beds and Bracklesham Beds.]	Blue clay [specimens of grey clay, rather sandy]	17	35
	Sandy blue clay } [Specimens of rather sandy grey clay.]	2	37
	Green sand ... } [Specimens of rather sandy grey clay.]	1	38
	Blue clay. [Specimens, 39–41, grey sandy clay]	2	40
	Green sand ; great quantity of water. [Specimens, 42–44, fine grey clayey sand]	4	44
	Blue clay ... } [Specimens of grey more or less sandy clay]	3	47
	Blue clay with sand } [Specimens of grey more or less sandy clay]	3	50
	Blue clay ... } [Specimens of grey more or less sandy clay]	1	51
	Blue clay with sand } [Specimens of grey more or less sandy clay]	2	53
	Green sand ... } [Specimens of grey more or less sandy clay]	3	56
	Blue clay with sand } [Specimens of grey more or less sandy clay]	11	67
	Blue clay with much sand ... ... } [Specimens of grey more or less sandy clay]	? 1½	68½
	Blue clay with sand } [Specimens of grey more or less sandy clay]	9	77½
	Green sand. [Specimens of fine clayey sand]	2	79½
	Blue clay with sand. [Specimens, 80–85, 87, 88, grey sandy clay ; 86, 89–91, grey clayey sand]	? 11½	91
	Hard blue clay. [Specimens 92, 93, grey sandy clay ; 94 grey clayey sand ; 95 green-grey sand]	4	95
	Hard blue clay. [Specimens of grey clay]	6	101
	Hard blue clay with sand. [Specimens of grey, partly greenish, clay, some rather sandy]	22	123
	Hard blue clay. [Specimens of grey clay, some slightly sandy, some slightly greenish]	19	142
	Hard blue clay with sand. [Specimens grey clay]	3	145
	Blue sandy clay } [Specimens, grey and greenish sandy clay]	1	146
	Blue sand with very little clay } [Specimens, grey and greenish sandy clay]	3	149
	Blue sand with more clay. [Specimen brownish]	1	150
	Hard blue clay, very little sand ... } [Specimens of grey and greenish rather sandy clays, more or less with green grains]	3	153
	Hard blue clay, with sand ... ... } [Specimens of grey and greenish rather sandy clays, more or less with green grains]	3	156
	Hard blue clay, less sand, and with a mass of stone ... } [Specimens of grey and greenish rather sandy clays, more or less with green grains]	1	157
	Hard blue clay ... } [Specimens of grey and greenish rather sandy clays, more or less with green grains]	2	159
	Hard blue clay with a few small pieces of shell. [Specimens of greenish-grey and brownish clays, some sandy] ...	9	168

Hythe—*cont.*

			Thickness. Feet.	Depth Feet.
[Barton Beds and Bracklesham Beds]—*cont.*	Very hard brownish clay, with a few shells	[Specimens of brown clays, with a little green sand at 176]	6	174
	Green sandy clay		2	176
	Brown mottled clay, with a few small shells		4	180
	Green sand with streaks of clay, and a few small shells	[Specimens of brownish with green sand at 183]	4	184
	Blue sandy clay ...		1	185
	Hard brownish-blue clay. [Specimens of brownish and slightly greenish sandy clay]		3	188
	Green sandy clay, with fragments of shells. [Specimens greenish-grey]...		2	190
	Very hard blue clay, with a little sand, and fragments of shells. [Specimens of greenish-grey sandy clay, at 191, 192, 193]		3	193
	Green sandy clay		5	198
	Green sand, with a large quantity of fresh water		3	201
	Green sand, with more clay		1	202

It is hard to make a division between the Barton Beds and the Bracklesham Beds.

Idworth Waterworks, *see* Blendworth.

Kingsclere.

Geol. Map 283, new ser.

The first three from the Memoir on the Geology of Andover, 1908.

1. Field Barn Farm, on the main road, about three-quarters of a mile southward of the town.

Sunk and communicated by Mr. G. W. Ockenden, of Kingsclere.

Shaft 37 feet, the rest bored.

		Thickness. Feet.	Depth. Feet.
Lower Chalk.	Chalk	37	37
	Hard chalk	5	42
	Soft chalk mixed with clay	25	67
Upper Greensand.	Rock-beds (glauconitic marl) / Darker sandy clay	26	93

2. Park House, on the main road, about half a mile southward of the town. 1890.

Information from Mr. C. Garrett, of Kingsclere.

		Thickness. Feet.	Depth. Feet.
Grey chalk		15 or 20	63
[Upper Greensand.]	Green sand and sandstone	25 „ 30	
	Sand with beds of very hard stone	18	

As Mr. Jukes-Browne remarks, the well can hardly be at the house, which is on the sand and not on the chalk. He suggests that it may be at the farm to the south. [? = No. 1.]

3. Stanton's Farm, about three-quarters of a mile north-westward of the town.

Also from Mr. Ockenden.

		Thickness. Feet.	Depth. Feet.
Well (? in London Clay)		—	34
Reading Beds.	Mixed sand ...	25	59
	Bright yellow sand	5	64
	Darker sand ...	4	68

Kingsclere—*cont.*

4. BUNGALOW, east of the Mill. 1907.

Made and communicated by Messrs. ALLSEBROOK and Co., and Mr. H. J. O. WHITE (who has added notes, in these brackets).

Water-level at first 20 feet down, but when the boring had reached the depth of 34 feet the level fell to 27½ feet, where it remained. Ample supply.

About 362 feet above Ordnance Datum.

Chalk	18	70 feet.
(Melbourn Rock.) Very hard chalk (sub-nodular)	2	
Chalk-marl (sample much like Belemnite Marl) ...	50	

5. "The deepest well in the Chalk (in map 284) appears to be that at Freemantle Park Farm, north-west of Hannington: this was 347 feet in the spring of 1908, when it was about to be deepened."

Information from Dr. F. P. JOSCELYNE (Geology of Basingstoke).

Linkenholt.

Geol. Map 283, new ser.

MANOR FARM.

From the Memoir on the Geology of Andover, 1908. Well made and communicated by Mr. C. ALDERMAN, of Little Down.

650 feet above Ordnance Datum.

20 feet of water.

(Upper and Middle) Chalk, 291 feet.

The well at Little Down, given in the Memoir as in this parish, is really in Vernhams Dean, which see.

Lockerley.

Geol. Map 299, new ser.

1. CANEFIELD FARM.

Made and communicated by Messrs. DUKE and OCKENDEN.

Plenty of water.

[Reading Beds.]	Dug well [? old]	40	70 feet.
	Mottled clay and sand, about	12	
Chalk		18	

2. CARTER'S CLAY.

No water.

		Thickness. Feet.	Depth. Feet.
Well sunk in sand and clay (the rest bored)		—	40
[Reading Beds.]	Sharp white sand	5	45
	Black clay	10	55
	Mixed sand and clay	27	82
	Mottled clay	15	97
	Dark green sand	2	99
Soft chalk		133	232 (said to be 234 feet deep.)

3. THE MILL. On the northern side of the stream, for the supply of Lockerley Hall.

About 95 feet above Ordnance Datum.

Information from Mr. DALGETY (from memory).

Shaft about 50 feet. Boring about 150 feet, some way into the Chalk.

Water overflows, and is pumped down 12 feet, beyond which it has not been lowered.

Lymington.

Geol. Map 330, new ser.

WATERWORKS. Ampress, north of the town. 1908.

Made and communicated by Messrs. ISLER & Co.

About 11 feet above Ordnance Datum.

Water overflowed, but was lowered to 42 feet below the surface by pumping, returning to the original level after pumping had ceased for 16 hours. Yield, as found by continuous pumping for 14 days, 264,000 gallons a day. (Information from the Local Government Board.)

		Thickness. Feet.	Depth. Feet.
Made ground		3	3
[? River Drift]	Ballast	4	7
	Barton sand	3	10
	Large [coarse] gravel	5	15
[Barton Sand 105 feet.]	Barton sand	29	44
	Green running sand	23	67
	Loamy sand	53	120
Barton Clay. With claystone, from 127 to 128 and from 251 to 251½ feet down		227	347
[? Bracklesham Beds]	Sand and pebbles	1 or 11 ?	348 or 358
	Grey sand	11 or 1 ?	359

Mr. W. MATTHEWS tells me that 9,000 gallons an hour were pumped at 36½ feet, 10,000 at 40½ and 11,000 at 45, and that sand comes up.

The supply has been from springs, *see* p. 41.

According to the Water Works Directory, 1909, the water overflowed 2 feet above the surface at the rate of 1,800 gallons an hour.

Lyndhurst.

Geol. Map 315, new ser.

Boring communicated by Messrs. A. WILLIAMS & Co.

Water-level, 6 feet down. Yield, 900 gallons an hour.

		Thickness. Feet.	Depth. Feet.
[Barton Sand, Upper Bagshot of old map].	Live yellow sand ...	21	21
	Dead sand	4	25
	Live sand	4	29
	Blue dead sand ...	22	51
	Dead sand and shells ...	38	89
	Dead sand	7	96
[Barton Clay.]	Sandy blue clay ...	5	101
	Brown clay and shells...	4	105
	Blue clay and shells ...	14	119
	Blue clay and sandstone	6	125

For an analysis of the water, *see* p. 198.

Marchwood.

Geol. Map 315, new ser.

CAMP FIELD, on the Marsh W. of "Inner Marsh" of six-inch Map 65, S.W. 1907.

From Lieut. O. H. HANSON, R.N.V.R.

A well about 10 feet deep yielded an abundant supply, and the water had no unpleasant taste. In 1908 the water was very unpalatable, and it was suggested that water had soaked in from the ditch in the Inner Marsh.

The well was filled up, and a tube-well was driven 50 yards nearer to Cracknore Hard. The water from this looked turbid, but was delicious to drink.

In 1909 another tube was driven about 80 feet west, and the water from this tastes of iron.

Both tubes go down about 8 to 12 feet.

Michelmersh.

Geol. Map 299, new ser.

E. Spon. "Water Supply. The Present Practice of Sinking and Boring Wells," pp. 176, 177. 8vo. *Lond.* 1875. Ed. 2 (1885), pp. 221, 222.

Shaft 400 feet [but the total only 300½].

Water rose 19 feet in the shaft, and is abundant.

	Thickness. Feet.	Depth. Feet.
Surface soil	4	4
Dark clay [Reading Beds] ...	27	31
Chalk	250	281
Calcareous sand	2½	283½
Upper Greensand	17	300½

This section is impossible. The whole thickness of the Chalk would have to be pierced before reaching the Upper Greensand, and that thickness is probably 800 feet at least. It should be noted that the bed classed as Upper Greensand is undescribed, and therefore we are given no reason for such classification. I have no doubt but that the bed in question is simply a hard layer in the Upper Chalk. No further particulars are procurable.

Milton, near Lymington.

Geol. Map 330, new ser.

Waterworks. Close to the Railway Station. 1892.

Made and communicated by Messrs. Le Grand and Sutcliffe. Notes in square brackets from specimens examined by Clement Reid.

Water-level 17 to 36 feet down, during boring. No supply.

		Thickness. Ft.	Ins.	Depth Ft.	Ins.
[Headon Beds.]	Well (undescribed), the rest bored ...	—		24	0
	Bricks and rubbish at the bottom of the well	2	0	26	0
	Clay and shells (*Cerithium*, *Cyrena*) ...	2	0	28	0
	Light-green sandy clay [not sandy] ...	5	0	33	0
	Grey sand and brown clay	10	0	43	0
	Dark grey sand and shells	11	0	54	0
	Clay [light-green]	6	0	60	0
	Mottled clay and sand	6	0	66	0
	Blue clay...	17	6	83	6
	Stone	0	3	83	9
	Blue clay	3	9	87	6
	Sandstone	2	0	89	6
	Blowing sand	18	6	108	0
	Light-blue clay [greenish with whitish concretions]	12	0	120	0
	Wood and "stuff"	1	6	121	6
[Barton Sand.]	[Mead End Bed ?]. Sand, shells and mundic (blackish)	2	6	124	0
	Dead grey sand	19	0	143	0
	[Becton Bunny Bed ?] ... Blue clay and shells	9	0	152	0
	[Becton Bunny Bed ?] ... Blue clay	6	0	158	0
	Grey sandy clay	6	0	164	0
	Live grey sand	28	0	192	0
	[Chama Beds ?]. Grey clay [soft] ...	34	6	226	6
[Barton Clay.]	Blue clay	2	8	229	2
	Stone and shells [septaria ?]	1	2	230	4
	Blue clay and shells [*Corbula* at 230 ft. 4 in. and 250 ft.]	68	8	299	0
	Blue clay and sand [green]	9	0	308	0
	Brown clay	29	0	337	0
	Blue clay	14	6	351	6
[? Barton and Bracklesham Beds.]	Blue, green and grey sand	17	6	369	0
	Rock	0	6	369	6
	Blue sandy clay	20	6	390	0
	Brown sandy clay	4	6	394	6

Monk Sherborne.

Geol. Map 284, new ser.

THE RECTORY (within 10 feet of the eastern wall). 1887.

Made and communicated by Messrs. LE GRAND & SUTCLIFF.

Shaft 30 feet, the rest bored.

		Thickness. Feet.	Depth. Feet.
[London Clay]	Clay and septaria	30	30
	Clay with shells	5	35
[Reading Beds, 67 feet.]	Mottled clay ...	25	60
	Sandy clay ...	16	76
	Mottled clay ...	9½	85½
	Hard clay ...	14½	100
	Black sand ...	2	102
Chalk and flints...	... ...	28	130

An analysis of the water is given on p. 199.

Netley.

ROYAL VICTORIA HOSPITAL.

Geol. Map 315, new ser.

Sections from A. BEAMISH, Lieut. R.E., dated 1867 (and 1869 ?), with further information from Major NIXON, R.E. (1886).

1. NORTH WING.

Shaft 40 feet, the rest bored. Water-level 16 feet down. (Figures in brackets from another account, by Major R. BULLEN, R.E.)

		Thickness. Ft.	in.	Depth. Ft.	in.
Gravel	... ...	1 to 16	6	16	6
[Bracklesham Beds.]	Hardened sand (29)	37	2	53	8
	Mottled sandy clay (11 feet 9 inches)	1	9	55	5
	Hard clay	1	0	56	5
	Greenish-yellow sand	27	0	83	5
	Light-coloured clay	6	0	89	5
	Light-grey clay	11	0	100	5
	Hard clay	5	0	105	5
	Sand and clay, with fossils	11	0	116	5
	Coarse grit sand ... — ...	9	0	125	5
	Fine running sand	6	0	131	5
	Dark chocolate-coloured sand... ...	7	6	138	11
	Grey sand, full of shells (11)... ...	11	1	150	0
	Mottled sand, with clay and shells (9)	10	0	160	0
	Dark green sand, mixed with clay (21 feet 1 inch)	20	0	180	0

2. SOUTH WING (850 feet from the above).

Shaft 37 feet, the rest bored. Water-level 16 feet down.

		Thickness. Feet.	Depth. Feet.
[Bracklesham Beds.]	Brickearth	0½	0½
	Green sand	5	5½
	Hard clay	1	6½
	Green clay and small shells	2½	9
	Dark brown clay	4	13
	Rather stiff green clay and large shells	9	22
	Green clay, with fossils ?	6	28
	Greenish sand	89	117
	Stiff clay, with bed of white sand ...	12	129
	Stiff clay	12	141
	Very stiff clay	20	161
	Green sand	15	176

An analysis of the water is given on p. 199.

Netley—*cont.*

3. Laundry Well.

Shaft 45 feet, the rest bored. Water-level 14 feet down.

		Thickness. Feet.	Depth. Feet.
Not observed ...	... ...	—	60
[Bracklesham Beds.]	Sand	20	80
	Stiff grey clay, with pieces of black turfy material	9	89
	Dark greyish or greenish slightly loamy sand	36	125
	Dark-green sand	21	146
	Dark-grey sand, with shelly particles	4	150
	Light-grey and greenish sand... ...	10	160
	Grey mottled clay	7	167
	Chocolate-coloured loamy sand ...	3	170
	Black turfy soil...	2½	172½
	Coarse light-grey crystalline sand ...	9½	182
	Stiff clay...	5	187
	Chocolate-coloured loamy sand ...	3	190
	Fine yellow quicksand...	3	193
	Black turfy soil...	3½	196½
	Dark-grey sand...	4½	201
	Dark loamy sand	1	202
	Clay	4½	206½
	Black turfy soil...	1	207½
	Dark stiff clay	3½	211
	Stiff blue clay	8	219
	Mottled clay	18	237
	Greenish sand	15	252
	Hardened sand	1	253
	Light-greenish sand	4	257
	Light-brown and grey stiff clay ...	16	273
	Grey sand	2	275
	Stiff clay...	1½	276½
	Light-green sand, with pieces of hardened yellow sand	13½	290
	Stiff light-blue clay	20	310
	Hard black clay...	1	311
	Stiff dark clay	9	320
[Lower Bagshot Beds.]	Black [flint] pebbles	8	328
	Light-green sand	3	331

North Stoneham.

Geol. Map. 315 new ser.

1. Red Lodge, Bassett.

Communicated by Mr. W. E. Darwin.

		Thickness. Feet.	Depth. Feet.
Gravel	... ...	11	11
[Bracklesham Beds.]	Sand	3	14
	White clay	4	18
	White sand	8	26
	Brown clay	15	41
	Black clay	9	50
	Brown sand, with water	9	59
	Black clay or mud (offensive)... ...	4	63

North Stoneham—*cont.*

2. Red Lodge Nursery, Bassett. Close to the house.

From a drawing in the possession of the Corporation of Southampton.
230 feet above high water level.

		Thickness. Feet.	Depth. Feet.
Shaft, the rest bored ...	about	—	50
Yellow sand	„	10	60
Blue clay	„	26	86
Black sand and clay ...	„	20	106

Nursling.

Geol. Map. 315 new ser.

Railway Station. ? 1884.

Information from Mr. J. Drage, Local Engineer, L. & S. W. R. Also from J. W. Elwes, *Geol. Mag.* 1884, dec. iii., vol. i., p. 549.

		Thickness. Feet.	Depth. Feet.
Soil		½	½
Gravel		7¼	7¾
[London Clay.]	Dark slate-coloured loamy sand ...	9¾	17½
	Layer of shells [in stone. Specimens at the Hartley College]	0¼	17¾

The last bed Mr. Elwes describes as a "sandy bed with hardened blocks containing *Pectunculus brevirostris*, *Rostellaria lucida*, *Cancellaria læviuscula*, *Turritella sulcifera;* the blocks closely resemble the well-known Bognor rock."

Odiham.

Geol. Map. 284 new ser.

For Messrs. Helliss, Builders.

Made and communicated by Messrs. Isler and Co.

Lined with 145 feet of 5-inch tubes from 4 feet down.
Water-level 36 feet down.

		Thickness Feet.	Depth. Feet.
[London Clay.]	Dug well, 3 feet 9 inches broad ...	—	60
	Blue clay...	4	64
	Green sand and clay [? basement-bed]	10	74
[Reading Beds, 72 feet.]	Brown clay	13	87
	Green sand	3	90
	Brown clay	10	100
	Mottled clay	9	109
	Light-coloured sand and clay	9	118
	Light-grey sand	5	123
	Blue clay	8	131
	Running sand	6	137
	Blue clay...	6	143
	Black peat	1	144
	Green sand and pebbles	2	146
[Upper.] Chalk		57	203

Otterbourne.

Geol. Map. 299 new ser.

Southampton Waterworks.

About 90 feet above Ordnance Datum.

Chiefly from various papers and records by Mr. W. Matthews, with some notes from Mr. C. H. Roberts.

A trial-boring of 3 inches diameter was first made, and water was found at the depth of 20 feet. It was lowered 3 feet by pumping at the rate of 3,000

Otterbourne—*cont.*

gallons an hour, the normal height being quickly regained on cessation of pumping. The section was as follows :—

	Thickness. Feet.	Depth. Feet.
Soil, &c.	2½	2½
Chalk, hard and dry, without flints... ...	15½	18
Chalk, white and fairly firm, with occasional flints, one layer, at 65 feet, 1¼ feet thick...	67	85
Chalk, white and pasty, with a few flints ...	20	105

Two borings of 12 inches diameter were then made, each 50 feet from the small boring, all in line parallel to the line of outcrop of the Chalk. Pumping from both was carried on day and night for sixteen days and the mean discharge was 20,960 gallons an hour, with a loss of head of 9·62 feet, the water-level in the small boring being lowered 2·92 feet. Afterward the water rose rapidly to the normal level, which here has little seasonal variation.

Permanent works were then started, by the boring of two wells of 6 feet diameter and 11½ feet apart from centre to centre, to a depth of 100 feet, or of 72 feet from the floor of the pump-chamber. The more easterly of these is on the site of the small trial-boring.

Later on galleries were driven, and these have been extended at various times. A short one runs westward and a little eastward from the well and a very long one starts from the eastern end of this, just outside the engine-house, runs irregularly northward to within a very little of the middle part of the southern border of Sparrowgrove Copse and then turns W.N.W., near to the waterworks-road, to a point a little beyond the north-western corner of Oakwood Copse.

The level of the floor of the headings varies from 33½ feet above Ordnance Datum at the wells to 41½ at the end.

Two additional pumping-wells have been made, on the west of the others, and the supply has been extended to meet the increased demand. The rest-level of the water is 72½ feet above Ordnance Datum.

TABLE showing the Yield, Extent of the Works, &c., over 20 years.

YEAR.	Rainfall, in Inches.	Amount Pumped in the Year, in Millions of Gallons.	Average Daily Supply, in Thousands of Gallons.	Average Water-level, in feet above Ordnance Datum. ?	Extent of Works
1889	—	836·9	2,292	—	2 wells.
1890	—	815·7	2,235	—	
1891	—	830·5	2,275	—	
1892	22·75	895	2,452	—	2 wells and 400 feet of headings.
1893	23·7	998·3	2,735	—	
1894	34·38	976·7	2,676	—	
1895	22·8	997·4	2,733	—	4 wells and 700 feet of headings.
1896	23·3	1,049·8	2,868	58·5	
1897	29·	1,066·9	2,921	52·6	
1898	23·7	1,116·6	3,059	40·6	
1899	22·9	1,210·7	3,317	43·2	4 wells and 1,160 feet of headings.
1900	28·2	1,175·4	3,211	44·	
1901	27·5	1,373·9	3,764	40·3	4 wells and 1,960 feet of headings.
1902	25·2	1,293·8	3,544	44·	
1903	39·1	1,295·1	3,548	42·	
1904	26·9	1,326·4	3,621	40·8	4 wells and 3,000 feet of headings.
1905	22·4	1,330·2	3,658	45·2	4 wells and 4,020 feet of headings.
1906	26·6	1,164·6	3,190	50·4	
1907	25·6	1,199·2	3,285	48·4	
1908	23·6	1,296·6	3,542	44·7	
1909	31·14	1,329·8	3,641	—	

The great increase in 1901 was owing chiefly to very great consumption for docks and railways during the South African War.

Otterbourne—*cont.*

TABLE showing the Maximum Yield per Day, due to the making of Wells and Headings, and the falling off in quantity afterwards.

DATE.	No. of Wells.	Feet of Headings.	Gallons of Water.
1889	2	—	1,700,000
1892	2	400	2,850,000
1895	4	700	4,000,000
June, 1898 ...	4	700	3,000,000
January, 1899 ...	4	1,160	3,600,000
July, 1900 ...	4	1,160	3,300,000
October, 1901 ...	4	1,960	3,910,000
October, 1903 ...	4	1,960	3,600,000
July, 1905 ...	4	4,020	4,293,000
December, 1909	4	4,020	4,120,000

According to the Waterworks Directory, 1909, the estimated population supplied was 82,000 (in 1908), the area of supply being the Borough of Southampton before the Extension Order of 1895 (the added areas are supplied by the South Hants. Water Co.), and the maximum day's consumption was 4,526,000 gallons in July.

Analyses of the water are given on pp. 200, 201.

Owslebury.

Geol. Maps. 299, 315, new ser.

Maxwell Hall, southward of the village, 1908.

Made and communicated by Messrs. DUKE and OCKENDEN.

Shaft 95 feet, the rest bored. Water-level 89 feet down.

Chalk 198 feet.

For an analysis of water from another well in this parish *see* p. 202.

Petersfield.

Geol. Maps. 300, 316 new ser.

1. BEDALES SCHOOL.

Boring, made and communicated by Mr. F. W. OCKENDEN.

		Thickness. Feet.	Depth. Feet.
Lower Greensand.	Sandy loam	6	6
	Yellow sand (some water)	25	31
	Black clay	6	37
	Sand beds	98	135

Some of these beds very irony and hard.

2. BOROUGH FARM BREWERY, from 300 to 400 yards S. of the Railway Station, and on the eastern side of the railway.

Communicated by Mr. T. AMEY.

Water at 37 feet, good for brewing. Sand chokes the tubes.

Water from the lowest sand is impure, but does for cooling.

		Thickness. Feet.	Depth. Feet.
Shaft, then a tube driven		—	20
[Folkestone Beds.]	Rich loam	2	22
	Mixed clay, sand and gravel	7	29
	Clean sand; then thin course of running sand	17	46
	Clean sand with some very green grains	23	69
[Sandgate Beds, 27 feet.]	Blue clay...	4½	73½
	Sand and small [fine] gravel [? broken up stone]	7	80½
	Hard blue clay	25½	106

Petersfield—*cont.*

Another boring made and communicated by Messrs. Isler and Co. 1898.

Lined with 56 feet of 5-inch tubes from 18 feet below the surface and with 124 feet of 4-inch tubes from 21 feet.

Water-level, 34 feet down.

		Thickness. Feet.	Depth. Feet.
Well [? old]	... ...	—	26
[Lower Greensand.]	Sand	14	40
	Live sand ...	8	48
	Sandy clay ...	20½	68½
	Blue clay... ...	15	83½
	Green sand ...	4½	88
	Sandstone ...	17	105
	Live sand ...	17	122
	Dark sand ...	5	127
	Mixed hard sand	7	134

Another boring. Also made and communicated by Messrs. Isler & Co.

Lined with 65 feet of 5-inch tubes from 19 feet down and 138 feet of 4-inch tubes (the top 48 feet perforated), from 18 feet down.

Water-level, 34 feet down.

		Thickness. Feet.	Depth. Feet.
Dug well	... ...	—	20
[Lower Greensand.]	Red sand... ...	6	26
	Red sand and ballast	12	38
	Dark sand ...	16	54
	Dark clay ...	30	84
	Dark sandstone ...	37	121
	Dark sandy clay...	19	140
	Red sandstone ...	20	160
	Dark sandstone ...	2	162
	Dark sandy clay...	19	181

An analysis of the water from one of these borings is given on p. 202.

3. Collyers, about 1½ miles W. of Railway Station. 1899.

Made and communicated by Messrs. Merryweather.

Water-level, 166 feet down. Yield 250 gallons an hour.

		Thickness. Feet.	Depth. Feet.
[Lower Greensand.]	White and yellow sand...	88	88
	Green sandy clay	51	139
	Green sand	3½	142½
	Clay	13½	156
	Dark green sand, more or less mixed with clay	3	159
	Clay with sand	22	181
	Green sand, more or less mixed with clay	9½	190½
	Green and yellow sand, with hard beds, and more or less mixed with clay ...	88½	279

4. Elmwood (Mr. J. Holder's). 1898.

Bored and communicated by Messrs. Duke and Ockenden.

Lined with 96 feet of tubes, of 4½ inches diameter, and 153 feet, of 3 inches diameter, from the surface.

Sand and clay, 200 feet.

Petersfield—*cont.*

5. THE JOLLY SAILORS. The Causeway, on the Portsmouth road, about three-quarters of a mile S.W. of the town.

Bored and communicated by Messrs. DUKE and OCKENDEN.

Water rose above the ground, but sand choked the bore-hole.

		Thickness. Feet.	Depth. Feet.
Old well (the rest bored)		—	58½
[Gault.]	Black clay	37½	96
	Dark green sand	21	117
[Folkestone Beds.]	Soft sand-rock	7	124
	Light [coloured] running sand ...	78	202
	Soft sand-rock	6	208
	Light-coloured running sand	16	224

6. LONDON AND SOUTH WESTERN RAILWAY. 1897.

Made and communicated by Messrs. DUKE and OCKENDEN.

Dug well, 44 feet. Bored to 304. 202 feet of lining tubes from the surface. Water-level, 125 feet down.

7. Mr. J. RICHARDSON'S DAIRY FARM. 1897.

Made and communicated by Messrs. DUKE and OCKENDEN.

Dug well, 40 feet. Two boreholes to 57 feet and to 100 feet.

Lined with tubes of 4½ inches diameter to the depth of 28 and 76 feet respectively.

8. STEEP MARSH BRICKFIELD (Mr. J. HOLDER). 1898.

Bored and communicated by Messrs. DUKE and OCKENDEN.

109 feet deep, lined to 82 feet.
Water level, 32 feet down.

9. TILMORE (Mr. HOLDER'S). 1898.

Made and communicated by Messrs. DUKE and OCKENDEN.

Lined for 12 feet from the surface with tube of 4½ inches diameter.
Water-level, 45 feet down. Yield not more than 10 gallons an hour.

Sand ...	30	112 feet
Clay ...	18	
Sandstone ...	64	

10. Boring 100 yards S. of the Railway Station (and ? 30 feet east of the Railway.)

Recorded by MR. W. TOPLEY.
Water at 25 feet (from the top or in the sand ?).

		Thickness. Feet.	Depth. Feet.
Soil		1	1
Loamy gravel [? broken up carstone]...		7	8
[Folkestone Beds.]	Sand with a hard bed [? carstone] 6 inches thick (? at the base)	40	48
[? Sandgate Beds.]	Clay	4	52
	Sand, to clay	6	58

11. WATERWORKS.

Prof. H. ROBINSON, *Proc.*, *Inst. C.E.*, vol. xc., 1887, pp. 98, 99.

230·8 feet above Ordnance Datum.

Well 77½ feet deep and 8⅓ feet square, broadened into a storage chamber 16 feet in diameter, from 44 to 75 feet down. An adit, about 4 feet in diam., at 53 feet down. Boring to 96 feet 2 inches.

360 yards west of the point of crossing (a little more than 1 mile north of Petersfield Station) of the Portsmouth Direct Line and the Ashford Stream.

The site was chosen with a view to avoiding the Sandgate Beds from which ferruginous water was feared, and, though not the best, was the most eligible of

Petersfield—*cont.*

those available, being as close as possible to the junction of the Sandgate Beds with the underlying Hythe Beds, in the latter of which the water was known to be pure.

The strata were dry for 50 feet down. Small amount of water at 51 feet down. Water increased (but still insufficient) by two fissures at 56 and 66 feet respectively.

An adit, along the upper fissure, for 53 feet increased the supply less than expected, and the yield still being insufficient the boring was made.

From this bore a greatly increased supply was obtained from a bed of Greensand, the water-level rising 4 feet.

Details of Yield.

Water-level with well and adit, but without storage-chamber or bore-hole, 179 feet above Ordnance Datum or about 52 feet down.

Pumping till water-level was 165 feet above Ordnance Datum, or 66 feet down. Yield, 1,300 gallons an hour.

Pumping till water-level was 175 feet above Ordnance Datum, or 56 feet down. Yield, 800 gallons an hour.

With boring and storage-chamber.

Water-level 183 feet above Ordnance Datum, or 48 feet down.

Pumping till water-level was 175 feet above Ordnance Datum, or 56 feet down. Yield, 6,000 gallons an hour.

By increased pumping a supply far in excess of the requirements (8,000 gallons an hour for a day of 10 hours) was obtained.

Water soft and of good quality.

Section. Thicknesses approximate only.

	Thickness. Feet.	Depth. Feet.
Loam	10	10
Gravel with dark grains	9	19
Gravel with streaks of ironstone	18½	37½
Hard sand-rock	19½	57
Hard sand-rock with blue boulders full of shells	15½	72½
Light-brown sand	12¾	85¼
Greensand	11	96¼

For an analysis of the water, *see* p. 203.

See also **Steep.**

12. Laundry. 1905.

Made and communicated by Messrs. Duke and Ockenden.

Shaft 22 feet, the rest bored. Water-level 35 feet down.

Lower Greensand. Very coarse black sand between 98 and 114 feet down. 138 feet.

Pilcot.

Geol. Map 284, new ser.

1. Dogmersfield Park, near the house. 1841.

Prestwich, *Quart. Journ. Geol. Soc.*, vol. x., p. 97, and MS. note.

		Thickness. Feet.	Depth. Feet.
Bagshot Sand, 40 feet.	Clay and sand	15	15
	Fine light-bluish sand	25	40
London Clay, 335½ feet.	Blue clay with septaria layer of pebbles, 6 inches thick, at 340 feet	330	370
	Basement-bed: Green sand	1½	371½
	Basement-bed: Stone (septaria) ...	2½	374
	Basement-bed: Green sand*	1½	375½
Reading Beds, 41½ feet.	Mottled clay, yellow, red and grey ...	5	380½
	Clayey sand, bluish-grey striped red ...	10	390½
	Brown clay mottled with grey	11½	402
	Mottled light-grey and red clay	15	417

* I have classed this with the London Clay rather than with the Reading Beds, as Prestwich did.

Pilcot—*cont.*

2. DOGMERSFIELD. Tamplin's Farm. 1900.

Made and communicated by Messrs. DUKE and OCKENDEN.

Lined with 30 feet of tubes of 4½ inches diameter, with 13 feet of sand-screen at the base.

Evidence of water at 34¾ feet, but nothing to stand pumping on.

Mottled clay ...	10	44 feet.
Green sand ...	1	
Whitish clay ...	11	
Sand	22	

Porchester.

Geol. Map 331, new ser.

For Mr. BEAVER. 1904.

Boring made and communicated by Messrs. DUKE and OCKENDEN.

Lined to 57 feet. Water-level 6½ feet down; lowers to 50 when pumping 750 gallons an hour.

Clay and stones	4	145 feet.
Soft marl and large flints	7	
Chalk and layers of flints	34	
Hard chalk, with flints ...	100	

Portsmouth or Portsea.

Geol. Map 331, new ser.

1. CATHERINE BREWERY. Nearly two-thirds of a mile north-eastward of the Harbour Railway Station. 1886?

Communicated by Messrs. JEWELL, who made the boring themselves.

About 20 feet above Ordnance Datum.

Water-level 10 feet down when there is no pumping (to 1896). About 27,000 gallons a week drawn, lowering the water 20 feet.

		Thickness. Feet.	Depth Feet.
[River Drift.]	Gravel and sand [? Bagshot]	40	40
[London Clay, 320 feet.]	Blue clay	25	65
	Sand	5	70
	Blue clay, with occasional layers of septaria	200	270
	Sand	30	300
	Blue clay	60	360
[Reading Beds, 115 feet.]	Plastic clay	105	465
	Stone [flints?]	10	475
Chalk		230	705

For an analysis of the water, *see* p. 203.

2. Mr. CURTIS'. Junction of Commercial Road and Lake Street. (Before 1871.)

Communicated by Mr. C. J. A. MEYER.

		Thickness. Feet.	Depth Feet.
	Gravel	12	12
[Bracklesham Beds.]	Blue clay	65	77
	Rock	5	82
	Sand	10	92
	Clay	130	222
[? Bagshot Beds,] with abundance of water.	Sand	3	225
	Pebbles. ? wrongly described; pebbles probably take up much less depth; ? partly fallen down	11	236

Mr. MEYER adds, that at the Kingston Brewery, about a mile northward, the lower sand-bed has risen to within 20 feet of the surface, and is full of water. Perhaps, however, we may have the Bagshot pebble-bed here.

Portsmouth—*cont.*

3. Dockyard, near the Ship Basin [old]. 1825.

From a drawing in the Royal Engineers Office, Milldam, Portsmouth (copied 1849), and from a tracing of the original drawing communicated by Mr. C. H. Meyer.

Measurements from the level of the yard. Shaft and cylinders, 102 feet; the rest based. To below the base of the gravel backed with clay and puddle, to keep out salt water.

Pump delivered about 22 tons of water an hour. In summer it was worked about 10 hours and in winter about 8 hours a day. The water in summer stood from 35 to 40 feet down, and on leaving off pumping, at about 70 feet. In September, 1825, after pumping all night, 92 feet down; in August, 1826, before pumping, 35¾ feet down; after pumping 12 hours, about 67 feet down.

Another account varies slightly, making the gravel to 50 feet, the running sands to 238 and to 264, and the stiffer sand to 278.

		Thickness. Ft.	in.	Depth. Ft.	in.
[River Drift.]	Gravel and sand	49	6	49	6
[? Bracklesham Beds.]	Blue clay	52	6	102	0
	Sandy clay (elsewhere described as running sand, with small spring)	10	6	112	6
	Flint-pebbles and sand	1	0	113	6
	Hard grit stone, apparently sand united by pyrites	2	2	115	8
	Clay, with a few shells and nodules of claystone and pyrites ...	114	4	230	0
	Running sand (elsewhere described as sandy clay)	8	6	238	6
	Flint-pebbles and sand	1	6	240	0
[? Bagshot Sand]	Very hard grit stone	1	0	241	0
	Running sand and water, with a few shells	25	0	266	0
	Stiffer sand...	8	9	274	9
[? London] Clay	... ...	15	3	290	0

4. Dockyard, near the Sawmills (? Shipbuilding Shop No. 2). 1850?

From a drawing, dated 1851, communicated by Col. P. Smith, R.E., Director of Works, Admiralty.

Shaft and (chiefly) cylinders, 102 feet; the rest bored, and lined to the depth of about 320 feet.

		Thickness. Feet.	Depth. Feet.
Mould and red and white gravel, with sand		? 3 or 8	? 3 or 8
[? Bracklesham Beds, 23 feet?]	Yellow clay	? 9 or 14	17
	Blue sandy clay	... 4	21
	Red sand	... 4	25
	Blue sandy clay	... 2	27
	Blue loamy sand	... 2	29
	Blue clay and pebbles	... 2	31
[? Lower Bagshot Sand, 39 feet.]	Fine blue sand, with water ...	... 29	60
	„ „ „ more clayey ...	... 10	70
[London Clay, 332 feet.]	Blue clay	... 18	88
	Sand, with pebbles	... 2	90
	Sharp green sand	... 14	104
	Blue clay	... 189	293
	Sand and pebbles	... 10	303
	Sand	... 30	333
	Blue clay	... 69	402
[Reading Beds, 98 feet.]	Flint	... 1	403
	Red sand and pebbles	... 4	407
	Mottled clay	... 92	499
	Flints	... 1	500
Upper] Chalk	... ...	... 100	600

Portsmouth—*cont.*

5. Dockyard. Fresh Water Well.

From a drawing (copy) at Royal Engineers Office, Milldam, Portsmouth, from a tracing from Col. P. Smith, Director of Works, Admiralty, and from a tracing from C. H. Meyer.

An account in a MS. Book of Well-sections in the Geological Survey Office, Jermyn Street, London, differs slightly in many of the figures and also in some of the details.

Measured from basement-floor-line of Factory Storehouse. Shaft 3 feet and cylinders to 76 feet, backed by concrete to a depth of 8½ feet ; the rest bored. Cylinders to a depth of 80 or 83 feet, according to a MS. account in the Geological Survey Office, which also gives the yield as 143,500 gallons in 24 hours (1856), and the usual water-level as 18 feet below the basement-floor. In another MS. (1855) the yield is given as over 10 tons an hour. The water is said to be very good and of 56° temperature. The water-level is said to vary about 3 feet, apparently with the tide.

		Thickness. Feet.	Depth. Feet.
[London Clay, 288½ feet.]	Blue Clay...	6½	6½
	Blue clay, lighter coloured	4	10½
	Yellow clay, deep colour	5¼	15¾
	Yellow clay, paler	14¼	30
	Mixture of yellow and blue clay with sand	3½	33½
	Mixture of brown clay and sand ...	18	51½
	Brown clay and sand	9¾	61¼
	Mixture of brown clay and sand, with nodules of blue clay (septaria in MS. book)	10¼	71½
	Blue clay and sand	7	78½
	Light-brown clay, very sandy	21½	101
	Brown clay, less sandy	7½	108½
	Brown clay and shells	2	110½
	Brown clay, with a slight mixture of sand	5¼	115¾
	Dark brown clay, 6 inches or more of stone at base	10	125¾
	Brown clay, 6 inches or more of stone at base	1	126¾
	Blue clay and nodules	8¾	135½
	Blue clay, nodules and shells	1	136½
	Dark brown very stiff clay (shelly in MS. book)	1	137½
	Clay and large nodules	½	138
	Stiff blue clay	6½	144½
	Sand united with pyrites	½	145
	Blue clay, with 3 inches or more of clay-stone and metal [pyrites] at base ...	12½	157½
	Blue clay, bottom 6 inches with nodules	3	160½
	Blue clay, with 3 inches or more stone at base	16¼	176¾
	Blue clay, with 3 inches or more stone at base	1¾	178½
	Blue clay, with 3 inches or more of clay-stone (and shells ?) at base ...	4	182½
	Blue clay	1¼	183¾
	Blue clay and pebbles	3¼	187
	Blue clay	½	187½
	Blue clay, sand and pebbles	1	188½
	Pebbles	1	189½
	Hard stone (? sand)	5	194½
	Very hard fine sand	15½	210
	Very hard stone, with fossils	1	211
	Very hard fine sand	6½	217½
	Blue clay, with shells	5	222½
	Blue clay	4	226½

Portsmouth—*cont.*

		Thickness. Feet.	Depth. Feet.
[London Clay 288½ feet]—*cont.*	Blue clay, rather sandy	2	228½
	Blue clay	3	231½
	Blue clay, with a mixture of sand ...	1¾	233¼
	Stiff blue clay, with a foot hard clay-stone at base	2½	235¾
	Blue clay, with 9 inches stone at base...	17¾	253½
	Blue clay, with 3 inches or more stone at base	8¼	261¾
	Blue clay, with 6 inches hard clay-stone at base	20¾	282½
	Blue clay	6	288½
[Reading Beds, 119 feet.]	Mixture of blue clay, sand and mottled clay	2	290½
	Mottled clay	37	327½
	Mottled clay, much redder	16	343½
	Mixture of blue, brown and red clay ...	6	349½
	Mixture of blue, dark brown and red clay	2	351½
	Mixture of the like, more red	2½	354
	Mottled blue clay	12	366
	Blue, red and yellow clay	4	370
	Red and blue clay, mostly red	14¾	384¾
	Blue and red clay, mostly blue... ...	8	392¾
	Blue, red and yellow clay	3¾	396½
	Mixture of brown clay and chalk ...	10	406½
	Flints	1	407½
Chalk, 626¾ feet.	Chalk, bluish	7	414½
	Chalk. Flints at 997, 1,001-1,007 (6 feet) and at bottom (5 feet)	619¾	1,034¼

6. Gasworks. N. of the town. 1902.

New well. Water got 5 feet down in the Chalk. Yield about 36,000 gallons an hour.

To bottom of mottled clay	25	70 feet.
Chalk	45	

7. Great Salterns, ½ mile S. of Saltern House.
Bored and communicated by Messrs. Duke and Ockenden.

		Thickness. Feet.	Depth. Feet.
[London Clay.]	Hard blue clay	104	104
	Hard blue clay and running sand ...	4	108
[Reading Beds, 116 feet?]	Red and mottled clay	22	130
	Rock and sand	7	137
	Red and mottled clay	29	166
	Sandy clay	7	173
	Red and mottled clay	27	200
	Clay and sand	8	208
	Running sand	11	219
	Hard rock	5	224
Chalk and flints, with a little water		206	430

8. Lion Brewery, Landport. On the western side of the London Road, just north of Kingston Crescent. 1886.
Made and communicated by Messrs. Isler & Co.

A tube-well of 6 inches diameter.

No supply from the Chalk. The tubes were withdrawn into the Reading Beds.

		Thickness. Ft.	Ins.	Depth Ft.	Ins.
[Drift and London Clay.]	Made ground and clay	53	0	53	0
	Mixed clay	3	0	56	0
	Blue clay	41	0	97	0
	[Basement-bed.] Green sand and shells ...	1	0	98	0
	[Basement-bed.] Sandstone. Water rose to 58 feet down ...	0	6	98	6

Portsmouth—*cont.*

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
[Reading Beds, 106½ feet.]	Red mottled clay. Spring at 104 feet, which overflowed into well	11	6	110	0
	Yellow mottled clay	19	0	129	0
	Sandy clay	12	0	141	0
	Sand	11	0	152	0
	Sand and mundic [pyrites]	7	0	159	0
	Sandstone	3	0	162	0
	Light-blue clay	4	0	166	0
	Brown sandy clay	5	0	171	0
	Blue mottled clay	4	0	175	0
	Red mottled clay	5	0	180	0
	Red bastard clay	25	0	205	0
[Upper Chalk, 227½ feet.]	Flints	3	6	208	6
	Hard chalk and flints	1	6	210	0
	Hard chalk	2	0	212	0
	Hard stone	1	0	213	0
	Chalk and flints	88	6	301	6
	Hard chalk	7	0	308	6
	Chalk and flints	19	6	328	0
	Hard chalk and flints	15	6	343	6
	Chalk and flints	47	6	391	0
	Chalk rock	1	4	392	4
	Chalk	1	0	393	4
	Chalk and flints, with flint at 401 to 401½ feet	39	2	432	6

9. Milton, Portsmouth Lunatic Asylum. 1885.

Made and communicated by Mr. W. Hill, of Gosport.

Cylinders 48 feet, the rest bored.

Greatest height of water 11 feet down.

		Thickness. Feet.	Depth. Feet.
Mould	varying up to	1½	1
[? Drift.]	Brickearth	5	6
	White running sand	29	35
	Ordinary gravel	2½	37½
[London Clay, 290¾ feet.]	Blue bine clay	42½	80
	Hard sandstone [? septaria]	3	83
	Blue clay and sand mixed	23	106
	Hard blue clay	82	188
	Hard clay-boulder [? septaria] ...	0½	188½
	Hard blue clay	8	196½
	Black sand	3½	200
	Hard sand-boulder [? septaria] ...	3	203
	Dark green sand with water	22	225
	Hard boulder [? septaria]	1½	226½
	Hard blue clay	78½	305
	Rock with metal [pyrites]	1¼	306¼
	Stiff light-red clay	10½	316¾
	Pipe-clay	1½	318¼
	Brown clay, resembling brickearth ...	10	328¼
[Reading Beds, 98¾ feet.]	Light-red clay, with layer of sand 3 to 4 inches thick	6¾	335
	Black loamy sand	5¼	340¼
	Dark red clay	2¾	343
	Grey clay	3½	346½
	Red plastic clay	75¾	422¼
	Hard stone	1¾	424
	Plastic clay and stones	3	427
Chalk, with occasional bands of flints...		177	604

Except for the occurrence of "ordinary gravel" beneath the white sand one would certainly class the latter as Bagshot. Perhaps the names, &c., of the two beds have been transposed by accident.

Portsmouth—*cont.*

10. Portsea Lines, Curtain to the right of Townsend Bastion. 1849.

From Mr. H. W. Bristow's notes. Another account varies slightly in the figures and gives less details in the Reading Beds.

		Thickness. Feet.	Depth Feet
[Drift.]	Red and white gravel with sand	7	7
[Bracklesham and Bagshot Beds.]	Yellow clay	10	17
	Blue sandy clay...	4	21
	Red sand	5	26
	Blue sandy clay...	6	32
	Fine blue sand	28	60
	Fine blue sand, more clayey	10	70
	Blue clay	20	90
	Sand with pebbles	2	92
	Green sand	14	106
[London Clay, 300 feet.]	Blue clay (a stone was met with 3 to 4 feet from bottom)	64	170
	Blue clay, more sandy	10	180
	London blue clay	60	240
	London blue clay, shells	1½	241½
	London blue clay	51½	293
	Sand with pebbles	2	295
	Green sand	40	335
	Blue clay (stone at 364 feet, 367 feet 6 inches, 378 feet)	69½	404½
	Flint	1½	406
	Red clay with pebbles	3	409
[Reading Beds, 126 feet.]	Red mottled clay	48	457½
	A more sandy bed	1½	459
	Red mottled clay	24	483
	Black mottled clay	2	485
	Red mottled clay	4	489
	Yellow mottled clay	1½	490½
	Red mottled clay	18	508½
	More sandy	2	510½
	Red mottled clay	15	525½
	Marl with pebbles and flint	10	535½
Chalk, a fissure or spring 564 to 564½ feet down		70	605½

An account of one of the Government wells in Portsea was given by Maj.-Gen. Portlock in 1850 (*Journ. Geol. Soc. Dublin*, vol. iv., p. 248); but it is difficult to make out to which of the above it refers; probably however to that at Townsend Bastion. It makes the depth to the Chalk 610 feet, which does not agree with any of the sections.

I have seen a large collection of specimens, but with no locality, at the Royal Engineers Office, Milldam, Portsmouth, which probably came from a Portsmouth well. They range in depth from 75 to 523½ feet, and are all of Tertiary beds. Presumably these also are from the Townsend Bastion.

11. Southsea Brewery, Mr. Long's. New well, 1887.

Made and communicated by Messrs. Isler and Co.

Shaft 19 feet, the rest bored.

Water-level, at rest, 61 feet down. Supply, through a 4-inch pump 60 feet long, 18 gallons a minute.

		Thickness. Feet.	Depth. Feet.
Made ground and gravel		19	19
[Bracklesham Beds.]	Blue clay	37	56
	Light-coloured sandy clay	36½	92½
	Greenish sand, with little water... ...	9	101½
	Blue clay with stones	3½	105
	Green live sand	22	127
	Tough blue clay	61½	188½
	Clay and pebbles	3	191½

Portsmouth—*cont.*

		Thickness. Feet.	Depth. Feet.
[? Bracklesham Beds.]	Sand, with water, no supply [=brackish?]	16½	208
	Loamy sand	39	247
[Lower Bagshot Sand.]	Live sand, with mundic [pyrites] ... } with water, no supply [=brackish]	24	271
	Coarse sand ... } with water, no supply [=brackish]	3½	274½
	Live sand	3½	278
	Sandy clay and pebbles	1	279
[London Clay.]	Tough clay, stony...	42	321
	Very hard stone	2	323
	Green sand, with bands of stone and shells: with water: no supply [=brackish]	28½	351½
	Tough sandy clay	33½	385
	Tough blue clay	28	413
	Sandy clay, with bands of stones ...	29½	442½
	Sand, with mundic and shells [Specimens of sandy limestone, with *Pectunculus*, about 443, and of pyrites] ...	20	462½

12. Young's Brewery. About half a mile E. of the Dockyard. 1902.

Boring made and communicated by Messrs. Duke and Ockenden. No water.

		Thickness. Feet.	Depth. Feet.
[Drift.]	Clay and gravel	14	14
[London Clay]	Clay	48	62
	Rock	3	65
	Sand intermixed with clay. Very little soak-water	5	70
	Clay and sand	6	76
	Clay	11	87
	Hard rock	1½	88½
	Clay	72½	161

Ramsdell. East of the church.

Geol. Map 284, new ser.

Information got by Mr. J. H. Blake.

Lower Bagshot Beds, 23 feet.

Ringwood.

Geol. Maps 314, 329 new ser.

1. St. Ives District, just N. of church, westward of the town.

Sunk by Messrs. Grace. Communicated by Mr. T. H. Russell.

Water-level, 96 feet down.

		Thickness. Feet.	Depth. Feet.
[Drift.]	Soil ... ... } Sand and peat ... ... } Gravel	9½	9½
[Bracklesham Beds.]	Fine sand varying in colour from light-yellow to almost white	35	44½
	Buff-coloured clay with some sand ...	½	45
	Coarser sand, pale yellow	12	57
	Pebbles, white throughout and mostly 1 to 1½ inches long	1	58

Ringwood—*cont.*

		Thickness. Feet.	Depth. Feet.
	Pale buff clay with some sand ...	2	60
	Red-yellow sand and some clay. Retains water	3	63
	Alternating layers of sand and clay, changing from red to brown with increase of depth	14	77
	Grey sand moderately fine, becoming whiter and finer	23	100
	Black compressed vegetable matter ...	1	101
	Pale yellow sand (with 7 feet of water; but only 2 feet after 21 months) ...	2	103
	Grey sand, moderately fine, becoming finer and whiter	80	183
	Grey sand mixed with clay and much black matter	20	203
[Bagshot Beds.]	Masses of cemented sand, grey and black	10	213
	Grey sand	30	243
	Clay with some sand	12	255
	Grey sand, fine	28	283
	Sandy clay	20	303
	Grey sand	3	306
	Dark grey sharp sand	20	326
	Stiff clay...	½	326½
	Sharp grey sand, varying in tint ...	24½	351
	Grey clay slightly sandy	16	367
	Fine grey sand	2	369
	Bluish clay	14	383
	Brown clay	15	398
	Rock of cemented sand-grains ...	¼	398¼
	Fine grey sand, water-bearing ...	7¾	406

Perhaps the Bracklesham Beds should be taken lower ? to 101 feet. On the other hand perhaps London Clay may have been reached.

2. St. Leonards Poultry Farm.

3½ miles from Ringwood Station (possibly in Dorsetshire). On the Wimborne Road.

Communicated by Mr. W. M. Bell, the proprietor. Rough account of section from memory.

The pump brought up a great amount of sand, containing black lumps [? lignite], small lumps of stone with a metallic glint [? pyrites] and occasional pieces of shell or lime.

The water rises to within 4½ feet of the surface.

In the summer of 1907 8,000 gallons a day were pumped for 3 weeks and the water came more freely than ever.

When the pump is working the water overflows (if allowed) through a 4 inch pipe 6 feet above ground at the rate of about 1,200 gallons per hour, but the average consumption is about 1,000 gallons a day.

The water contains iron, the amount being very variable.

Mr. Bell adds, in a letter of September 1909, that the boring is of 4 inches diameter, the tubes reaching 187 feet down, then open to about 200 feet; and that he can get from 1,200 to 1,500 gallons an hour at about 6 feet down.

When the army was manœuvring here he supplied the troops at the rate of 10,000 gallons a day for 27 days, and had to pump only about eight hours a day. At the end of that time the flow was if anything stronger than before.

	Feet.
Practically all sand, most of it running	27
Light-coloured clay ... ... about	30
Sand	20 or 30
Clay	20 to 30
Sand	60 or 80

Then at the depth of 185 feet a hard bed was reached which buckled the tubes.

An analysis of the water is given on p. 204.

Rockbourne.

Geol. Map 314, new ser.

1. Down Farm, near Knap Barrow.

Sunk by Mr. Hobbs. 5 feet water.

Gravel ...	6	14 feet.
Chalk ...	8	

2. Pebble Pit Cottage.

Sunk by Mr. Hobbs. 3 feet of water.

Sandy loam, with pebbles [Reading Beds]	20	50 feet.
Chalk	30	

3. Cottage, ¼ mile east-north-east of West Park Farm.

Sand	10	27 feet.
Bluish loam		
Glauconitic loam with *Ostrea bellovacina* bored by *Pholadidea*?	13	
Chalk	4	

Romsey.

Geol. Map 299, new ser.

The Brewery. New Well. 1900.

Communicated by Mr. W. Matthews.

About 48 feet above Ordnance Datum.

A boring, with a four-inch pipe, to the depth of 450 feet. Water rose to 60 feet above the surface.

3,600 gallons an hour pumped, and the well always full to the top.

There are also older wells.

Ropley.

Geol. Map 300, new ser.

Parkes Farm. 1907.

Made and communicated by Messrs. Duke and Ockenden.

Shaft 184 feet, the rest bored. Water-level 183 feet down.

Chalk and flints 244 feet.

Rotherwick.

Geol. Map 284, new ser

1. In his Report on the Hartley Wintney Rural District (L.G.B., 1907) Dr. J. S. Low says:—"At Rotherwick . . there are dangerously polluted wells. The Medical Officer of Health has recently tested 20 samples of well water here . . and he has found that all were more or less polluted. With the object of confirming his results, 9 samples of well water were submitted to the County Analyst, who judged that 8 of them were so impure as to be unfit for drinking purposes. . . The dangerous character of the present water supply can hardly be overestimated."

2. Tylney Hall. 1901.

Made and communicated by Messrs. Margrett and Allsebrook (and with note, in brackets, from Prof. T. R. Jones).

Shaft 48 feet, the rest bored. Tubed to 455 feet from the surface.

Water-level 45 feet down.

		Thickness. Feet.	Depth. Feet.
Lower Bagshot Sands	about	15	15
London Clay	"	241	256
Reading Beds	"	80	336
Chalk with flints (with slushy white chalky stuff, about 520 feet down)		258	594

Sarisbury.

Geol. Map 315, new ser.

In WINNARDS COPSE, Holly Hill (now Sarisbury Court), 1898.

From notes and samples communicated by Messrs. DUNN and BOOTH. The classification and the notes on samples (in brackets) by C. REID.

Surface about 102 feet above Ordnance Datum.

Water-level 78 feet down. Sand flows in and chokes the bore.

		Thickness. Feet.	Depth. Feet.
Drift.	Mould	1½	1½
	Earthy gravel	2½	4
Bracklesham Beds.	Mottled red and grey clay	2	6
	White clay	3	9
	Orange sandy clay	2½	11½
	Green sand	6½	18
	Dark green sand	5½	23½
	Dark green loamy sand	3½	27
	Mixed sand and clay, green	6	33
	Dark blue-green sandy clay	2½	35½
	Grey loamy sand	17½	53
	Dark grey clay and sand	2½	55½
	Grey sand	2½	58
	Brown clay	13	71
	Brown and white mottled clay... ...	5	76
	Black carbonaceous clay	7½	83½
	Dark grey clay with vegetable matter	10½	94
	Dark grey loamy sand	30½	124½
	Hard black and grey loam	17½	142
	Green loamy sand (glauconitic) ...	19	161
Bagshot Sands.	Green sand (no glauconite) pyrites at base	18½	179½
	Brown sandy clay	1	180½

No fossils were observed, and the division between Bracklesham and Bagshot is not clear. The strata below 53 feet resemble the lowest and sparingly fossiliferous part of the Bracklesham Series in Sussex.—C.R.

Selborne.

Geol. Map 300, new ser.

Nearly two miles west of BLACKMOOR HOUSE. 1904?

Made and communicated by Mr. F. W. OCKENDEN.

Shaft 82 feet, the rest bored.

Water in the sand 82 feet down. No trace of any since.

Upper Greensand, about 98 feet.

Gault Clay (samples from 350 and 399 feet seen by Mr. H. B. WOODWARD). Several hard layers. About 301 feet.

Mr. WOODWARD remarks that this is ahead of the estimate of the combined Upper Greensand and Gault in this part (280 feet).

According to Mr. J. W. TITT, further boring, to the depth of 421½ feet, reached Lower Greensand.

GILBERT WHITE says "Our wells, at an average, run to about sixty-three feet, and when sunk to that depth seldom fail; but produce a fine limpid water, soft to the taste, and much commended by those who drink the pure element, but which does not lather well with soap." *Natural History of Selborne*, 1789. Letter 1 to T. Pennant.

Sherfield-upon-Loddon.

Geol. Map 284, new ser.

1. The Rev. G. A. BARKER'S. ? Sherfield Hill, south-westward of the village, about five-eighths of a mile north of Basing Lodge Farm and half a mile east of Four Lanes Farm. 1906.

Made and communicated by G. ALLSEBROOK and Co.

Ground-level about 222 feet above Ordnance Datum.

Water rose about 12 feet above ground.

Well, 15 feet; the rest bored.

Sherfield—*cont.*

Yield, between 200 and 235 feet down, about 100 gallons per hour. At 235 feet down, 500 gallons per hour. When finished (1906), the yield was 1,000 gallons per hour, most of which came from a bed of flints, 248 feet down. The water overflowed and rose to about 12 feet above ground.

		Thickness. Feet.	Depth. Feet.
[London Clay, 128 feet.]	Brown and blue clay	15	15
	Blue and brown clay	3	18
	Blue clay	9	27
	Black, water-worn gravel (small flint pebbles) with water	3½	30½
	Blue clay	3	33½
	Loamy sand	7	40½
	Blue sandy clay	20	60½
	Blue clay	51½	112
	Brown sandy clay	2	114
	Clay, green sand, and shells	14	128
[Reading Beds, 68½ feet.]	Sand (water rose to within 2 feet of the surface)	4	132
	Sand and bands of mottled clay ...	5	137
	Sand	17	154
	Sand and bands of clay	4	158
	Sand	10½	168½
	Mottled clay	20½	189
	Grey sand and pyrites	5	194
	Green sand and green-coated flints ...	2½	196½
[Upper] Chalk	... ...	53½	250

2. Longbridge Mill. By the river, N.N.E. of the village. 1891.
Communicated by Mr. C. Lethbridge.

Dug 10 feet, the rest bored.

Water, from the depth of 297 feet, overflowed, at the rate of about 7,600 gallons in 24 hours. (Dec., 1890.)

Mr. J. H. Blake was told that the water rose 9 feet above the ground.

The water was lost by absorption, when the well was deepened.

		Thickness. Ft.	In.	Depth. Ft.	In.
Gravelly	... ...	5	0	5	0
[London Clay.]	Sandy clay, with 4 or 5 thin beds of white hard stuff, something like chalk, from 3 to 8 inches thick [septaria]...	165	0	170	0
	Rock. Saline spring at the base, yielding, at the surface, 1,728, gallons in 24 hours	1	10	171	10
	Black stiff clay	91	2	263	0
[? London Clay or Reading Beds]	Red clay [? brown] ...	25	0	288	0
[? Basement-bed of London Clay, or Reading Beds.]	Greensand	7	0	295	0
	Hard stone	2	0	297	0
	Sandstone. Water increased suddenly and enormously	4	6	301	6
[? Reading Beds.]	Clay. Bored into for holding the silt, and lost the water. Filled in with rammed clay, and the water recovered	4	0	305	6
	Bed which took away the water [presumably dry sand].				

It is difficult to make out the division between the London Clay and the Reading Beds.

3. Sherfield Hall. 1903.

Made and communicated by Messrs. Duke and Ockenden.

Shaft 83 feet, the rest bored.

Water-level 40 feet down. Good supply from sand, at the bottom.

London Clay and Reading Beds, 223 feet.

Shidfield or Shedfield.

Geol. Map 316, new ser.

Capt. M. NICHOLL'S. House marked "Parsonage" on the map. 1893.

Communicated by Mr. W. MATTHEWS (and from specimens).

Water-level 13 feet down.

		Thickness. Feet.	Depth. Feet.
Old brick-lined well (the rest bored and tubed, 3 inches diameter)		—	21
[Bracklesham Beds, 23 feet.] ? + 21 (to top ?)	Very sandy grey clay (fine buff and pale grey sand)	2	23
	Very sandy yellow clay (fine pale brownish and grey sand)	9	32
	Rather sandy blue clay (fine orange-brown sand, a little grey)	8	40
	Sandy orange-coloured clay (fine grey sand)	2	42
	Blue sandy clay (fine grey sand) ...	2	44
	Blue clay (clayey sand) with nodules of pyrites and traces of pebbles ...	15	59
[Bagshot Sand] Grey sandstone (? fine buff sand), with a few black pebbles at top		10½	69½

? Deepened to 81 feet.

The site is mapped as on Bagshot Sand, and it certainly seemed to be so on the ground.

For an analysis of the water *see* p. 204.

Soberton.

Geol. Map 316, new ser.

1. MISLINGFORD. London and South-Western Railway's Goods Depôt 1903.

Made and communicated by Messrs. DUKE and OCKENDEN.

Lined for 99 feet, with tubes of 4½ inches diameter.

Water-level 15¾ feet down. Good supply.

		Thickness. Feet.	Depth. Feet.
[Drift.]	Clay and ballast ...	9	9
[Reading Beds.]	Reading clay	91	100
	Rock [? flints]	6	106
Chalk and flints		44	150

2. GOSPORT WATERWORKS CO. 1903.

Trial-boring. Communicated by Mr. E. T. HILDRED.

126 feet above Ordnance Datum.

Hole 5 feet deep, the rest bored, with tubes of 6 inches diameter to 63 feet down.

First rest-level of water 15 feet down. In December, 1903, 10¾ feet down.

After a 48 hours' test the water-level was lowered 21¼ feet, 3,600 gallons an hour being pumped.

		Thickness. Feet.	Depth. Feet.
	Brown clay and flints	7	7
[Reading Beds.]	Mottled clay	5	12
	Mottled sandy clay	22	34
	Dark blue sandy clay	4½	38½
	Light-red sandy clay	5½	44
	Green sand and pebbles...	3	47
	Light-coloured sandy clay and flints ...	4	51
[Upper Chalk.]	Chalk, soft	9	60
	Chalk, with flints every 4 to 6 feet ...	70	130
	Chalk, with a 9 inch band of flints at top (from which water rose), 4 inch bands at 151 and 154 feet, 6 inch bands at 161½ feet and 164 feet, and a 3 inch band at 167 feet	41	171

Soberton—*cont.*

The pumping well is oval, 11 × 9 feet, and 155 feet deep. Lined with bricks in cement to 48 feet. It is about 155 feet from the trial-boring, and at 48 feet down 4 feet of chalk-rock capped the ordinary chalk. This shaft was practically dry until the rock was reached, when the water rose to the same level as in the boring. There is a heading 385 feet long. Yield 1¾ million gallons a day.

For an analysis of the water *see* p. 205.

Somerley.

Geol. Map 314, new ser.

DAIRY.

Sunk and communicated by Mr. HOBBS.

4 feet of water.

Gravel	20	42 feet.
Light-coloured sand [Bagshot]	22	

Southampton.

Geol. Map 315, new ser.

In the Memoir on the Geology of Southampton by some mischance some of my notes of the wells were passed over. In consequence, some particulars were omitted, and now some differences appear in the accounts.

1. COMMON. Deep boring for the water-supply of the town. 1838–1851.

About 140 feet above Ordnance Datum.

Details of the beds from W. RANGER'S "Report to the Local Board of Health, Southampton, on the various sources of Water Supply," 1851, plate; with corrections from a large drawing in the possession of the Corporation.

Shaft and cylinders 563 feet the rest bored.

Water-level 40 feet down (1882). Yield, in September, 1851, 130,000 gallons a day.

Measurements from top of brickwork, which was about 2½ feet above the original surface of the ground.

		Thickness. Feet.	Depth. Feet.
Brickwork		—	2½
Soil		2	4½
[Bracklesham Beds, 41 feet.]	Sand and water	6	10½
	Sand	2½	13
	Sandy clay	1½	14½
	Watery sand	3	17½
	Clay	5	22½
	Sandy clay, with clay-loam and water...	3½	26
	Crust of hard sand	½	26½
	Clay with pyrites	4	30½
	Sandy clay	3½	34
	Sandy, coloured clay and petrified wood	2	36
	Hard clay	4	40
	Sand	3	43
	Stiff clay, with veins of sand and much water	2½	45½
[Bagshot Beds, 32½ feet.]	Sharp sand, with pebbles and petrified wood	7	52½
	Crust of hard sand	½	53
	Sandy clay [? firm sand]	23	76
	Sand, with pebbles	1	77
	Running sand, very watery	1	78
[London Clay, 301 feet.]	Dry sand, with shells	2	80
	Hard, dead sand, full of pebbles and shells	4	84
	Hard, dead sand, with pieces of wood	1	85
	Hard stone, with shells, pebbles, and water	1	86

Southampton—*cont.*

		Thickness. Feet.	Depth. Feet.
[London Clay, 301 feet]—*cont.*	Dead sand, full of shells.	1¾	87¾
	Very watery sand	¼	88
	Dead sand, with pebbles in top foot ...	3	91
	Sandy clay and shells	12	103
	Hard, jointed clay, rather watery ...	½	103½
	Rather sandy clay	6½	110
	Very hard, dead sand, full of shells and pebbles...	8¼	118¼
	Hard stone, full of pebbles, shells and water	1½	119¾
	Very sandy clay, with shells, wood, &c.	6¼	126
	Rather sandy clay, with a thin vein of watery sand at bottom	9	135
	Rather sandy clay, with shells... ...	2	137
	Clay, with more sand, shells, and pebbles...	3	140
	Hard, dead sand and shells. 9 inch bed of stone, with water under, 10 feet down	20	160
	Dead sand, with many shells. 15 inch layer of stone, 8 feet down	13½	173½
	Stone, with shells	6	179½
	Sandy clay. Spring of water a foot down. Large stone on one side over 3 feet down. 6 inch layer of pebbles at bottom	16½	196
	Sandy clay, with a variety of shells. Petrified wood at about 218–222 ...	44	240
	Clay, with many shells. A foot layer of stone 6 feet down...	40	280
	Hard clay, with shells	3	283
	Clay, with shells. A foot layer of stone 6 feet down	20½	303½
	Sand, with pebbles	2	305½
	Watery sand	6½	312
	Stone	3½	315½
	Dead sand	1	316½
	Running sand, very watery	2	318½
	Rather sandy clay, with shells. 18 inch layer of stone about 8½ feet down ...	34½	353
	Rather sandy clay, with 9 inch layers of stone, one at top, another 9 inches below this	7	360
	Pieces of petrified wood	1	361
	Sandy clay, with a 15 inch layer of hard sand 4 feet down	18	379
[Reading Beds, 85 feet.]	Plastic clay. Beds of various colours...	72	451
	Plastic clay, with chalk [? calcareous concretions]	3	454
	Plastic clay	6	460
	Green sand, with veins of clay Green sand, with pebbles Green sand, flints, and chalk ...	4	464
[Chalk, 859½ feet. ? Should be 853.]	Chalk, with flints	812½	1276½
	Chalk, with flint...	3½	1280
	Chalk, with flint, and brown	19	1299
	Chalk, with flint, light-coloured, and very free	1½	1300½
	Chalk, with flint, blue and cloggy ...	14½	1315
	Chalk, dark blue, with flints and sponges	2	1317
	Chalk, dark blue, with veins of clay ...	2	1319
	Chalk, dark blue, very cloggy ...	4½	1323½

Southampton—*cont.*

The details of the Chalk are not given in the drawing in the possession of the Corporation, and there must be some slight error in the thicknesses, as the total depth is only 1,317 feet.

The divisions between the Bracklesham and the Bagshot Beds, and between the latter and the London Clay can hardly be made with certainty, and the occurrence of fossils in what seems to be the top part of the last formation is unusual. The "hard" and "dead" sand in this formation is, perhaps, loam, for the most part, or, at all events, clayey sand.

In the Memoir on the Geology of Southampton (1902) two other versions of this well are given, varying in details. I am inclined to take the above, derived from the earliest printed account and from the Corporation record, although it may err in giving a few feet in excess of the total depth.

Messrs. SHORE and WESTLAKE make the total depth 1,317 feet. Their paper gives the following further particulars :—

Most of the water seems to come from the Chalk.

Before the boring was begun (1842) 20,000 gallons a day were raised. In 1844, after considerable progress with the boring, this increased to 50,000.

Details of the construction of the well and boring are given by J. R. KEELE *Rep. Brit. Assoc.* for 1846, *sections*, pp. 52–56, and in a drawing by W. MATTHEWS, *Proc. Inst. C.E.*, vol. xc., pl. 1.

An analysis of the water is given on p. 206.

For Southampton Waterworks *see* also **Otterbourne.**

2. DOCKS. Now included in the southern end of the Western Graving Dock, on the southern side of the old open dock. 1846.

T. W. SHORE, *Rep. Brit. Assoc.*, for 1883, pp. 152, 153. Some further particulars from the London and South Western Railway Co.

Shaft and cylinders, the latter decreasing from about 6 to 5 feet in diameter, 65 feet (Messrs. DOCWRA say 76). The rest bored, decreasing from 2 feet diameter.

Water-level, 11 feet down. Pumps [? pumped] 20 feet down. Water-level kept about 2 feet higher [? after pumping ceased.]

A great quantity of water found 22 feet down [? in gravel] and 40 feet down. Influx of sand into cylinders at 46 feet. Sand forced up nearly 80 feet, in the 2 feet boring pipes as soon as the tubes reached the depth of 136 feet, when there was a sudden influx of water.

		Thickness. Feet.	Depth. Feet.
Made ground	... ...	10	10
Not accounted for	[? Alluvium and gravel]	20	30
[Bracklesham Beds.]	Blue clay	10	40
	Sand	10	50
	Not described	58	108
	Very hard blue clay	27	135
[Bagshot Sand and partly London Clay ?]	Dark green sand, with water	5	140
	Fine whitish running sand, with water	16	156
	Mass of stone / Not described	28	184
[? London Clay, 190 feet or more.]	Light-brownish clay, with sand and occasional fragments of stone ...	11	195
	Bluish clay	5	200
	Hard blue clay, with a little sand ...	15	215
	Hard blue clay, with broken shells ...	1	216
	Hard lead-coloured clay, with a little sand, when dry	14 ?	230
	Hard lead-coloured clay	20 ?	250
	Hard blue clay, with a little sand ...	5	255
	Hard bluish clay	5	260
	Hard lead-coloured clay, with pyrites	5	265
	Very hard dense lead-coloured clay ...	5	270
	Hard clay, with pyrites	2	272

Southampton—*cont.*

		Thickness. Feet.	Depth Feet.
[?London Clay 190 feet or more] —*cont.*	Hard dense clay, with sand and whitish fragments of half-formed nodules...	4	276
	Hard clay	16	292
	Dense hard clay, with a 6-inch layer of stone at about 302	21	313
	Fine dense sand	3	316
	Black pebbles	2	318
	Fine hard sand, with a little clay ...	3	321
	Black pebbles	1	322
	Light-coloured sand	1	323
	Hard sand	7 ?	330
	Sandy clay	6 ?	336
	Hard sand, with clay	4 ?	340
	Clay, with sand...	2	342
	Clay, with less sand	8	350
	Clay	3	353
	Sandy clay	2	355
	Clay	19	374

The classification is by no means safe. It may be that the Bracklesham Beds go as far down as 313 feet, the sandy top of the London Clay beginning at 340. The base of the Bracklesham Beds ought certainly to be deeper here than at the Railway Station, a third of a mile N.W. (*see* pp. 131, 132).

A note from Messrs. Docwra as to a well at Southampton Docks gives 110 feet of sand and shingle, beneath 10 feet of water, and then blue clay, to running sand, at 220 feet. As there are two wells at the Docks this may refer to the other (at the former Sugar Factory, at the northern edge of the Docks and just W. of the Royal Mail Company's Factory), about a third of a mile northward of the one above described. The shaft, I am told, is about 40 feet deep and the boring goes to the depth of 220 feet. Here too there was an influx of sand.

Analyses of the water from one of the wells at the Docks are given on p. 206.

3. Forder's Brewery, between High Street and French Street. 1895.

Made and communicated by Messrs. Isler & Co.

Supply 1,000 gallons an hour. Water overflows.

		Thickness. Feet.	Depth. Feet.
Well (the rest bored)		—	40
[River] Gravel		2	42
[Bracklesham Beds, 131 feet.]	Green sand	16	58
	Green sand and marl ...	3	61
	Green sand	7	68
	Green sand and clay ...	5	73
	Green sand and shells ...	6	79
	Clay and sand	6	85
	Clay	9	94
	Brown clay	79	173
Brown [Bagshot] sands		9	182

4. French Street, Messrs. Thomas and Mowatt, western side, a little S. of St. Michael's Church. 1902.

Made and communicated by Messrs. Isler & Co., with some notes from Mr. H. Guillaume.

About 30 feet above sea-level.

At 200 feet, no supply; but at 220 a bountiful one (6,500 gallons an hour) of potable water. A great quantity of sand was brought up during 3 weeks' pumping (January, 1903), and then the water began to get clear. Water-level about 22 feet down [when the work was finished] and the supply 6,500 gallons an hour.

180 feet of tubes, of 11½ inches diameter, 11 feet from the surface, and 40 feet, of 10 inches diameter, 180 feet from the surface, of which latter 30 feet are perforated.

Southampton—*cont.*

The above refer to the boring at the depth of 222 feet. The later work gave a water-level of 27½ feet down; but no supply.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Subsoil		13	0	13	0
Fine shingle		2	0	15	0
[Bracklesham Beds.]	Brown loamy clay	5	0	20	0
	Black clay	10	0	30	0
	Light-coloured sand	2	0	32	0
	Dark sandy clay	15	0	47	0
	Light-brown sand	6	0	53	0
	Light-green sand	10	0	63	0
	Dark-green sand	10	0	73	0
	Black clay with shells	10	0	83	0
	Pyrites	1	0	84	0
	Light-grey clay	84	0	168	0
	Light-grey sand	1	0	169	0
	Brown clay	11	0	180	0
	Pyrites	1	0	181	0
	Black sand	7	0	188	0
	Light-grey sand	16	0	204	0
	Light-blue clay	3	0	207	0
	Sand (? with pyrites)	15	0	222	0
	Clay and sand	3	0	225	0
	Sand	22	0	247	0
[Bagshot Sand.]	Sand and pebbles	18	0	267	0
	Sand	27	0	292	0
[London Clay, 105½ feet.]	Clay and ballast	5	0	297	0
	Blue clay	34	0	331	0
	Sand and pebbles, with 4 inches of rock at the bottom	3	11	334	11
	Hard brown loam	0	11	335	10
	Red marl	6	6	342	4
	Brown clay	3	0	345	4
	Brown clay-rock	0	8	346	0
	Rock	0	10	346	10
	Rock and pebbles	1	0	347	10
	Sand and clay	2	0	349	10
	Blue clay	4	0	353	10
	Clay and sand	6	0	359	10
	Loamy clay	7	0	366	10
	Clay and pebbles	2	0	368	10
	Clay and shells	3	0	371	10
	Loamy clay	4	0	375	10
	Clay and pebbles	1	0	376	10
	Hard blue clay	2	0	378	10
	Loamy clay	11	6	390	4
	Loamy clay and sand	3	0	393	4
	Clay and sand	4	2	397	6

5. London and South Western Railway, Terminus. 1840.

T. W. Shore. *Rep. Brit. Assoc.* for 1883, p. 152. With some further particulars from the Railway Company.

Shaft and cylinders, decreasing from about 8 to 5 feet in diameter. The rest bored, the last course of piping, by which water is admitted, being 6 feet of copper-tube, 7½ inches in diameter, with small holes.

		Thickness. Feet.	Depth. Feet.
Turf, mud and shingly gravel (new made soil)		8	8
[Alluvium.]	Whitish clay and stones	2	10
[River Drift.]	Whitish clay; Gravel, with clay; Yellow gravel, with water	5	15

Southampton—*cont.*

		Thickness. Feet.	Depth. Feet.
[Bracklesham Beds 162½ feet.]	Green sand, with water	5	20
	Blue [? green] sand, with *Venericardium* and *Turritella* at about 24 feet ...	10	30
	Blue sand, like indigo	5	35
	Blue [? green] sand	5	40
	Slate-coloured sand	5	45
	Bluish-green sand, with shells and water	10	55
	Slate-coloured clay	5	60
	Slate-coloured clay, with sand	4	64
	Blue clay	6	70
	Dark-blue clay	10	80
	Dark-blue clay, with sand	2	82
	Bluish sand, with brackish water ...	10	92
	Clay, with sand	35	127
	Bluish sand, with water	3	130
	Black sand, with water	2	132
	Green sand, with water	5	137
	Blue clay, with sand	10	147
	Light-bluish clay, with sand	23	170
	Light-blue clay, with little sand ...	5	175
	Blue clay	2½	177½
[Bagshot Sand.]	Dark-blue [? wet] sand	2½	180
	Dark-blue coarse sand, with water ...	2	182
	Coarse white sand, with water	38	220

According to Mr. G. L. F. Giles, the Blue sand with water goes down to 220 feet and then the White sand with water begins.

6. Northam. Site not given.

W. Ranger. Report to the Local Board of Health, on the Various Sources of Water Supply. 1851. Plate.

	Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Vegetable earth [soil &c.]	9	0	9	0
Gravel	7	0	16	0
Sand	7	0	23	0
Clay	6	0	29	0
Very hard light-coloured clay... ...	3	0	32	0
Sand, with a little clay	8	0	40	0
Dark clay	1	0	41	0
Coarse sand, with much water ...	2	0	43	0
Fine sand	1	0	44	0
Sand, with veins of white clay ...	8	0	52	0
Sand, with a little water	18	0	70	0
Sandy clay, with black pebbles ...	14	0	84	0
Light-coloured rather sandy clay ...	6	0	90	0
Dark clay, with sand	15	0	105	0
Black pebbles, with much water ...	0	6	105	6
Sandy clay	10	6	116	0
Sand, with shells and pebbles... ...	34	0	150	0
Sandy clay	4	8	154	8
Limestone and shells	0	10	155	6
Hard sandy clay	1	3	156	9
Very hard limestone	1	4	158	1
Hard sandy clay	2	0	160	1
Hard stone	1	10	161	11
Veins of barytes [? pyrites] with hard sandy clay	3	2	165	1
Sandy clay, with a little water ...	5	2	170	3
Hard limestone	4	10	175	1
Shells and sandy clay	3	10	178	11
Sand, with shells and soft clay ...	4	0	182	11
Very hard stone	2	2	185	1
Very hard dark sandy clay	10	10	195	11
Small black pebbles	1	0	196	11

Southampton—*cont.*

	Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Limestone	1	3	198	2
Very hard dark clay	3	9	201	11
Hard stone	0	3?	202	2
Dark hard rather sandy clay	10	8	212	10
Hard sandy clay with shells	3	0	215	10
Stone, with shells	0	3	216	1
Hard clay	9	0	225	1
Hard clay, with veins of sand... ...	9	6	234	7
Sandstone	2	1	236	8
Very hard clay	9	2	245	10
Sandstone	1	1	246	11
Very sandy hard clay	3	11	250	10
Barytes [? pyrites]	0	2	251	0
Hard dark clay	17	10	268	10
Shells, stone, and hard clay	3	0	271	10
Very hard stone	0	5	272	3
Hard clay	18	7	290	10
Hard stone	0	8	291	6
Sandy clay	21	4	312	10
Hard stone, with pebbles	14	6	327	4
Hard limestone	1	10	329	2
Fine sand	7	8	336	10
Sandy clay	11	0	347	10
Limestone	0	10	348	8
Fine hard dark clay	27	8	376	4

The depth is given as 376 feet 6 inches.

In the absence of information as to the precise site it is difficult to classify the beds.

According to the Rev. J. S. Davies (History of Southampton, 1883) there were two deep wells at Northam. Others have been made since.

7. Northam. A bore-hole for the Southampton Gas Light and Coke Company. Just north of No. 9 Gasholder. 1904 ?

Made and communicated by Mr. J. Grace (Notes from specimens in brackets). Tube for 101⅓ feet. Water rose to 13 feet below the surface.

		Thickness. Feet.	Depth. Feet.
Made ground [out of gasholder]		8	8
[River Drift.]	Loam	2	10
	Gravel	11	21
[Bracklesham Beds.]	Loamy sand (grey loam)	4	25
	Sandy clay (clayey sand at 25 feet) ...	6	31
	Stiff blue clay (sandy clay)	8	39
	Dark clayey sand (rather greenish) ...	4	43
	Sharp sand with water	36	79
	Clay with (flint) pebbles...	1½	80½
[Bagshot Sand.]	Sharp grey sand with water	22½	103

An estimation of the chlorine in the water is given on p. 206.

8. Northam Lead Works (Messrs. James and Rosewall). At the corner of Clarence Street and George Street, northward of the Northam School Board. 1896.

About 10 or 12 feet above Ordnance Datum.

Bored and Communicated by Messrs. Legrand and Sutcliff, and from a few specimens, the account with which differed somewhat from the following :— Water rose to 7½ feet above the ground.

		Thickness. Feet.	Depth. Feet.
[River Drift.]	Dug well [brickearth and gravel. Mr. James says clay for about 10 feet]	—	17
	Gravel, said to have been put in the well	3	20
	Sandy gravel. Specimen shows a mixture of grey sand and gravel ...	2½	22½

Southampton—*cont.*

		Thickness. Feet.	Depth. Feet.
[Bracklesham Beds.]	Loamy sand (specimen grey loam) ...	1	23½
	Grey sand [? clayey]	2½	26
[Bagshot Sand.]	Live grey sand (specimen sharp sand)	34	60
	Live grey sand and pebbles (specimen sharp sand, with black flint pebbles)	6½	66½
[Bagshot Sand or London Clay.]	Live grey sand (specimen, apparently from this, grey loam)	27½	94
[London Clay. All the specimens dried hard.]	Dark grey loamy sand (specimen loam)	13	107
	Sandy clay (specimen brownish-grey)	4	111
	Hard blue sandy clay	5	116
	Hard sandy clay	13	129
	Sandy clay and shells (specimens brownish-grey, shells broken) ...	5	134
	Sandy clay	22	156
	Sandstone-rock (specimen septarian limestone)	1	157
	Sandy clay (specimen brownish-grey)	8½	165½
	Rock (specimen septarian limestone)	3	168½
	Sandy clay	20½	189
	Stone [septaria]	1½	190½
	Sandy clay	15½	206

9. St. Paul's Church (near). Mr. Payne's Well.

From a drawing in the possession of the Corporation.

60 feet above high-water level.

			Thickness. Feet.	Depth. Feet.
Shaft, the rest bored		about	—	22
[Bracklesham Beds.]	Yellow sand ...	,,	12	34
	Blue sand	,,	10	44
	Black sand and clay	,,	20	64

(? The total should be 56, in which case the shaft is probably only 14 feet.)

10. Shirley Road, eastern side, northward of the Board School. Hayward's Nursery, 1895?

Information from Mr. H. G. Vacher.

No spring found, only soakage water, easily pumped dry in summer.

Gravel		about 6	30 feet.
[Bracklesham Beds.]	Blackish sandy clay	24	

11. Three Fields Lane. Messrs. Drivers, northern end, close to Marsh Lane, 1900.

Made and communicated by Messrs. Legrand and Sutcliff.

12 feet above Ordnance Datum.

Water rises to 8 feet below the surface at times; but the level varies considerably with the work (November, when 183 feet down).

		Thickness. Feet.	Depth. Feet.
Well (old), the rest bored		—	22
[Bracklesham Beds.]	Sandy clay and mundic (pyrites)	73	95
	Clayey sand	3	98
	Sandy clay	10	108
	Sandy clay and stones ...	14	122
	Hard sandy clay and stones ...	18	140
	Very hard clay	13	153
	Green sandy clay	1½	154½
	Hard clay	1½	156
	Live grey sand	2½	158½
	Sand and loam	7½	166
	Loamy sand, stones, and clay	17	183
	Hard clay	7	190
	Hard clay, stones (? pebbles)	3	193

Southampton—*cont.*

		Thickness. Feet.	Depth. Feet.
[Bagshot Sand 30 feet.]	Blowing sand	3	196
	Blowing sand with pebbles ...	1	197
	Blowing sand	6	203
	Sand	14	217
	Loamy sand	6	223
[London.]	Dark sandy clay	9	232

I differ from the classification given by Mr. C. Reid in the Memoir on the Geology of Southampton (p. 64). He classes as Bagshot Sand up to 156 feet; but I have no doubt that the pebbles below 190 feet belong to the bed that constantly marks the base of the Bracklesham Beds here. He takes the London Clay up to 196 feet, in which again I differ. There are some small differences of details in the two versions.

12. Victoria Brewery, Commercial Road (Northern side).

About 27 feet above Ordnance Datum, at the entrance.

Two old wells, communicated by Mr. Barlow.

A large one in the field westward of the northern end of the brewery. 1871 Shaft 28 feet, bored to 113.

Clay with occasional sand. 4 inches of hard smut at 90 feet.

A smaller well, southward, close to the western side of the brewery. Shaft 42 feet, bore-hole 73 more. Water-level 14 feet down.

White sand touched, whence water rose quickly.

Trial-boring, made and communicated by Messrs. Legrand and Sutcliff. (Notes in these brackets from specimens). 1896.

Water rose 8 feet above the ground. Mr. Barlow reports that a supply at the rate of 12 gallons a minute was got at 287 feet.

	Thickness. Feet.	Depth. Feet.
Made ground [stony soil]	6	6
Red mottled sandy clay (brown and green-grey)	5	11
Green mottled sandy clay (grey)	4	15
Sandy clay (grey)	15	30
Sand and clay (grey)	60	90
Clay with little sand (grey)	11	101
Live sand, with clay (fine grey sand)	11½	112½
Clay and sand (grey sandy clay)	21½	134
Clay and stones (pyrites and small nodules)	1	135
Clay and sand (greenish-grey clayey sand and sandy clay) ...	7	142
Very fine sand and clay (dark brownish-grey clayey sand, damp)	7	149
Coarse sand (grey sharp sand, with lumps of clay and bits of lignite)	8	157
Brown clay, little sand and peat (sand of the colour of coffee-grounds when damp)	17	174
Brown clay and black pebbles (flint)	½	174½
Greenish clay and sand	18½	193
Greenish clay and shells	3	196
Greenish clay and sand	15	211
Greenish clay (black flint) pebbles and shells	2	213
Greenish sand and clay (In the top 2 feet a bit of fossil wood and some small patches of green earth. The green colour is throughout, not from grains of glauconite)	17	230
Brown and green clay, sand and shells	2	232
Brown clay and sand, with 4 inches of claystone at top and 2 at base	5½	237½
Brown clay, sand and shells	12½	250

Southampton—*cont.*

	Thickness. Feet.	Depth. Feet.
Rock	2	252
Clay, sand and shells	11	263
Rock	$1\frac{2}{3}$	$264\frac{2}{3}$
Clay, sand and shells, with 4 inches of rock 10 feet down ...	$15\frac{1}{3}$	280
Clay and sand	6	286
Greenish sand and pebbles	9	295

Apparently everything below the made ground belongs to the Bracklesham Beds.

South Hants. Water Company.

Works established, 1876. Yearly supply 620 million gallons (Water Works Directory, 1907). 680,219,460 (Directory, 1909).

Mr. W. MATTHEWS tells me that the following places are supplied :—Bishopstoke, Bitterne, Brockenhurst, Bursledon, Chandlersford, Chilworth, Compton, Eastleigh, Eling, Fairoak, Houndsdown, Itchen, Loperwood, Lyndhurst, Michelmersh, Netley, North Baddesley, North Stoneham, Nursling, Otterbourne, Pitt, Romsey, Shawford, Sholing, Southampton (part : Bassett, Bitterne Park, Freemantle, Hampton Park, Millbrook and Shirley), South Stoneham, Swaythling, Thornhill, Timsbury, Totton, Twyford, West End, Woodlands and Woolston.

Analyses of the waters are given on pp. 207–209.

See **Timsbury** and **Twyford.**

South Stoneham.

Geol. Map 315, new ser.

WORKHOUSE, West End. 1885.

Communicated by Mr. A. J. BROWN.

	Feet.
Gravel	6
Clay	3
Thin layer of ironstone ...	—
Sand ... ... about	26

Mr. JUKES-BROWNE writes that the well was deepened and then a boring made to the depth of 70 feet, without getting water, and that another boring, made in the same well, 34 feet deep, got plenty of water.

Steep.

Geol. Map 300, new ser.

1. Made in 1903.

Made and communicated by Messrs. DUKE and OCKENDEN.

Bored 140 feet. Atherfield Clay at the bottom.
Water-level 84 feet down.

2. Under STONER HILL. Trial-work for the supply of Petersfield ; abandoned ? about 1886.

About 380 feet above Ordnance Datum.

Communicated by Mr. W. B. KINSEY.

Shaft of 60 feet, through Upper Greensand, then a boring of 10 feet. Heading 45 feet long, a little W. of N. For 26 feet the rock very close, and with very little water ; beyond this more fissured and with a little water ; fissures at right angles. Mr. C. E. HAWKINS thinks that the boring must be in the marl forming the base of the Upper Greensand. Yield 1,000 gallons a day.

Steep—*cont.*

3. Steep Mill Waterworks. 1904?

Communicated by Messrs. Docwra.

Shaft 75 feet, with gallery, the rest bored.

Water-level, at rest, 51½ feet down. Well soon pumped dry.

		Thickness. Feet.	Depth. Feet.
[Surface-Beds.]	Soil	3	3
	Blue clay and flints	2	5
[Gault, 236½ feet.]	Gault, with occasional nodules ...	88	93
	Gault, sandy	9	102
	Gault	132	234
	Dark-green sandy clay	3	237
	Grey sandstone	¾	237¾
	Sandy clay and bands of greenish sandstone	3¾	241½
[? Folkestone Beds.]	Greenish-grey sand and thin bands of sandstone and pebbles	4½	246
	Green clayey sand	1	247
	Greenish-grey sand and bands of clay and pebbles	3	250

This section seems to start a little way below the top of the Gault, the total thickness of which formation here would therefore be over 250 feet, probably.

Stratfield Saye.

Geol. Map 268, new ser.

1. Milton's Farm.

Bored and communicated by Mr. Edward Margrett (of Reading).

About 190 feet above Ordnance Datum.

Water rose to 40 feet from the surface.

London Clay	295 [?]	365 feet.
Reading Beds	40 [?]	
Chalk ...	30	

Mr. J. H. Blake, who got this section, thinks that the Reading Beds must be thicker and the London Clay thinner, judging by the section at the Rectory, where the former are over 51 feet without being bottomed.

2. The Rectory. 1898.

? About 165 feet above Ordnance Datum.

Made and communicated (to Mr. J. H. Blake) by Mr. A. Callas, of Reading.

Shaft 34 feet, the rest bored.

Water rose to within 19 feet of the surface. It lowered to 60 feet, and takes a long time to rise again, the supply being small.

		Thickness. Feet.	Depth. Feet.
Well (? old), the rest bored		—	34
[London Clay.]	Clay, with stone [septaria] at 60 to 60½, 115 to 115¾, 123 to 123⅓, 143 to 143⅓, 149 to 149½, and 154 to 154¾ feet ...	120¾	154¾
	Pebble-bed	¾	155½
	Clay	49½	205
	[Basement-bed.] Black sand, shells and water	3	208
	[Basement-bed.] Stone	1	209
	[Basement-bed.] Green and black sand ...	5	214
	[Basement-bed.] Sandstone	¾	214¾
[Reading Beds, 51¾ feet.]	Mottled clay and loam	11¼	226
	Sand, mixed, and a little water ...	3	229
	Mottled clay, brown sand and water ...	37½	266½

3. Writing of a well at Stratfield Saye, the Rev. J. C. Clutterbuck says that the depth to the Chalk was 300 feet, and that the water rose to within 20 feet of the surface. (*Journ. R. Agric. Soc.*, ser. 2, vol. i, p. 280.)

Swanwick.

Geol. Map 315, new ser.

1. Cold East (Mr. Montefiore's), beyond Laundry, near the bottom of the valley, about a third of a mile W.N.W. of the Railway Station. 1904.

Water-level 45 feet down. No supply got.

100 feet of tubes of 7¼ inches, diameter, 450 feet of 6 inches level with surface.

		Thickness. Feet.	Depth. Feet.
Old boring		—	200
[London Clay.]	Blue clay	16	216
	Light-coloured sand ...	38	254
	Blue clay	48	302
	Light-coloured sand ...	10	312
[Reading Beds.]	Mottled clay	90	402
	Hard light-coloured stone	23	425
Chalk		258	683

Mr. J. H. Blizard says that at 402 feet sand with very small shells was struck, and at 420 feet sand with small white particles.

2. Cold East, near the house. 1903.

Boring made and communicated by Messrs. Isler and Co.

50 feet of tubes of 7¼ inches diameter, 8½ feet down; 200 feet of 6 inches diameter, 7 feet down; 31 feet of 5 inches diameter (perforated), 201 feet down. Standing water-level 85 feet down. Running water-level 118 feet. Supply, 1,200 gallons an hour.

		Thickness. Feet.	Depth. Feet.
[Drift]	Ballast [gravel]	8½	8½
	Sand	1½	10
	Dry loam	5	15
	Sandy clay	12	27
	Blue clay, with rock at 64¾ to 65	62	89
	Blue sandy clay	59	148
	Blue clay	45	193
	Sandy loam	31	224
	Blue clay	12	236
	Sandy loam	2	238

It is difficult to classify the beds; from 10 to 89 feet may be Bracklesham, the rest may be Bagshot, and from 148 feet down may be London Clay. On the other hand, all below 10 feet may be Bracklesham.

3. Messrs. Raikes and Cogswell. 1900.

Made and communicated by Messrs. Duke and Ockenden.

Water-level 85 feet down.

Well, the rest bored	38	210 feet.
Clay and sand ...	172	

Sway.

Geol. Map 330, new ser.

1. QUARR LODGE or COOKHAM FARM, North Sway, about half a mile N. of Sway Station. 1904.

Communicated by Mr. H. ST. BARBE.

In field 17, Sheet 79, 12, Ordnance Map 25-in. scale.

	Thickness. Feet.	Depth. Feet.
Soil	1	1
Gravel and subsoil	4	5
Mottled clay	6	11
White sandy marl	6	17
Stiff mottled clay	12	29
Grey sand...	1	30
Tawny sand	10	40
Mottled clays, from olive green to grey	15	55
Grey loamy sand, rapidly weathering white on exposure	118	173

No water met with after passing the sand 30 to 40 feet down.

2. For Mr. B. HAGEN. 1896.

Bored and communicated by Messrs. DUKE and OCKENDEN.

Water-level 30 feet down.

[Drift.]	Gravel	8	
[? Headon Beds.]	Sand and clay ...	40	55 feet.
	White marl ...	5	
	Black marl ...	1	
	Grey sand ...	1	

Tangley.

Geol. Map 283, new ser.
(From the Memoir thereon, 1908.)

The FOXHOUNDS INN, 550 feet above Ordnance Datum.

Made and communicated by Mr. C. ALDERMAN.

Water burst through at the bottom.
Soft (Upper) Chalk, with few flints, to rock, 240 feet.

Timsbury.

Geol. Map 299, new ser.

SOUTH HANTS WATERWORKS.

Information from Mr. W. MATTHEWS.

Rest-level of water about 67 feet above Ordnance Datum. Supply, about 1½ million gallons a day.

An oval well 13 × 6½ feet, and a circular well of 6 feet diameter, both 87½ feet deep, and connected at the bottom by a short heading. Surface level, 84½ feet above Ordnance Datum.

Another circular well of 12 feet diameter, 100 feet deep, and connected by a heading about 80 feet long with the 6-foot well, near the bottom. Surface-level, 87½ feet above Ordnance Datum.

About 660 feet of headings, at a depth of 70 feet, and 460 feet of headings, at a depth of 92 feet, are connected with the 12-foot well.

The works are wholly in Upper Chalk.

Mr. J. S. BURNETT gave me the following records, in 1891. Rest-level of water, from 15 to 18 feet down. Yield, about 30,000 gallons an hour.

Mr. W. E. DARWIN told me that a bore-hole was made on the slope to the north, below the large reservoir at Michelmersh. It passed through 30 feet of clay and then 20 feet of sticky chalk. A deep boring was also made at the works.

An analysis of the water is given on p. 207.

Titchfield.

Geol. Map 316, new ser.

1. Dr. Hoare's Brewery, at the western end of the village.

Made and communicated by Mr. W. Hill.

Nearly 23½ feet above Ordnance Datum.

Plenty of water, from above the London Clay. Good at first, but got unsatisfactory, probably from access of top water.

		Thickness. Feet.	Depth. Feet.
Shaft, the rest bored. Bore-pipe carried up more than half-way		—	20
[? Bracklesham Beds.]	Blue loamy sand	35	55
	Blue clay	5	60
[? Bagshot Sand.]	Grey sand and black [flint] pebbles ...	15	75
[London Clay, 95 feet.]	Blue clay, with claystone from 98 to 99	49	124
	Blue clay, with black [flint] pebbles ...	2	126
	Blue clay, with 8 inches of very hard sandy clay at 135, and a little sandy at 140	44	170

The Bagshot Sand seems to be unusually thin, and ought to be twice as thick. The layer of flint-pebbles in the London Clay agrees with what was seen in the railway-cutting between Titchfield and Fareham, where two such layers were seen, separated by a few feet of clay.

2. Stubbington House.

Made and communicated by Mr. W. Hill.

Cylinders 52½ feet, the rest bored.

Nearly 40 feet above Ordnance Datum.

Good supply and of good quality.

		Thickness. Feet.	Depth. Feet.
Mould		2	2
[Drift, 8 feet.]	Brickearth	5	7
	Gravel	3	10
[Bracklesham Beds, 163½ feet.]	Yellow sand	3	13
	Peat [lignite?]	1½	14½
	Blue sandy clay	25½	40
	Sand	1	41
	Sand and clay	8	49
	Hard clay...	1½	50½
	Sandy clay	19½	70
	Dark sand	30	100
	Sand and clay	20	120
	Sandy clay	13	133
	Hard blue clay	17	150
	Sandy clay	4	154
	Hard clay with shell, the bottom 2 feet, with black [flint] pebbles	19½	173½
[Bagshot Sand, 25½ feet.]	Sand and clay	6½	180
	Sand	14	194
	Undescribed	1	195
	Fine sand, with water	4	199
[London Clay, 166 feet.]	Hard blue clay. A little sandy at top. A foot of black [flint] pebbles at 225. A little sandy next below. With shells from 250 to 255. 8 inches of stone [septaria] at 272. 2 feet of black [flint] pebbles at the bottom... ...	88	287
	Sandy clay	10	297
	Hard clay, with small shells. Black [flint] pebbles in the top 5 feet ...	68	365

Twyford.

Geol. Map 299, new ser.

SOUTH HANTS WATERWORKS.

Information from Mr. W. MATTHEWS. (1909.)

125 feet above Ordnance Datum.

Two wells, 24 feet apart, both 130 feet deep. Lined with iron-cylinders of 10 feet diameter for 45 feet; the rest 9 feet and 8 feet in diameter unlined. All in Chalk. Connected by a heading 127 feet down.

Rest-level of water, about 96 feet above Ordnance Datum.

Yield, 830,000 gallons a day.

For an analysis of the water *see* pp. 208, 209.

Upham.

Geol. Map 316, new ser.

WINTERSHILL HOUSE. 1891.

Specimens and information from Messrs. DUKE & OCKENDEN. Old well, and new boring.

		Thickness. Feet.	Depth. Feet.
London Clay.	Specimens of brownish-grey sandy clay and clay, from 73 to 172 feet, with carbonaceous matter at 150 and bit of pyrites at 170; buff calcareous earth at 181; grey clay at 186	190	190
[Reading Beds.]	Mottled clays of various colours and tints (purplish, grey, brown, red, crimson, puce, maroon). Specimens at 196, 197, 201, 202, 207, 211, 212, 215, 216, 220 (last 6 a trifle sandy), 223, 226, 230, 236 (these 4 rather pure clays), 242 and 243; (pale-grey clayey sand, compacted), 250, 260 ...	74?	264
[Reading Beds with admixture of Chalk.]	Pale greenish-grey slightly sandy clay, with whitish earth in part (which, with the clay near is calcareous), at 264	1?	265
	Brownish and grey clay, with red spots, bits of chalk (?) and of flint; calcareous at 265		
Chalk.	Specimens at 269, 274, 278		
[Mixture of Chalk with a little earth.]	Cream-coloured calcareous earth. Specimen at 285		
	Light-brownish clay, calcareous, ? with wee bits of chalk; specimens at 286, 287, the latter more chalky		309?
	Impure chalk, or chalk mixed with a little earth; specimens at 290, 295, 300, 305		
[Mixture of clay with Chalk.]	Buff calcareous clay, with very small bits of chalk; and brown and buff calcareous clay, with bits of chalk; specimens at 309		

The lower part of the section is very difficult to understand, there being no likeness to any of the older Tertiary beds, and the mixture with chalk being unique.

Vernhams Dean.

Geol. Map 283, new ser.

The first three apparently in the village, in the valley-bottom.

From the Memoir on the Geology of Andover, 1908; all made and communicated by Mr. C. ALDERMAN.

1. In the VILLAGE. 440 feet above Ordnance Datum.

Water rises to near the top, where the springs are, and have been known to overflow.

Soft (Middle) Chalk, with few flints, 120 feet.

Vernhams Dean—*cont.*

2. Near the "George Inn."

Sometimes runs and sometimes dry.
Soft (Middle) Chalk, with few flints, 20 feet.

3. "New Inn," Woodside. 443 feet above Ordnance Datum.

Water rises to 10 feet from the top when the springs are high.
Soft (Middle) Chalk, with few flints, 138 feet.

4. Little Down, close to the Chapel.

650 feet above Ordnance Datum.
Often dry.

(? All Upper Chalk, 252½ feet.)	Chalk, with few flints ...	120 feet.	
	Rock	1½ „	
	Soft chalk		131 „
	Rock		
	Soft chalk		
	Rock		

5. Vernham Street. In the Village, 550 feet above Ordnance Datum.
(Upper) Chalk, 210 feet.

Weston.

Geol. Map 315, new ser.

By Woolston. Vicarage, by the Southern side of the Churchyard.

Communicated by the Rev. G. W. Minns.

About 75 feet above sea-level.
Shaft 36 feet, the rest bored. Not successful.

		Thickness. Feet.	Depth Feet.
Gravel		10?	10
[Bracklesham Beds.]	Loam, with 6 inches of sandy rock at the base	26?	36
	Blue stiff clay	8	44
	Sandy loam	6?	50

Weyhill. 1881.

Geol. Map 283, new ser.

From Messrs. Le Grand & Sutcliff.

Water-level 35 feet down.
Chalk and flints, 80 feet.

Wickham.

Geol. Map 316, new ser.

1. Cold Harbour, about ⅞ of a mile W.N.W. of the church. 1895.
Made and communicated by Mr. Conway, of Wickham (through Mr. N. C. H. Nisbett).

		Thickness. Feet.	Depth Feet.
[Bracklesham Beds?]	Old well. Sandy bottom	—	90
	Sandy clay	20	110
	Sand, as above	3	113
	Red clay...	2	115
	Blue clay with sandy veins	2	117
	Clay	8	125
	Clay, but more loamy and with large pebbles (2 or 3 inches diameter) ...	5	130
	Clay, as above, but browner, and with iron-pyrites	27	157
	Clay, as above, but with small pebbles	8	165
	Rather darker, with pebbles and sand	2	167
	Clay, like the 27 feet bed, above ...	3	170
Black [Bagshot] Water	Sand, with irregular angular [?] pebbles.	1	171

Wickham—*cont.*

2. Mr. Murphy's.

Made and communicated (1901) by Messrs. Isler and Co.

130 feet of tubes, of 4 inches diameter, 22 feet down.
Water-level 102 feet down.

		Thickness. Feet.	Depth. Feet.
Well (? old ; the rest bored)		—	25
[London Clay.]	Blue lias and marl ...	8	33
	Marl	28	61
[Reading Beds, 102 feet.]	Mottled clay	10	71
	Brown marl	17½	88½
	Dead green sand ...	6½	95
	Live sand	10	105
	Mottled clay	33½	138½
	Mottled clay and marl ...	8½	147
	Mottled clay	12½	159½
	Green sand	1½	161
	Flints	2	163
[Upper Chalk.]	Hard marl	2½	165½
	Marl-rock	1½	167
	Chalk and flints ...	38	205

Winchester.

Geol. Map 399, new ser.

Waterworks. 1847.

Particulars from Water Works Directories, 1907 and 1909.
Wells and borings in hard Chalk.
Yearly supply 253,727,000 gallons (259 millions, in Directory of 1909). Maximum day's supply, in July 1906, 800,000.
District of supply, besides the city, Avington, Headbourne Worthy, Itchen Abbas, Kingsworthy and Martyr Worthy.
An analysis of the water is given on p. 210.

Winchfield.

Geol. Map 284, new ser.

1. Brewery (late Messrs. Cave's).

E. Spon's "Present Practice of Sinking and Boring Wells," p. 189, London, 1875, * Ed. 2 (1885), p. 236, and from Mr. T. Docwra.
Shaft (and cylinders) 124¾ feet, the rest bored.

		Thickness. Feet.	Depth. Feet.
Made earth and soil		350	350
Gravel			
[London Clay.]	Blue clay, with a bed of dead sand, 6 feet thick, 102¾ feet down ...		
	[Basement-bed.] Dark sandy clay...	3	353
	[Basement-bed.] Black pebbles ...	2	355
[Reading Beds.]	Coloured [mottled] clay	5	360
	Stone (septaria ?)	2	362
	Coloured clay	22	384
	Coarse shifting sands	7	391

2. Brickyard, about a quarter of a mile S.S.W. of the railway station.

Information got by Mr. J. H. Blake.

About 5 feet of water. Little variation in level.

Bracklesham Beds.	Clay	4	25 feet.
	White and yellow sand	21	

* A great amount of information in this book was taken from a Geological Survey Memoir (vol. iv), but without further acknowledgment than as from a "Government Report."

Winchfield—*cont.*

3. London and South Western Railway, western end of Shapley Heath cutting.

Information got by Mr. C. Reid.

Lower Bagshot Beds. Fine sand, 25 feet.

According to a MS. note left by Sir J. Prestwich a well here was 70 feet deep, in sand.

Woodgreen (north-eastward of Fordingbridge).

Geol. Map 314, new ser.

Two wells. Sunk and communicated by Mr. Hobbs.

1. At eastern end of Common. 2½ feet of water.

Gravel	18	35 feet.
Light-coloured sand [Bagshot]...	17	

2. At south-eastern end of Common. 3 feet of water.

Gravel ...	13	22 feet.
Blue clay ...	9	

Wootton St. Lawrence.

Geol. Map 284, new ser.

Woodgreen Farm, Upper Wootton.

Information got by Mr. C. E. Hawkins.

Chalk 322 feet. About 17 feet of water.

Yateley, Minley.

Ordn. Map 285, new ser. Geol. Map 8.

Light-coloured (buff) fine sand...	? 26
Darker and firmer sand	? 14
At 30–50 many lumps, same kind of sand, buff; all clogged, as if clayey, but drying to sand.	

All about here coloured as Bracklesham Beds on the map; but this looks more like Bagshot Sand.

Locality doubtful.

Daneshill. Near Basingstoke. Mr. W. R. Hoare's.

Made and communicated by Mr. F. W. Ockenden.

		Thickness. Feet.	Depth. Feet.
[Reading Beds.]	Well sunk in sand and clay (the rest bored)...	36	36
	Mottled clay	16	52
	Dark green sand and chalk	6	58
Chalk		44	102

Wimborne (Dorset).

Geol. Map 329, new ser.

Bournemouth Waterworks.

1. Trial-boring. Lined to 108½ feet. 1895.

F. S. Cripps, *Water*, vol. vii., 1906, pp. 265, 266.

To chalk, through gravel, clay, sand and flints	101	223 feet.
Chalk	122	

At the depth of 123½ feet "it was found that the water when pumped out to a depth of 25 ft. from the surface took two and a-half hours to rise to the natural level, or about 4 ft. below the ground line. On reaching 173 ft. . . a pump was lowered to 105 ft., and the yield proved to be 103,500 gallons per day. The

Wimborne—*cont.*

boring was then continued to the full depth. . . The pump was lowered to 200 ft., but it was found that by working the pump to its utmost capacity, the water could not be exhausted. The pump was after various experiments at different levels finally raised to 75 ft., where it just drew air when yielding about 220,000 gallons per day. From observations made during the boring into the chalk, it was concluded that the greatest . . increase in the yield, took place shortly before arriving at the full depth, the chalk removed appearing to be much softer. This yield of nearly a quarter of a million gallons when pumping from a depth of less than 100 feet . . was considered eminently satisfactory, and indicated that a very plentiful supply . . was to be obtained by sinking a well and driving headings."

2. Well. Started 1896. Same authority, pp. 266–269.

Cast iron cylinders 11 feet diameter to 62 feet, then 10 feet diameter? to depth of 106; feet then 9 feet diameter to depth of 167 feet. Well continued to depth of 210 feet. Then trial-boring of 6 inches diameter 45 feet further. Well finished 1899.

Headings begun March 1899 at depth of 195 feet, about 6 feet high and 4 wide, to west and north-east. By end of June they were 800 feet long, with a yield of over 1¼ million gallons a day. Several short branch-headings were driven, where fissures appeared likely. These yielded a fair supply of water, which was much increased by the trial-boring, of 21 inches diameter, which was cut into by the western heading.

From an examination of the beds as the headings proceeded it was inferred that at a higher level the chalk would be less compact and the fissures more open and frequent. Headings were started 155 feet down in July 1899. After driving 150 feet a large quantity of chalk fell in, at the end, and it was decided to run two headings, to the north-east and south-west, at a point 120 feet from the well.

By November the upper headings were 786 feet long and the water from them was about 1,620,000 gallons a day.

For the purpose of ventilating both sets of headings, two borings of 6 inches diameter were made, and these resulted in an extra yield. They were finished in January 1900.

The north-eastern heading was then extended, and on March 15, the water in the well standing at 172 feet down, the yield was about 1,800,000 gallons a day.

Both headings were then extended and three more borings were made, and finished on July 15.

Ultimately Mr. Cripps estimated that the yield would be about 3,000,000 gallons a day.

"Every time a breakdown occurred the water rose to within 4 ft. of the top of the well, and a curious phenomenon was observed at the unplugged boring No. 3. After the water had risen in the well to a certain height above the upper headings, water was ejected like a water spout to a height of about 40 ft. in the air from the borehole, and this would continue for about 10 minutes."

		Depth. Feet.
[River Drift.]	Ballast	7½
	Sand-ballast	12¾
[? London Clay and Reading Beds, 84 feet.]	Coloured clay	22
	Yellow clay	30
	Blue clay	37½
	Grey sand	42
	Blue clay	46
	Sandy blue clay	56
	Grey sand	96
	Flints	96¾
[Upper Chalk.]	Soft chalk	
	Hard chalk, with flints at 181½ to 182 ...	
	Chalk	256

An analysis of the water is given on p. 212.

WELLS AND BORINGS FOR WATER.
ISLE OF WIGHT.

The special Isle of Wight Map of the Geological Survey of course includes all these sites; but some, in the northern and central parts of the island, are also in sheets 330 and 331 of the new series.

In the latter case only are the maps entered under the names of places.

Bembridge.

Geol. Map 331, new ser.

1. Bembridge Hotel.

R. F. Grantham. *Trans. Surveyors' Inst.*, vol. xx., pt. v., p. 144, plate. (1888.)

23¾ feet above Ordnance Datum.

Shaft 70 feet, the rest bored.

Water-level, 24½ feet down. Yield 2,200 gallons in 12 hours.

		Thickness. Feet.	Depth. Feet.
[Bembridge and Osborne Series.]	Brown and blue clay [no details] ...	70	70
	Clay	5	75
	Stone	2	77
	Mixture of sand	12	89
	Light-coloured sand	4	93
	Stone	2½	95½
	Dead grey sand	4½	100
	Coloured [mottled] clay	36	136
	Stone	1	137
	Blue clay with shells	10	147
	Blue clay with sand	3	150
[Headon Beds.]	Rock	2½	152½
	Green sand	3½	156
	Clay and stone	5½	161½
	Green sand	1	162½
	Sandstone	2½	165
	Green sand	½	165½
	White marl	3½	169
	Green sand with clay	6	175
	Purple clay	23	198
	Clay and shells	22	220
	Green clay	3	223
	Small shells	7	230
	Dark green clay	6	236
	Light-coloured sand	6	242
	Hard rock	2¾	244¾
	Sand	2¼	247
	Brown clay	2½	249½
	Hard rock	3	252½
	Black clay and shells	4	256½
	Mixture of sand	2½	259
	Light-coloured sand	4	263
	Rock	1	264

The Bembridge Limestone was probably reached at about 35 feet, but no record has been kept of the beds passed through in the shaft.

Bembridge—*cont.*

2. STEYNE HOUSE, Bembridge Cross. 1902.
Made and communicated by Messrs. ISLER & CO.
Water-level, 100 feet down.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
[? Bembridge Marls and Limestone.]	Brown clay	4	0	4	0
	Blue clay	4	0	8	0
	Sand and clay	0	6	8	6
	Brown mottled clay	15	6	24	0
	Black clay	8	0	32	0
	Light-brown rock	0	6	32	6
	Blue clay and shells	3	0	35	6
	Blue clay	5	0	40	6
	Blue mottled clay	46	6	87	0
	Red mottled clay	10	0	97	0
	Loamy clay	2	6	99	6
	Grey rock	0	6	100	0
	Red mottled clay	3	6	103	6
	Blue mottled clay	3	0	106	6
	Brown mottled clay...	3	0	109	6
	Dark blue clay	10	6	120	0
	Grey rock	10	0	130	0
	Grey clay	3	0	133	0
	Black clay	2	6	135	6
	Blue rock	3	6	139	0
	Light-grey stone	3	0	142	0
	Blue rock	3	0	145	0
[Osborne and Headon Beds, 311 feet.]	Black clay	2	6	147	6
	Blue rock	2	0	149	6
	Black mottled clay	5	0	154	6
	Brown mottled clay...	5	6	160	0
	Blue rock	2	6	162	6
	Red mottled clay	6	6	169	0
	Green clay	4	6	173	6
	Bembridge stone	1	0	174	6
	Green clay	14	6	189	0
	Red mottled clay	1	0	190	0
	Blue and red clay	3	0	193	0
	Brown clay	7	0	200	0
	Grey clay	23	0	223	0
	Green clay	18	0	241	0
	Light-coloured fine sand	1	0	242	0
	Blue clay	4	0	246	0
	Blue rock	15	0	261	0
	Brown mottled clay	15	0	276	0
	Red mottled clay	5	0	281	0
	Green clay	3	0	284	0
	Clay and shells	3	0	287	0
	Dark sand	3	0	290	0
	Blue mottled clay	3	0	293	0
	Red clay	3	0	296	0
	Blue clay	8	0	304	0
	Light-blue clay	13	0	317	0
	Dark-blue clay	69	0	386	0
	Brown rock	3	0	389	0
	Black clay	17	0	406	0
	Brown loamy clay and shells ...	16	0	422	0
	Black clay and shells	20	0	442	0
	Blue clay	14	0	456	0
[Barton Sands, 244 feet.]	Sandy rock	10	0	466	0
	Light-coloured clay	1	0	467	0
	Sandy rock	92	4	559	4
	Blue rock	0	8	560	0
	Light-coloured sandy rock ...	42	0	602	0

Bembridge—*cont.*

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
[Barton Sands, 244 feet]—*cont.*	Blue sandy rock	34	0	636	0
	Grey sandy rock	20	0	656	0
	Sandy clay	24	0	680	0
	Light-coloured rock	0	1	680	1
	Light-coloured sand	20	0	700	1
[Barton.]	Dark blue clay	18	11	719	0

The depth of the blue rock below 147½ feet is given as 149. The inches in the last three beds are given as 5, 5, 4, in the column for depths.

Mr. C. Reid, who examined samples, feels doubts as to whether the marine Middle Headon has not replaced the Lower Headon, and whether the bottom bed is true Barton Clay. He would classify the beds as follows :—

Bembridge Marl to 120 feet; Bembridge Limestone to 139; Osborne and Upper Headon to 283; Middle Headon to 441; Lower Headon to 445; Barton Sand to 700; and Barton Clay.

He also suggests that the great thickness of the formations may be owing to the site being in the curve of the beds toward Whitecliff Bay, where they are thinner (from squeezing?).

3. Waterworks. Home Farm, two-thirds of a mile N.W. of Bembridge Cross. 1904.

Cylinders 20 feet, the rest bored and lined the whole depth, the pipes perforated from the bottom up to 455 feet from the surface.

Bored by Mr. Thos. Parsons. Samples communicated to C. Reid. (The depths of these in brackets).

Very good supply rising to within 6 inches of the surface. Pumping going on at the rate of 700 gallons an hour and could not get ahead of the water with the pumps in use (Jan. 5, 1891).

		Thickness. Feet.	Depth. Feet.
[Bembridge Marls.]	Mottled Clay (48, 50), [? part Alluvium]	51	51
[Bembridge Limestone.]	White shelly limestone (51) ...	1	52
[Osborne and Headon Beds 250 feet.]	Loamy sand (52)	4	56
	Sand (56, 61)	7½	63½
	Calcareous grit (63½, 66, 71)	10½	74
	Sand and sandstone with pyrites (74, 75, 76, 78, 89, 93)	21	95
	Mottled clays (95, 98)	4	99
	Calcareous sandstone, shelly	2	101
	Mottled clays (101, 104, 106, 107, 108, 115, 116, 117, 120, 124)	24	125
	Grey clay (125, 126)	3	128
	Brown earthy limestone [? nodule] (128)	1	129
	Light-grey shelly marl (129)	7	136
	Grey clay (136)...	4	140
	Grey sand (140)	1	141
	Grey clay (141)...	4	145
	Crushed ironstone or septarian nodule (145)	½	145½
	Grey clay (145½, 146)	1½	147
	Green and brown clays (147, 149, 150, 154, 155)	9	156
	White limestone (156)	2½	158½
	Green and brown clay (158½, 161, 162)	4½	163
	Pinkish limestone (163)	1	164
	Green clay (164)	1	165
	Cream-coloured limestone (165) ...	2	167
	Light-green sandy clay (167)	2	169
	Green clay (169)	4	173
	Red clay (173)	3	176
	Green sandy marl (176)	½	176½
	Calcareous sandstone or sandy limestone (176½)	1	177½

Bembridge—*cont.*

		Thickness. Feet.	Depth. Feet.
[Osborne and Headon Beds 250 feet]—*cont.*	Mottled clays (177½, 179, 182, 184, 186, 187)	10½	188
	Light-grey sandy marl	1	189
	Green clay	2	191
	Hard sandy and shelly limestone (? ½ seam)		191
	Greenish sandy clay (199)	11	202
	Brown shelly marl (202)	3	205
	Earthy limestone (205)	1	206
	Green and brown clay (206)	½	206½
	Greenish shelly marl (206½)	1	207½
	Brown earthy limestone (207½) ...	½	208
	Pale green sandy marl (208)	2	210
	Shell-limestone (210)	11 (?)	221
	Green and brown shelly marls (221, 225, 226½, 227, 228, 229, 232, 233)...	13	234
	Whitish clay (234)	1	235
	Fine sand with shells (235)	1	236
	Blackish sandy clay with shells (236)	1	237
	Green and brown clay (237)	5	242
	Concretionary shelly limestone (242)...	1	243
	Calcareous sandstone (243)	½	243½
	Buff sand (243½)	2½	246
	Blackish purple clay (246)	1	247
	Mottled green and white sandy clay with shells (247)	2	249
	Black shelly clay (249, 250, 251) ...	3	252
	Mottled green and brown clay (252) ...	1	253
	Black shelly clay (253)	½	253½
	Mottled green and brown clay (253½)	4½	258
	Green clayey sand (258)	1½	259½
	Fine grey sand (259½)	1½	261
	Grey shelly sand (261)	8	269
	Greenish sandy clay, *Cytherea incrassata* (269)	1	270
	Blackish clay and shells (270) ...	4	274
	Sandy clay and shells (274, 276, 280)	8	282
	Stiff blue clay, full of shells (282, 284, 286, 287)	7	289
	Grey sandy clay, full of shells (289) ...	13	302
	Hard grey sandy limestone and shells (concretion, 302)		

Boring made by Messrs. C. Isler and Co. Communicated by Dr. H. F. Parsons.

A continuation of the above.

Yield. 120,000 gallons per 24 hours pumping; overflows when pumps are at rest, but reduced 40 feet by pumping. September, 1904.

	Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Existing borehole ...	300	0	300	0
Blue silt	9	0	309	0
Blue stone with shells	40	3	349	3
Green mottled clay ...	4	0	353	3
Stone and shells ...	2	6	355	9
Green mottled clay ...	18	0	373	9
Dark clay	2	6	376	3
Hard stone	14	6	390	9
*White sandstone ...	56	9	447	6
Sandy clay	1	6	449	0
Sandstone	45	0	494	0
Loamy green sand ...	22	3	516	3

* There seems to be some error here, the depth being given as 456½ feet, and this addition of 9 feet continues downward, the total depth being given as 525¼ feet.

Bembridge—*cont.*

A number of shells obtained from this borehole were chiefly *Cerithium elegans*.—H. F. P.

For an analysis of the water *see* p. 213.

Brading.

Geol. Map 331, new ser.

ISLE OF WIGHT BREWERY CO. (late YARBRIDGE STEAM BREWERY.) 1898.
Between the road and the railway, just S. of the road to Bembridge.

Bored and communicated by Messrs. DUKE and OCKENDEN.

The top is 6 feet below road-level.

Dug well 17 feet. Bored to 134. Lined from the surface with 117 feet of tube, of 4½ inches diameter.

Water-level 14 feet down.

		Thickness. Feet.	Depth. Feet.
Gault.	Strata not known (the well in this formerly gave the supply to the brewery, but the supply gave out, in 1898 ?)	22	22
	Blue clay	6	28
Carstone, very little water.	Brownish-yellow clay with sand intermixed	20	48
	Blue clay with brown clay intermixed	10	58
	Grey sand and clay	4	62
	Yellow sand and clay	21 (? 31)	93

The dip is probably about 40°, and therefore the thickness of the beds is exaggerated. Lower beds not noted?

Carisbrook.

Geol. Map 330, new ser.

NEWPORT WATERWORKS.

About 58 feet above Ordnance Datum.

Information from Dr. T. THOMSON's Report on Newport, Local Government Board, 1895.

At that time the supply was got from springs and from wells in the Chalk, at the eastern end of the village, the springs being near the wells (*see* p. 42).

There were two wells about 30 feet apart. The old well was sunk in 1876 and is 23 feet deep and 6 feet in diameter, with a bore-hole of 18 inches diameter to 20 feet further down. The new well, outside the engine-house, was sunk in 1891 and is 27 feet deep (the diameter decreasing from 8½ to 6½ feet) with a boring to a further 80 feet, of 18 inches diameter for 30 feet, the rest of, 15 inches. The two wells are united by a syphon.

The amount supplied from the wells averaged about 339,000 gallons a day in the week ending 4th November, 1894.

When at the works I was told that the water was pumped down 10 feet, but soon rose again (to the surface) on the cessation of pumping, and that the supply was abundant.

Dr. THOMSON came to the conclusion that the water was liable to contamination from cess-pits, &c., and from the mill-pond just above the works, the water of that pond being fouled in various ways. Such contamination was facilitated by the very small amount of protection that had been given to the wells.

An experiment made by Mr. B. LATHAM about the end of November, 1894, showed that after "a considerable quantity of chloride of lithium was thrown into the mill-pond at various points . . lithium was found in the water of the low-level reservoir and in the water of the 'old well'; none was discovered in the water of the 'new well' (protected by iron cylinders). . . It is evident, then, that water on or near the surface of the ground might gain access to at least two out of the three sources of Newport supply," the old well and the springs in the reservoir.

Carisbrook—*cont.*

According to the Water Works Directory, 1909, the maximum day's consumption is 750,000 gallons.

For analyses of the water *see* p. 214.

Chale.

For Public Supply. N.E. of the church.

Communicated by the Local Government Board.

About 500 feet above Ordnance Datum.

Water-level, before pumping, over 461 feet above Ordnance Datum, after pumping about 455. Returned to original level in 1¼ hours after pumping ceased. Yield 12,000 gallons in 24 hours.

Wells 47 and 49 feet in Upper Greensand. *See* also under Analyses, p. 215.

Cowes, *see* West Cowes.

Freshwater.

Geol. Map 330, new ser.

1. Golden Hill Fort.

Communicated by Messrs. Docwra.

Water-level, 95 feet down.

94 feet to bottom of shaft, the rest is bored.

			Feet
[Osborne Beds ? 74 feet.]	Light-red clay	All thin beds ...	6
	Light-coloured clay ...		
	Dark red clay		
	Yellow clay		
	Red clay and shells ...		
	Light-coloured stone ...		
	Light-coloured loam ...	Thicker beds ...	44
	Brown clay		
	Light-coloured loam ...		
	Light-blue clay		
	Brown loam		
	Light-blue clay and shells		
	Blue mottled clay ...		
	Rock and shells		
	Shells		
	Black sand and shells ...		
	Light-red clay		
	Dark-blue clay		
	Light-blue clay		
	Light-red clay	Thick beds	24
	Light-blue clay		
	Red mottled clay... ...		
[Headon Beds, 99½ feet.]	Brown clay and shells ...	Thin beds	22
	Light-coloured rock ...		
	Light-coloured loam ...		
	Light-blue clay and shells		
	Blue clay		
	Blue mottled clay (dark)		
	Light-coloured loam ...		
	Shells		
	Blue clay and shells ...		
	Rock and shells		
	Blue clay and shells ...		
	Shelly stone		
	Light-coloured clay ...		
		Carried forward ...	96

Freshwater—*cont.*

			Feet.
		Brought forward ...	96
[Headon Beds, 99½ feet]—*cont.*	Mottled loam	Moderately thick ...	50
	Green loam		
	Brown loam		
	Stone		
	Green loam		
	Sand-rock...		
	Mottled loam		
	Dark sand...		
	Brown sand and clay ...		
	Brown clay and sand ...		
	Brown sand		
	Blue clay and sand ...		
	Dark sand...		
	Blue loam...		
	Black sand	Thinner beds ...	24
	Dark sand...		
	Stone		
	Blue clay		
	Black sand		
	Black sand and shells ...		
	Blue clay		
	Black sand		
	Sand		
	Blue clay		
	Yellow mottled clay ...		
	(Bed, not named) ...		
	Black clay	Thin beds	3½
	Limestone...		
	Light-green clay		
	Dark green clay		
		Total	173½

Another account makes the depth to the water-level 85 feet, and the total depth 193½ feet.

2. Freshwater and Yarmouth Waterworks.

On the eastern side of the Afton road, by the edge of the Marsh, an eighth of a mile from the sea.

Information from Mr. E. T. Hildred.

Well in chalk, 13 feet 4 inches deep, and 12 feet in diameter.

Water-level about the same as in the Marshland, which is influenced by the tide. *See also* pp. 50, 51, and for analyses, p. 217.

Gatcombe?

Geol. Map 330, new ser.

Lunatic Asylum. About 220 yards S.S.W. from centre of homestead, Whitecroft Farm, and therefore about two-thirds of a mile N.N.E. of church.

About 120 feet above Ordnance Datum.

Communicated by Mr. F. Newman.

Cylinders to 75 feet. Large quantity of water found; but it was thought well to cut off surface-water, and therefore a boring was made to the depth of 370 feet. A little water was found under a bed of black-clay and shingle (165 feet down), but none since. The great thickness of dark-blue and brown clays was notable.

Godshill.

WEEK'S FARM. 1881.

About 446 feet above Ordnance Datum.

Made and communicated by Messrs. LE GRAND and SUTCLIFF.

Water-level, 85½ feet down.

		Thickness. Ft. Ins.	Depth Ft. Ins
Dug well [the rest bored]. Top ground		—	2 0
[Upper Greensand.]	Rag stone	8 6	10 6
	Free stone	14 10	25 4
	Yellow sand ...	14 0	39 4
	Green sand	34 0	73 4
	Hard stone	7 4	80 8
	Green sand	2 6	83 2
	Sandstone	2 10	86 0
	Stone and sand ...	6 0	92 0
	Blue shale and stone	7 0	99 0
[Gault.] Black shale		31 0	130 0

Another account makes the depth 7 inches more, by additions of an inch and of six inches to the 3rd and 2nd beds from the base

Haven Street.

Geol. Map 331, new ser.

1. LONGFORD HOUSE.

From specimens communicated by Mr. TOWNEND. (C. REID.)

Old well 100 feet (no record), the rest a 10-inch bore (on Parsons' system).

At first yielded over 22,000 gallons a day, the water rising 12 feet above the ground. In July 1887 the water rose 9 feet above the ground after several hours pumping. In October 1887 the supply had fallen off greatly, the water not rising above the surface and being greatly lowered by pumping. The water is unpalatable and ferruginous. Temperature 55°.

		Thickness. Ft. Ins.	Depth. Ft. Ins.
Hamstead Beds (perhaps 40 feet). and Bembridge Marls (about 120 feet).	Old well (no record)	—	100 0
	Shelly blue and green clay	42 0	142 0
	Whitish marl	5 0	147 0
	Green clay	2 0	149 0
	White granular marl	1 0	150 0
	Shelly blue clay...	6 6	156 6
	Hard and soft whitish marl	3 6	160 0
	Black and green clay	1 6	161 6
	Bluish-white very shelly marl ...	2 6	164 0
[Bembridge Limestone.]	Grit and rotten stone, with much water	0 10	164 10
	Rock, very hard	2 2	167 0

For analysis of the water *see* p. 218.

2. Six chains north-west of the church.

From specimens and notes communicated by Mr. TOWNEND. (C. REID.)

Old well 30 feet, then bored to 378 feet.

No water obtained. [The term "slipper" is probably used for damp clay or loam.]

		Feet.
Hamstead Beds and Bembridge Marls.	Sand } old well : no record ...	about 20
	Clay } old well : no record ...	about 10
	Shelly blue slipper	at 130 to 208
Bembridge Limestone.	Hard earthy limestone with *Limnæa*	at 208 to 210

Haven Street—*cont.*

		Feet.
Osborne Beds and Headon Beds.	Blue and black slipper	to 230
	Sand (?)	at 249
	Blue shelly slipper	at 264
	Mottled yellow and white marl ...	at 278
	Stiff red clay	280 to 286
	Shaly slipper	290 to 320
	Yellow and green slipper	at 330
	Reddish slipper	at 343
	Reddish marl	at 350
	Greenish slipper and clay	at 357
	Rock, light blue	at 366
	Hard green sandy marl	at 368
	Spongy fine-grained grit	at 378

Owing to the destruction of the fossils it is impossible to fix the limits of the different beds in this boring. The sand in the old well is the bed at the base of the Middle Hamstead Beds. The limnæan Limestone is apparently the Bembridge Limestone. The boundary between the Osborne and Headon Beds is uncertain. (C. Reid.)

Newchurch.

Geol. Map 331, new ser.

Ryde Waterworks, Knighton. Established 1861.

Borings, from information and specimens (in No. 1) communicated by Mr. F. Newman, Borough Engineer.

1. South-eastern part of the Pumping Station, about 130 yards south of Knighton Mill. 1885. About 46 feet above Ordnance Datum.

Shaft 15 feet, the rest bored. Water at 53 feet, rose above the surface, but the tubes soon filled with sand. Water was again met with at 66 feet, and from this downward the sand was all wet. The greatest quantity was at 53 feet.

		Depth of Specimens in Feet.
[Alluvial Beds, about 12½ feet.]	Dark-grey (blackish) sand, with plant-remains	9
	Grey and brown dirty sand	10
	Dry. Pieces of chalk, a little grey clay and pieces of flint	11
	Moist. Grey and brownish sandy clay, with green sand, plant-remains and bits of flint	12
[Carstone. Base uncertain, about 40 feet.]	Brown gritty sand	12½
	Dry. Brownish-grey firm clayey sand ...	22
	Moist. Brownish-grey firm clayey sand. This and the above with small pieces of a more clayey character	40
	Moist. Brownish-grey clayey sand	44
	Brown clayey sand, with quartz grains and small pebbles; only slight differences in the specimens	45, 46 49, 50
	Brown and grey clayey sand, like the above but finer, partly hard, with a trace of plant-remains...	51
	Described as stony and with water at great pressure. Specimen brown firm clayey sand with quartz grains	53
[Sandrock Series, about 57 feet +.]	Dry. Grey and greenish-grey firm clayey sand	56
	Described as moist Greensand, as also are the beds below. Specimen grey and blackish firm clayey sand	66
	Grey firm clayey sand, with quartz grains and pebbles	74

Newchurch—*cont.*

		Depth of Specimens in Feet.
[Sandrock Series, about 57 feet +] —*cont.*	Greenish sand	78
	Green clayey sand	82
	Fine grey sand	91
	Loose light-grey fine sand	101
	Fine grey sand	110

2. Just north of the Engine-house, 1885

About 45½ feet above Ordnance Datum

Gault, to Lower Greensand, with water, 46 feet.

The boring at the mill, of which a note follows this, is 185 feet to the north. The difference of level of the bottom of the Gault in the two borings shows a northerly dip of between 16° and 17°, supposing that the inclination is uniform: it probably increases northwards.

3. Boring in the Mill, 1885. Floor of mill 48 feet above Ordnance Datum.

Gault, mixed with sand at 101 feet below the floor of the mill. At 120½ feet a specimen of clayey sand, with clay and small pebbles [? junction of Gault and Lower Greensand].

Water flowed up from the bottom, and, at the surface, seemed to have some head.

4. Well made in 1899.

Shaft about 60 feet, concrete about 4 feet. Total 65.

Boring, of 18 inches diameter, to the depth of 102 feet.

Water abundant. Overflows in winter. In summer, after pumping, rises to 6 feet below the ground. Lowest level pumped to, 41 feet down (at the rate of 450,000 gallons a day).

All Gault clay, with a hard layer at the base, to Lower Greensand

An older boring (1888?) said to be 606 feet deep and all in sand. ? Choked up, being of small diameter.

For analysis of the Knighton water *see* p. 218.

Newport.

Geol. Map 330, new ser.

1. Anchor Brewery, 3 wells.

Communicated by Mr. Lock.

	Ft.	Ins.
To rock	150	0
Rock ...	7	5

2. Gas Works.

Communicated by Mr. H. J. Ibbetson. Notes on specimens (in brackets) by Mr. C. Reid, who also classified the beds.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Made ground ...	... ...	12	0	12	0
Hamstead and Bembridge Beds.	Dark green clay	46	0	58	0
	Green and brown clay	14	0	72	0
	Dark green clay and thin beds of sandy limestone	16	0	88	0
	Fresh water marl	21	6	109	6
	Sandy limestone	2	0	111	6
	Shale	14	6	126	0
	Limestone (yellowish)	2	6	128	6
	Shale	15	6	144	0
	Sandy limestone	5	0	149	0
	Shale, thin beds of limestone	15	6	164	6
	Limestone	2	0	166	6
	Very hard shale...	2	6	169	0

Newport—*cont.*

		Thickness. Ft.	Thickness. Ins.	Depth. Ft.	Depth. Ins.
Bembridge Limestone		6	0	175	0
Osborne Beds.	Shale clay (hard)	19	0	194	0
	Limestone (white)	8	0	202	0
	Very hard shale and clay with two thin shell-beds	24	6	226	6
	Mottled clay, red and blue	67	6	294	0
Upper Headon.	Hard blue clay	11	0	305	0
	Tough red clay	5	6	310	6
	Mottled clays, red, blue and yellow ...	18	0	328	6
	Rag rock...	5	0	333	6
	Shelly limestone	5	0	338	6
	Mottled clay with thin green, yellow and red beds, limestone	4	0	342	6
	Blue clay, thin beds of rock	3	6	346	0
	Red clay (hard)	2	6	348	6
	Blue clay, thin bedded limestone ...	7	0	355	6
Middle Headon? 69½ feet?	Mottled clay, red and blue, thin bedded limestone	2	6	358	0
	Limestone, grey	3	6	361	6
	Mottled clay, red and blue, thin beds of limestone	5	0	366	6
	Mottled clay, red and blue and marl ...	5	6	372	0
	Mottled clay, red and blue, limestone, thin beds	15	0	387	0
	Dark blue clay, limestone, thin beds ...	3	0	390	0
	Rag rock...	1	6	391	6
	Hard blue clay	2	0	393	6
	Hard grey limestone with shale ...	3	3	396	9
	Clay (blue) with shells	4	9	401	6
	Limestone, grey, dark	1	2	402	8
	Hard blue clay and iron-pyrites ...	3	4	406	0
	Hard blue clay	3	2	409	2
	Limestone, very hard	7	10	417	0
	Green and blue shelly marl	3	0	420	0
	Hard white and green shelly marl ...	5	0	425	0
Lower Headon? 75 feet.	Hard green and brown mottled marl...	7	0	432	0
	Hard green marl	11	0	443	0
	Green and brown sandy clay	4	0	447	0
	Greenish very sandy clay	5	0	452	0
	Fine sand with green specks	5	0	457	0
	Brown and blue mottled clay (specimens, green sandy clay at 469 feet; hard brown and green marl at 470, 475, 478, and 482 feet)	27	0	483	0
	Sandy clay	2	0	485	0
	Sandstone (specimen green and brown marl, more sandy, at 485½ feet) ...	1	6	486	6
	Sandy clay (specimen green and white at 489 feet)	3	6	490	0
	Sandstone (specimen green sandy clay at 491 feet)	1	6	491	6
	Sandy clay (specimen green at 493½ feet)	2	6	494	0
	Very hard sandstone	2	0	496	0
	Hard clay	1	6	497	6
	Sandy clay and rock (specimen green and white marl at 498 feet) ...	0	6	498	0
Barton Sand, 14 feet.	Sandy clay and rock, thin beds ...	2	0	500	0
	Hard clay, black (specimen 502 feet)...	4	0	504	0
	Sandy clay (specimens, pale at 504 feet, fine sand with black specks at ? 512 feet)	8	0	512	0

Newport—*cont.*

3. Isle of Wight Union, on the eastern side of the high road, north of the town. 1897.

From section and samples communicated by Mr. John I. Barton to Mr. C. Reid.

Old well 260 feet, the rest bored.
Yield about 50,000 gallons in 24 hours.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Hamstead and Bembridge Beds?	Old well	—		260	0
Osborne Beds? 133 feet.	Light-grey tough clay	4	9	264	9
	Green shelly tough clay	12	0	276	9
	Red mottled clays	78	0	354	9
	Strong shaly blue marls	16	0	370	9
	Red and blue marl	23	0	393	9
Headon Beds? 162 feet 3 inches.	Limestone, hard white	2	0	395	9
	Red and green marl	4	0	399	9
	Fine-grained hard calcareous sandstone	1	6	401	3
	Tough blue clay with shells	30	0	431	3
	Red, brown, and green mottled clay, with shells	28	0	459	3
	Fine-grained hard calcareous sandstone	1	6	460	9
	Tough blue clay with shells	21	0	481	9
	? (unrecorded)	2	8	—	
	Fine-grained hard calcareous sandstone	0	4	484	9
	Sandy and shelly green clay	13	0	497	9
	Shelly sand and loam (water at 502) ...	5	0	502	9
	Tough blue clay full of shells, *Cytherea*	6	0	508	9
	Fine-grained hard calcareous sandstone	3	0	511	9
	Sandy clay with shells	4	0	515	9
	Clayey sand and shells (much water), *Serpula*, *Balanus*, *Mya*, *Cyrena*, *Cerithium*, *Pleurotoma*, *Planorbis*, fish otoliths	38	3	554	0
	Tough sandy green clay (no fossils) ...	2	0	556	0

4. Messrs. Mew and Co.'s Brewery.

From information and samples communicated by Mr. Arthur Kinder to Mr. C. Reid.

Surface 12 feet above Ordnance Datum. Well 138 feet, the rest bored. Temperature of the water 61·5°.

		Thickness. Feet.	Depth. Feet.
Hamstead and Bembridge Beds.	Clay, with thin rock at 26 feet and 90 feet (no samples preserved)	148	148
Bembridge Limestone		4	152
Osborne Beds, 107 feet.	Mottled clays	28	180
	Shell-limestone and green marl full of *Cyrena* at about 180 feet. Platy shale full of Ostracoda at about 180 feet. *Cyrena obovata* in green clay at about 200 feet [samples not marked with the depths]	20	200
	Mottled clays. *Cyrena* at 245 feet ...	59	259
Upper Headon Beds, 82½ feet.	Lead-coloured shelly clays	8	267
	Mottled green, red, and yellow clays ...	22	289
	Greenish sand	1	290
	Mottled dark-red and green clays ...	5	295
	Mottled green, red, and yellow clays ...	9	304
	Limestone	4	308
	Green clay	4	312
	Limestone. Lignite and turtle-bone at 313 feet	3	315
	Pale green, red, and yellow clays ...	26½	341½

Newport—*cont.*

		Thickness. Feet.	Depth. Feet.
Middle Headon Beds, 106½ feet.	Brown and green clays	2½	344
	Whitish marl and green soapy clay ...	3	347
	Darker green marl	1	348
	White marl, with indeterminable shells and fish-bones	2	350
	Lead-coloured clay and shell-marl ...	4	354
	Green clay	½	354½
	Lead-coloured clay with *Cyrena* ...	1½	356
	White chert [Fragments marked 356 feet]		
	Greenish marl full of *Cyrena*	3	359
	Pale green marl	2½	361½
	Green marl. *Potamomya*, *Cyrena*, *Serpula*	5½	367
	Dark-green and yellow marl. *Melania muricata*	3	370
	White shell-marl with indeterminable bivalves and fish-bones	5	375
	White marl and dark-green clay. *Potamomya*	3	378
	Green clay and ironstone nodule ...	1	379
	Lead-coloured shelly marl	1	380
	Dark-green shelly marl full of *Cyrena*	1	381
	Limestone or hard marl, full of indeterminable shell-fragments ...	7	388
	Hard shell-bed (pyrites)	1	389
	Hard flaggy sandstone with nodule ...	1	390
	Black sandy clay with shells	13	403
	Dark-green shelly clay with ironstone nodules. *Cyrena obovata*, *Paludina*, *Melania*, *Planorbis*, *Balanus*, and *Serpula* at 409 feet	6	409
	Lead-coloured shelly clays. *Cytherea incrassata*, *Melania ?* *Natica*, and *Balanus*	10	419
	Greenish and lead-coloured clay ...	1	420
	Green sandy clay. *Cytherea incrassata*, *Cyrena*, *Natica* at 420 feet	28	448
	Green sand and sandy clay. Water at 448 feet	13	461

5. Pyle Street Steam Mills.

Communicated by Mr. Taylor.

Clay, dry ...	70	149½ feet.
Clay, bored ...	75	
Soft marly rock	4½	

6. Round Pump.

Communicated by Mr. Lock.

Clay to rock, 140 feet.

7. South Street, corner of Archer Street.

Communicated by Mr. Lock.

To rock, 145 feet.

Newport—*cont.*

8. West Medina Cement Works.

Sunk and communicated by Mr. Parsons (to Mr. C. Reid who classified the beds).

Water, to the amount of 2,500 gallons an hour, found in the sandy clay from 368 to 376 feet down.

		Thickness. Feet.	Depth. Feet.
Hamstead and Bembridge Beds, 173 feet.	Clay with 5 beds of shaly rock } old	153	153
	Stone, with water ... ... } well	5	158
	Black and green clays	12½	170½
	Yellow and white marl	1½	172
	Limestone and marl	1	173
Bembridge Limestone		6	179
Osborne Beds, 113 feet.	Green and carbonaceous clays... ...	8	187
	Mottled red, green and yellow clays ...	26	213
	Hard fine-grained grit (concretion ?)...	—	213
	White and green clays	2	215
	Green and red clays	1	216
	Mottled green, yellow and carbonaceous clays	17	233
	Black clay	6	239
	Mottled clays, green, black, yellow, and brown	26	265
	Hard green clay with *Paludina* ...	½	265½
	Green clayey sand	1½	267
	Limestone	1½	268½
	Sand	½	269
	Rock	3	272
	Green clay	1½	273½
	Red clay...	4½	278
	Red and green clay	4	282
	Green clay	½	282½
	Sand rock	1½	284
	Light-green clay	2	286
	Blue clay	1	287
	Rock 1 foot 4 inches (sandy limestone) ... ... } Blue clay ... ... } Hard detrital limestone 3 feet 4 inches	—	292
Upper Headon Beds, 64¼ feet.	Light-green clay	¾	292¾
	Limestone	1¼	294
	Light-green sandy clay...	2½	296½
	Limestone	2½	299
	Dark green clay...	1	300
	Black peaty substance	1½	301½
	Green clay	4½	306
	Limestone	2	308
	Red, green and mottled clays	21	329
	Green clay and ¼-inch concretionary limestone	2	331
	Dark green clay...	¾	331¾
	Dark blue clay		
	Black clay full of shells	6¼	338
	Light-coloured very fine loam ...	1	339
	Dark green shelly clay	½	339½
	Dark-coloured shelly clays	3	342½
	Whitish clays	2½	345
	Very dark shelly clays, black at the base	11¼	356¼

Newport—*cont.*

		Thickness. Feet.	Depth. Feet.
Middle Headon Beds.	Green clays	2¼	358½
	Black clays full of shells, *Cyrena obovata*, *Potamomya gregaria*, *Limnæa*, Fish-bones...	6¼	364¾
	Dark-green clay...	¾	365½
	Black shelly clay	1½	367
	Sandy clay, very shelly	1	368
	Sandy clay, very shelly	8	376
	Dark sandy clay	½	376½
	Deep black clay...	13½	390
	Dark-green sandy clay, with *Cyrena obovata*, *C. deperdita*, *Melania muricata*, *Buccinum labiatum*, *Nematura parvula*, *Planorbis*, and *Cerithium pseudocinctum*...	15	405
	Blue clay with *Cytherea incrassata* [Venus Bed?]	5	410
	Blue sandy clay with *Cytherea incrassata*	1	411
	Very shelly greenish clay with *Cytherea*	1	412
	Blue and brown clay with *Cytherea* ...	2½	414½
	Greenish clay full of *Cytherea* ...	2½	417
	Brown sandy clay	3	420
	Brown very sandy clay	6	426
	Hard blue clay	3	429
	More sandy brown clay	7	436
	Hard earthy limestone...	4½	440½
	Fine micaceous sandy loam	7	447½
	Micaceous loam and lignite	3	450½
	Brown sandy loam	2¼	452¾
	White sandy marl	¼	453
	Brown shelly clay with *Nucula*, *Buccinum?* *Nerita*, *Polyzoa*, &c. ...	4	457
	Brown clay, more sandy	1	458
	Brown clayey sand	1	459
	Green shelly sand	2	461
	Green clay	½	461½
	Mottled green and brown clay ...	½	462
	Greenish clayey sand	¼	462¼
	Rather coarse green sand	7¾	470
	Purple or blackish sandy clay ...	2½	472½
	Green unctuous clay	2	474½
	Green shelly clay, with *Cyrena*, *Neritina*, &c.	½	475
Lower Headon?	Sand with water		

9. Isle of Wight Lunatic Asylum. *See* under Analyses, p. 218.

Newport Waterworks. *See* **Carisbrook.**

According to Dr. T. Thomson's Report to the Local Government Board, 1895, at that time only about 50 houses got water from local wells: all the rest from the public supply.

Newtown. 1894?

Geol. Map. 330, new ser.

Communicated by the Rev. R. S. Davis.

There is only about 5 inches of water which "weeps" in.

	Ft.	
Field mould; Grey clay ...	50	Total depth of well, 84 feet.
"Rotten bones,"	¼	
Blue slatey slob; Blue clay ...	25	
Blue clay and shells	5	
"Metallic ore" (pyrites).		

Parkhurst.

Geol. Map 331, new ser.

1. Barracks.

Clay, to rock, 236 feet.

Water rises to 56 feet below surface, but after pumping sinks much and continuously. Pumping affects the wells at the Cement Works and Prison, as also at High Street, Newport [?]. On Aug. 29th, 1887 water stood at 70 feet from the surface. C. Reid.

2. Lower Prison.

Communicated by Mr. Lock. As also Nos. 3 and 4.

Clay, with thin rocks, to freestone, 239 feet.

At the Prison this well was said to be 250 feet deep. It was probably deepened afterwards.

3. Prison Farm.

To rock, about 200 feet.

4. Upper Prison.

Clay, &c.	255	259½ feet.
Limestone [Bembridge Limestone]	4½	

Ryde.

Geol. Map 331, new ser.

1. Electric Works, ¼ mile west of St. Johns Station.

Made and communicated by Messrs. Duke and Ockenden.

	Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Brown clay and ballast	5	0	5	0
[Bembridge Beds] Green mottled clay	15	0	20	0
[Bembridge Beds] Bembridge rock	0	6	20	6
Green mottled clay	4	6	25	0
Sandstone	0	8	25	8
Stiff blue clay, dark green at intervals	54	4	80	0
A bed presumably sandstone. Water rose to 50 feet below surface	0	9	80	9
Stiff blue clay (with a sample of chalk)	8	3	89	0
Stiff blue clay, with small layers of sandstone and limestone rock	7	0	96	0
Very hard rock (as per sample)	0	3	96	3
Sandstone	0	7	96	10
Very hard rock	1	6	98	4
Green clay (with sand-veins)	6	8	105	0
Mottled clay (with sand-veins)	5	0	120	0
Blue clay (with shells and sand-veins)	24	0	144	0
Blue and green clay (intermediate layers of shell-deposits)	8	0	152	0
Blue clay (with thicker sand-veins) and shell-deposits ...	8	0	160	0
Blue and green clay [intermediate layers with layers of sand 1 foot thick (sample of sand)]	5	0	165	0
Sand (slightly intermingled with clay)	11	6	176	6
Blue clay and sand	20	0	196	6
Blue clay and sand (sand in layers)	14	6	211	0
Blue clay	9	0	220	0
Clay and sand (mostly the latter)	15	0	235	0
Clay and sand	10	0	245	0
Slowly moving sand, estimated 3 to 5 feet in depth... ...				
Sand (a little clay and shells)	4	0	249	0
Green and yellow clay, and sand and shells	11	0	260	0

All below 20½ feet seems to belong to the Osborne and Headon Beds.

Ryde—*cont.*

2. Waterworks.

Information from the Waterworks Directory, 1909.

Places within the area of control :—Ashey, Binstead, Haven Street, Haylands, Ryde, St. Helens (including Carpenters, Sea View, and Springvale).

Quantity drawn yearly from surface-springs	104,200,700 gallons
Quantity drawn yearly from deep wells ...	103,873,100 gallons
Total	208,073,800 gallons

But in addition to this 12,356,000 gallons a year are said to be supplied in bulk to other authorities.

Maximum day's consumption 800,000 gallons : holiday season.
Maximum day's consumption 500,000 gallons : normal.

Maximum annual rainfall over drainage-area 40 inches ; minimum 25 ; average (over 10 years) 30.

The Ashey Works are southward of the town, just west of Bloodstone Copse, and were established in 1855.

There are two wells, in chalk, of 80 and 160 feet depth, connected by a heading.

Dr. Bulstrode, in his Report of 1901, to the Local Government Board, makes the following remarks :—"The supply of water from this well is limited. During the winter months, the amount is sufficient to enable daily pumping to be resorted to, but during the remainder of the year weekly pumping is alone practicable. In winter, some 3,000,000 gallons are raised weekly ; in summer only 250,000."

For an analysis of the water *see* pp. 219–221.

See also **Newchurch.**

St. Helens.

Geol Map 331, new ser.

1. Nearly half a mile south-east of the church. Height about 150 feet above the sea. Sunk 15 feet, the rest bored.

Sunk and communicated by Mr. Parsons. The classification by Mr. C. Reid.

		Thickness. Feet.	Depth. Feet.
Hamstead Beds ?	Blue slipper, black at base	15	15
Bembridge Marls, 118½ feet (?).	Green and brown clay	75	90
	Stone (3 or 4 inches)	—	—
	Blue clay (shelly at 100 feet)	11	101
	Green clay	2	103
	Green clay and marl	2	105
	Green clay	3	108
	Brown clay	2	110
	Green clay	1	111
	Mottled brown and green clay ...	½	111½
	Green clay	½	112
	Green marl	2	114
	Green clay	4	118
	Green stone	1	119
	Dark marl and black clay	1	120
	Green clay	½	120½
	Green stone and clay	3¼	123¾
	Brown carbonaceous clay	2¼	126
	Black shelly clay	½	126½
	Black clay with *Serpula*	½	127
	Dark-green shelly clay with *Cyrena* ...	3½	130½
	Black clay	1½	132
	Green clay and pyrites...	2	134
Bembridge Limestone, 16 feet.	Freestone	5	139
	Greenish grey clay	4	143
	Sandy clay	4	147
	Freestone	3	150

St. Helens—*cont.*

		Thickness. Feet.	Depth. Feet.
Osborne Beds (St. Helen's Sands) 25½ feet.	Dark green clay...	1	151
	Very dark green clay	1¾	152¾
	Very dark green clay, sandy	1¾	154½
	Dark green and brown clay	1	155½
	Green sandy clay and sandstone ...	3½	159
	Grit	1	160
	Fine-grained sandstone	1¾	161¾
	Blue sandstone	1¼	163
	Buff sandstone	6	169
	Rock	½	169½
	Buff sandstone	5	174½
	Hard sandstone...	¾	175¼

No fossils from the first 15 feet could be found among the waste and no fragments of the Black Band. A thin black seam is said to have been passed through at 15 feet, but samples were only preserved below that depth. Perhaps the first 133½ feet is entirely in Bembridge Marls. (C. Reid.)

2. North-east of the station.

Height about 5 feet above high-water.

Sunk and communicated by Mr. Parsons (to C. Reid).

Bembridge Marl. Blue marl with *Ostrea vectensis*, *Cyrena obovata*, *C. obtusa*, *C. semistriata*, *Melania muricata*, *Cerithium mutabile*, *Serpula tenuis*	28	48 feet.
Bembridge Limestone	9	
Osborne Beds. Blue and variously coloured clays ...	11	

In his Report of 1901 to the Local Government Board, Dr. Bulstrode makes the following remarks on the water-supply of the place :—

"The water is still procured under eminently unsatisfactory and unsafe conditions. On St. Helens Green are numerous wells sunk, presumably in the gravel," and many of them were not protected from surface-pollution ; but this would be a temporary defect as "the Ryde water will shortly be in use over the whole of the St. Helens district."

Shalfleet.

Freshwater and Yarmouth Water Co., just north of Pond, Shalcombe Farm. 1909?

Communicated by Mr. E. T. Hildred.

234 feet above Ordnance Datum.

A well of 8 feet diameter, lined with brickwork, with perforations through the lowest 5 feet.

Yield at exhaustion 19,000 gallons an hour. In November 1909, the water overflowed, following the abnormal rainfall, the level of the pond, not 20 feet away, being at the same time 2½ to 3 feet lower than the water in the well.

[Reading Beds.] Greeny-grey sandy clay	4	21¼ feet.
Chalk with some flints	17¼	

For an analysis of the water *see* p. 221.

Shanklin.

Geol. Map 331, new ser.

Water Works. In the middle of Greatwood Copse, about half a mile south-westward of St. John's Church.

Communicated by Mr. F. Newman.

416 feet above Ordnance Datum.

Chief well 70 feet deep, the last 20 in close Gault [the rest in Upper Greensand].

Another well, a little south, at the end of the short southern gallery, 408 feet above Ordnance Datum, 54 feet deep.

The first heading driven runs east-north-eastward from the chief well, for a short distance, with its floor 376 feet above Ordnance Datum. The second runs from the middle of the first for a short distance south-south-westward, to south of the chief well, with its floor 356 feet above Ordnance Datum. The third runs westward for a short distance from the chief well, with its floor 415 fee

Shanklin—*cont.*

above Ordnance Datum at the entrance. The fourth, or long heading, runs from near the end of the first irregularly westward to beneath the eastern edge of Shanklin Down, with its floor 425 feet above Ordnance Datum. [The last two apparently are driven from the open ground.] This is a composite supply, from wells and springs.

According to the Water Works Directory, 1909, the works were established in 1863, and the maximum day's supply, in August and September, was 200,000 gallons.

An analysis of the water is given on p. 225.

Ventnor.

UNDERCLIFF ISOLATION HOSPITAL. 1903.

Made and communicated by Messrs. DUKE and OCKENDEN.

Water-level, when at rest, 208 feet down. Another account says 195.

		Thickness. Feet.	Depth. Feet.
Chalk ...		105	105
[Upper Greensand ? slipped mass.]	Hard green shotterwit ...	11	116
	Grey freestone ...	8	124
	Hard grey freestone ...	24	148
	Hard green freestone ...	27	175
	Green freestone ...	25	200
	Black and grey freestone ...	30	230
	Hard black freestone ...	6	236
[Gault.]	Black bed and malm merging into blue slipper	12½	248½

West Cowes.

Geol. Map 330, new ser.

1. EGYPT POINT. Boring at, by Mr. VIGNOLLES.

8 feet above datum-line.

[Osborne Beds.] Clays of various colours, 94 feet.

2. THE BRIARY, close to the Light-house. 1901 ?

Made and communicated by Messrs. MERRYWEATHER.

30 feet above sea-level. Fairly good supply.

	Thickness. Feet.	Depth. Feet.
Old well ...	—	44
Blue clay ...	35	79
Mottled clay ...	14	93
Blue clay ...	4	97
Mottled clay ...	10	107
Blue clay ...	11	118
Blue clay and shells	8	126
Blue clay ...	2	128
Clayey sand ...	9	137
Loamy sand ...	7	144
Mottled clay ...	6	150
Blue clay ...	62	212
Grey sand ...	2	214

3. WATERWORKS. 7 chains east of Broadfield. Height 167 feet above Ordnance Datum.

From samples and measurements communicated by Mr. ATKEY and Messrs. TILLEY and SONS. The classification by C. REID.

Water, apparently from the sand at 321 feet, rose to 165 feet from surface.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Drift gravel ...		10	0	10	0
Lower Hamstead Beds, 29 feet.	Greenish clay (disturbed on one side of the well and containing a drain at 23 feet) ...	13	0	23	0
	Blue clay (a 2-inch seam of shells at 30 feet) ...	9	0	32	0
	Flat cement-stone ...	0	6	32	6
	Blue clay ...	5	6	38	0
	Black shaly clay ...	1	0	39	0

West Cowes—*cont.*

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Bembridge Marls, 116 feet.	Blue and green clay. A shell-bed with *Melania muricata* at 40 feet. Rock with *Melanopsis* and *Paludina lenta* at 61 feet	33	6	72	6
	Stone and a little water	0	6	73	0
	Blue and green clay	31	0	104	0
	Cement-stone	1	0	105	0
	Green shelly clay and shale with nodular stone at 110 feet. Very shelly at 115 feet	14	0	119	0
	Green clay and stone	5	0	124	0
	Blue clay (pyrites at 127 feet) ...	31	0	155	0
Bembridge Limestone, 9 feet.	Very hard freestone	5	0	160	0
	White bed	2	0	162	0
	Black, brown and white clay	2	0	164	0
Osborne Beds, 103½ feet.	Red and green mottled clays	36	0	200	0
	Blue shell-marl	30	0	230	0
	Green clay	21	0	251	0
	Green clay, rather sandy	0	6	251	6
	Stone, and a little water	1	0	252	6
	Dark green and brown mottled clay ...	14	0	266	6
	Stone	1	0	267	6
Upper Headon Beds, 53½ feet.	Mottled clay, with veins of sand and a little water	21	0	288	6
	Stone and a little water	1	0	289	6
	Blue clay...	3	0	292	6
	Stone and a little water	0	6	293	0
	Blue clay (fragments of shell at 320 feet)	28	0	321	0
Middle Headon Beds, 116 feet.	Sand with shells and water (pumping from this spring dried the well at Woodvale)	7	0	328	0
	Green sandy clay and blue clay, full of *Cyrena obovata* and *Melania muricata* at 331 feet; green and carbonaceous at 341; at 365 blue and very shelly, with *Cytherea incrassata*, *Cyrena* sp., *Natica labellata*, *Nematura parvula*, *Buccinum labiatum*, Fish-otolith (VENUS BED); at 375 green clay with *Natica*, *Cerithium*, &c.; at 385 blue shelly clay; at 400 hard clay; at 414 green sandy clay full of fossils (the following species were found in the spoil-heap, so the exact depth to which they belong is uncertain, but lies between 414 and 420 feet—*Ostrea ventilabrum*, *Cardita simplex*, *Cytherea incrassata*, *Cyrena obovata*, *C. deperdita*, *Corbula cuspidata*, *C. pisum*, *Cancellaria elongata*, *Buccinum labiatum*, *Voluta geminata*, *Pleurotoma plebia*, *Rostellaria* sp., *Cerithium elegans*, *Natica labellata*, *Bulla* sp., (BROCKENHURST BED?))	92	0	420	0
	Grey shelly sand, *Natica*, *Pleurotoma*, *Nematura parvula*, *Planorbis*, *Cyrena*, *Potamomya*	14	0	434	0
	Clay	3	0	437	0

For an analysis of the water, *see* p. 222.

For the other source of supply, *see* p. 43.

The following particulars from the Water Works Directory, 1909:—Works established, 1845: bought by the Council, 1859 Yearly supply (from all

West Cowes—*cont.*

sources) 94 million gallons. Daily supply 257,000 gallons. Maximum daily supply, in August, appparently only 20,000 gallons more [? some error]. The estimated quantity available in a year from deep wells is 150 million gallons.

Maximum annual rainfall over drainage-area, 37·84 inches, in 1894. Minimum, 22·6 inches, in 1887. Average, 28·68 (1878–1897).

Natural rest-level of water (in well), 158 feet down; when pumping 400,000 gallons a day, 270 feet down.

4. Woodvale. West of the town. 1885.

From specimens communicated by Messrs. Addie, of Preston.

The fossils determined by Mr. J. W. Elwes. The classification by Mr. C. Reid.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Bembridge Beds.	Whitish earth, calcareous	2	0	2	0
	Grey shelly clay. *Melania muricata*...	10	6	12	6
	Light-buff calcareous earth	1	6	14	0
	Grey clay with shells. *Melania muricata*	30	0	44	0
	Light-greenish-grey clay with some broken shells	2	0	46	0
	Grey and brownish clay	15	0	61	0
	Dark-grey or blackish clay with some shells	2	0	63	0
	Dark-grey and brown clay (specimen from bottom). *Melania muricata*...	3	0	66	0
	Grey clay with some broken shells ...	9	0	75	0
	Cream-coloured limestone	4	3	79	3
Osborne Beds, 109 feet.	Light-grey clay, mottled brownish ...	8	0	87	3
	Puce and grey mottled clay	2	0	89	3
	Pale-grey clay (specimen marked 89)...	2	0	91	3
	Crimson and grey mottled clay ...	42	0	133	3
	Light-greenish and brownish clay (specimen marked 131)	2	0	135	3
	Grey clay with some very fine and soft sand?	2	0	137	3
	Grey clay, partly brownish (specimen from 138 feet)	24	0	161	3
	Crimson, grey and brown mottled clay	27	0	188	3
Upper Headon Beds, 73 feet.	Limestone ? nodular	3	6	191	9
	Pale greenish-grey clay	18	3	210	0
	Greenish-grey and puce mottled clay...	30	0	240	0
	Light-grey clay with some broken shells	10	3	250	3
	Grey clay with crushed shells. *Potamomya*	1	0	251	3
	Grey clay with some broken shells ...	3	0	254	3
	Calcareous nodule (?)	0	6	254	9
	Greenish-grey clay with broken shells	6	0	260	9
	Stone (no specimen)	0	6	261	3
Middle Headon Beds, 13½ feet.	Fine grey sand, with shells: *Cerithium concavum* (many), *C. trizonatum*?, *Melania muricata*, *Cyrena obovata*, *Potamomya gregaria* (? 2 vars.) *Ostrea* with *Serpula*	9	0	270	3
	Firm grey clayey sand with some shells, with water (? from rock at 272 feet), which rose to within 136 feet of the surface	4	6	274	9

This well was subsequently deepened to 437 feet, at which depth shelly sand occurred (perhaps representing the Headon Hill Sands), but no further details can be obtained.

An analysis of the water is given on p. 223.

Wootton.

Geol. Map 331, new ser.

1. At Beech.

Middle Hamstead Beds	Clay	36	44 feet.
	Sand	5	
	Clay	3	

The bed of sand corresponds with the one seen at Brannon's Cottage, and in the cutting above the station. C. Reid.

2. A quarter of a mile north of Beech. Good supply of water.

Drift.	Gravel	15	34 feet.
	Sand	? 15	
	Loam and ironstone	4	

3. Beech Lane. Six chains north of the station.

From specimens communicated by Mr. Newbury, of Wootton, and notes and specimens communicated by Mr. Brown, of Tottenham, to Mr. C. Reid, who classified the beds.

Water at 370 feet, rose to 100 feet from surface.

		Thickness. Feet.	Depth. Feet.
Lower Hamstead Beds, about 110 feet.	Light-blue clay [no specimens] ...	40	40
	Clay [no specimens] ... ... about	50	90
	Dark-blue and carbonaceous clay, full of fossils. *Paludina lenta*, *Hydrobia pupa*, *H. Chasteli*, *Neritina tristis*, *Melania Forbesii*, *M. muricata*, *Melanopsis carinata*, *M. subulata*, *Planorbis*, small sp., *Cyrena semistriata*, *Modiola Prestwichii* ...	5	95
	Clay	15	110
Bembridge Marls, about 115 feet.	Green clay &c. [specimens preserved are green clay at 114 feet, cement-stone and pyrites with *Paludina* and *Melania turritissima* at 140 feet, grey clay at 143 feet, green clay at 155, 160, 166 feet, green and black clay at 169, 170 feet, green clay at 175, 180, 185 feet, bright-green clay at 206 feet]	115	225
Bembridge Limestone	[black clay and limestone at 228 feet]	3	228
Osborne Beds, about 117 feet.	[Red clay at 254 feet, red and green clay at 260, 265, 278, 285 feet, bright-green clay at 290 and 340 feet, red and green clay at 341 and 345 feet]	117	345
Upper Headon Beds, 59 feet.	Clay	11	356
	Rock	3½	359½
	White sand, very sharp. [Very fine brown sand at 370 feet]	10½	370
	? [no record kept]	34	404

The thicknesses are only approximate, as no complete record or series of specimens is available. Another memorandum gives 385 feet to sand with water, and a total depth of 420 feet. C. Reid.

4. Brannon's Cottage (close to). About 170 feet above the sea.

From notes made during the excavation. C. Reid.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Middle and Lower (?) Hamstead Beds.	Red and green clay	10	0	10	0
	Sand	4	0	14	0
	Green clay	10	0	24	0
	Concretionary sandstone	0	8	24	8
	Hard blue and green loamy clay ...	20	0	44	8
	Ironstone with casts of *Limnæa* ...	0	4	45	0
	Harder green and purple clay... ...	12	0	57	0

Wootton—*cont.*

5. Briddlesford Lodge, in the middle of the farm-buildings. 181 feet above the sea.

From notes made during the excavations. C. Reid.

		Thickness. Ft. Ins.	Depth. Ft. Ins.
Drift	Clayey gravel	4 6	4 6
Upper Hamstead Beds.	Yellow clay, much weathered	5 0	9 6
	Dark-blue shelly clay, full of *erithium plicatum* and *Melania inflata* ...	1 0	10 6
Middle Hamstead Beds.	Grey loamy clay	1 0	11 6
	Green clay	8 6	20 0
	Green clay with faint red mottling ...	3 6	23 6

6. Briddlesford Lodge. At the south-eastern corner of the farm-buildings. 190 feet above the sea.

From notes made during the excavations. C. Reid.

		Thickness. Ft. Ins.	Depth. Ft. Ins.
Middle? Hamstead Beds.	Mottled light-grey and dark-red clay...	8 0	8 0
	Yellow and brown mixed clay, perhaps reconstructed shaly clay	2 0	10 0
	Greenish-blue clay	1 0	11 0
	Tenacious blue clay	6 0	17 0
	Sand-parting	0 1	17 1
	Reconstructed clay	0 11	18 0
	Mottled green and red clay, slightly carbonaceous	7 0	25 0
	Blue carbonaceous clay, full of *Unio*...	5 0	30 0

Though these two wells are only two chains apart the sections are quite different. No trace of the bed with *Cerithium plicatum* could be found in the second. C. Reid.

7. Fernhill (five chains west of).

Drift	Gravel	13	18 feet.
	Sand	3	
Hamstead Beds.	Clay	2	

8. Whitehayes.

From notes made during the excavation. C. Reid.

		Thickness. Ft.	Depth. Ft.
Middle Hamstead Beds.	Yellow clay	10	10
	Blue clay	3	13
	Red clay	1½	14½
	Blue and yellow clay with turtle bones	3½	18

This well was unfinished at the time of the completion of the survey.

9. Wootton Creek, western side of. About half a mile N.E. of St. Edmund's Church.

Communicated by Mr. F. Newman, of Ryde.

About 75 feet above Ordnance Datum.

A little water oozed in 32 feet down (? in the bore).
Well 70 feet. Bored to 147.

10 (? in Wootton Parish). Staplers. Farm west of the gravel-pits. About 257 feet above the sea.

From information supplied by the farmer. C. Reid.

		Thickness. Feet.	Depth. Feet.
Drift	Gravel	1½	1½
Middle? Hamstead Beds.	Blue clay	64	65½
	Mottled clay		
	Fine-grained hard concretionary sandstone	2½	68
	Clay	5	73

We may conclude the accounts of wells with the description of three belonging to the *Spithead Defences*, in the channel between the mainland and the Isle of Wight. The first two were communicated by MAJOR E. A. HEWITT, R.E., to MR. H. W. BRISTOW, and the fossils were determined by MR. R. ETHERIDGE.

Horse Sand Fort.

Surface of shoal, 24¼ feet below high water of ordinary spring-tides Measurements from the Pump Room Floor, 3½ feet above high water-level 6-foot Cylinders to 83 feet; the rest bored.

		Thickness. Feet.	Depth. Feet.
Water, &c., to surface of shoal		—	27¾
Recent Marine Deposits, 70¼ feet.	Shingle and a little sand		
	Natural concrete	5	32¾
	Clean shingle		
	Moderately fine sand and occasional shingle, pieces of bark and branches of trees	18	50¾
	Shingle, sand and vegetable matter, the latter almost entirely compressing to centre dark band [shown on the drawing sent]	8	58¾
	Shingle, sand and shells	5	63¾
	Blue clay, shingle and sand	14	77¾
	Pure sand	¼	78
	Blue clay	1	79
	Chalk-flints	½	79½
	Shingle, sand and shells	2½	82
	Rock	¼	82¼
	Flint-shingle and clean orange sand ...	15¾	98
Bracklesham Beds, 471¼ feet.	Greenish-grey clay with slight sand and occasional flint-pebbles and stone ...	45	143
	Greenish-grey clay	25	168
	Greenish-grey clay and slightly more sand. *Ostrea*, *Cardita planicosta* ...	37	205
	Greenish-grey clay, less sand, no fossils	30	235
	Greenish-grey sandy clay	20	255
	Greenish-grey clay, no fossils	18	273
	Greenish-grey clay. *Nummulites*, *Corbula*	15	288
	Brownish-grey clay. Nodules of siliceous sandstone full of glauconite at 335 feet. No fossils	50	338
	Fine clean greenish-grey and black sand. *Cardita planicosta*. Many nodules of sandstone and iron pyrites	20	358
	Grey rock. *Pecten corneus*, *Cardium semigranulatum*	1½	359½
	Brownish-grey clay. *Cardium semigranulatum*, *Pectunculus pulvinatus*, *Pecten corneus*	12	371½
	Darker brownish-grey clay and flint-pebbles. *Pectunculus pulvinatus*, *Turritella imbricataria*	4½	376
	Very fine greenish-grey and some orange sand, and flint-pebbles. *Cardium semigranulatum*, *Pectunculus*, *Voluta*, *Turritella imbricataria*, *Fusus longævus*	10	386
	Greenish-grey sandy clay, slightly stratified	34½	420½
	Greenish-grey clay, with some sand, slightly stratified. *Cytherea suberycinoides*, *Pectunculus*	24	444½

		Thickness. Feet.	Depth. Feet.
Bracklesham Beds, 471¼ feet—*cont.*	Greenish-grey sand-rock, numerous fossils. *Nummulites*	2	446½
	Light-greenish-grey and black very fine quicksand. *Cardita planicosta* and *Turritella* at 494 feet	58½	505
	Rather darker green-grey sand with clay in lumps. *Cytherea lucida*, *Corbula gallica*, *Cardita planicosta*, *Fusus pyrus*	27¾	532¾
	Dark-green band of sandstone and iron-pyrites	½	533¼
	Light-grey clean sand. Frequent nodules of iron-pyrites and pieces of lignite. *Cardita planicosta*	24¼	557½
	Brownish-grey sand and stratified clay with iron-pyrites	2½	560
	Brownish-grey clay, occasionally stratified and with vegetable impressions and plant-remains	7	567
	Clean sharp light-grey (almost white) sand. No fossils	2¼	569¼

Noman Fort.

Surface of shoal, 34 feet below high water. Measurements from Powder Magazine floor, 3½ feet above high water.

Water rose to 4 feet 4 inches below the Powder Magazine, or 10 inches below high water of ordinary spring-tides. The supply of water was as follows :—

At 50 feet below Powder Magazine Floor, 10,800 gallons a day.
At 100 feet below Powder Magazine Floor, 23,000 gallons a day.

		Thickness. Feet.	Depth. Feet.
Water, &c., to surface of shoal		—	37½
Recent Marine Deposits.	Hard compact flint-shingle, bright sand, chalk stones, Isle of Wight stone, shells, &c. Jaw of Red Deer fifty feet down. Large flint-shingle, fine pale-yellow sand, shells, &c. ... ... Fine flint-shingle, coarse angular pale-yellow sand. Remains of trees, shells, &c. *Nassa reticulata*, *Trochus ziziphinus*	90	127½
Bracklesham Beds.	Grey sand with slight clay and occasional flint-shingle, shells, &c. ...	28	155½
	Greenish-grey sandy clay. No fossils	11¾	167¼
	Green-grey clay. *Cardita acuticosta*, *Astarte*, *Cytherea*, *Ostrea tenera?* fragments	130	297¼
	Green-grey clay, fossils numerous. Indurated phosphatic nodules with *Plicatula*	43¼	340½
	Green-grey clay, rather more sand, fossils	100	440½
	Brown-grey clay, fossils. *Conus*, *Turritella sulcifera*, in sandy clay ...	25½	466
	Brown-grey clay, slight sand, *Pinna margaritacea*, *Corbula*, *Turritella sulcifera*, *Nummulites variolarius*, *Serpula*, at 502 feet from surface; at 506, *Cardium semigranulatum*; at 510, *Pecten corneus*, *Cytherea suberycinoides*, *Cardium semigranulatum*	47	513

		Thickness. Feet.	Depth. Feet.
Bracklesham Beds—*cont.*	Darker green-grey sandy clay	27	540
	Hard grey-green sandstone rock, numerous fossils. *Cardium semigranulatum*, *Cytherea suberycinoides*, *Cardita planicosta*, *Turritella*, *Fusus*	1	541
	Pale green-grey sand, numerous fossils. *Cardita planicosta*, *Turritella sulcifera*, *Seraphs* sp., *Cardium semigranulatum*, *Pectunculus pulvinatus* ...	9	550
	Brown-green clay, with slight sand in layers, chalk [weathered flint?] pebbles from 558–560 feet. *Turritella imbricataria*, *Pectunculus pulvinatus*, flint-pebbles	21½	571½
	Green-grey with some orange-coloured sand slightly stratified in places, *Cerithium giganteum*, *Turritella imbricataria*	8⅓	579

Bottom of bore at 571 feet [? filled in].

St. Helen's Fort. 1867.

Sunk and communicated by Messrs. Docwra and Son. (The words in brackets from an account communicated by Mr. Mylne.)

Bored throughout.

	Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Concrete	—		19	0
Speckled sand	3	0	22	0
Shingle and black pebbles	15	0	37	0
Grey clay (yellow sandy clay, 57) ...	54	0	91	0
Peat (black earth)	2	0	93	0
Greenish sand (coarse green sand) ...	7	0	100	0
Stones (flint gravel)	2	0	102	0
Greenish clay and shells	15	0	117	0
Pale green shell-marl (shelly clay) ...	13	0	130	0
Green clay and shells (hard green clay)	10	0	140	0
Claystone	0	6	140	6
Grey clay and shells (brown shelly clay)	9	0	149	6
Claystone	0	4	149	10
Green clay and shells	1	6	151	4
Stones	0	4	151	8
Dark green clay and shells	2	6	154	2
Claystone	0	10	155	0
Green sand...	7	0	162	0
Green clay and pebbles	2	0	164	0
Grey sand	6	0	170	0

Mr. Mylne's account is as follows, below 149 feet.

	Thickness. Feet.	Depth. Feet.
Claystone ... / Hard blue clay ...	5	154
Limestone ... / Green clayey sand	8	162
Dark blue clay ...	6	168
Dark sandy clay...	2	170

It is difficult to classify the beds. Down to 37 feet are Recent marine deposits.

The following particulars communicated by Mr. C. G. Vincent, 1891.

Water said to have been got in stone below 150 feet: fresh, sweet, and rose to 2½ feet below the level of High Water Ordinary Spring Tides at high tide, and 9½ feet at low tide; gave a supply of 120 gallons an hour at the depth of 27 feet below High Water Ordinary Spring Tides.

After standing some time the water deposited considerable soft sediment, probably silty clay, and this filled the pipe 10 feet up in a year from the completion of the well in 1867; since then no accumulation.

TRIAL-BORINGS, NOT FOR WATER.

Of these the only one of special note, from its depth, is that on Keyhaven Marshes (Milford), which reaches through the Headon Beds well into the Barton Sand.

Mainland.

Bursledon.

Geol. Map 315, new ser.

Four borings along the centre-line of the Netley and Fareham Railway.

Communicated by Mr. J. Drage (L. S. W. Co.'s District Engineer), 1886.

A. On the mud-land on the right side of the Hamble River, a little eastward of the cross-roads (high-road).

		Thickness. Feet.	Depth. Feet.
[Alluvium.]	Soft dark alluvial soil	4	4
Dark gravel, dirty	... ...	1	5
[London Clay.]	Soft yellow clay	7	12
	Dark blue clay	8	20
	Hard dark blue clay	6	26
	Light-coloured compact sandstone [? septaria]	1	27

B. At the right edge of the Hamble River, a little E. of S. of the house named Maidenstone Heath.

		Thickness. Feet.	Depth. Feet.
[Alluvium.]	Soft dark alluvial soil	4	4
[London Clay.]	Soft yellow clay ...	7	11
	Dark blue clay ...	10	21
	Hard dark blue clay...	20	41

C. Eastward of the middle of the river, S.E. of Maidenstone Heath.

		Thickness. Feet.	Depth. Feet.
[Alluvium.]	Soft dark alluvial soil	11	11
	Soft yellow clay ...	6	17
Gravel mixed with clay		5	22
[London Clay.]	Dark blue clay ...	6	28
	Hard dark blue clay...	4	32

D. Near edge of mud-land on the left side of the River Hamble eastward of *C.* (about a quarter of a mile W. of N. from Lower Swanwick).

		Thickness. Feet.	Depth. Feet.
[Alluvium.]	Mud	3	3
[London Clay.]	Light-yellow clay ...	5	8
	Dark blue clay ...	14	22
	Hard dark blue clay	13	35

In a geological section across the River Hamble, on the tracing from which the above were taken, Mr. Drage regards all the yellow clay as a continuous mass, above the gravel of boring *C.* I am inclined to think, however, that except in that boring, it is merely the discoloured top of the London Clay.

Christchurch.

Geol. Map 329, new ser.

Communicated by Mr. J. DRAGE of the L. S. W. Ry. Co.

1. On the bank of the Avon, east of the station.

Sand and gravel 20 feet.

2. On the eastern side of the Stour, on the railway half a mile from the station.

Water-level 3½ feet down.

Clay and peat...	10	18½ feet.
Gravel and sand	6	
Black sand ...	2½	

3. On the western side of the Stour, on the railway about half a mile from the station.

Water-level about 1 foot down.

Gravel	6	20¼ feet.
Light-coloured sandy clay ...	6	
Dark brown wet running sand	8¼	

At this point rock or other hard material was met with but not entered.

Gosport.

Geol. Map 331, new ser.

ROYAL NAVAL HOSPITAL, HASLAR. Shaft for lift.

Information at the HOSPITAL, 1886.

	Thickness. Feet.	Depth. Feet.
Gravel ... ... to below floor	—	18
Clayey gravel	3	21
Light-brown clay	2	23
Gravel	1	24
Buff sandy clay	1	25
Light-grey sandy clay, with pieces of shell (marine) in top 5 feet	9	34
Loamy gravel	3	37
Buff sandy clay or clayey sand	1	38

Hound, western side of Badnam Creek in the course of the Netley and Fareham Railway.

Geol. Map 315, new ser.

		Thickness. Feet.	Depth. Feet.
Soil		½	½
[Alluvium.]	Dark peaty clay...	5½	6
	Soft bluish sand	3	9
	Soft light-blue clay, with yellowish streaks and a mixture of sand ...	3	12
Gravel		½	12½
[Bracklesham Beds.]	Fine soft wet sand	5½	18
	Soft yellowish sandy clay	3	21
	Stiff dark-blue clay	2	23
	Stiff blue clay of a lighter tint ...	3	26
	Bluish sandy clay	7	33
	Strong blue clay	4	37

Hythe.

Geol. Map 315, new ser.

Eleven trial-borings on the mud in front of Winterton Hall, 1885?

Communicated by Mr. G. F. L. GILES.

[Alluvium.]
- Mud, thickening away from the shore; a foot or 2 feet in three close to the shore, 5 to 25 feet in the rest, the furthest being about two-thirds of the way from high to low water mark.
- Peat, in three of the four outermost only (not the outermost, in which the mud rests on the gravel), 2 feet or 4 feet (in two).
- Clay, in two of the four outermost only; 2 or 4 feet, in the former case doubtful and not pierced.

Gravel, in all but one, 2 to 10 feet, not always pierced (not to S.E., where thickest).
Clay, in five on N.W., 4 to 13 feet.
Another boring on edge of marsh, near well.

Michelmersh.

Geol. Map 299, new ser.

On the line of railway by the side of stream N.N.E. of Kimbridge Mill and ½ a mile E.S.E. of Mottisfont Station.

Communicated by Mr. J. DRAGE of the L. S. W. Ry Co.

Peat ...	11	18 feet.
Rough Gravel	4	
Fine Gravel...	3	

Milford.

Geol. Map 330, new ser.

KEYHAVEN.- At the edge of the Marsh, about two-thirds of a mile east of the village.

Trial-boring, for the South Western and Isle of Wight Junction Railway, 1901

Made and communicated by Messrs. LE GRAND and SUTCLIFF.

Moisture in fine white live sand at 53 to 62 feet and in sandy loam at 101½ to 146 feet. Water in sand met with at 162 feet, rose to 2½ feet above the surface.

		Thickness. Feet.	Depth. Feet.
[? Made ground.]	Ballast	7	7
[Alluvium.]	Mud	2	9
[Gravel.]	Ballast	14	23
[Headon Beds.]	Light-blue clay and shells	30	53
	Fine white live sand and shells ...	9	62
	Blue clay	2	64
	Hard blue rock	½	64½
	Sand-rock	1½	66
	Blue clay	5	71
	Blue loamy clay	4	75
	Black loamy clay and shells, sandy in places	11	86
	Grey loam	12	98
	Rock	¾	98¾
	Grey loam	2¾	101½
[? Barton Sand.]	Sandy loam, hard in places	40½	142
	Sandy loam, more clayey	4	146
	Clayey sand and shells...	9	155
[? Becton Bunny Clay.]	Light-blue clay	11	166
	Rnnning sand	2	168

Millbrook.

Geol. Map 315, new ser.

REDBRIDGE. East of the river and between the two railways.

Communicated by Mr. J. DRAGE of the L. S. W. Ry. Co.

Gravel	9½	40 feet
Hard light-coloured clay ...	25½	
Clay and sand intermixed ...	5	

Portsmouth.

SOUTHSEA. South Parade Pier. To test foundations. 1908.

Made and communicated by Messrs. DUKE and OCKENDEN.

	Thickness Feet.	Depth. Feet.
Concrete and beach	2	2
Peat	7	9
Gravel	2	11
Clay	4	15
Shingle	4	19
Sand	6	25

Southampton.

Geol. Map 315, new ser.

1. CHAPEL (a place on the right shore of the Itchen a little above the Floating Bridge). 1885.

From specimens taken at intervals of a foot, communicated by Mr. BENNETT, Borough Surveyor.

Made ground and rubbish found at first.

[Drift.]	Gravel, from 12 to 16 feet. Sand and gravel to 17 feet.
[Bracklesham Beds.]	Loam, with sand and small stones, to 18 feet. Brown loam to 20 feet. Grey loam to 42 feet, more sandy in places (26, 28, 36, 40, and 42 feet).

2. On the right (western) bank of the Itchen, close to the Floating Bridge. (Dock-side) 1900?

Made and communicated by Messrs. TILLEY.

		Thickness. Feet.	Depth. Feet.
Trench already dug		—	9
[Alluvium, 15 feet.]	Soft mud	4	13
	Blue clay	2	15
	Sandy clay	1	16
	Clay and pebbles ...	2	18
	Peat	3	21
	Sandy clay	2	23
	Clay and shells ...	1	24
[River Gravel, 5 feet.]	Fine ballast	1	25
	Coarse ballast ...	4	29
[? Bracklesham Beds.]	Sandy blue clay	3	32

Southampton—*cont.*

3. Gasworks. At N. corner of the Gas Co.'s land, N.E. of Northam Station. 1899.

		Thickness. Ft.	Ins.	Depth. Ft.	Ins.
Mould		4	0	4	0
[River Drift.]	Dirty clay ...	1	0	5	0
	Gravel with clay	6	6	11	6
[Bracklesham Beds.]	Blue clay ...	6	0	17	6
	Very fine sand ...	7	1	24	7
	Sandy clay ...	4	8	29	3
	Hard blue clay ...	7	9	37	0
	Sandy clay ...	3	0	40	0
	Very fine sand ...	1	6	41	6

4. Docks. For Messrs. Lacey, Sellor & Co. 1907.

Made and communicated by Messrs. Duke and Ockenden.

River-sand ... 28 }
Gravel ... 7 } 35 feet.

Sway.

Geol. Map 330, new ser.

Two bores along the line of the railway.

Communicated by Mr. J. Drage, of the L. S. W. Ry. Co.

1. About three-quarters of a mile south-westward of Lymington Junction.

	Thickness. Feet.	Depth. Feet.
Soil	1	1
Loamy gravel ...	4	5
Sandy gravel ...	2	7
Marl	13	20

2. About 1¼ miles south-westward of Lymington Junction.

	Thickness. Feet.	Depth. Feet.
Soil	1	1
Loamy gravel...	2	3
Red gravel ...	9	12
White sand ...	9	21

Titchfield.

Geol. Map 316, new ser.

Just west of the river and north-east of Segenworth, on the line of the railway.

Communicated by Mr. J. Drage, of L. S. W. Ry. Co.

	Thickness. Feet.	Depth. Feet.
Soil	1½	1½
Light-coloured sandy clay	2½	4
Soft dark peaty clay	4	8
Alluvial deposit, with sand and small shells	2	10
Gravel...	4	14

Totton.

Geol. Map 315, new ser.

On the marsh just west of the river and north of the railway.

Communicated by Mr. J. DRAGE, of the L. S. W. Ry. Co.

	Thickness. Ft.	Ins.	Depth Ft.	Ins.
Mud	6	6	6	6
Gravel	10	3	16	9
Sand	1	3	18	0
Hard light-coloured clay	4	2	22	2

ISLE OF WIGHT.

Cowes.

Trial-borings for MEDINA TUNNEL, 1893.

Geol. Map 330, new ser.

Communicated by Mr. J. RUSSELL.

About 8 feet above Ordnance Datum.

Western side of the Medina

Gravel ...	23	55 feet.
Clay (alluvial)	32	

Eastern side of the Medina.

		Thickness. Feet.	Depth. Feet.
	Soil and clay...	5	5
	Gravel ...	8	13
Osborne Beds.	Clay (Osborne)	23	36
	Sand	1	37
	Clay (Osborne)	18	55

ANALYSES OF SPRING-WATERS.

MAINLAND.

Barton-on-Sea.

Spring on beach at foot of cliff opposite the Hotel.

Made by Dr. J. C. THRESH. November, 1900.

In parts per 100,000.

Ca	Mg	Na	CO_3	SO_4	Cl	NO_3	Probable combinations.	
6·6	·4	—	9·5	3·1	3·9	1·		
6·3	—	—	9·5	—	—	—	Calcium carbonate...	15·8
·3	—	—	—	·7	—	—	Calcium sulphate ...	1
—	·4	—	—	1·6	—	—	Magnesium sulphate	2
—	—	·4	—	·8	—	—	Sodium sulphate ...	1·2
—	—	2·55	—	—	3·9	—	Sodium chloride ...	6·45
—	—	·4	—	—	—	1·	Sodium nitrate ...	1·4
							Silica, &c.	1·65
				Total solid constituents dried at 180° C. ...				29·5

Bedhampton. (*See* Portsmouth).

Bournemouth.

Dr. J. C. THRESH. "The Examination of Waters and Water Supplies," 1904, pp. 306, 320, 321.

Spring at base of Barton Beds, on the shore near Bournemouth.

Ca	...	6·6	parts per 100,000.
Mg	...	·4	
CO_3	...	9·5	
SO_4	...	3·1	
Cl	...	3·9	
NO_3	...	1·	
		24·5	

Probable saline constituents.

Calcium carbonate ...	...	15·8	parts per 100,000.
Calcium sulphate ...	...	1·	
Magnesium sulphate	...	2·	
Sodium sulphate ...	...	1·2	
Sodium chloride ...	...	6·45	
Sodium nitrate ...	...	1·4	
&c.	...	1·65	
Total solids, dried at 180° C.		29·5	

Hartley Wintney. (*See* p. 41).

Source. Moorland gathering ground.

By A. J. G. Lowe. Communicated by Dr. F. Parsons.

In grains per gallon

Total solids	5·5	
Chlorine	1·6	
Free ammonia ...	·04	
Albuminoid ammonia	·02	
Nitrites	none.	
Nitrates	small.	
Poisonous metals ...	nil.	
Appearance	yellowish.	Some sediment.
Smell	none.	

If properly filtered, would be very good for drinking and other domestic purposes.

Havant. (*See also* Portsmouth).

Made by Dr. J. C. Thresh, March 1899.

In parts per 100,000.

Ca	Mg	Na	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
9·45	·2	—	12·5	·5	1·55	1·95		
8·3	—	—	12·5	—	—	—	Calcium carbonate...	20·8
·2	—	—	—	·5	—	—	Calcium sulphate ...	·7
·6	—	—	—	—	—	1·95	Calcium nitrate ...	2·55
·35	—	—	—	—	·5	—	Calcium chloride ...	·85
—	·2	—	—	—	·6	—	Magnesium chloride	·8
—	—	·3	—	—	·45	—	Sodium chloride ...	·75
							Silica, &c.	1·05
				Total solid constituents dried at 180° C....				27·5

Hardness. Temporary 16·5°, permanent 3·5°, total 20°.
Organic ammonia (free ammonia, nil) ... ... ·001
Oxygen absorbed in 4 hours at 27° C. ... ... ·063
Nitrites ... ... Nil.

Lymington. Public supply. (*See* p. 41).

By the Jenner Institute. From Water Works Directories, 1907, 1909.

In parts per 100,000.

Dissolved solids	20·6
Chlorine	4·1
Alkalinity expressed as calcium carbonate	3·5
Free and saline ammonia	·001
Albuminoid ammonia	·004
Nitrogen as nitrates (none as nitrites)	·29
Oxygen absorbed from permanganate at 80° F. in 4 hours	·009

Hardness 6·5°.

From the later publication this analysis might be taken to refer also to the well-water.

Portsmouth.

Water Company's Springs at Havant and Bedhampton. (*See* pp. 21, 22, 38–40).

Made by Dr. B. H. MUMBY. Compiled from Appendix B in Dr. T. THOMSON'S Report (L.G.B.). 1897.

1886. 14 analyses (roughly monthly) gave the following results :—

—	Grains per Gallon.
Total solid residue ... varied from	20·1 March and April to 21·3 Aug. and 25 on Dec. 30th.
Chlorine ... ... „ „	1·5 March and July to 1·8 Dec. 30th.
Nitrogen as nitrates ... „ „	Not given.
Total hardness ... „ „	15 Dec. 30th, 17 and 18 all the others.
	Parts per Million.
Ammonia, free ... „ „	Nil March to ·06 Aug.
„ albuminoid „ „	„ Dec. 21st to ·04 Jan.

No mention of other details which are included in some subsequent years.

1887. 13 analyses (roughly monthly) gave the following results :—

—	Grains per Gallon.
Total solid residue ... varied from	13·7 Aug. to 22 Jan. 3rd and Feb.
Chlorine ... ... „ „	·7 Aug. to 1·5 Jan. 17th.
Nitrogen as nitrates ... „ „	Not given.
Total hardness ... „ „	16 Jan. 3rd, June, July to 18 Jan., Feb., March.
	Parts per Million.
Ammonia, free ... „ „	Nil May to ·04 Sept.
„ albuminoid „ „	„ June to ·04 April and May.

No mention of other details which are included in some subsequent years.

1888. 14 analyses (roughly monthly) gave the following results :—

—	Grains per Gallon.
Total solid residue ... varied from	18·3 March to 22 Dec.
Chlorine ... ... „ „	·6 Feb. and March to 1·3 April and June 18th.
Nitrogen as nitrates ... „ „	Not given.
Total hardness ... „ „	14·4 June 8th to 16·4 Dec.
	Parts per Million.
Ammonia, free ... „ „	·01 Aug. and Sept. to ·06 March and April.
„ albuminoid „ „	·01 May, Sept. and Dec. to ·04 March, June 8th, 14th, 28th and Oct.

No mention of other details which are included in subsequent years.

Portsmouth—*cont.*

1889. 9 analyses from January to December gave the following results :—

—		Grains per Gallon.
Total solid residue ...	varied from	18·5 Feb. to 24 Aug.
Chlorine	„ „	·1 Nov. to 1·3 June.
Nitrogen as nitrates ...	„ „	·089 Aug. to 1·04 Feb.
Total hardness ...	„ „	14·3 April to 17·8 Aug.
		Parts per Million.
Ammonia, free ...	„ „	Nil Aug. to ·06 June.
„ albuminoid	„ „	·01 Aug. and Dec. to ·04 Feb. and June.
Poisonous metals	...	Absent throughout.

No mention of other details included in subsequent years.

1890. 12 monthly analyses gave the following results :—

—		Grains per Gallon.
Total solid residue ...	varied from	16·1 Nov. to 22·4 Dec. and 30·8 in July.
Chlorine	„ „	·8 July to 1·3 April and Sept.
Nitrogen as nitrates ...	„ „	·07 Nov. to ·38 June.
Total hardness ...	„ „	14·2 Nov. to 18·4 April.
		Parts per Million.
Ammonia, free ...	„ „	Nil May and Aug. to ·06 Feb.
„ albuminoid	„ „	·01 March to ·08 Aug.
Iron	„ „	A trace in July.
Turbidity or otherwise	one entry	July, considerable amount of sand.

1891. 12 monthly analyses gave the following results :—

—		Grains per Gallon.
Total solid residue ...	varied from	19·6 Feb. and Dec. to 24·5 Sept.
Chlorine	„ „	1·1 Jan., March and June to 1·7 July.
Nitrogen as nitrates ...	„ „	·017 Feb. to ·134 Oct.
Total hardness ...	„ „	14·2 Feb. and June to 16·8 Dec.
		Parts per Million.
Ammonia, free ...	„ „	Nil May to ·06 Feb.
„ albuminoid	„ „	„ Jan. and Aug. to ·04 Feb. and Dec.
Turbidity or otherwise	one entry	Nov., turbid deposit of sand and infusoria.
Appearance	„	Dec., bright.

Portsmouth—*cont.*

1892. 13 analyses (roughly monthly) gave the following results :—

—		Grains per Gallon.
Total solid residue ...	varied from	18·5 Sept. to 21·4 Jan. and Dec.
Chlorine	„ „	1·1 March, June, Oct. to 1·4 Jan., April and May.
Nitrogen as nitrates ...	„ „	·087 March and July to ·9 Aug.
Total hardness ...	„ „	14·6 Sept. to 17·1 May.
		Parts per Million.
Ammonia, free ...	„ „	Nil May to ·04 Nov.
„ albuminoid	„ „	„ March to ·05 Oct.
Iron	one entry	Trace on May 14.
Turbidity	two entries	June, slight deposit of sand. Dec., slightly turbid.
Colour...	two entries	Oct., clear greenish-grey. Dec., greenish.

1893. 12 monthly analyses gave the following results :—

—		Grains per Gallon.
Total solid residue ...	varied from	21 March to 23·9 Sept.
Chlorine	„ „	1·1 March, July and Nov. to 1·7 Sept.
Nitrogen as nitrates ...	„ „	·04 Dec. to ·215 Oct.
Total hardness ...	„ „	15·6 Feb. to 18·7 May.
		Parts per Million.
Ammonia, free ...	„ „	Nil June, July, Nov. and Dec. to ·08 Oct.
„ albuminoid	„ „	·01 Dec. to ·08 March and June.
Turbidity or reverse...	three entries	Feb. and May, clear. Jan., slight deposit of sand. March, slightly turbid.
Colour	two entries	March, greenish-brown. Aug., greenish-grey.

The November sample was described as "pure."

1894. 12 monthly analyses gave the following results :—

—		Grains per Gallon.
Total solid residue ...	varied from	20·6 April to 24·2 March.
Chlorine	„ „	1·1 April to 1·7 Aug.
Nitrogen as nitrates ...	„ „	·093 Feb. to ·999 May.
Total hardness ...	„ „	15·1 Nov. to 17·2 July.
		Parts per Million.
Ammonia, free ...	„ „	Nil Jan., Feb., May and Sept. to ·06 Oct.
„ albuminoid	„ „	·01 Jan., April, May and June to ·06 Dec.
Turbidity	three entries	March, slight deposit of sand. Nov., turbid. Dec., slight deposit of suspended matter.
Colour...	„ „	May, slightly green. Nov., yellowish-brown. Dec., light grey.

The May sample was described as "pure."

Portsmouth—*cont.*

1895. 13 analyses (roughly monthly) gave the following results :—

—	Grains per Gallon.
Total solid residue ... varied from	20·3 April, Nov. and Dec. to 25·2 March.
Chlorine ... ... „ „	1·1 June and Nov. to 1·7 Sept.
Nitrogen as nitrates ... „ „	·035 Jan. to ·75 Aug.
Total hardness ... „ „	15·4 Dec. to 16·6 Sept.
	Parts per Million.
Ammonia, free ... „ „	Nil Feb. and Oct. to ·04 April and Dec.
„ albuminoid „ „	„ Feb. to ·04 March 28th.
Turbidity or reverse...	No deposit April, May, Aug. to slightly turbid.
Colour...	Greyish-blue, Jan. and Nov. Light-brown, March. Greyish-brown, Dec. Greyish or light-grey, April, May and Aug. Light-green, Oct.
Appearance	Clear, April, May, June, July, Aug., Sept. Brilliantly clear, Oct.

The February sample is described as "remarkably free from organic matter."

It may be useful to add an epitome of the monthly analyses, 1886–95.

—	Grains per Gallon.
Total solid residue ... varied from	13·7 Aug., 1887, to 25·2 March, 1895.
Chlorine ... ... „ „	·1 Nov., 1889, to 1·8 Dec. 30, 1886.
Nitrogen as nitrates (after 1888) ... „ „	·017 Feb., 1891, to 1·04 Feb., 1889.
Total hardness ... „ „	14·2 Nov., 1890, to 18·7 May, 1893.
	Parts per Million.
Ammonia, free ... „ „	Nil March, 1886, May, 1887, Aug., 188,9 May and Aug., 1890, May, 1891, May, 1892, June, July, Nov., Dec., 1893. Jan., Feb., May, Sept., 1894, and Feb, and Oct., 1895, to ·08 Oct., 1893.
„ albuminoid „ „	Nil Dec. 21, 1886, June, 1887, Jan. and Aug., 1891, March, 1892, and Feb., 1895, to ·08 Aug., 1890, and March and June, 1893.
Turbidity or reverse	Generally no mention, but occasionally a deposit is mentioned which is usually classed as sand. Nov., 1891, sand and infusoria.
Appearance	Generally no mention, only noted 1891 and 1895.
Colour...	Generally no mention, only 1892–1895.
Iron	A trace in July, 1890.

Spring-waters.—From *Rivers Pollution Commission. Sixth Report*, 1874.

Analyses by [Sir] E. FRANKLAND and others.

In parts per 100,000.

—	Temperature, Centigrade.	Total Solid Impurity.	Organic Carbon.	Organic Nitrogen.	Ammonia	Nitrogen as Nitrates and Nitrites.	Total combined Nitrogen.	Chlorine.	Hardness. Temporary.	Hardness. Permanent	Hardness. Total.	Remarks.	Geologic formation.
Bedhampton. Springs. March 7, 1873 ..	11·1°	29·62	·053	·008	0	·397	·405	1·85	15·8	8·1	23·9	Clear and palatable.	Chalk.
The Blue Hole Spring March 7, 1873.	11·3°	30·34	·076	·011	0	·379	·39	1·85	19·5	4·4	23·9	" "	"
Farlington Waterworks. March 7, 1873	12·5°	38·8	·032	·008	0	·421	·429	5·55	19·5	5·	24·5	" "	
Havant. Springs supplying Portsmouth. March 7, 1873.	11·1°	28 48	·04	·007	0	·338	·345	1·85	17·3	6·	23·3	" "	"

ISLE OF WIGHT.

Bembridge.

CENTURION'S or ST. ARIAN'S WELL. Over two-thirds of a mile N.N.E. of Yaverland Church. For the supply of Bembridge.

Source. Well, 11 feet deep in Bembridge Limestone, at the spring.

Made by Mr. R. A. CRIPPS. Communicated by Dr. H. F. PARSONS.

In grains per gallon.

Total solids	53·
Chlorine	10·2
Ammonia	·0007
" albuminoid ...	·0014
Nitrogen as nitrites ...	none
" " nitrates ...	·12
Oxygen absorbed in 5 mins.	none
Oxygen absorbed in 3 hours	·012
Hardness, temporary ...	21·1°
" permanent ...	9·4°
" total	30·5
Phosphoric acid	merest trace

Microscopic examination, some vegetable débris. Smell when heated, slightly earthy.

May be safely used for drinking purposes. Free from sewage-pollution and poisonous metals.

Hardness high, but mostly removable by boiling or by a simple softening process.

During part of the year the water overflows; at other times it has to be pumped.

Chale.

Chalybeate Spring (see p. 23).

By Dr. A. MARCET, *Trans. Geol. Soc.*, 1811, vol. i., pp. 213–248.

No smell, except faintly chalybeate. Taste intensely chalybeate. Temperature 51° F. Specific gravity (3 samples) 1·0083, 1·0072, 1·0069, average 1·0075.

In grains per pint of 16 ounces (? a tenth of a gallon).

Total solids, dried at 170° to 180° F. (varying results due, to some small extent, to variations of temperature), from 63·6 to 92 grains, average 80·5.

The analysis of the residues made on a sample giving 86 grains of solids to the pint of 16 ounces. The following account compiled by H. L. WHITAKER.

The various constituents are returned as in their crystalline forms, and the aluminium-sulphate is assumed to be present as alum (though no potash was found), and thus high figures are got, the total solids coming to 107·4 instead of 86. When the aluminium-sulphate is estimated as such, instead of as alum, that figure is 89·1 ; the excess of this last figure over the 86 may be accounted for by the loss of water of crystallization in drying.

The following figures are calculated from those given in this long and involved paper. Those given at the end and reprinted in the Isle of Wight Memoir are based on a calculation which gives the total solids as 107·4 instead of 86 :—

Solids in a pint of 16 ounces? = $\frac{1}{10}$ gallon.		Found by Evaporation.	Estimated.	
Iron-sulphate ($Fe\,SO_4$)... ...	Anhydrous	20·7	Crystalline	37·9
Aluminium-sulphate	,,	8·2	,,	15·9
Calcium-sulphate	,,	8·1	,,	10·2
Magnesium-sulphate	,,	2·1	,,	4·3
Sodium-sulphate	,,	7·1	,,	16·1
Sodium-chloride...	,,	4·	,,	4·
Silica	,,	·7	,,	7
Water of crystallization (theoretically 38·2, but some expelled in drying)		35·1	—	
	Total	86·		89·1

The water gave off on boiling about a hundredth part of its volume of carbonic acid gas.

Newchurch.

LORD ALVERSTONE'S Waterworks. Source, Collecting drains laid 40 feet below surface of pasture land, in the Sand-rock beds of the Lower Greensand. Yield 20,000 gallons per 24 hours.

Made by Dr. O. HEHNER, August 1900.

Communicated by Dr. H. F. PARSONS.

In parts per 100,000.

Chlorine	4·2
Sulphuric acid	4·04
Nitric ,, ...	·35
Phosphoric ,, ...	trace
Ammonia, free	·001
,, albuminoid	·0047
Oxygen absorbed from permanganate in 15 minutes, at 80° F.	·0124
,, ,, ,, 4 hours ,, ,,	·0296
Total solids dried at 212° F.	36·
Loss on ignition	3·44
Total hardness	21·

Colour, none.

Satisfactory in every respect.

Shalfleet.

SOURCE. Springs from Chalk, Shalcombe. Close to the Waterworks Well. (*See* p. 163).

Yield over 40,000 gallons per 24 hours.

Made by Dr. O. HEHNER, December 1900.

Communicated by Dr. H. F. PARSONS.

In parts per 100,000.

Chlorine	3·6
Sulphuric acid	·68
Nitric „	·37
Phosphoric „	none.
Ammonia, free	·0045
„ albuminoid	·0039
Oxygen absorbed from permanganate in 15 minutes at 80° F.	·0228
„ „ „ 4 hours „	·0476
Total solids, dried at 212 ° F.	26·64
Loss on ignition	2·24
Total hardness	16·6

Appearance :—Very turbid from suspended chalk, but colourless after filtration.

Total number of bacteria in 1 cubic centimetre, 1,980
„ „ growing in phenolised acid agar, none.

The results of the chemical analysis are entirely satisfactory. The dissolved organic matter is low. No indication of pollution. Has the usual characters of a Chalk-supply.

Shanklin.

Chalybeate water issues from the Lower Greensand here. The spring known as Shanklin Chalybeate Spa (Esplanade) was first noticed by Dr. FRASER, physician to Charles II. It has been analysed by Dr. A. H. HASSALL, with the following result, in grains per gallon :—

Chemical Composition.

Total residue ...	23·46
Lime	5·64
Magnesia	1·9
Potash	·25
Soda	2·01
Sulphuric acid ...	2·81
Chlorine	3·23
Iron	1·03
Silica	1·4
Nitrogen as nitrates and nitrites ...	—
Free ammonia ...	—
Organic nitrogen ...	·01

Combined as follows :—

Carbonate of lime	7·66
„ magnesia	2·35
„ protoxide of iron	2·13
Sulphate of lime	3·28
„ magnesia	1·32
Chloride of potassium	·4
„ sodium	3·04
„ magnesium ...	·85
Silica	1·4
Volatile and combustible matter	·14

Hardness, 9·3°.

Totland Bay.

Made and communicated by Dr. J. C. Thresh, May 1909.

Parts per 100,000

Ca	Mg	Na	K	CO_3	SO_4	Cl	NO_3	Probable Combination.	
9·5	·5	—	trace.	12·	5·7	9·2	·6		
8·	—	—	—	12·	—	—	—	Calcium carbonate	20·
1·5	—	—	—	—	3·6	—	—	„ sulphate ...	5·1
—	·5	—	—	—	2·	—	—	Magnesium „ ...	2·5
—	—	6·	—	—	—	9·2	—	Sodium chloride ...	15 2
—	—	—	·3	—	—	—	·6	Potassium nitrate ...	·9
								Silica, etc.	·9
				Total solid constituents dried at 180° C. ...					44·6

Free ammonia ... ... ·003
Organic ammonia ... ... ·005
Oxygen absorbed in 4 hours at 27° C. ... ... ·025
Nitrites... ... ... nil.
Hardness: temporary 17°, permanent 8°, total 25°

Ventnor.

Wroxall.—Spring from Upper Greensand, 286 feet above Ordnance Datum.

Yield 14,400 gallons a day (May, 1893).

Made by Dr. O. Hehner, September, 1893. Communicated by Dr. H. F. Parsons.

In parts per 100,000.

Chlorine...	11·
Sulphuric acid	2·24
Nitric „	·44
Phosphoric „	none
Ammonia, free	·0011
„ albuminoid	·0059
Total solids	46·32
Loss on ignition	5·92
Total hardness	24

Slightly turbid from suspended mineral matter. No chemical trace of organic pollution and may be safely used for drinking. Somewhat high in dissolved mineral matter and slightly harder than is usual in water derived from the Greensand, but will nevertheless be found a thoroughly satisfactory supply for all domestic purposes.

Spring Waters.—From *Rivers Polution Commision. Sixth Report*, 1874.

Analyses by [Sir] E. FRANKLAND and others.

In parts per 100,000.

—	Temperature Centigrade.	Total Solid Impurity.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Combined Nitrogen.	Chlorine.	Hardness. Temporary.	Hardness. Permanent.	Hardness. Total.	Remarks.	Geologic Formation.
Newport.													
Spring near Carisbrook, November 4, 1871 ...	8·6°	28·5	·008	·005	·001	·369	·375	3·3	23·4	6	29·4	Clear and palatable	Chalk.
Ryde. March 7, 1873. Springs near	5·8°	27·62	·053	·013	0	·485	·498	2·7	13·5	7·1	20·6	" "	Fluvio Marine Series.
Ventnor. For public supply. September 12, 1872 ...	17·5°	34·38	·031	·004	0	·187	·191	3	21	4·4	25·4	Slightly turbid. Palatable.	Upper Greensand.
In railway-tunnel. November 16, 1872 ...	10·4°	32·8	·048	·006	0	·189	·195	3·15	21	4·7	25·7	" "	" "
Coombe Wood. September 12, 1872 ...	11·8°	45·92	·092	·013	0	1·116	1·129	7·1	9·7	15·1	24·8	Clear and palatable.	" "
Dr. Leeson's Cave ...	11·5°	29·36	·052	·019	·003	·119	·14	3·6	14·9	6·6	21·5	" "	" "
The Wishing Well. St. Boniface Down— November 16, 1872	10·9°	26·4	·097	·018	·006	·078	·101	6·4	6·8	5·6	12·4	Turbid. Palatable. Variations due to sea-spray, and concentration of rainfall by sun.	Chalk.
March 8, 1873 ...	11·°	27·68	·064	·013	0	·061	·074	7·4	7	7·3	14·3		

ANALYSIS OF WELL-WATERS.—MAINLAND.

Aldershot.

WATER COMPANY. (*See* pp. 56–58).

Made and communicated by Dr. J. C. THRESH. May, 1907.

In parts per 100,000.

Total solid matter dried at 180° C.	39·4
Chlorine	2·4
Nitric nitrogen	·56
Nitrites...	Nil.
Hardness : permanent 7, temporary 16, total	23
Lead, copper, zinc, iron	Nil.
Free ammonia	·0004
Organic ammonia	·0036
Oxygen absorbed at 98° F. in 3 hours ...	·016

Turbidity : slight white sediment. Colour : faint green tint. Odour, none.

Alverstoke.

FOXBURY WELL. GOSPORT WATER COMPANY. (*See* p. 60).

From a report by Dr. J. C. THRESH, in 1897 (? October).

Three samples collected. 1 from rising main, which would represent the water then supplied. The bottom of the main being 200 feet down, it is clear that only water from the bottom of the well was pumped. 2 from surface of water in well, then about 80 feet down. 3, subsoil-water running in through an opening left in the brickwork about 10 feet down. Results, in grains per gallon.

—	1.	2.	3.
Total solids	67	41	—
Nitric nitrogen	·04	·2	·75
Nitric acid (NO_3)	·18	·9	3·37
Chlorine (=common salt)	22·4 (37)	15·8 (26·05)	4·4 (7·3)
Nitrites...	none	large traces	traces
Sodium carbonate	trace	trace	trace
Iron	none	minute trace	—
Oxygen absorbed in 4 hours... ...	·52	1·92	—
	In parts per million.		
Free ammonia	·64	·48	·66
Organic ammonia	none	·04	·04

Results of microscopic examination :—

1. No deposit. 2. No living organisms observed. A little oxide of iron and a few vegetable fibres. 3. A little fine sand and clay.

Physical characters.

1. Clear, bright, colourless. 2. Clear and slightly yellow. 3. Dull and turbid.

Hardness. In 1 : total 15·5°, temporary 14·5°. In 2, ·3° (all temporary). In 3, 5·5° (all temporary).

1. A moderately hard water, of a high degree of organic purity.

2. Consists chiefly of subsoil-water. By standing in contact with the iron cylinders some of the nitrates have been reduced to nitrites and ammonia. No indications of sewage-pollution ; but the water is not of a high degree of organic purity.

3. A fair sample of subsoil-water which has been acted on by the iron with which it has been in contact. An undesirable addition.

Alverstoke—*cont.*

He concludes that the water of the well is good and that when the subsoil-water should be cut off (as was intended) it would be a safe supply.

The subsoil-water that had already entered the well, being less dense than the water from the Chalk was floating as a layer at the top of the column of water. As the lowering of the water-level by pumping did not exceed 30 or 40 feet and the amount of subsoil-water was small, it had not yet appreciably affected the water below.

The quantity of common salt is not in excess of that in certain Chalk-waters, notably from those got from a great depth.

Two analyses made by Dr. J. C. THRESH. In parts per 100,000.

1. October, 1897.

Ca	Mg	Na	NH_4	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
6·6	1·3	—	·07	12·4	7·4	32	·3		
6·6	—	—	—	9·9	—	—	—	Calcium carbonate...	16·5
—	1	—	—	2·5	—	—	—	Magnesium „ ...	3·5
—	·3	—	—	—	1·2	—	—	„ sulphate	1·5
—	—	3	—	—	6·2	—	—	Sodium sulphate ...	9·2
—	—	20·8	—	—	—	32	—	„ chloride ...	52·8
—	—	·1	—	—	—	—	·3	„ nitrate ...	·4
								Silica, &c.	3·1
				Total solid constituents dried at 180° C. ...					87

Hardness : temporary 20·5, permanent 1·5, total 22
Free ammonia (no organic ammonia) ... ... ·06
Oxygen absorbed in 4 hours at 27° C. ... ... ·054
Nitrites ... ... Nil.

2. September, 1899.

Ca	Mg	Na	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
7·7	2·9	—	1·9	26·1	41·4	·7		
1·25	—	—	1·9	—	—	—	Calcium carbonate ...	3·15
6·45	—	—	—	15·5	—	—	„ sulphate ...	21·95
—	2·65	—	—	10·6	—	—	Magnesium „ ...	13·25
—	·15	—	—	—	—	·7	„ nitrate* ...	·85
—	·1	—	—	—	·3	—	„ chloride ...	·4
—	—	26·7	—	—	41·1	—	Sodium chloride	67·8
							Silica, &c.	2·2
					Total solids dried at 180° C.			111·5

* Water combined with magnesium nitrate ? 1·95.

Hardness : temporary 4°, permanent 28°, total 32°
Free ammonia (organic ammonia, nil) ... ·004
Oxygen absorbed in 4 hours at 27° C. ... ·003
Nitrites ... ... Nil.

Alverstoke—*cont.*

Two analyses made by Dr. J. C. Thresh. May, 1903.

(1) From boring 50 feet down in Western Adit. (2) From new fissure found in extension of West Heading.

In parts per 100,000.

(1)

Ca	Mg	Na	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
11·9	4·2	—	15·	12·2	83·8	·29		
10·	—	—	15·	—	—	—	Calcium carbonate...	25·
1·9	—	—	—	4·55	—	—	„ sulphate ...	6·45
—	1·9	—	—	7·65	—	—	Magnesium „ ...	9·55
—	2·3	—	—	—	6·8	—	„ chloride	9·1
—	—	50	—	—	77·	—	Sodium chloride ...	127·
—	—	·11	—	—	—	·29	„ nitrate ...	·4
							Silica, &c.	·5
				Total solid constituents dried at 180° C....				178·

(2)

Ca	Mg	Na	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
6·2	2·5	—	15·6	5·6	22·5	·58		
6·2	—	—	9·3	—	—	—	Calcium carbonate...	15·5
—	2·5	—	6·25	—	—	—	Magnesium „ ...	8·75
—	—	2·7	—	5·6	—	—	Sodium sulphate ...	8·3
—	—	14·6	—	—	22·5	—	„ chloride ...	37·1
—	—	·22	—	—	—	·58	„ nitrate ...	·8
							Silica, &c.	·3
				Total solid constituents dried at 180° C....				70·75

Hardness : temporary 20°, permanent 4°, total 24°.

By Herbert Jackson. June, 1902. Communicated by Dr F. Parsons.

Total solids	100·4	grains per gallon.
Nitrates (no nitrites)...	trace.	grains per gallon.
Chlorine	41·5	grains per gallon.
„ as common salt	(nearly 70).	grains per gallon.
Sulphates (as SO_4)	6·5	grains per gallon.
Ammonia, free	·52	parts per million.
„ organic or albuminoid ...	·05	„ „
Hardness (mainly temporary) ...	17·1	

Physical characters, clear, colourless, tasteless, odourless.

The analyst comments on the high common salt content, and assumes sea-water infiltration. Of the free ammonia, he says that the very high figure would indicate an objectionable amount of organic contamination if it were due to the bacterial decomposition of nitrogenous matter ; but the low (and constant) figure for albuminoid ammonia is reassuring. "From the extent and nature of the mineral constituents, the water cannot be described as a good one for drinking and domestic purposes."

Andover.

Public Supply (*see* p. 61).

Made by Dr. J. C. THRESH. March, 1899.

In parts per 100,000.

Ca	Mg	Na	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
10·1	·1	—	12·8	·8	1·6	3·7		
8·55	—	—	12·8	—	—	—	Calcium carbonate...	21·35
·35	—	—	—	·8	—	—	„ sulphate ...	1·15
1·2	—	—	—	—	—	3·7	„ nitrate ...	4·9
—	·1	—	—	—	·3	—	Magnesium chloride	·4
—	—	·85	—	—	1·3	—	Sodium chloride ...	2·15
							Silica, &c.	2·05
			Total solid constituents dried at 180° C. ...					32·

Hardness : temporary, 17° ; permanent, 5½°. Total, 22½°.

Organic ammonia (free ammonia, nil) ... ·003
Oxygen absorbed in 4 hours at 27° C. ... ·022
Nitrites ... ... nil.

Basingstoke.

Town well (the old supply). 19th September, 1905. (*See* p. 61).

By Mr. A. ANGELL. In Dr. R. FARRAR'S Report, 1905.

Colourless at a depth of two feet.
Smell, when heated, not noticeable.
Appearance of residue after evaporation, clean and white.
Bright and clear. A trace of suspended matter.
Residue on ignition, darkened very slightly, and emitted an odour of burning organic matter.
Microscopic and biologic examination. A very small deposit. Some particles of organic débris, fungus, starch-grains, various fibres. Some bacteria.

Chemical analysis, in parts per 100,000.

Albuminoid ammonia (no free ammonia)	·003
Oxygen absorbed in 15 minutes at 80° F.	·0045
„ „ 4 hours at 80° F. ...	·0085
Nitrogen as nitrates and nitrites	·46
Chlorine (= 1·98 common salt)	1·2
Phosphoric acid, slight trace	—
Total solids, dried at 212° F.	32

Another analysis, of water taken on 11th October, 1905, apparently from the same source. By the Clincal Research Association, also from Dr. FARRAR'S Report, in which are some others. In parts per 100,000.

Total solids, dried at 120° C.	20·44
Combined chlorine (expressed as chloride of sodium, 1·65)...	1·
Nitrogen as nitrates (no nitrites) ...	·6
Albuminoid ammonia (no saline) ...	·0008
Oxygen absorbed in 4 hours at 27° C. ...	·008

Hardness, 16·7°.

The bacteriologic examination points to an extremely slight degree of sewage-pollution, inappreciable by chemical analysis.

Basingstoke—*cont.*

West Ham Works. (*See* p. 62).

Analysis of water from new well after pumping 12,662,720 gallons in 14 days.

Made by Mr. A. Angell. March, 1905.

From the Engineer's Report, and also in Water Works Directories, 1907, 1909.

Physical Properties (all good).

Colour in depth of 2 feet, smell when heated, suspended matter, all nil.

Bright and clear. Appearance of residue after evaporation, clean and white.

Chemical analysis. In parts per 100,000.

Ammonia, albuminoid, none free	·003
Oxygen absorbed in 15 minutes at 80° F. ...	0
" " after 96 hours incubation at 80° F., trace	
" " in 4 hours at 80° F.	·02
Nitrogen as nitrates and nitrites	·41
Chlorine (= common salt 1·98)	1·2
Phosphoric acid	trace
Total solids dried at 212° F.	30·8

Hardness (Clark's scale). Total, 15° ; permanent, 4° ; removable by boiling, 11°.
Behaviour of residue on ignition, satisfactory.

Microscopical and biological examination. A few ordinary water-bacteria and minute particles of mineral matter. Bacteriological examination. MacConkey bile-salt-test. *No acid. No gas.*

Number of colonies on gelatine (Room-temperature) 50 per cubic centimetre.

A typical Chalk Water, the purest obtainable. A very excellent public supply.

Boldre.

Loyal Court Farm. 15 July, 1901. (*See* p. 65).

By C. E. Cassal. Communicated by Messrs. Le Grand and Sutcliff.

Appearance before filtration, opaque, brownish.
Appearance after filtration, slightly cloudy, marked greenish-yellow.
Odour and taste, not abnormal.
Reaction, neutral.
Permanent hardness 4. Temporary 9. Total 13.

Total solid matters	23·6 parts per 100,000.
Chlorine as chlorides (= 4·12 chloride of sodium) ...	2·5 " "
Saline ammonia	·666 parts per million.
Organic "	·066 " "
Oxygen absorbed from permanganate, 30° C. 4 hours, after filtration	1·353 " "

No nitrogen as nitrates or nitrites, lead, or copper. Iron present in an insoluble form. Faint traces of phosphates.

Appearance of solids on ignition, slight browning.

Microscopic examination of suspended matters : Finely divided mineral matter ; a little broken down vegetable matter.

"The results show that this sample represents a water which at the time of sampling contained only a small amount of nitrogenous organic matter. The water is, in all respects, far better than that which was previously analysed. . . . The amount of 'saline ammonia' is very high and this fact requires to be satisfactorily accounted for before the water can be approved of."

Bournemouth.

1. WELL at the MONT DORE. (*See* p. 67).

By A. KINSEY-MORGAN. 1889. Communicated by the Rev. J. H. WANKLYN.

Appearance in two-foot tube, very pale straw-colour.
No smell when heated to 100° F.

Chlorine		4·75
Iron		trace
Nitrogen as nitrites		·84
Free ammonia		·0003
Albuminoid ammonia		·0055
Oxygen absorbed	15 min. at 80° F.	·002
	4 hours ,,	·026

Hardness, before boiling 6°, after 3·5°

Total solid matter, dried at 220° F., 11·5

Microscopical examination: No traces of insect-organisms, of surface-pollution, or of vegetable decay. The deposit consists of ferruginous sand, white sand and clay, containing iron and silica.

The water is free from contamination, and fit for all dietetic purposes. It is capable of dissolving iron; it would attack and etch unprotected iron-work.

In the analysis are entered: Phosphoric acid, none; nitrites, none.

2. WATERWORKS. (*See* p. 68).

Wells in Bagshot Beds. Water filtered.

From Annual Report, Medical Officer of Health, for 1893.

From main at drinking-fountain. Pier-approach.

By Sir T. STEVENSON. April, 1893.

In grains per gallon.

Total solid matters	18·48
Loss on ignition	·84
Combined chlorine	1·26
Equal to common salt	2·08
Nitrogen as nitrates	0·02
Nitrites	none
Ammonia	none
Albuminoid or organic ammonia	·005
Oxygen required to oxidise organic matter	·03
Hardness	14·8°

A pure, unpolluted water of excellent quality and moderate hardness.

Sample direct from main at cabstand, Old Christchurch Road, Bournemouth. 26 October, 1893.

By Prof. J. ATTFIELD. October, 1893. Communicated by Dr. F. PARSONS.

In grains per gallon.

Total suspended solid matter, dried at 250° F.	none
,, dissolved ,, ,, ,,	19
Ammoniacal matter, yielding 10 per cent. of nitrogen	none
Albuminoid organic matter, yielding 10 per cent. of nitrogen (equal to ammonia in parts per million, ·03)	·02
Nitrites	none
Nitrates, containing 17 per cent. of nitrogen (equal to grains of nitrogen per gallon, ·06)	·35
Chlorides, containing 60 per cent. of chlorine (equal to grains of chlorine per gallon, 1·5)	2·5
Oxygen absorbed in 3 hours	·03

Bournemouth—*cont.*

Hardness reckoned as chalk grains or "degrees": Removed by boiling, 10·5. Unaffected by boiling, 3·5. Total, 14.

Lead or copper, none.

Physical examination, satisfactory.

Does not contain objectionable proportions of organic or inorganic matter. No excessive amount of hardness.

Clear and bright, and of excellent quality for all drinking and general household-purposes.

Burseldon.

Made by Dr. J. C. Thresh. July, 1904.

	Grains per gallon.	Parts per 100,000.
Chlorine	2·5	3·6
Equivalent to chlorides (60 per cent. Cl.) ...	4·2	6
Nitric nitrogen	·48	·7
Equivalent to nitrates (17 per cent. N.)... ...	2 88	4·2
Nitrites...	Nil	Nil
Hardness; permanent, 1°; temporary, 4°; total, 5°.		
Organic ammonia (no free ammonia)	·0035	005
Oxygen absorbed at 98° F. in 3 hours	·0154	·022

Clear; faint yellow; odourless.

Christchurch.

1. Well at Honeywood.

Made by Dr. J. C. Thresh. September, 1903.

	Grains per gallon.	Parts per 100,000.
Chlorine	3·1	4·4
Equivalent to chlorides (60 per cent. Cl.) ...	5·1	7·4
Nitric nitrogen	·16	·23
Equivalent to nitrates (17 per cent. N.)... ...	·96	1·4
Nitrites...	Nil	Nil
Hardness; permanent, 3·2°; temporary, 10·3°; total, 13·5°.		
Organic ammonia (no free ammonia)	·07	·01
Oxygen absorbed at 98° F. in 3 hours	·0448	·064

Dull; faint yellow; odourless.

2. Public Pump in High Street, near junction with Crisple Street.

By Dr. A. Dupré. 19 October, 1893.

From Dr. Mivart's Report to the Local Government Board, 1899. *See* p. 72.

Bright, pale yellowish. Inodorous. No deposit. No nitrous acid. A very large amount of phosphoric acid. Hardness before boiling, 21·6°, Clark; after boiling, 12°.

Oxygen absorbed from permanganate	·09	? grains per gallon.
Total dry residue (pale brownish) ...	56·84	
Chlorine	9 73	
Nitric acid	6·99	
Ammonia	·0007	
Albuminoid ammonia...	·0093	

The dry residue on ignition blackens very strongly, and burns off with some difficulty.

Clapperton.

Made by Dr. J. C. THRESH. March, 1899.
In parts per 100,000.

Ca	Mg	Na	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
8·4	·25	—	10·65	1·15	1·6	2·3		
7·1	—	—	10·65	—	—	—	Calcium carbonate...	17·75
·5	—	—	—	1·15	—	—	„ sulphate ...	1·65
·7	—	—	—	—	—	2·3	„ nitrate ...	3
—	·25	—	—	—	·75	—	Magnesium chloride	1·
—	—	·55	—	—	·85	—	Sodium chloride ...	1·4
							Silica, &c.	2·7
				Total solid constituents dried at 180° C. ...				27·5

Hardness ; temporary 18°, permanent 5°, total 23°
Organic ammonia (free ammonia, nil) ... ·003
Oxygen absorbed in 4 hours at 27° C. ... ·126
Nitrites ... ... nil.

Fareham.

WATERWORKS. (*See* p. 81).

By Prof. J. ATTFIELD. September, 1897. Communicated by Dr. F. PARSONS.

In grains per gallon.

Total suspended solid matter dried at 250° F. ... ... none
„ dissolved „ „ „ „ 29
Ammoniacal matter, yielding 10 per cent. of nitrogen (= ammonia per million, 0·02) ... ... ·01
Albuminoid organic matter, yielding 10 per cent. of nitrogen (= ammonia per million, ·04) ... ... ·02
Nitrites ... ... none
Nitrates, containing 17 per cent. of nitrogen (= grains of nitrogen per gallon, ·23) ... ... 1·4
Chlorides, containing 60 per cent. of chlorine (= grains of chlorine per gallon, 1·8) 3
Hardness, reckoned as chalk grains, or degrees, removed by boiling 10°, not removed by boiling 4°, total 14°.
Lead or copper ... ... none
Oxygen absorbed in 3 hours ... ... ·05
Clear, bright, inodorous.
Free from contamination, animal, vegetable, or mineral.
Rather hard than soft, but not excessively so.
Of good quality for all drinking purposes.

Farnborough.

ALDERSHOT. North Camp.

From an Appendix by the Professor of Hygiene, Netley (Prof. DE CHAUMONT), in a Report by LT.-COL. A C. HAMILTON (LORD BELHAVEN) of May 22, 1884.

1. No. 2 Pump. Q Lines. 18 November, 1883.

Colourless ; clear ; slight sediment ; good lustre ; good taste ; no smell.
Microscopic characters. A few particles of sand.
Remarks. An unsafe water. There is probable sewage-contamination.

Farnborough—*cont.*

2. No. 2 Pump. P Lines. 18 November, 1883.

Colourless ; clear ; slight sediment ; good lustre ; good taste ; no smell.
Microscopic characters. A few particles of sand.
Remarks. An unsafe water. There is probable sewage contamination.

3. No. 1 Pillar Pump. Q Lines. Well, 20 feet deep. 19 January, 1884.

Colourless ; clear ; very small sediment ; good lustre ; good taste ; no smell.
Microscopic characters. Sediment very small, consisting of a few algoid cells and shreds of vegetable tissue, together with crystals of various forms.
Remarks. But little improved since last analysis. Still remains a suspicious water, although evidence of active organic matter appears to be very slight. With so shallow a well there is little chance of improvement. If no other supply is obtainable, boiling and filtering before use for drinking purposes is recommended.

4. No. 1 Pillar Pump. P Lines. Well, 18 feet deep. 19 January, 1884.

Colourless ; clear ; very small sediment ; good taste ; good lustre ; no smell.
Microscopic characters. The sediment consists only of a few crystalline bodies.
Remarks. As in 3.

5. No. 4 Well. Near the Hut Stables. 24 March, 1884.

Colourless ; clear ; very small sediment ; good lustre ; good taste ; no smell.
Microscopic characters. Sediment very small, consisting of a little vegetable débris and one small Rotifer.
Remarks. Shows former contamination, but at present but little sign of active organic matter. Usable, but would be improved by filtration through a spongy iron filter.

Gosport.

1. Mumby's Mineral Water Works. (*See* p. 87).

By Prof. C. Heisch. In grains per gallon.

Total solids (no loss on ignition)	17·85
Silica	·3
Chlorine as chlorides	2·17
Sulphuric acid as sulphates ...	3·36
Carbonate of soda	2·6
Magnesia	1·21

A first-rate water, absolutely free from organic impurity, specially well adapted for the manufacture of mineral waters. No ammonia, albuminoid ammonia, nitrates or nitrites.
Hardness (Clark's scale), 5°. Permanent hardness, 1°.

2. Sea Horse Brewery. (*See* p. 89).

Communicated by Messrs. Biden and Co.

Two analyses by Dr. J. C. Thresh. October, 1908.

No. 1, after 3 days pumping. No. 2, after 6 days pumping.

In parts per 100,000.

	No. 1.	No. 2.
Total solid matter dried at 180° C.	227	227·4
Chlorine	114	119·
Equivalent to chlorides (60 per cent. chlorine)	190	198·3
Nitric nitrogen	·45	·75
Equivalent to nitrates (17 per cent. nitrogen)	2·7	4·5
Nitrites	Nil	Nil
Hardness—Permanent	70°	70°
Temporary	10°	10°
Total	80°	80°
Iron	·23	·15
Free ammonia	·29	·264
Organic ammonia	·003	·003
Oxygen absorbed at 98° F. in 3 hours	·25	·22

Gosport—*cont.*

Turbidity: No. 1, opalescent, due to oxysalt of iron; No. 2, decidedly opalescent, chiefly due to oxy-carbonate of iron.

Colour: No. 1, yellow tint; No. 2, yellowish.

Odour: both none.

These waters are practically identical. They contain so much salt and are so hard as to be useless for either domestic or manufacturing purposes.

Continued pumping has affected no improvement. Both contain a little less salt than a sample taken on Aug. 26th, but more than one reported on July 30th.

3. WATERWORKS, Bury Cross? (*See* pp. 90–93).

Taken whilst the boring was in progress, 1886.

By Mr. J. BRIERLEY. No. 1 in May. No. 2 in September.

In parts per 100,000.

	No. 1.	No. 2.
Free ammonia, no albuminoid ammonia ...	·1036	·1482
Nitrogen as nitrates and nitrites	·0675	·1499
Total nitrogen...	·1538	·2719
Chlorine in chlorides	48·	70·6
Equal to common salt	79·2	116·34
Oxygen absorbed in 15 minutes at 80° F. ...	none	none
,, ,, ,, 4 hours ,, ,, ...	none	·11425
Volatile solids (including CO_2)	12·2	14·
Fixed solids	92·4	131·6
Total ,, ...	104·6	145·6
Iron	none	traces
Total hardness	18°	23·89°
Fixed ,, ...	11°	14·6°
Removable hardness	7°	9·29°

Microscopic examination. No. 1, moving organisms and vegetable cells. No. 2, satisfactory, no living organisms.

Physical characters; copious clayey deposit.

Colour, pale greenish-blue.

Headbourne Worthy.

RECTORY.

Made and communicated by Dr. J. C. THRESH, February, 1906.

In parts per 100,000.

Total solid matter dried at 180° C.	34·2
Chlorine	2·
Nitric nitrogen	1·06
Nitrites	Nil
Hardness: permanent, 6·4; temporary, 16·4. Total	22·8
Lead, copper, zinc, iron	Nil
Free ammonia	·0008
Organic ammonia	·0048
Oxygen absorbed at 98° F. in 3 hours	·0344

Turbidity, slight flocculent deposit. Colour, faint green tint. Odour, none.

Lyndhurst.

Boring for WATERWORKS. (*See* p. 105).

Made and communicated by Mr. E. C. BERRY. October, 1889.

Parts per 100,000 (pounds per 10,000 gallons).

Total solid matter	32·36
Chlorine	4·4
Sodium chloride (common salt)	7·25
Free ammonia	·0262
Albuminoid ammonia... ...	·0056

Hardness, 9·5°.

The amount of free ammonia is high ; but taking into consideration the source of the water, it is suitable for a town-supply. In order, however, to render it wholesome, and above suspicion, it would be advisable to subject the water to careful filtration through sand.

The water is moderately soft and consequently good for washing purposes.

Monk Sherborne.

RECTORY. (*See* p. 107).

Two analyses by E. C. BERRY. 1889.

A, from well 30 feet deep in clay immediately previous to the boring through the clay into the chalk.

B, from boring continued through clay into chalk.

In grains per gallon.

	A.	B.
Solid ingredients	80·5	23·45 (principally chalk)
Chlorine	7·372	·89 (indicative of sewage)
Oxidised nitrogen	Very excessive	Slight trace
Free ammonia	·006	·003
Albuminoid ammonia ...	·013	·002
Metals. Iron	Not given	None

Netley.

ROYAL VICTORIA HOSPITAL. From the deep well in the south wing (*see* p. 107). Sample drawn very soon after the boring was completed, November, 1887.

Made and communicated by Surgeon A. M. DAVIES.

Physical characters.

Very slightly yellowish. Nearly colourless after 14 hours.
Very slightly turbid. Very clear after 14 hours.
Slight sediment. Lustre good. No taste or smell.
Hardness, 10. Fixed, 6. Removable, 4.

Quantitative examination. In parts per 100,000.

Volatile matter	1·7
Chlorine	2·2
Calcium carbonate	2·6666
Fixed hard salts	6·
Sulphuric acid (SO_4)	
Alkaline carbonates	
Sodium or other metal (combined with Cl. or SO_4) not included in fixed hard salts	18·9334
Silica, aluminium, iron, &c.	
Slight trace of magnesia and of phosphoric acid.	
Total solids (by evaporation)	31·5

Oxygen required for organic matter		·048
These, with the oxidisable organic matter are included in the volatile matter.	Free ammonia	·0584
	Nitric acid	·1152
	Total nitrogen in nitrates ...	·026

No albuminoid ammonia or nitrous acid.

The sediment consists of sand and finely-divided clay, with a very few minute infusoria.

The turbidity will probably disappear when the well is in good working order. There is a large amount of free ammonia, but this is often found in deep well-water. This water is of excellent quality.

Otterbourne.

WELL of the SOUTHAMPTON WATERWORKS. In Chalk (*see* pp. 109–111).

By J. BRIERLEY.

In parts per 100,000.

Free ammonia	0
Albuminoid ammonia	·001
Nitrogen, as nitrates and nitrites	·581
Total nitrogen	·5843
Chlorine as chlorides (equal to sodic chloride, 2·47)	1·6
Oxygen absorbed at 80° F.	none
Volatile solids (including CO_2)	5·8
Fixed solids	32·4
Total solids, by evaporation	38·2

Total hardness, 16·57°. Fixed hardness, 2·32°. Removable hardness (by boiling), 14·27°, Clark's scale.

Physical characters.—Very clear ; pale green ; no odour ; pleasant taste.

Microscopic appearances.—Deposit almost entirely of calcareous matter, with a few vegetable cells.

A first-class drinking water, remarkably free from organic matter.

Another analysis by Dr. P. F. FRANKLAND. In parts per 100,000.

The figures in brackets are from a version of this analysis in the Water Works Directory, 1909.

	Unsoftened.	Softened.
Total solid matters	31·69	14·07
Organic carbon	·024	·021
„ nitrogen	·012	·013
Ammonia	·005 (·001)	·004 (·0007)
Nitrogen, as nitrates and nitrites	·365	·381
Total combined nitrogen	·381 (·378)	·397 (·294)

Mineral analysis.

Silica...	1·02	·94
Iron and aluminic oxides (Fe_2O_3 and Al_2O_3) ...	·14	·11
Lime (calcic oxide, CaO)	14·53	4·42
Magnesia (magnesic oxide, Mg O)	·25	·28
Soda (sodic oxide, Na_2O)	1·21	1·12
Sulphuric acid, SO_3...	·39	·45
Nitric acid, N_2O_5	1·41	1·47
Chlorine	1·6	1·6
Carbonic acid, CO_2 (calculated from carbonates of Mg and Ca)	10·64	2·64
	31·19	13·03
Less oxygen for chlorine	·36	·36
Total solid residue ...	30·83	12·67
Calcic carbonate	23·93	5·67
Magnesic carbonate	·21	·29
Hardness, temporary ...	23°(16·1°)	5·6°(3·92°)
„ permanent ...	2·7° (1·89°)	3°(2·13°)
„ total ...	25·7°(17·99°)	8·6°(6·05°)

Otterbourne—*cont.*

Two analyses by Dr. J. C. THRESH. March, 1899.

(1) Well-water before softening. (2) Well-water after softening.
In parts per 100,000.

(1)

Ca	Mg	—	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
10·05	·15	—	13·2	·5	1·5	1·7		
8·8	—	—	13·2	—	—	—	Calcium carbonate...	22·
·2	—	—	—	·5	—	—	„ sulphate ...	·7
·55	—	—	—	—	—	1·7	„ nitrate ...	2·25
·5	—	—	—	—	·9	—	„ chloride ...	1·4
—	·15	—	—	—	·45	—	Magnesium „ ...	·6
—	—	·1	—	—	·15	—	Sodium „ ...	·25
							Silica, &c.	3·3
				Total solid constituents dried at 180° C ...				30·5

Hardness: Temporary, 18°; permanent, 4°. Total 22°
Organic ammonia (free ammonia, nil) ... ... ·003
Oxygen absorbed in 4 hours at 27° C. ... ... ·0084
Nitrites ... ... nil

(2)

Ca	Mg	—	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
4·8	·2	—	6·	·6	1·35	1·6		
4·	—	—	6·	—	—	—	Calcium carbonate...	10·
·25	—	—	—	·6	—	—	„ sulphate ...	·85
·5	—	—	—	—	—	1·6	„ nitrate ...	2·1
—	·2	—	—	—	·6	—	Magnesium chloride	·8
—	—	·5	—	—	·75	—	Sodium „	1·25
							Silica, &c.	2·
				Total solid constituents dried at 180° C. ...				17·

Hardness: Temporary, 6°; permanent, 5°. Total 11°
Organic ammonia (free ammonia, nil) ... ... ·002
Oxygen absorbed in 4 hours at 27° C. ... ... ·0105
Nitrites ... ... nil

Owslebury.

WATERWORKS.

Made and communicated by Dr. J. C. THRESH. March, 1899.

In parts per 100,000.

Ca	Mg	—	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
8·5	·125	—	11	·4	1·3	2·2		
7·3	—	—	11	—	—	—	Calcium carbonate...	18·3
·15	—	—	—	·4	—	—	„ sulphate ...	·55
·7	—	—	—	—	—	2·2	„ nitrate ...	2·9
·35	—	—	—	—	·65	—	„ chloride ...	1·
—	·125	—	—	—	·4	—	Magnesium „ ...	·5
—	—	·15	—	—	·25	—	Sodium „ ...	·4
							Silica, &c.	3·35
				Total solid constituents dried at 180° C. ...				27·

Hardness : Temporary, 14° ; permanent, 5°. Total 19°
Organic ammonia (free ammonia, nil) ... ... ·001
Oxygen absorbed in 4 hours at 27° C. ... ... ·029
Nitrites ... ... nil

Petersfield.

1. BOROUGH FARM AND BREWERY. (*See* pp. 111, 112).

Communicated by Mr. AMEY.

Analysis (partial) by E. R. SOUTHLY. July, 1884.

Total solid residue dried at 212° F.	15·75	grains per gallon.
Nitric acid	·69	„ „
Ammonia, free	·01	parts per million.
„ albuminoid	·05	„ „
Oxygen consumed	·017	„ 100,000

Slight but distinct blackening of residue on ignition.

Microscopical examination : No moving organisms, but numerous particles of fibre (fibre explained by Mr. Amey as derived from joints in the pipes ; he says it soon disappears). Otherwise only some mineral particles.

The analyst says that, apart from this fibre, the water is organically pure ; he also says it will probably be too soft for the purposes of the brewery, but that this can be easily put right.

Petersfield—*cont.*

2. Public Supply (*see* pp. 113, 114).
Made by Dr. J. C. Thresh. February, 1900.
In parts per 100,000.

Ca	Mg	Fe	—	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
5·6	·7	·2	—	10·2	3·	1·6	·09		
5·6	—	—	—	8·4	—	—	—	Calcium carbonate ...	14·
—	·7	—	—	1·7	—	—	—	Magnesium ,, ...	2·4
—	—	·2	—	·2	—	—	—	Iron ,, ...	·4
—	—	—	1·45	—	3·	—	—	Sodium sulphate ...	4·45
—	—	—	1·05	—	—	1·6	—	,, chloride ...	2·65
—	—	—	—	—	—	—	·09	Traces of nitrates, &c.	·1
				Total solid constituents dried at 180° C. ...					24

Hardness: Temporary, 10° ; permanent, 7°. Total 17°
Organic ammonia (free ammonia, nil) ... ... ·001
Oxygen absorbed in 4 hours at 27° C. ... ... ·01
Nitrites ... ... nil

Porchester.

Wicker (? Wicor Farm, over a mile west of village).
Communicated by Messrs. Duke and Ockenden.
Made by R. A. Cripps. March, 1904. Results in grams per gallon.

Total solids 80
Chlorine ... ... 28·7
Albuminoid ammonia (no free ammonia) ·0007
Nitrogen as nitrates (none as nitrites) ... ·4

Total hardness (Clark's scale), 32·6°. Microscopic examination very satisfactory.

"I am of opinion that this water is free from organic pollution, and that it may be safely used for drinking purposes. It is very hard, and contains a considerable proportion of dissolved saline matter."

The first two figures seem to be somewhat suggestive of infiltration from tidal water.—W.W.

Portsmouth.

The Portsmouth Brewery (? Catherine Brewery of p. 115).
Made by Dr. J. C. Thresh. March, 1899.
In parts per 100,000.

Ca	Mg	Na	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
7·5	3·5	—	11·95	16·2	49·3	·18		
7·5	—	—	11·2	—	—	—	Calcium carbonate ...	18·75
—	·3	—	·7	—	—	—	Magnesium	1·
—	3·2	—	—	12·8	—	—	,, sulphate	16·
—	—	1·65	—	3·4	—	—	Sodium sulphate ...	5·05
—	—	32·05	—	—	49·3	—	,, chloride ...	81·35
—	—	·05	—	—	—	·18	,, nitrate ...	·25
—	—	—	—	—	—	—	Silica, water of hydration, &c.	5·6
			Total solid constituents dried at 180° C. ...					128·

Free ammonia (organic ammonia, nil) ... ·088
Oxygen absorbed in 4 hours at 27° C. ... ·096
Nitrites ... ... trace
Hardness, temporary 7·1, permanent 15·7.

Ringwood.

St. Leonard's Poultry Farm (*see* p. 122).

Two analyses. June, 1906. Made and communicated by W. J. Dibdin.

1. From the top, after the well had been standing overnight.

2. From bottom of well (*i.e.*, 160 feet down), after two or three hours' pumping.

	In grains per gallon. 1.	2.
Total solids (in solution)	7·5	7·5
„ appearance on ignition... ...	Very slight blackening.	Very slight blackening.
Phosphoric acid	None	None
Ammonia, free	·0017	·0017
„ albuminoid	·0018	·002
Chlorine	1·2	1·25
Oxygen absorbed from permanganate at 80° F. in 15 minutes	·0238	·078
Oxygen absorbed from permanganate at 80° F. in 4 hours	·0484	·1175
Organic elements, carbon and nitrogen ...	None	None
Nitrogen as nitrates	„	„
Solids in suspension	6·09	26·67
Poisonous metals	None	None
Appearance	Red, with oxide of iron.	Opalescent, with clayey sand.
Odour at 100° F.	None	None
Hardness, total and permanent	2·8° and 2·2°	2·7° and 2·3°

Microscopic Examination.

	Nearly all oxide of iron (rust) with a few sandy particles and a little fine lignite.	Nearly all greyish sand, with fragments of lignite.

Bacteriologic Examination.

Cultivation on gelatine plates; colonies per cubic centimetre	299	Liquified
Micro-filter, mm. per litre	250	200
Pathogenic organisms	No gas-forming organisms; no streptococci.	Same as 1

Except for the oxide of iron (in suspension) in 1, and the clay and sand in 2, both are excellent soft waters, showing no sign of sewage-pollution. They are evidently from the Reading Beds, and it seems probable that going a little lower would reach a hard chalk-supply.

After continued pumping the supply should become clear.

Shedfield or Shidfield.

The Parsonage House (*see.* p. 126).

Made and communicated by T. P. Laws. In grains per gallon.

Ammonia, free	·0014
„ albuminoid	·0105
Sodium chloride	6·31=chlorine 3·83.
Nitric anhydride (N_2O_5)	9·363
Nitrous „ (N_2O_3)	None
Oxygen required to oxidise organic matter at 85° F.:—In 15 minutes ...	·1549. In 3 hours ·2421.
Total solid residue	34·44

Hardness—Total 14·38°. Temporary 1·88°. Permanent 12·5°.

Bacteria :—
Growing in gelatine cultivating media, at 22° C., 164 (? per cubic centimetre).
" Agar " " 36° C., 1 " " "

Microscopic and bacteriologic examinations, satisfactory.

"Under ordinary circumstances the chemical analysis would condemn the water, and I am still inclined to think that although the geological formation may account for a great deal, the water supply is to some extent contaminated." [This must refer especially to the high Nitric Anhydride figure and to the Ammonia.]

Sherfield.

HALL.

By R. A. CRIPPS, 1903. Communicated by Messrs. DUKE and OCKENDEN.

	Grains per gallon.
Total solids	·38
Chlorine	2·3
Ammonia (albuminoid ammonia, none) ...	·0154
Nitrogen (as nitrites or nitrates)	None

Hardness (Clark's scale), 25·6°.

Microscopic examination satisfactory.

"This water is of excellent quality, but hard; it may be safely used for drinking purposes."

Soberton.

GOSPORT WATERWORKS (*see* p. 126).

Made by Dr. J. C. THRESH. December, 1904

In parts per 100,000.

Ca	Mg	—	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
10	·6	—	15·9	1·3	1·9	·6		
10	—	—	15·	—	—	—	Calcium carbonate	25·
—	·4	—	·9	—	—	—	Magnesium "	1·3
—	·2	—	—	·8	—	—	" sulphate	1·
—	—	·2	—	·5	—	—	Sodium sulphate ...	·7
—	—	1·2	—	—	1·9	—	" chloride ...	3·1
—	—	—	—	—	—	·6	" nitrate ...	·8
							Silica, &c.	·7
			Total solid constituents dried at 180° C. ...					32·6

Hardness: temporary 21·5, permanent 3, total 24·5 (=15°, 2°, 17°).

Free ammonia	·001
Organic "	·001
Oxygen absorbed in 4 hours at 27° C.	·0115
Nitrites	Nil

There is another analysis, but less detailed, in the Water Works Directories, 1907, 1909, with the results of bacteriologic axamination added, and the following remarks :—"The water is of exceptional organic purity. It is also free from all objectionable bacteria, and from bacteria indicating pollution."

Southampton.

1. Deep Well on the Common (*see* pp. 127–129).

By J. H. Robson. *Quart. Journ. Chem. Soc.*, 1852, vol. iv., pp. 7–12.

Apparently from a sample taken before the boring was finished, the total depth being given as 1,280 feet.

The boring is said to yield a mean supply of 125,000 gallons a day.

Temperature of the water 63° F. (31° C.), that of the air being 57° F. (28° C.). Specific gravity 1·00223. Reaction acid.

Fixed residue, 91·175 grains a gallon.

The following figures are the mean of two observations. In grains per gallon.

Carbonate of protoxide of iron ...	·434
Carbonate of lime	9·618
Carbonate of magnesia	3·696
Phosphate of lime...	·8736
Sulphate of lime	3·059
Chloride of magnesium	2·576
Sulphate of potash	2·737
Chloride of sodium	62·804
Silica	·931
Organic matter	4·9

The amount of common salt is notable, as it cannot come from tidal water It is an example of what often occurs in deep seated waters.

2. Docks, near the Sugar House (*see* pp. 129, 130).

For boiler-purposes.

By G. R. Barrel, May, 1896? Communicated by Mr. W. R. Galbraith

Silica	·98	Grains per gallon.
Carbonate of lime... ...	4·48	
„ „ magnesia ...	1·68	
Total incrusting solids ...	7·14	
Non-incrusting „ ...	4·06	
Total ...	11·2	

A first class or very good water for steam-boilers.

Another analysis by and from same, April, 1896 :—

Ammonia	·0063	Grains per gallon.
„ albuminoid ...	·0049	
Oxygen consumed by organic matter :—		
In 15 minutes	·0084	
In 4 hours	·0168	

Indicated degree of impurity as per scale following = ·112 :—

Water-scale :—under ·25 is a 1st class water.
„ ·4 „ 2nd „
over ·4 is an undrinkable-water.

4. Gas Works (*see* p. 133).

A chlorine-estimation by Mr. J. Brierley, January, 1904.

Chlorides = 47·09 grains per gallon (the usual quantity in river-waters not tidal and not fouled by chemical manufacturers is about 3 grains per gallon).

South Hants. Water Works.

PUMPING STATIONS, TWYFORD and TIMSBURY (combined).

From Annual Report for 1903, of Medical Officer of Health for New Forest Rural District. Made by Messrs. OGSTON and MOORE. In grains per gallon.

	Reservoir.	Well (? which).
Total solids...	14·7	25·76
Containing—		
Chlorine	1·3	1·22
Sulphuric acid ...	·48	·52
Nitric acid	·76	·76
Lime	4·34	10·36
Magnesia	·55	·52
Hardness—		
Total	8·5°	18·5°
Permanent	3·8°	3·8°
Ammonia, free	nil	nil
Albuminoid	·01	trace
Appearance	bright	bright.

These analyses clearly indicate an excellent and pure water.

The differences in solids, lime, and hardness, are due to the water in the reservoir having been softened.

See also **Timsbury** and **Twyford** next below.

Timsbury.

SOUTH HANTS WATER CO. (*see* p. 139).

From Dr. BULSTRODE'S Report on the Itchen Urban District (L.G.B. 1904). Made by Messrs. OGSTON and MOORE.

—	Well.		Reservoir.	
	Dec. 7, 1903.	Jan., 1904.	Dec. 7, 1903.	Jan., 1904.
Total solids ... grains per gallon	26·32	26·18	14·	13·72
Chlorine ... ,, ,,	1·3	1·3	1·25	1·25
Sulphuric acid ,, ,,	·53	·5	·55	·48
Nitric acid ... ,, ,,	·76	·7	·76	·7
Lime ... ,, ,,	10·36	10·36	4·2	4·06
Magnesia ... ,, ,,	·57	·55	·55	·5
Hardness, total	18·5	18·5	8·5	8·5
,, permanent... ...	3·9	3·9	3·8	3·9
In parts per million.				
Ammonia, free	nil	·012	nil	·006
,, albuminoid ...	nil	·008	·01	·006
Appearance	bright	bright	bright with slight deposit.	bright, no deposit on standing.

The difference between the water from the well and that from the reservoir is due to the latter having been softened.

All are very satisfactory as regards organic purity

Twyford.

SOUTH HANTS WATER CO. (*see* p. 141).

From Dr. BULSTRODE's Report on the Itchen Urban District (L.G.B. 1904).

Made by Messrs. OGSTON and MOORE.

—	Well.		Reservoir.	
	Dec. 7, 1903.	Jan., 1904.	Dec. 7, 1903.	Jan., 1904.
Total solids ... grains per gallon	21·91	20·86	12·25	10·29
Chlorine ... „ „	·9	·98	·9	·98
Sulphuric acid „ „	·43	·38	·33	·28
Nitric acid ... „ „	·97	·97	·97	·97
Lime ... ... „ „	7·84	7·42	3·22	2·66
Magnesia ... „ „	·45	·4	·4	·35
Hardness, total	14·6	14·2	5·5	5·
„ permanent... ...	3·8	3·6	3·7	3·5

In parts per million.

Ammonia, free	nil	nil	nil	nil
„ albuminoid ...	·005	·012	·009	·02
Appearance	bright	bright	bright with slight deposit after some days.	bright.

The difference between the water from the well and that from the reservoir is due to the softening of the latter.

The reservoir-water of January, 1904, had been further softened than that of December, 1903.

All are very satisfactory as regards organic purity.

From a paper by Mr. B. LATHAM, "Plumbism due to Electrolysis," *Trans. Brit. Assoc. Waterworks Eng.*, vol. x, p. 145. 1906.

A case of lead-poisoning occurred at Twyford and lead was found in the Company's water. The water in question came from a chalk-well at Twyford, and was softened with lime (to 4° or 5°) by HAINES' method.

Twyford—*cont.*

The following are analyses, before the discovery of lead in the water, made by Messrs. Ogston and Moore.

In grains per gallon (except ammonias).

—	September 4, 1905.		October 7, 1905.	
	Well water.	Softened water.	Well water.	Softened water.
Total solids	19·81	11·34	19·46	10·5
Chlorine	1	1	1	1
Sulphuric acid	·38	·36	·33	·38
Nitric acid	1·08	1·08	1·08	1·08
Lime	7·56	3·15	7·42	2·66
Magnesia	·4	·42	·35	·4
Hardness, total	13·16	5·2	12·83	4·7
„ permanent	3·	3·	3·	2·9
In parts per million.				
Ammonia, free	nil	nil	nil	nil
„ albuminoid... ...	trace	·005	·005	·008
Appearance, in all, bright.				

The poisoning-case occurred in October, 1905, and the water from the cottage where the case occurred was found to contain ·14 grains of lead per gallon. However, the water both softened and unsoftened, was found to dissolve no lead in 24 hours. But after 48 hours there was the faintest trace (inestimatable). The supply-pipe to the cottage was found to be pure lead and the tests were made with pure lead. Upon "composition" pipe the water had no action. Similar experiments made with New River Company's water (? for this purpose equivalent to South Hants Co. unsoftened water) in each case showed strong evidence of lead having been dissolved. The analysts' conclusions were that the presence of lead to the extent of ·14 grains per gallon could not be due to ordinary solution.

Mr. Latham, on examination of the site, reported that the solution of lead was due to electrolytic action while the water was passing the engine-house and storage-batteries used for the electric lighting of Twyford Lodge.

The analysts also reported that a white powder on the inner surface of the lead service-pipe was carbonate of lead. Also that the old lead pipe gave a greater amount of lead to the water than similar new piping.

They then passed an electric current through water contained in the pipe, allowing the action to go on over night, and they found the activity (of the water for lead-solvency) had increased from ·005 to ·03, that white patches formed on the pipe and that a white powdery substance floated on the water. The floating powdery substance was found to be carbonate of lead, and "we have no doubt the white patches are also carbonate of lead." This confirms Mr. Latham's conclusion that the lead-solution was due to electrolysis.

Further confirmation was supplied by Dr. Roberts (Medical Officer of Health to the Winchester Rural District Council) who found a feeble electric current coming from the tap in the cottage, and also in other parts of the Company's district.

Messrs. Lucas and Dyke, electrical engineers, found a leakage into the lead pipe amounting to 1·8 volts, and the analysts found that this current produced in four hours a water containing ·07 grains of lead per gallon, and that running the experiment all night did not add to this figure. This proportion of lead is amply sufficient to cause lead-poisoning.

[The length of lead piping in question was 200 or 300 yards, and the houses supplied were Twyford Lodge and then two cottages. The engine (if steam) at Twyford Lodge and the greater domestic consumption would ensure circulation in the portion up to Twyford Lodge, but there would be stagnation and ample time for electrolytic or other action in the pipe to the cottages.]

Winchester.

1. Public Supply (*see* p. 143).

Made and communicated by Dr. J. C. Thresh, April, 1899.

In parts per 100,000.

Ca	Mg	—	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
9·5	·3	—	11·7	·65	·17	4·45		
7·8	—	—	11·7	—	—	—	Calcium carbonate...	19·5
·25	—	—	—	·65	—	—	„ sulphate ...	·9
1·45	—	—	—	—	—	4·45	„ nitrate ...	5·9
—	·3	—	—	—	·9	—	Magnesium chloride	1·2
—	—	·5	—	—	·8	—	Sodium chloride ...	1·3
							Silica, etc.	·7
				Total solid constituents dried at 180° C....				29·5

Hardness: temporary, 10°; permanent, 4°. Total 14°
Free ammonia ... ... ·001
Organic ammonia ... ... ·002
Oxygen absorbed in 4 hours at 27° C. ... ... ·014
Nitrites ... ... Nil.

2. House Well. 3. Well at Cottage.

Two analyses by Dr. J. C. Thresh, February, 1905.

In parts per 100,000.

	2.	3.
Total solid matter dried at 180° C. ...	—	—
Chlorine	8·7	1·5
Equivalent to chlorides (60 per cent. Cl.)	14·4	2·5
Nitric nitrogen	2·3	·057
Equivalent to nitrates (17 per cent. N.)	13·2	·34
Nitrites	none	none
Hardness, permanent	4°	3°
„ temporary	20°	11·5°
„ total	24°	14·5°
Lead, copper, zinc, iron	none	none
Free ammonia	·008	·018
Organic ammonia	·008	·006
Oxygen absorbed at 98° F. in 3 hours...	·032	·018
Turbidity	clear	dull
Colour	very faint yellow	yellow

WELL WATERS. From *Rivers Pollution Commission. Sixth Report.* 1874.

Analyses by [Sir] E. FRANKLAND and others.

In parts per 100,000.

—	Temperature, Centigrade.	Total Solid Impurity.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Combined Nitrogen.	Chlorine.	Hardness.			Remarks.
									Temporary.	Permanent.	Total.	
Basingstoke.												
Water Supply. October, 1873...	11·2°	29·26	·041	·016	0	·661	·677	1·6	19	6·1	25·1	Clear and palatable.
Christchurch.												
Public Well, No. 3, in Pit, High Street. March 12, 1873.	—	125·6	·528	·119	·025	7·706	7·846	16·8	5·4	36·7	42·1	Slightly turbid. Palatable.
Public Well, No. 4, in High Street. March 12, 1873.	—	85·1	·179	·086	·001	2·218	2·305	18·5	11·6	17·7	29·3	Clear and palatable.
Dunbridge.												
Well at Queenwood College. October 13, 1873.	11·5°	29·54	·044	·005	0	·541	·546	2·2	16·1	6·3	22·4	Clear and palatable.
Gosport.												
Well at Waterworks. March 7, 1873.	5·6°	38·16	·069	·017	·054	·106	·167	5·9	7	7·9	14·9	Slightly turbid. Palatable.
Petersfield.												
Mr. J. Soames's. December 9, 1873.	—	44·88	·254	·073	·002	3·168	3·243	5·4	4·3	12·5	16·8	Slightly turbid. Palatable.
Winchester.												
Waterworks. March 12, 1873...	—	29·56	·048	·018	0	·624	·642	1·7	17	6	23	Clear and palatable.

Wimbourne.

BOURNEMOUTH WATERWORKS (*see* pp. 144, 145).

Though the site is in Dorset, the supply is for Hampshire, and so may be noticed here.

Made by Dr. J. C. THRESH. February, 1904.

In parts per 100,000.

Ca	Mg	—	CO_3	SO_4	Cl	NO_3	Probable combinations.	
9·3	1·25	—	15·3	2·8	2·4	·1		
9·3	—	—	13·95	—	—	—	Calcium carbonate...	23·25
—	·55	—	1·35	—	—	—	Magnesium carbonate	1·9
—	·7	—	—	2·8	—	—	Magnesium sulphate	3·5
—	—	1·6	—	—	2·4	—	Sodium chloride ...	4·
							Nitrates, &c. ...	1·35
				Total solid constituents dried at 180° C. ...				34·

Hardness. Temporary 18°, permanent 7°, total	25°
Free ammonia	·0044
Organic ammonia	·0006
Oxygen absorbed in 4 hours at 27° C.	·0224
Nitrites	nil.

The analysis given in the Water Works Directory, 1907, is presumably of mixed waters, or from the old source of supply, though made in March, 1907, as it differs considerably from the above.

ANALYSES OF WELL-WATERS. ISLE OF WIGHT.

Bembridge.

WATERWORKS (*see* pp. 148, 149).

Made by Dr. OTTO HEHNER. Communicated by Dr. H. F. PARSONS.

In parts per 100,000.

Chlorine	3·1
Sulphuric acid	·68
Nitric acid	·22
Phosphoric acid	trace
Ammonia, free	·0235
„ albuminoid	·0049
Oxygen absorbed from permanganate in 15 mins. at 80° F.	·0416
„ „ „ „ „ 4 hours „ „	·0952
Total solids dried at 212° F.	20·4
Loss on ignition	2·8
Appearance of solids on heating	charred
Total hardness	11

Colour, very faint yellow.

Dr. Hehner speaks of the above analysis as referring to a sample from a well 475 feet deep.

Sample received 8th September, 1904, and was still turbid on the 14th. The turbidity is due to sand-particles and indicates that the water has not assumed normal conditions.

The mineral contents are very satisfactory. Saline matters in solution are low, and the hardness is consequently slight; but not so slight as to lead to an attack on lead pipes, and containing sufficient lime-salts for the purposes of the human frame.

Calbourne.

WATERWORKS.

Source. Trial well, 18 feet deep, in chalk.

Yield. 100 gallons per minute.

Made by Dr. O. HEHNER. June, 1904. Communicated by Dr. H. F. PARSONS.

In parts per 100,000.

Chlorine	3
Sulphuric acid	·46
Nitric acid	1·08
Ammonia, free	·0019
„ albuminoid	·0032
Oxygen absorbed from permanganate in 15 mins. at 80° F.	·0152
„ „ „ „ „ 4 hours „ „	·026
Total solids dried at 212° F.	23·6
Loss on ignition	2·8
Appearance of solids on heating	no change
Total hardness	16

Total number of bacteria per cubic centimetre, 88; growing at blood-heat 15; growing in phenolides acid agar, none.

Perfectly clear, and showed the faint blue tinge of pure water.

Perfectly satisfactory, chemically and bacterially. Contains very little organic matter in solution and shows no sign of animal impurities. Contains very little dissolved mineral matter and is therefore not unduly hard.

In every respect satisfactory; quite suitable for drinking and all domestic purposes.

Carisbrook.

1. NEWPORT WATERWORKS (*see* p. 150).

By Messrs. ALLEN and HANBURY. From Dr. T. THOMSON'S Report to the Local Government Board, on Newport, 1895. 1 from the new well. 2 from the old well. 3 from the low level reservoir.

Colour in 2 feet tube. Pale blue and clear in all three.

Suspended matter, smell, when heated to 100 F. and taste. None in all three.

Analyses, in grains per gallon.

——	1.	2.	3.
Total solid matter	21	21	20·3
Loss on ignition	2·7	3·5	4·9
Total mineral matter	18·3	17·5	15·4
Chlorine as sodium-chloride	3·44	3·44	3·44
Nitrogen as ammonia	·0013	·0016	·0007
,, ,, albuminoid ammonia	·0005	·0005	·0005
,, ,, nitrates	·2912	·2484	·3718
Oxygen absorbed from permanganate of potash at 80° F. in two minutes	none	none	none
Ditto, in 4 hours	·0241	·0126	·0126

Hardness before boiling 11° in all three, after boiling 3·5° in all three.

Lead, copper, iron, phosphoric acid, none in all three.

All are described as good water.

Other analyses, of water taken from taps or hydrants, are given.

Bacteriologie examination, by Dr. KLEIN.

New well. In addition to the ordinary water-bacteria one colony presented a suspicious appearance, but it was found to be neither *bacillus coli communis* nor the *bacillus* of enteric fever.

Old well. A good many colonies of *proteus vulgaris* in addition to the ordinary water-bacteria. On a later sample *bacillus fluorescens putidus* was observed.

Low level reservoir. Besides ordinary water-bacteria there were *proteus vulgaris*, *bacillus fluorescens putidus* and a few colonies of a gas-forming *bacillus* of the *coli* group.

A later analyses from the Annual Report of the Medical Officer of Health for Newport Borough. 1903.

Made by "THE CLINICAL RESEARCH ASSOCIATION." Communicated by Dr. H. F. PARSONS.

In grains per gallon.

Total solids (dried at 120° C.)	17·85
Combined chlorine	2·4
,, ,, expressed as sodium chloride	3·96
Nitrogen as nitrates	·19
Nitrites	nil
Ammonia, saline	nil
,, albuminoid	·0013
Oxygen absorbed in 4 hours at 27° C.	·007
Total hardness	13·3
Lead or copper	nil

Organically very pure. Moderately hard. Excellent for dietetic use.

Carisbrook—*cont.*

2. WELL at the Castle in Chalk.

By H. GRIMSHAW. 1878.

Sample taken, 19th April ; but not opened or interfered with until September.

Water when taken very bright and clear, free from sediment, without odour, and of fresh and sparkling taste, free from carbonic acid or other gas.

Well said to be 240 feet deep.

When the bottle was opened there was a strong smell of sulphuretted hydrogen and a strong reaction for that gas was obtained.

The analytical data, as far as possible from the quantity of water, were as follows, in grains per gallon.

Mineral matter	22·4	Total solid matter	42·
Volatile ,,	19·6		
Chlorine ...	4·5		
Total hardness	12·3	Magnesia hardness	1·7

The residue on heating blackened very much and gave off an unpleasant odour.

The peculiarity is "the production of sulphuretted hydrogen, on standing for some time . . . out of contact with the atmosphere. On leaving a small portion of the water in the bottle again corked up for some time the presence of sulphuretted hydrogen was not exhibited. This production of sulphuretted hydrogen proceeds undoubtedly from the reduction of the sulphates contained in the water by the excess of organic matter."

He adds that it is "a most unfit water for potable purposes."

Chale.

WATERWORKS (*see* p. 151).

SOURCE.—Adits 18–33 feet below the surface in Upper Greensand, St. Catherines Down, under arable land, growing turnips and leguminous crops ; but not manured except by feeding sheep on it.

Communicated by Dr. H. F. PARSONS.

Two analyses by Dr. O. HEHNER. 1. May 16, 1901. 2. July 16, 1901.

In parts per 100,000.

	(1).	(2).
Chlorine	7·1	7·4
Sulphuric acid	2·04	2·08
Nitric ,, ...	1·11	1·41
Phosphoric acid	heavy trace	faint trace
Ammonia, free	·0052	·002
,, albuminoid	·0084	·01
Oxygen absorbed from permanganate in 15 minutes at 80° F.	·0244	·0176
Ditto in 4 hours at 80° F.	·0504	·0364
Total solids dried at 212° F.	42·24	43·2
Loss on ignition	4·4	3·6
Appearance of solids on heating	no visible change.	slight change
Total hardness	25·	24
Colour in two foot tube	bright, clear and distinctly blue.	blue and clear.

Bacterioscopic examinations.

	(1).	(2).
Total number of bacteria per cubic centimetre ...	countless	37
Sewage-bacteria	none	not given
Growing at blood-heat in neutral agar	not given	20
,, ,, ,, ,, acid ,, ...	,,	0

Remarks (1). In present condition unfit for public supply for the following reasons :—Free and albuminoid ammonia, rather higher than in a normal water ; the "heavy trace" of phospheric acid ; it has more oxidisable organic matter than a pure Greensand-water should have ; it swarms with bacteria (though none are traceable to sewage). The condition of the water would be intelligible if the well were a new one.

The analyist recommends prolonged pumping and rigorous exclusion of surface-water.

Remarks (2). [Presumably advice regarding (1) had been carried out.]

Some chemical and profound bacterial change since 16th May previous. The ammonia, oxidisable matter and phospheric acid are materially lower. Bacteria reduced from (per cubic centimetre) "countless" to 37.

"For a greensand water the supply contains even now a rather higher proportion of albuminous matter (as measured by the albuminoid ammonia), than should be expected, but otherwise no fault can be found." Provided the surface-water is excluded this figure may continue to improve.

"The water can now, in my opinion, be safely used for drinking and for all domestic purposes."

Cowes (? East or West).

Boring for the URBAN DISTRICT COUNCIL.

Made and communicated by Dr. J. C. THRESH. January, 1907.

In parts per 100,000.

Total solid matter dried at 180° C. ...	29·
Chlorine	3·
Nitric nitrogen	·03
Nitrites	nil
Hardness, permanent 12, temporary 8, total	20
Lead, copper, zinc, iron	Slight trace of iron
Free ammonia	·1124
Organic ammonia	·0046
Oxygen absorbed at 98° F. in 3 hours ...	·093

Turbidity, slight. Colour, slight yellowish. Odour, none.

East Cowes.

BORE-HOLE made in 1904 in Bembridge, Osborne, and Headon Beds.

Two analyses by Dr. HARLAND. Communicated by Dr. H. F. PARSONS.

1. 14 May, 1904. Yield at 105 feet, 7,000 gallons an hour.
2. 28 June, 1904. At 107 feet a copious supply (28,140 gallons per hour) burst into the well.

	1	2.
Appearance	—	turbid (*see* remarks).
Colours (after settlement)	pale blue	—
Taste, smell	none	none
Hardness (by soap)	20°	22°
	In grains per gallon.	
Calcium carbonate	not given	19·56
Magnesium sulphate	,,	4·61
,, nitrate	,,	·53
Sodium chloride	8· (= Chlorine 4·88).	8·19
Loss on ignition	not given	2·81
Total dissolved solids	35	35·7
Lead, copper, iron	nil	nil
Phosphoric acid	,,	,,
Nitrogen as ammonia	·0016	·0019
,, albuminoid ammonia ...	·0006	·0016
,, nitrites	nil	nil
,, nitrates	·112	·1008
Oxygen absorbed by organic matter in 15 mins.	·0084	·0056
Ditto in 4 hours	·014	·0123
Microscopical examination	Deposit entirely siliceous particles.	Deposit entirely mineral matter (clay and sand)

Remarks.—Both are practically identical, showing constancy of composition. Both show no sign of organic pollution, and are quite satisfactory except as regards Chlorine (Sodium Chloride) and hardness, which are slightly high. In 2 (presumably also in 1) the hardness is mainly due to calcium carbonate, and is therefore removable by boiling.

The turbidity (due to mineral matter) will probably disappear as pumping proceeds, or can in any case be removed by settlement.

Both satisfactory for drinking and general domestic use.

Freshwater.

WATERWORKS (OLD), (*see* p. 152).

By Dr. O. HEHNER. In parts per 100,000.

—	1.	2.	3.
Chlorine	82·4	18·8	82·3
Sulphuric acid	10·2	2·48	10·16
Nitric acid	·93	·94	·9
Phosphoric acid	none	none	none
Free ammonia...	·0016	·0015	·0017
Albuminoid ammonia	·0036	·0048	·0037
Oxygen absorbed from permanganate in 15 mins. at 80° F.	·02	·016	·018
Ditto in 4 hours	·05	·034	·048
Total solids dried at 212° F.	194	59·76	194
Loss on ignition	19·6	7·2	19·2
Appearance of solids on heating	no visible change		
Total hardness	50·6	20	50
Colour in two foot stratum	all faint greenish colour, clear		

1 and 3 are identical in composition. Both are high in chlorides (82·4 parts chlorine = 135·8 parts of sodium chloride). Both strongly brackish They show no indication of pollution with sewage or other animal matter. They would be perfectly suitable for drinking but for the sea-water infiltration, to which also the high degree of hardness must be largely due. The sea-water infiltration is in no way injurious to health, but the supply must be highly inconvenient, especially for cooking and washing.

2 contains far less sea-water, but, nevertheless, the amount of chlorides is far larger than it should be in good drinking water. Otherwise it is pure and unpolluted. It is far the best of the three waters. All three appear to be the same water mixed with different proportions of sea-water.

Another analysis made and communicated by Dr. J. C. THRESH. January, 1905.

In parts per 100,000.

Ca	Mg	—	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
7·9	2·	—	10·1	4·4	21	1		
6·7	—	—	10·1	—	—	—	Calcium carbonate...	16·8
1·2	—	—	—	2·9	—	—	,, sulphate ...	4·1
—	·4	—	—	1·5	—	—	Magnesium sulphate	1·9
—	1·6	—	—	—	4·65	—	,, chloride	6·25
—	—	10·6	—	—	16·35	—	Sodium chloride ...	26·95
—	—	·4	—	—	—	1	,, nitrate ...	1·4
				Total solid constituents dried at 180° C.				57·4

Haven Street.

LONGFORD HOUSE (*see* p. 153).

Analysis of sample of water taken 13th August, 1887.

Total solids	25·	grains per gallon.
Chlorine	2·5	,, ,,
Free ammonia	·063	,, ,,
Albuminoid ammonia	·0014	,, ,,
Nitrogen as nitrates and nitrites	·03228	,, ,,

Newchurch.

RYDE WATERWORKS, Knighton (*see* pp. 154, 155).

Two analyses. 1. Mill well, February, 1900. 2. Mill well and new boring, June, 1900, after filtration.

Made by Dr. O. HEHNER. Communicated by Dr. H. F. PARSONS.

In parts per 100,000.	1.	2.
Chlorine	2 4	3·8
Sulphuric acid	1 92	1 96
Nitric ,, ...	·27	·26
Phosphoric acid	not given	nil.
Ammonia free	·0016	·0082
,, albuminoid	·0071	·003
Oxygen absorbed from permanganate in 15 minutes at 80° F.	·0032	·0134
,, ,, ,, ,, 4 hours ,, ,,	—	·0348
Total solids, dried at 212° F.	25·2	26·8
Loss on ignition	2·56	2·4
Total hardness	15°	16·8°
Colour	none	faint blue

1. "Is water of excellent quality." It is to be treated with lime, to remove iron.

2. Contained a considerable quantity of oxide of iron in suspension. The amount of oxidisable organic matter is minute. No indication of sewage or other organic pollution. When freed from the oxide of iron above mentioned will be satisfactory in every way. [This to be done with lime, see above.] "This supply is of excellent quality."

Newport.

Two wells at ISLE OF WIGHT COUNTY LUNATIC ASYLUM.

Two analyses communicated by Dr. H. F. PARSONS.

1. Well and borehole, total depth 160 feet, in Lower Greensand under 20 feet of clay (Gault).

Made by Dr. O. HEHNER.

2. NEW WELL. Well and boring 525 feet in Lower Greensand. Yield 28,746 gallons per day after 14 days' pumping.

Made by Mr. W. D. SEVERN.

Both in parts per 100,000.

1 (and 2 in brackets where similar denomination is used).

Chlorine	2·25 (2·6)
Sulphuric acid	2·72
Nitric ,, ...	2·43
Phosphoric acid	trace.
Ammonia, free	·0018 (·0014)
,, albuminoid	·0042 (·0016)
Oxygen absorbed from permanganate in 15 minutes at 80° F.	·0052
,, ,, ,, 4 hours ,, ,,	·0146
Total solids...	16·88 (21·8)
Loss on ignition	2·
Hardness	4·9

Remarkably free from organic matter and shows no chemical sign of pollution with sewerage or animal matter. Exceedingly soft ; perfectly pure.

Newport—*cont.*

2 (figures in brackets are similiar items of 1).

Colour in two foot tube, practically none. Deposit and odour none.

Taste pleasant; almost perfectly bright; well aerated.

Chlorine	2·6	(2·25)
Nitrogen as nitrates and nitrites	·005	
Poisonous metals	nil	
Ammonia saline	·0014	(·0018)
„ albuminoid	·0016	(·0042)
Total solids	21·8	(16·88)
Oxygen absorbed from permanganate at 80° F.	·0034	

Bacteria.

280 per cubic centimetre on nutrient gelatine at 20–22° C.
25 „ „ „ liquefying.

Only three species, perfectly well known and harmless.

Cultures in various media, detailed in a former report, showed no suspicious forms. No gas-producing forms noted.

Newtown.

SOURCE. Well 84 feet deep in ? Hamstead Beds.
Yield inadequate.

Made by Dr. O. HEHNER, May, 1894. Communicated by Dr. H. F. PARSONS.

In parts per 100,000.

Chlorine	29·65
Sulphuric acid	28·08
Nitric „	none
Phospheric acid	very faint trace
Ammonia, free	·3583 [?]
„ albuminoid ...	·0088
Total solids	121·76
Loss on ignition	15·84

The above analysis shows, as far as chemical analysis can show, freedom from sewage-pollution, and the water may therefore be safely used for drinking.

But the mineral matters, mainly sulphates and chlorides of sodium and calcium, are so high as to render it extremely undesirable for all domestic purposes. Good drinking water should not contain much more than 30 parts per 100,000 of mineral matters, while the total solids of this water amount to four times that quantity.

If a better supply can be obtained, Dr. HEHNER strongly recommends that the water be not used as an every day supply.

Ryde.

ASHEY WATERWORKS. Well in chalk (*see* p. 162).

Made by Dr. O. HEHNER. 1900. 1 in January, 2 in February, 3 and 4 in July (3 after filtration). Results in parts per 100,000.

—	(1.)	(2.)	(3.)	(4.)
Chlorine	2·7	2·8	3·8	3·1
Sulphuric acid	1·76	1·52	1·96	1·2
Nitric acid	1·93	1·66	·26	·33
Phosphoric acid	faint trace	faint trace	none	—
Free ammonia	·0019	·0034	·0032	·0108
Albumenoid ammonia	·0048	·0044	·003	·0037
Oxygen absorbed from permanganate of potash in 15 minutes.	·0078	·012	·0134	·0124
Ditto in 4 hours (both at 80° F.)	·0188	·0192	·0345	·0272
Total solids dried at 212° F. ...	30·8	32	26·8	22·8
Loss on ignition	3·12	2·8	2·4	2·56
Hardness	21·3°	20·2°	16·8°	15 4°

Ryde—*cont.*

Colour in two foot tube, faint greenish in No. 1, greenish-blue in No. 2.

Number of bacterial organisms per cubic centimetre (in No. 1) 650. Bacteria capable of growing at blood heat in neutral agar 2. Ditto in acid phenolided agar 1.

In two cases the following further information is given :—

	(1.)	(4.)
Silica...	·9	·66
Carbonic acid	7·27	5·76
Oxide of iron	·22	·32
Lime	11·2	7·82
Magnesia	·53	·57
Soda	1·85	2·41
Total (with top 3 items given above)	28·36	22·17
Less oxygen for chlorine	·6	·7
Total dissolved mineral matter ...	27·76	21·47

The mineral constituents, of these two, are present probably in the form of the following salts :—

	(1.)	(4.)
Sodium chloride	3·48	4·55
Calcium chloride...	·92	·54
„ sulphate	2·99	2·03
„ nitrate	2·94	·5
„ carbonate	15·2	11·68
Magnesium „	1·11	1·19
Silica	·9	·66
Oxide of iron	·22	·32
	27·76	21·47

Speaking of No. 1, Dr. HEHNER says : "Organically the supply is of great purity. The proportion of dissolved mineral constituents is moderate, but the amount of . . . calcium carbonate is now somewhat greater, and the hardness consequently somewhat higher, than it was in July, 1899. In one respect the water has undergone a change for the worse . . . At that time the amount of nitric acid was very small . . . only ·16 parts per 100,000 . . . As nitric acid is a product of oxidation of animal organic matter I cannot but look with suspicion upon this change, in spite of the organic purity of the present sample. Whatever impurity has meantime found its way into the well has become oxidised, but has left its traces behind. This change for the worse is also shown by the bacterioscopic results. The total number of bacteria has increased from 39 to 650 per cubic centimetre, and although, with a single exception, these bacteria belong to a perfectly harmless class, the change is so serious that I would strongly recommend an immediate enquiry into the causes of the alteration. [Such enquiry has been made.] In its present condition the water may almost certainly be used with perfect safety ; but any notable alteration in the composition of a public supply is an indication that surface-water can, under some conditions, find its way into the well."

Of No. 2 he says : "The proportion of organic matter, though not large, is greater than I would expect in a water coming from a well 60 feet in depth. This and the faint trace of phosphoric acid . . . make me suspect that there must be some surface-water mixed with that coming from the bottom." Curiously the water from the reservoir is better than that from the well.

On No. 3 the following remarks are made : "The water as received contained in suspension a considerable amount of oxide of iron. The above results are obtained . . . after filtration . . . The composition . . . is in every way satisfactory . . . and there is no indication whatever of sewage or other organic pollution."

As to No. 4 we are told : "The composition . . . is quite satisfactory. There is . . . an unusually high proportion of free ammonia, but this is evidently

derived from mineral sources and not from organic pollution. The proportion of oxidisable organic matter is quite small and the amounts of chlorides, sulphates and nitrates such as are present naturally in the pure . . . water of the district."

In the Water Works Directory, 1909, an analysis of the Ryde water is given; but the source is not specified; it may be from the mixed waters of Ashey and Knighton.

Shalfleet.

FRESHWATER AND YARMOUTH WATER COMPANY, Shalcombe. (*See* p. 163).

Made and communicated by Dr. J. C. THRESH, May 1909.

In parts per 100,000.

Ca	Mg	Na	CO_3	SO_4	Cl	NO_3	Probable Combinations.	
7·6	Too small to estimate.	—	10·7	·9	3·8	1·5		
7·2	—	—	10·7	—	—	—	Calcium carbonate ...	17·9
·4	—	—	—	·9	—	—	„ sulphate ...	1·3
—	—	2·5	—	—	3·8	—	Sodium chloride ...	6·3
—	—	·5	—	—	—	1·5	„ nitrate ...	2·
—	—	—	—	—	—	—	Trace of magnesia, etc.	·1
			Total solid constituents dried at 180° C. ...					27·6

Free ammonia	·0006
Organic „	·0032
Oxygen absorbed in 4 hours at 27° C... ...	0
Nitrites	0

Hardness.—Temporary 15°, permanent 3°, Total 18°

The water contains no objectionable saline matter and is practically free from organic matter. Is admirably adapted for a public supply. The sample was taken during the construction of the well.

Ventnor.

WATERWORKS.

Source, from Chalk.

From Annual Report of Medical Officer of Health for Ventnor, 1897.

Made by Dr. O. HEHNER, October, 1897. In parts per 100,000.

Chlorine	3·3
Sulphuric acid	1·
Nitric acid	·38
Phosphoric acid	None.
Ammonia, free	·001
„ albuminoid	·0033
Oxygen absorbed from permanganate in 15 minutes at 80° F.	·0049
Ditto in 4 hours at 80° F.	·006.
Total solids	35·12
Loss on ignition	1·6

Colour in two-foot tube, faintly bluish.

Of excellent quality. Organic matter practically absent, and the figures are those of a perfectly pure, and unpolluted water. The figures are identical with those of an analysis of the same supply made 17 years before (1880). Only deep seated waters show this remarkable constancy.

West Cowes.

1. WATERWORKS, east of Broadfield (*see* pp. 164–166).

An analysis by Professor J. ATTFIELD, F.R.S. (November, 1887) of the spring at 320 feet gave the following results :—

	Grains per gallon.
Total suspended solid matter, dried at 250° F.	None after subsidence.
Total dissolved solid matter, dried at 250° F.	17·
Ammonia	·07
(Equal to ammonia per million, 1·).	
Albuminoid organic matter, yielding 10 per cent. of nitrogen	·01
(Equal to ammonia per million, ·02).	
Nitrites	None.
Nitrates containing 17 per cent. of nitrogen ...	·35
(Equal to grains of nitrogen per gallon, ·06).	
Chlorides containing 60 per cent. of chlorine	3·2
(Equal to grains of chlorine per gallon, 1·9).	
Hardness, reckoned as chalk-grains or "degrees": all removed by ebullition ...	10·
Lead or copper	None.
Oxygen absorbed in three hours	·02

Physical examination after subsidence satisfactory.

WELL at Broadfield.

Waterworks 167·4 feet above Ordnance Datum. Water-level 158 feet down.

Water from Barton Sand, by two borings, 468 and 530 feet deep. Trial-bore carried to 718 feet.

Made and communicated by Dr. J. C. THRESH, February 1902.

In parts per 100,000.

Ca	Mg	Na	CO_3	SO_4	Cl	NO_3	Probable combinations.	
5·9	1·06	—	12·3	3·75	2·	·3		
5·9	—	—	8·85	—	—	—	Calcium carbonate...	14·75
—	1·06	—	2·65	—	—	—	Magnesium ,, ...	3·71
—	—	·6	·8	—	—	—	Sodium ,, ...	1·4
—	—	1·8	—	3·75	—	—	,, sulphate ...	5·55
—	—	1·3	—	—	2·	—	,, chloride ...	3·3
—	—	·1	—	—	—	·3	,, nitrate ...	·4
							Silica, &c.	·05
			Total solid constituents, dried at 180° C. ...					27·16

Free ammonia	·0864
Organic ammonia	·002
Oxygen absorbed in 4 hours at 27° C.	Nil.
Nitrites	,,

West Cowes—*cont.*

2. WOODVALE (*see* p. 166)

Four analyses by Dr. J. C. BROWN, of Liverpool, 1885. In parts per 100,000.

—	1.	2.	3.	4.
Solid matter in solution ...	121·6	33·6	49·2	49
Organic carbon	Considerable quantities.	Considerable quantities.	Considerable quantities.	Large quantities.
„ nitrogen ...				
Ammonia	·008	·002	·005	·013
„ from organic matter*	·044	·033	·038	·058
Nitrogen as nitrates	2·92	—	·262	·371
Combined chlorine	17·75	4·26	7·8	8·52
Hardness	63°	17·4°	26°	25·7°

* By distillation with alkaline permanganate.

1. This water is excessively impure, and quite unfit for any purpose except irrigation or watering streets.

2. Slight deposit, and contains Rotifera. This sample is not of high quality; but if surface-water could be excluded it might be passable.

3. This sample is not good for domestic use.

4. This sample is quite unfit for use.

Analysis of and reports on water from WOODVALE.

By Prof. ATTFIELD, A. 5 November and B. 17 December, 1885.

One gallon contains the following number of grains of the respective substances :—

	(A.)	(B.)
Total solid matter, dried at 212° F.	20·	26
Ammoniacal matter, yielding 10 per cent. of N....	1·04	1·04
(= ammonia per million, 1·77).		
Albuminoid organic matter, yielding 10 per cent. of N.	·08	·07
(= ammonia per million, ·14 and ·12).		
Chlorides, containing 60 per cent. of chlorine	5·8	3·5
(= grains of chlorine per gallon)	3·5	2·1
Hardness, reckoned as chalk-grains or "degrees"	6	7
Removed by ebullition	2	3
Unaffected by „	4	4

A. This water contains excess of dissolved organic (animal or vegetable) matter, and large numbers of living organisms. It is therefore not well suited for drinking purposes. It contains but little salt, and not much mineral matter. It is quite a soft water.

The source of the organic matter is probably the nine-feet layer of shells above the bed of sand from which the sample, according to my instructions, was drawn.

B. This water has not improved in quality since it was analysed a month ago. It contains as much ammoniacal matter as ever; it contains as much or a little more organic matter; but especially it is less well aerated than when last examined, indeed it now has a distinctly unpleasant flavour and odour. In my opinion exposure to the air in tanks or other reservoirs would remove perhaps wholly remove, its present objectionable characters.

West Cowes—*cont.*

Another analysis by Prof. J. ATTFIELD, January, 1886.

This sample of water though not of the best quality is fairly potable. Like many waters from recently made wells it is slightly turbid, but the turbidity is only due to traces of ordinary mineral matter which soon subsides. It has neither objectionable flavour nor odour. In bulk it has a faint yellowish tinge.

Analytical data, in grains per gallon.

Total solid matter, dried at 212° F.	24·
Ammoniacal matter, yielding 10 per cent. of nitrogen (equal to ammonia per million 1·2)	·7
Albuminoid organic matter, yielding 10 per cent. of nitrogen (equal to ammonia per million ·085)	·05
Nitrates (no nitrites), containing 17 per cent. of nitrogen (equal to nitrogen ·33)	1·9
Chlorides, containing 60 per cent. of chlorine (equal to chlorine 2·2) ...	3·7

Hardness, removed by ebullition 1°, unaffected 4°, total 5°.

This sample, after being occasionally shaken with air and then allowed to rest for two days, has become beautifully bright without abnormal odour or colour, and pleasant to the taste.

It still contains the somewhat unusual proportion of ammoniacal matter observed in all the samples, which is doubtless derived from the shelly layer described.

Wootton Common.

WELL 8 feet deep in stiff yellow clay over Bembridge clay.

Made by Dr. O. HEHNER, February, 1901. Communicated by Dr. H. F. PARSONS.

In parts per 100,000.

Chlorine	3·95
Sulphuric acid	5·92
Nitric acid	2·02
Phosphoric acid	none
Ammonia, free	·0115
„ albuminoid	·0062
Oxygen absorbed from permanganate in 15 minutes at 80° F.	·016
„ „ „ „ „ 4 hours „ „	·0408
Total solids dried at 212° F.	25·76
Loss on ignition	4·
Total hardness	10·1

Appearance of solids on heating, charred. Appearance in 2-foot tube, colourless, some ferruginous deposit.

Dr. HEHNER remarks to the following effect :—

Has the characters of a surface-water. Is soft ; contains a moderate amount of organic matter in solution, partly of animal origin, but is not sewage-polluted, taking sewage to mean human sewage. As far as he can say from the analysis the supply is slightly contaminated with manure. It is impossible to say upon chemical evidence alone whether the water can safely be used for drinking. Generally speaking he distrusts a water supply liable to be polluted by drainage matters, and would not advise any public authority to sanction such a supply for public use.

Wroxall (? Ventnor Parish).

1. WATERWORKS for village, near Wroxall Cross Farm.

Communicated by Dr. H. F. PARSONS.

Source. Trial-hole in Upper Greensand. Yield 645 gallons an hour, June, 1896.

Made by Dr. O. HEHNER, May, 1896.

The sample was slightly turbid and was filtered through filter-paper for this analysis. After filtration there were still traces of clay in suspension, and one of the items given below (silica) is for that reason a trifle too high.

In parts per 100,000.

Chlorine	2·9
Sulphuric acid	2·06
Nitric acid	·5
Phosphoric acid	none
Carbonic acid (combined)	6·5
Silica (*see* remarks above)	1·76
Oxide of iron and alumina	·68
Lime	8·53
Magnesia	·83
Sodium	2·81
	26·57
Subtract oxygen for chlorine	·65
Total dissolved mineral matters	25·92
Mineral matter directly estimated	26·
Loss on ignition	1·52
Ammonia, free	·0004
„ albuminoid	·0041
Oxygen absorbed from permanganate in 15 minutes at 80° F.	·0252
„ „ „ „ „ 4 hours „ „	·0696

Mineral constituents, probably combined as follows :—

Sodium chloride	4·78
„ sulphate	·64
Calcium „	2·89
„ nitrate	·76
„ carbonate	12·67
Magnesium carbonate	1·74
Silica (with trace of clay)	1·76
Oxide of iron and alumina	·68
	25·92

Hardness: permanent, 2·6 ; temporary, 14·7. Total 17·3

The proportion of dissolved mineral matter is moderate, one half of it being chalk (calcium-carbonate). Minerally it is typical of the water from the Southern Isle of Wight Downs. Moderately hard. Organically very pure. Chemical traces of sewage are absent. An excellent water, well adapted for drinking and all domestic purposes.

2. SHANKLIN WATERWORKS (*see* p. 163).

Source. Trial-shafts in Upper Greensand at Cross Meadow.

295 to 309 feet above Ordnance Datum.

Made by Dr. P. FRANKLAND, July, 1896. Communicated by Dr. H. F. PARSONS.

In parts per 100,000.

Total solid matters	32·8
Organic carbon	·052
Ammonia	trace
Nitrogen as nitrates and nitrites	·247
Organic nitrogen	·012
Total combined nitrogen	·259
Chlorine	3·3
Hardness, temporary	18·1
„ permanent	3·4
„ total	21·5

Very slightly turbid ; palatable. No poisonous metals.

Well-waters. From *Rivers Pollution Commission. Sixth Report*, 1874.

Analyses by [Sir] E. FRANKLAND and others.

In parts per 100,000.

—	Temperature Centigrade.	Total Solid Impurity.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen as Nitrates and Nitrites.	Total Combined Nitrogen.	Chlorine.	Hardness. Temporary.	Hardness. Permanent.	Hardness. Total.	Remarks.	Geologic Formation.
Carisbrook.													
In castle, an old polluted well 240 feet deep, Mar. 8, 1873 ...	11·3	43·28	·169	·043	·002	1·365	1·41	6·4	13·9	10·	23·9	Clear and palatable	Chalk.
Osborne.													
Supplying kitchen-offices, Mar. 8, 1873	—	14·72	·142	·026	0	0	·026	2·9	4·8	5·9	10·7	Turbid. Palatable	Fluvio Marine Series.
Cross passage pump, Mar. 8, 1873	—	18·3	·228	·055	·001	·046	·102	3·3	1·8	6·6	8·4	Very turbid, brown, palatable.	" "
Pavilion-well, Mar. 8, 1873 ...	—	17·24	·267	·061	·001	·228	·29	2·4	1·7	6·7	8·4	Turbid. Palatable	" "
Entrance-yard, Mar. 8, 1873 ...	—	30·	·361	·065	·002	·026	·093	5·8	·8	12·3	13·1	Very turbid. Palatable ...	" "
Water-supply to Osborne Cottage, Mar. 8, 1873.	—	23·82	·181	·019	·001	0	·02	4·1	8·6	7·4	16	Very turbid. Palatable ...	" "
Trial-well, Dec. 13, 1873 ...	—	9·84	·075	·022	·007	0	·028	3·2	0	4·6	4·6	Palatable ...	" "
" No. 1, Jan. 19, 1874...	—	26·76	·319	·032	·016	0	·045	4·9	2·3	8	10·3	" ...	" "
" No. 2, " " ...	—	16·32	·137	·019	·001	0	·02	3·8	0	8·6	8·6	" ...	" "
" No. 3, Feb. 18, 1874...	—	54·84	·233	·038	·004	0	·041	4·45	12·1	22·7	34·8	" ...	" "
" No. 4, Jan. 19, 1874...	—	66·12	·429	·093	·001	3·64	3·73	7·2	7·1	29·3	36·4	" ...	" "
" No. 5, " " ..	—	13·08	·063	·01	0	0	·01	3·	0	7·7	7·7	" ...	" "
" No. 6, " " ...	—	8·16	·118	·023	0	0	·023	3·8	0	7·4	7·4	" ...	" "
Albert Cottage, Feb. 18, 1874 ...	—	58·84	·233	·038	·004	0	·041	4·45	12·1	22·7	34·8	" ...	" "
Ventnor.													
Waterworks, near railway station, Nov. 16, 1872.	10·5°	34·72	·056	·011	0	·061	·072	3·1	21·7	4·6	26·3	Slightly turbid. Palatable ...	Upper Greensand

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1909?

LYSTER, Dr. R. A. Hampshire County Council. Annual Report of the County Medical Officer, for the year 1908. Fol. *Portsmouth.* (Water, chiefly Rural Districts, pp. 7–10.)

ADDENDA.

Springs and Bournes.

Writing of Selborne Gilbert White says :—"At each end of the village . . . arises a small rivulet : that at the north-west end frequently fails : but the other is a fine perennial spring little influenced by drought or wet seasons, called Well-head. This breaks out of some high grounds joining to Nore Hill, a noble chalk promontory, remarkable for sending forth two streams into two different seas." And he adds, in a footnote :—"This spring produced, September 14, 1781, after a severe hot summer, and a preceding dry spring and winter, nine gallons of water in a minute. . . . At this time many of the wells failed, and all the ponds in the vales were dry." (Natural History of Selborne, 1789, Letter 1, to T. Pennant.)

Mr. W. Matthews, with whom I lately visited Twyford, has sent the following note on a small and usually dry Chalk valley, which is tributary to the valley of the Itchen, on its left or eastern side:—

"A bourne breaks out on the side of the road from Twyford to Hazely Down, first appearing at a point about 300 yards (eastward) from the Dolphin Inn at Twyford, and thence advancing up the valley, as the saturation-level rises, for a further distance of 400 yards after a very wet season."

"In March, 1899, the roadway was submerged for a considerable distance, the water overflowed from the wells at the cottages on the southern side of the road, and the fields near Bourne Lane were flooded."

"The bourne was flowing in the early months of 1900, 1904, and 1906. It broke out early in January of this year (1910), and is still rising (February 16). It starts at a level of 93 feet or thereabout above Ordnance Datum."

Analyses of Well-waters.

The following analyses of waters, mostly from shallow wells, in and around Portsmouth, have been contributed, after this Memoir was set up in pages, by Dr. A. N. Fraser, Medical Officer of that borough, and by Mr. F. W. F. Arnaud, the Public Analyst :—

Botley.

Kitnocks, Corbridge.

Two analyses made and communicated by F. W. F. Arnaud.

In parts per 100,000.

Source (and Date).	Remarks, &c.	Total Solids.	Chlorine.	Nitrogen as Nitrates.	Total Hardness.	Oxygen absorbed.	Ammonia.		Nitrites.
							Free.	Albuminoid.	
Old well, 20 feet deep. (16 March, 1903.)	Clear, colourless, no suspended matter, slight charring and fuming on ignition.	51·57	7·57	1·43	16·5	·0612	·0004	·0095	—
New well, 25 feet deep. (17 March, 1903.)	As above ...	44·14	9·28	1·35	15·4	·0274	·0014	·0062	—

Cosham.

PORTSDOWN HILL.

By F. W. F. ARNAUD, 26 February, 1907.
In parts per 100,000.
Shallow well.

Free ammonia ...	·05
Albuminoid ammonia	·01
Chlorine	5·8
Nitrogen as nitrates ...	·04
Nitrites	Present
Total solid residue ...	47

Fareham.

THE MOUNT.

Made and communicated by F. W. F. ARNAUD.
In parts per 100,000.

Total solids	104
Chlorine...	29·3
Nitrogen as nitrates and nitrites ...	Traces.
Nitrites	Present.
Magnesia	Present.
Hardness	23·2

Considerable charring and objectionable odour on ignition.

Hambledon.

DENMEAD.

Two Analyses, made and communicated by F. W. F. ARNAUD.
In parts per 100,000.

	1. Shallow well. (28 September, 1908.)	2. Well, 112 feet deep. (28 October, 1908.)
Free ammonia	·018	Nil.
Albuminoid ammonia...	·012	·002
Chlorine	21·6	2·2
Nitrogen as nitrates	·08	·23
Total solid residue	249	40
Oxygen absorbed in 4 hours at 27° C.	—	·056

No. 1 very hard.

Hayling Island.

Three analyses made and communicated by F. W. F. ARNAUD and Dr. A. N. FRASER.

In parts per 100,000.

Source (and Date).	Remarks, &c.	Total Solids.	Loss on ignition, grs. per gal.	Chlorine.	Nitrogen as Nitrates and Nitrites.	Total Hardness.	Oxygen absorbed.	Ammonia.		Nitrites.
								Free.	Albuminoid.	
Well, 32 feet deep. (14 Dec., 1908.)	—	147	—	28·2	·08	—	—	·0005	·009	—
Well, 22 feet deep.	—	121	—	25·8	·12	—	—	nil	·019	—
Well at Hayling Golf Club. (15 Apr., 1903.)	Clear, colourless, no suspended matter, no charring or fuming on ignition.	27	—	4·71	·175	14·07	—	·0027	·0046	—

The first two from the Croft Estate, North Hayling.

Porchester.

Made and communicated by F. W. F. Arnaud and Dr. A. N. Fraser.

In parts per 100,000.

Total solids	126
Chlorine	20
Nitrogen as nitrates and nitrites ...	2·01
Oxygen absorbed in 2 hours at 37° C.	·076
Ammonia, Free...	Trace
,, Albuminoid	·03
Nitrites	Nil
Total hardness	33

Clear, colourless, no suspended matter. Charring and fuming on ignition.

Portsmouth.

Communicated by Dr. Fraser and F. W. F. Arnaud.

In parts per 100,000.

Source (and Date).	Ammonia.		Chlorine.	Salt.	Total Solid Residue.	Nitrogen as Nitrates.	SiO_2	Fe_2O_3	CaO	MgO	CO_2	SO_3	Nitrites.
	Free.	Albuminoid.											
Eastney. Shallow well. (1 July, 1907.)	—	—	10·8	—	57	—	—	·3	7·6	3·78	4·88	8·82	—
Eldon Street. Well, 20 feet deep. (13 March, 1907.)	·001	·004	7·2	11·86	71·2	·72	·4	·4	17·4	1·44	7·48	9·61	—
Fratton Road. Shallow well. (31 May, 1907.)	—	—	8·85	—	104	1·8	—	·3	26·6	3·24	10·34	16·89	—

Continued on page 236.

Portsmouth—*continued.*

Analyses communicated by Dr. A. N. Fraser and F. W. F. Arnaud. In parts per 100,000.

Source (and Date).	Physical and Microscopical Characters, and Remarks.	Total Solids.	Loss on ignition (Grains per gallon.)	Chlorine.	Expressed as Salt.	Nitrogen as Nitrates and Nitrites.	Hardness.		Oxygen absorbed.	Ammonia.		Nitrites.
							Total.	Permanent.		Free.	Albuminoid.	
16, Artillery Terrace. (26 Jan., 1898.)	Loose wooden cover. Depth 30 (?) feet. Well aerated, clear, greenish. Dirty in wet weather. (Condemned.)	58·1	—	3·8	—	1·92	20	—	—	·01	·08	—
Buckland Street...	—	66	—	5·1	8·4	1·3	—	—	—	·08	·012	Present
Hyde Park Road. (22 Oct., 1907.)	30–40 feet deep	94·5	—	20·6	33·95	·361	57	—	·054	·002	·005	—
Kingston Road. (17 May, 1909.)	100 feet deep	126	—	16·4	27·03	·06	—	—	·12	·039	·02	—
346, Fratton Road. (10 Dec., 1903.)	Clear, no suspended matter, yellowish.	157·8	—	10·86	—	5·59	60·5	—	—	·0022	·0116	—
Sailors' Rest, Commercial Road. (20 Mar., 1905)	Clear, no suspended matter, very faint yellow, very slight charring on ignition.	85·7	—	8·9	—	4·1	56	—	·09	·2	·14	Trace
Landport. 101, Malins Road. (14 June, 1901.)	16 feet deep; yellowish, slightly cloudy, faint stale odour.	60·5	39·5	6·4	—	2·97	30·5	—	—	Nil	·12	Nil
Ditto. (31 Oct., 1901.)	Clear, faintly blue, poorly aerated.	85	35·4	7·5	—	2·81	30	—	·54	·03	·14	—
Milton. Langstone Cottage. (23 May, 1900.)	Markedly brown, putrid odour, opalescent, considerable charring on ignition. (Condemned.)	69·9	37·4	11·8	—	Trace	22	—	—	·72	·48	—

Milton. Old Engine House, Asylum Road. (26 May, 1902.)	Clear, yellowish, slight fuming and charring on ignition. Well-cover of rotten planks, bricks loose, and two defective cesspools within 15 feet.	49·14	6·2	8·28	—	·2	8·57	—	—	·086	·048	Nil
Milton. Park Royal Farm, Asylum Road. (10 Dec., 1902.)	Clear, very faint yellow, no suspended matter, slight charring on ignition.	92·86	—	16·28	—	2·62	11	—	·0231	·0019	·016	Nil
Milton. Russells, Cottage, The Locks. (8 Dec., 1902.) 16 feet deep.	Markedly brown, opalescent, cloudy, marked charring and fuming on ignition.	116·57	—	32·86	—	·33	28	—	·8385	·003	·2647	Marked
Milton. Old Oyster House, The Locks. (3 Dec., 1902.)	Light-brown, considerable sandy deposit, very cloudy, charring and fuming on ignition.	178	—	30·86	—	·116	28·8	—	·1068	·006	·0582	Nil
Milton. The Old Thatched House. (3 Dec., 1902.)	Clear, very faint yellow, well aerated, no suspended matter, very slight discoloration on ignition.	62·14	—	18·28	—	2·471	15·6	—	·0972	Nil	·0196	Trace
Portsea. 23, North Street. (15 Feb., 1901.)	35 feet from fowl-run, W.C., &c. Cloudy, considerable suspended matter, slight charring and fuming. (Condemned.)	91·6	51·3	16·75	—	2·6	33·6	—	—	·02	·16	Nil
Portsea Island Union. (18 Jan., 1903.)	Yellow, much suspended matter, dirty, transient charring on ignition. Well, 65 feet deep.	45·43	—	6·42	—	·191	18·2	—	·0938	·002	·0094	Nil
Southsea. Ada Cottage, Garden Lane. (31 Oct., 1902.)	Clear, no suspended matter, transient discoloration on ignition. Well, 20 feet deep.	31·14	—	2·4	—	·874	17·1	—	·163	·0014	·0019	Nil

Portsmouth—*continued.*

Analyses communicated by Dr. A. N. Fraser and F. W. F. Arnaud.

Source (and Date).	Physical and Microscopical Characters, and Remarks.	Total Solids.	Loss on ignition (Grains per gallon).	Chlorine.	Expressed as Salt.	Nitrogen as Nitrates and Nitrites.	Hardness.		Oxygen absorbed.	Ammonia.		Nitrites.
							Total.	Permanent.		Free.	Albuminoid.	
Southsea. Lisbon Cottage, Garden Lane. (31 Oct., 1902.)	Slight yellow, good deal of suspended matter, slight charring and fuming on ignition. Well, 15 feet deep. Not fit for domestic supply.	53·14	—	4·65	—	5·943	25·1	—	·248	·0312	·0151	Present
Southsea. Hampton Street. (6 Oct., 1908.)	Well, 50 feet deep ...	110	—	20·4	33·6	1·15	—	—	—	Nil	·006	—
Southsea. 1, St. James' Road. (30 May, 1900.)	Greyish, good deal of suspended matter, considerable charring on ignition. (Condemned.)	75·7	35·1	8·3	—	5·1	28	—	—	·12	·244	—
43, Sackville Street. (5 June, 1898.)	Greyish, considerable suspended matter, charring on ignition, slight organic smell. Near a soak-hole. (Condemned.)	74·5	38·4	6·9	—	2·21	32	—	—	1·08	·106	Faint trace

Purbrook.

Three Analyses made and communicated by F. W. F. ARNAUD and Dr. A. N. FRASER.

In parts per 100,000.

Source (and Date).	Remarks, &c.	Total Solids.	Chlorine.	Nitrogen as Nitrates and Nitrites.	Total Hardness.	Ammonia.		Nitrites.
						Free.	Albuminoid.	
Shallow well in Purbrook. (25 Aug., 1907.)	—	15	2·9	·2	9·2	Nil	·004	—
Shallow well near Cosham. (25 Aug., 1907.)	—	18	2·85	·39	10·2	·003	·004	—
Well at General Guise-Tucker's. (26 July, 1904.)	Clear; bright; no sediment.	26·4	4	·87	8·5	Traces	·037	Nil

Stubbington.

Analyses of three well-waters made and communicated by F. W. F. ARNAUD.

In parts per 100,000.

Loss on ignition in grains per gallon.

Source (and Date).	Remarks, etc.	Total Solids.	Loss on Ignition (grs. per gal.).	Chlorine.	Nitrogen as Nitrates and Nitrites.	Total Hardness.	Oxygen absorbed.	Ammonia.		Nitrites.
								Free.	Albuminoid.	
Well at Stubbington. (11 July, 1902.)	Clear; colourless or very faint blue; no suspended matter; no charring or fuming on ignition.	129·2	—	22·6	2·11	44·4	·0066	Nil	·0124	Nil
Hill Head. Well, 17 feet in clay and sand. (1 July, 1901.)	After very heavy rain. Yellowish brown; cloudy; faint odour: marked charring and fuming on ignition. 100 yards from cess-pool, cess-pit, etc.	43·5	26	6·5	1·11	14·2	—	1·11	·32	Marked trace
Hill Head. Well, 19 feet, and bore-hole, 40 feet. (13 April, 1902.)	Cloudy; yellowish; considerable deposit of iron. After filtration; clear, colourless, and tasteless. A very good water when filtered to get rid of iron.	34·42	—	7·14	Nil	12·85	·16	·064	·096	Nil

Warblington.

WELL, 30 feet deep.

Made and communicated by F. W. F. ARNAUD, 6 May, 1909.
In parts per 100,000.

Ammonia, Free...	·001
" Albuminoid	·006
Chlorine...	48
Nitrogen as nitrates	·28
Total solid residue	148
Oxygen absorbed in 4 hours at 27° C.	·16

COUNTRY SUPPLIES.

The following notes are from the reports of various Medical Officers of Health, put together in the Report of the County Medical Officer (Dr. R. A. LYSTER) for 1908. They serve to show the state of things in villages, &c., and it is useful to have such information collected together by a central authority.

Fleet Urban District.—Several samples of water from shallow surface-wells in outlying parts have been found to be contaminated.

Alton Rural District.—Some unsatisfactory samples were from old wells that wanted cleaning out.

Andover Rural District.—A case of enteric at Penton Mewsey may have been connected with impure water. The well has been closed. A well-water at Upper Clatford was also found to be impure.

Christchurch Rural District.—Some waters condemned. Some wells, from surroundings and defective construction, have long been liable to pollution.

Hartley Wintney Rural District.—Some wells are not fit for domestic supply.

Petersfield Rural District.—The water-supply to Lyss has been finished, and steps have been taken to supply East Meon from the springs near by.

Stockbridge Rural District.—In Stockbridge and other places by the river, wells are shallow, and risk of contamination is great. There is no public supply.

Whitchurch Rural District.—The water-supply is from wells and tube-pumps. Attention has been given to the covering of wells and the raising of curbs, to avoid surface-pollution.

This raising of wells above the surface is an important matter, which, in my experience, is rarely seen to, though the cost is small. —W. W.

WELLS.

The following accounts of wells have come to hand since this Memoir was set up in pages.

Alverstoke.

Steam Laundry. 1910.

Bored and communicated by Messrs. DUKE and OCKENDEN.

Lined with tubes of 6 inches diameter to 216 feet, of 4½ inches diameter to 355 feet, and of 3 inches diameter to 410 feet.

Water-level 40 feet down.

		Thickness. Feet.	Depth. Feet.
[Drift.]	Gravel	7	7
[London Clay, 289 feet.]	Clay	64	71
	Sand	6½	77½
	Rock	2½	80
	Clay	70	150
	Rock	2	152
	Clay	20	172
	Rock	3	175
	Clay	105	280
	Rock	1	281
	Clay	15	296
[Reading Beds, 96 feet.]	Sand	4	300
	Mottled clay	82	382
	Sand and loam	10	392
[Upper] Chalk and flints		108	500

Hambledon.

DENMEAD, near the Schools. 1909.

Bored and communicated by Messrs. DUKE and OCKENDEN.

Lined to 48 feet. Water-level 43 feet down.

Clay (Reading Beds)		33	110 feet.
[Upper Chalk.]	Marl	14	
	Chalk	63	

DENMEAD. The Nurseries. 1909.

Boring made and communicated by Messrs. DUKE and OCKENDEN.

Lined with 4½-inch tubes to 66 feet, and with 4-inch perforated tubes to 150 feet.

Water-level 36 feet down.

Well (old ?)		54	150 feet.
[Upper Chalk.]	Marl	6	
	Chalk and flints	90	

Titchfield.

Brownwich Farm. 1910.

Boring made and communicated by Messrs. DUKE and OCKENDEN.

Lined with 1½-inch tubes to 90 feet. Sand-screen to 102 feet.

Water-level 12 feet down.

	Thickness. Feet.	Depth. Feet.
Well (? old)	—	21
Sand	34	55
Hard clay	3	58
Sand and clay	11	69
Green sand	12	81
Sand and rock	12	93
Sand and water	12	105

East Cowes.

Waterworks. 1909.

Boring made and communicated by Messrs. DUKE and OCKENDEN.

	Thickness. Feet.	Depth. Feet.
Well (? old), the rest bored	—	103
Rock	16	119
Clay	4	123
Sand and water	3	126
Rock	2	128
Clay	70	198
Dark hard clay	16	214
Hard sand	2	216
Light-coloured sandy clay	7	223
Light-coloured clay	4	227
Dark sandy clay...	7	234
Light-coloured clay	34	268
Dark sandy clay	17	285
Light-coloured mottled clay	5	290
Black clay	3	293
Green clay	6	299
Hard sand	6	305
Green clay	25	330

Spithead Wells.

In regard to the question "as to the brackish character of water sometimes proceeding from borings near the sea," Mr. WOODMAN HILL has contributed the following remarks, in a letter printed in the discussion on a paper on Rural Water Supply, which escaped notice at first.*

"The Sea Forts at Spithead have each of them a fresh-water well, which has been made under considerable difficulties." Those of the Horse Sand and Noman Forts are described above, pp. 169–171, "and in each case, the water, which was found in some sand beds as far down as 150 or 200 feet . . . was brackish, but beyond these depths a bed or beds of extremely solid greenish sandy clay, some 200 feet thick, were passed through, which were impervious to, and completely shut off, the overlying brackish water."

"At the Spit Fort, which is about 2 miles nearer the mouth of Portsmouth Harbour, the water was found at a depth of 400 feet from high water-mark, after passing through the same beds of solid clay."

All three wells "yield a supply of excellent, though very soft, fresh water."

"With regard to the level to which the water rises . . . we find those at Spithead to stand at about mid-tide level, but they rise and fall some 3 or 4 feet simultaneously with, or rather following the rise and fall of, the tide and proportionately to its height . . . more at spring tides than at neap tides; approximately, the variation in level is only about one-third of that of the tide."

"At 'St. Helens' Fort . . . also the level of [the water in] the well is coincident with that of the mean tide, and varies somewhat with its rise and fall."

"At Fort 'Monckton,' on the Gosport shore . . . a well is now being sunk, which, at a depth of 170 feet, is still in brackish water."

* *Trans. Inst. Surveyors*, vol. xiii, 1881, pp. 187–189.

INDEX.

Names of authors, observers, &c. in small capitals. Names of places in italics. The rest in ordinary type. Places marked with an asterisk are outside the county.

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These include the Annual Summary of Progress and Monographs on Pliocene, Cretaceous, and Jurassic Rocks, &c.

DISTRICT MEMOIRS.

Of these some deal with the Coalfields of Yorkshire, East Somersetshire and Bristol, Warwickshire, Leicestershire and South Derbyshire, North Staffordshire and South Wales. Others are descriptive of definite districts whose limits do not correspond with those of the one-inch map.