Instances occur from time to time to point out isolated consequences of this pernicious practice, but I believe no one who has not gone into the geological question can realise its magnitude. It is not confined to one district or to a few towns or villages. It is the rule, and only within the last few years have there been any exceptions. The organised supply of water now furnished by companies in all large towns has, to a great extent, done away with the evil in those situations (though the root of the mischief has too often been left unextracted); but in villages and detached houses, great or small, it remains untouched and unchecked. Not a county, not a district, not a valley, not the smallest tract of permeable strata, is free from this plague-spot. It haunts the land, and is the more dangerous from its unseen, hidden, and too often unsuspected existence. Bright as the water often is, without objectionable taste or smell, it passes without suspicion until corrupted beyond the possibility of concealment by its evil companionship. Damage, slight in extent, or unimportant possibly for short use, but accumulative by constant use, may and does, I believe, pass unnoticed and unregarded for years. Nevertheless the draught, under some conditions, is as certain in its effects, however slow in its operation, as would be a dose of hemlock. Go where we may, we never know when the poisoned chalice may be presented to our lips. The evil is self-generating; for the geological conditions supplying our necessities lend themselves to its maintenance and extension. The knowledge necessary to remedy it is of very slow growth, and the too frequent want of that knowledge, or disregard of the subject, even amongst able architects and builders, is such that, without legislative enactment, I do not see how the evil is to be eradicated for many a long term of years.

This also is only one form of the evil—it is that where the water-bearing strata are thin and the wells do not exceed a depth of thirty feet. It was the one which prevailed in London, and in towns similarly situated, up to a very few years back. It even still lingers on in some private wells, and is moreover fostered among us by the bright-looking and cool water of too many of our public pumps; for not only does the ground still suffer from the effects of the original contamination, but also from much, almost inevitable, obnoxious surface-drainage, much gas escape, much rainfall on old open churchyards, which find their way to the one level of water supplying in common all these shallow wells. The evil still exists also, although to a less extent, in towns where the wells have to be carried to much greater depths; its effects varying according as the depth, and as the volume of the springs is to the sewage-escape; it is, however, only a question of degree.

But even our deeper and apparently inaccessible springs have not escaped contamination. As before mentioned, the underground water will, when tapped by artesian wells, rise to or above the surface, according to the relative height of the surface of the ground at the well, and of the outcrop of the water-bearing bed or beds, so that if the former is higher than the latter, or if by artificial means the line of water-level in a given area becomes lowered, then the surface of the water belonging to those great underground natural reservoirs will be established accordingly at a certain fixed depth beneath the surface. As each well deriving its supply in a stratum of this description represents a column of water communicating with one common reservoir, it follows that any cause permanently lowering the level of one well will tend to lower the level in the other wells in proportion to their number and distance. Further, it has been discovered that a well of this class can absorb a quantity of water equal to that which it can furnish; and as these wells give greater supplies than shallow wells, the absorbing wells of the same class are alike powerful in proportion to the others. The perverse ingenuity of man has here, again, taken advantage of these conditions to get rid of offensive waste waters by diverting them into such deep wells, whence they pass away in hidden underground channels, unseen and unsuspected, and mingle with those deep-seated water-sources feeding the artesian wells dependent upon them for their supply. In Paris, where there are several alternating beds of permeable and impermeable strata, and the depth to reach them is not very great, this system of absorbing wells connected with factories became, until regulated by the municipality, very common, to the great injury of many of the underground springs. From this and the other causes before alluded to, a great number of shallow wells have there become so contaminated as to necessitate their abandonment. Our own system of surface-drainage is generally too good, and the depth to the lower water-bearing strata too great, to have rendered the use of such wells here equally advantageous; nevertheless, I have reason to believe that they do exist, and that the sources even of our deep well-water supply in the Lower Tertiary Sands and in the Chalk are thus to some extent polluted and injured.

Nor do the great and perennial springs supplying our rivers altogether escape the evils arising from these obnoxious practices. On the high Oolitic ranges and amongst the undulating Chalk hills, the line of water-level is often so deep below the surface, that only in few cases are wells made—the population being generally dependent on rainwater for their water-supply. But this does not prevent the construction of dry wells for the disposal of sewage and refuse. It is true that the population in these hills is sparse—here and there a farm, a few cottages, and scarcely a village. Still as the ground is everywhere absorbent, and there are no streams even in the valleys (I am now speaking of the higher districts), every dwelling contributes its quota; for the rain and all liquid matter absorbed in these strata necessarily pass down to the great underground reservoirs of water feeding the springs thrown out in the deeper river-valleys. In these cases, however, the thickness of strata through which any liquid has to pass before reaching the line of water-level is such as to produce a more or less efficient filtration and complete decomposition; and as the injury caused is in proportion to the relative volumes of the water-sources and to the artificial additions, the great extent and dimensions of these water-bearing strata and the scanty population of such districts reduce it to a minimum.

Owing to these conditions, great as the evil is, experience teaches that it has, in some cases, its vanishing-point. It may be considered at its maximum in some of the wells of Paris; our own London shallow-well pumps follow next in order; in our river-waters away from towns it is but slight; in some of the springs of the Chalk and Lower Greensands it is hardly appreciable, while in the deep well-waters, especially those of Caterham and Grenelle, it sinks to the minimum attained by any potable waters, with the exception of rain-water. It is also a fortunate circumstance that the wonderful powers of oxidation possessed by air and water, and the powers of absorption and decomposition by soils and earths, are such as, even in the surcharged gravel-bed of London, to remove all the more offensive characters, and leave its spring-waters at all events limpid and bright; whilst the quick eddy, the moving ripple, the bright sunshine, the brisk breeze, the living organisms, are ever at work in our rivers, destroying the almost inevitable accompaniments of the presence of man, and restoring the waters to that original state of purity so essential to his health and welfare.

It was on considerations of quantity of supply thus dependent on geological conditions, and of quality as dependent jointly on geological and artificial conditions, that the Commission was mainly so long and assiduously engaged. With regard to the character of waters as dependent on the geological nature of the strata, while the evidence showed that the waters flowing off hard and insoluble rocks were, from their much greater freedom from mineral matter, more economical for many domestic and manufacturing purposes, yet that for drinking purposes, waters such as those derived from our Chalk and Oolitic districts were, on the whole, as good and wholesome as those from any other sources; while as regards quantity and permanence, the conditions presented by a large catchment-basin of a varied geological structure presented the most favourable conditions for the large and maintained supply so essential for a great city. And if, from any cause, it should at some future time be thought desirable to have a supply of a yet more assured and undoubted quality than a river supply, the large springs of the chalk and the Lower Greensand, or the great underground reservoirs of the most efficiently filtered water stored in those formations in Surrey and Hertfordshire, might, I believe, be resorted to with advantage, by means of ordinary and artesian wells, as auxiliary sources of supply for domestic and drinking purposes, supposing the engineering difficulties connected with a double water-supply could be overcome—a difficulty (which it, however, seems to me would possibly be less one of construction to our engineers than of cost) to the public. But in a great health-question there are other considerations than these which are of more primary importance.

(*To be continued.*)

## SCIENTIFIC SERIALS

*Journal of the Franklin Institute*, November 1871.—The editorial notes in this number are as usual very instructive;

amongst them we must notice Young's catalogue of the bright lines observed in the chromosphere of the sun, which have already reached a goodly number. Under Civil and Mechanical Engineering there are several useful and interesting articles, such as "On Woodworking Machinery," "On the Flow of water in rivers and canals," &c.—Prof. Cooke contributes the first of a series of papers "on the chemical theory of the Voltaic Battery." The present communication, however, deals with preliminary matters; it discusses molecules, atoms, and the quantivalence of elements. The paper which follows is "On some improvements in reflecting Telescopes," by J. A. Hill. The author proposes, in the first instance, to reflect the light from a movable plane mirror placed in the axis of the speculum, which receives the reflected rays; the convergent beam from the speculum passes through an aperture in the centre of the plane mirror, and can be received in a suitable eye-piece; no tubes are used, so that by this method it would be as easy to handle a mirror of 1,000 feet focal length as one of the same size of 50 feet focal length. The observer, too, would remain stationary, and need not be hoisted into mid-air.—Prof. Young continues his Spectroscopic Notes; this month's contribution is "on the construction, arrangement, and best proportion of the instrument, with reference to its efficiency." Under this head come the best angle and material for the prisms, the means of testing for flatness of surface and homogeneity of substance, and the number and arrangement of the prisms; there are also two other sections, "on dispersive efficiency and on luminous efficiency." A suggestion of a new form of chemical spectroscope is given, the dispersive part of this consists of two prisms, which are each concave on one side, and are cemented to the convex object-glasses of the collimator and observing telescope. By this it is hoped to save both material and light.

THE *Geological Magazine* for March (No. 93) opens with a new species of *Rostellaria* (*R. Pricei*) from the Grey Chalk of Folkestone, by the editor, Mr. H. Woodward.—Mr. A. H. Green communicates a paper on the method of formation of the Permian beds of South Yorkshire, in which he discusses the general arrangement and palæontology of these beds, and deduces from them a confirmation of Prof. Ramsay's theory that the Magnesian Limestone and associated beds of this part of England were formed in part by chemical precipitation in an inland sea.—Prof. H. A. Nicholson records the occurrence of the Cephalopod *Endoceras proteiforme* Hall, in Britain; the specimen described and figured was discovered by the author in the mudstones of the Coniston series near Ambleside, a set of rocks in which scarcely any fossils, except Graptolites, have hitherto been found.—Mr. James Geikie gives a fourth paper on Changes of Climate during the Glacial Epoch, in the conclusion of which he sums up his views as to the sequence of climates at this time as follows:—1. A succession of alternate glacial and temperate conditions, but associated with the great Continental ice-sheets; 2, a temperate climate, with removal of the ice-sheets from low grounds; 3, a period of subsidence, with temperate climate, and much denudation of moraines; 4, a period of emergence, with arctic conditions, floating ice dispersing erratics, and deposition of clays with arctic mollusca; and, 5, a period of local glaciers in Britain and Ireland, with gradual amelioration of climate. In future papers the author proposes to discuss the cave-deposits and older river-gravels of England. The post-glacial geology and physiography of West Lancashire and the Mersey estuary, form the subject of an interesting paper, by Mr. T. Mellard Reade; and Prof. T. Rupert Jones and Mr. W. K. Parker give us the corrected nomenclature of the Foraminifera from the English Chalk, figured by the Rev. Henry Eley in 1859.—The number also contains an abstract of an address on subsidence as the effect of accumulation, read before the Liverpool Geological Society, by Dr. Charles Ricketts.

THE *Journal of Botany* for March contains only one original article bearing specially on British Botany, Notes on the British *Ramalinæ* (a genus of Lichens) in the Herbarium of the British Museum, by the Rev. Jas. Crombie. We find also, "On *Symea*," a new genus of triandrous *Liliaceæ* from Chili, by Mr. J. G. Baker, with a plate; recent researches into *Diatomaceæ*, by the Rev. E. O'Meara; and *Castanea vulgaris* grown in Southern China, by Dr. Hance. Mr. Carruthers contributes his important Review of the Contributions to Fossil Botany published in Britain in 1871; and the editor commences in this number a valuable list of the articles contained in the German botanical journals for January.

## *SOCIETIES AND ACADEMIES*

### LONDON

Royal Society, Feb. 29.—"On the Relative Power of Various Substances in arresting Putrefaction and the Development of Protoplasmic and Fungus Life;" by Dr. F. Crace-Calvert, F.R.S.

March 14.—"Contributions to the History of the Opium Alkaloids," part iv.; by Dr. C. R. A. Wright.—"The Decomposition of Water by Zinc in conjunction with a more Negative Metal;" by J. H. Gladstone, F.R.S., and Alfred Tribe, F.C.S.

March 21.—"On some Heterogenetic Modes of Origin of Flagellated Monads, Fungus-germs, and Ciliated Infusoria," by Professor H. Charlton Bastian, F.R.S. In this communication Dr. Bastian announces results which, whilst confirming the previous observations of MM. Pineau and Pouchet, considerably extend our knowledge concerning the heterogenetic changes liable to take place in the pellicle (composed of aggregated Bacteria) which forms upon an infusion of hay. He describes all the stages by which certain Fungi, Flagellated Monads, and Ciliated Infusoria are produced, as a result of changes taking place in the very substance of the pellicle. Most of the observations were made under a magnifying power of 1,670 diameters, and, although more extensive, are confirmatory of others published in NATURE, No. 35. Dr. Bastian says, "I now wish to describe other allied processes, and the means by which I am enabled to obtain, almost at will, either animal or vegetal forms from certain embryonal areas which are produced in the pellicle." The simplest mode of origin of Fungus-germs and Monads is thus described:—"The pellicle which formed on a filtered maceration of hay during frosty weather (when the temperature of the room in which the infusion was kept was rarely above 55° F., and sometimes rather lower than this) presented changes of a most instructive character. On the third and fourth days the pellicle was still thin, although on microscopical examination all portions of it were found to be thickly dotted with embryonal areas. Nearly all of them were very small; but a few areas of medium size were intermixed. The smallest were not more than $\frac{1}{4000}''$ of an inch in diameter, and these separated themselves from the pellicle as single corpuscles; slightly larger areas broke up into two or three corpuscles; and others, larger still, into 4—10 corpuscles. In most of these small areas, the corpuscles were formed with scarcely any appreciable alteration in the refractive index of the matter of which they were composed; this simply became individualised, so that the corpuscles separated from the surrounding pellicle and from their fellows, still presenting all the appearance of being portions of the pellicle, and exhibiting from 4 to 10 altered *Bacteria* in their interior. In some cases the products of segmentation soon developed into actual flagellated Monads in a manner presently to be described; whilst in others they seemed to remain for a longer period in the condition of simple motionless corpuscles. Other solitary corpuscles or small areas began to form in the pellicle in precisely the same manner, though they speedily assumed a highly refractive and homogenous appearance. Why some should undergo such a change, and not others, seems quite impossible to say. One can only assert the fact, and add that these highly refractive ovoid corpuscles were, for the most part, more prone to produce Fungus-germs than Monads. Many of them soon grew out into dissepimented fungus filaments, which rapidly assumed the *Penicillium* mode of growth. The spores, which were abundantly produced in terminal chaplet-like series, were, however, small, homogeneous, spherical, and colourless." In other cases Monads and Fungus-germs are produced from the pellicle in precisely the same manner as that by which they arise within the terminal chambers of certain Algæ or Fungi—that is to say, they result from the segmentation of a mass of homogeneous protoplasm.

In speaking of such a mode of origin of Monads, Dr. Bastian says:—"Contrasting with the very pale fawn-colour of the evenly granular pellicle, there were numerous areas of a whitish colour, refractive, and more or less homogeneous. These areas differed very much in shape and size; some were not more than $\frac{1}{1000}''$, whilst others were as much as $\frac{1}{100}''$ in diameter. Their shape was wholly irregular. As in the instances previously recorded, the first appreciable stage in the formation of an embryonal area in the pellicle was a local increase in the amount of gelatinous material between the units of this portion of the pellicle, so that they became more distinctly separated from one another than in adjacent parts. Gradually these particles became less sharply defined, and at last scarcely visible, in the midst of