of the people lead them still to the earth, as the most fitting resting-place into which, when lifeless, they should be drawn.

Thus the cemetery holds its place in our city, but in a form much modified from the ordinary cemetery. The burial-ground is artificially made of a fine carboniferous earth. Vegetation of rapid growth is cultivated over it. The dead are placed in the earth from the bier, either in basket-work or simply in the shroud; and the monumental slab, instead of being set over or at the head or foot of a raised grave, is placed in a spacious covered hall or temple, and records simply the fact that the person commemorated was recommitted to earth in those grounds. In a few months, indeed, no monument would indicate the remains of any dead. In that rapidly-resolving soil the transformation of dust into dust is too perfect to leave a trace of residuum. The natural circle of transmutation is harmlessly completed, and the economy of nature conserved.

### RESULTS.

Omitting, necessarily, many minor but yet important details, I close the description of the imaginary health city. I have yet to indicate what are the results that might be fairly predicted in respect to the disease and mortality presented under the conditions specified.

Two kinds of observation guide me in this essay: one derived from statistical and sanitary work, the other from experience, extended now over thirty years, of disease, its phenomena, its origins, its causes, its terminations.

I infer, then, that in our model city certain forms of disease would find no possible home, or, at the worst, a home so transient as not to affect the mortality in any serious degree. The infantile diseases, infantile and remittent fevers, convulsions, diarrhœa, croup, marasmus, dysentery, would, I calculate, be almost unknown. Typhus and typhoid fevers and cholera could not, I believe, exist in the city except temporarily and by pure accident; small-pox would be kept under entire control; puerperal fever and hospital fever would probably cease altogether; rheumatic fever, induced by residence in damp houses, and the heart disease subsequent upon it, would be removed; death from privation and from puerpera and scurvy would certainly cease; delirium tremens, liver disease, alcoholic phthisis, alcoholic degeneration of kidney, and all the varied forms of paralysis, insanity, and other affections due to alcohol, would be completely effaced. The parasitic diseases arising from the introduction into the body, through food, of the larvæ of the entozoa, would cease, and that large class of deaths from pulmonary consumption, induced in less-favoured cities by exposure to impure air and badly-ventilated rooms, would, I believe, be reduced so as to bring down the mortality of this signally fatal malady one-third at least.

Some diseases, pre-eminently those which arise from uncontrollable causes, from sudden fluctuations of temperature, electrical storms, and similar great variations of nature, would remain as active as ever; and pneumonia, bronchitis, congestion of the lungs, and summer cholera would still hold their sway. Cancer, also, and allied constitutional diseases of strong hereditary character would yet, as far as we can see, prevail. I fear, moreover, it must be admitted that two or three of the epidemic diseases, notably scarlet fever, measles, and whooping-cough, would assert themselves, and, though limited in their diffusion by the sanitary provisions for arresting their progress, would claim a considerable number of victims.

With these facts clearly in view, I must be careful not to claim for my model city more than it deserves; but calculating the mortality which would be saved, and comparing the result with the mortality which now prevails in the most favoured of our large English towns, I conclude that an average mortality of eight per thousand would be the maximum in the first generation living under this salutary *régime*. That in a succeeding generation Mr. Chadwick's estimate of a possible mortality of five per thousand would be realised, I have no reasonable doubt, since the almost unrecognised though potent influence of heredity in disease would immediately lessen in intensity, and the healthier parents would bring forth the healthier offspring.

As my voice ceases to dwell on this theme of a yet unknown city of health, do not, I pray you, wake as from a mere dream. The details of the city exist. They have been worked out by those pioneers of sanitary science, so many of whom surround me to-day, and specially by him whose hopeful thought has suggested my design. I am, therefore, but as a draughtsman, who, knowing somewhat your desires and aspirations, have drawn a plan, which you in your wisdom can modify, improve, perfect. In this I know we are of one mind, that though the ideal we all of us hold be never reached during our lives, we shall continue to work successfully for its realisation. Utopia itself is but another word for time; and some day the masses, who now heed us not, or smile incredulously at our proceedings, will awake to our conceptions. Then our knowledge, like light rapidly conveyed from one torch to another, will bury us in its brightness.

By swift degrees the love of Nature works
And warms the bosom, till at last, sublim'd
To rapture and enthusiastic heat,
We feel the present Deity, and taste
The joy of God to see a happy world!

## THE INTERNAL HEAT OF THE EARTH

PROF. MOHR, of Bonn, has contributed to the *Neues Jahrbuch für Mineralogie*, &c. (1875, Heft 4), a very important paper on the causes of the internal heat of the earth. After indicating some of the objections which may be urged against the Plutonistic theory of the origin of the earth's internal heat, he discusses the data obtained by the thermometric investigation of a boring about 4,000 feet deep, through pure rock salt, at Speremberg, near Berlin.

The proposition from which he starts is as follows:—If the interior of the earth is still fused, then with every increase in depth, as we approach this furnace, a less space must be necessary to produce the same increase of heat. The heat passes outwards by conduction from a smaller into a constantly enlarging sphere, and supposing the conductivity of the materials to be uniform, the temperature of the outer coats of the sphere must gradually diminish in proportion as their volume increases; or, in other words, the increase of heat per 100 feet must become greater and greater in proportion as we descend.

Now the results of the thermometric investigation of the Speremberg boring give the following numbers:—

| For a depth of | | Increase per 100 feet. |
|---|---|---|
| 700 feet ... ... | 15·654° R. ... ... | — |
| 900 ,, ... ... | 17·849 ,, ... ... | 1·097 |
| 1100 ,, ... ... | 19·943 ,, ... ... | 1·047 |
| 1300 ,, ... ... | 21·939 ,, ... ... | 0·997 |
| 1500 ,, ... ... | 23·830 ,, ... ... | 0·946 |
| 1700 ,, ... ... | 25·623 ,, ... ... | 0·896 |
| 1900 ,, ... ... | 27·315 ,, ... ... | 0·846 |
| 2100 ,, ... ... | 28·906 ,, ... ... | 0·795 |
| 3390 ,, ... ... | 36·756 ,, ... ... | 0·608 |

The third column is a diminishing arithmetical series of the first order, showing equal differences of 0·050° or $\frac{1}{20}$° R. for every 100 feet. By applying this principle to the gaps left above 700 feet and between 2,100 and 3,390 feet, Prof. Mohr gets the following table of increase of heat for the whole depth:—

| Depth. | Increase per 100 feet in depth. |
|---|---|
| 100 to 200 feet ... ... ... ... | 1·35 ° R. |
| 200 ,, 300 ,, ... ... ... ... | 1·30 ,, |
| 300 ,, 400 ,, ... ... ... ... | 1·25 ,, |
| 400 ,, 500 ,, ... ... ... ... | 1·20 ,, |
| 500 ,, 600 ,, ... ... ... ... | 1·15 ,, |
| 600 ,, 700 ,, ... ... ... ... | 1·10 ,, |
| 700 ,, 900 ,, ... ... ... ... | 1·097 ,, |
| 900 ,, 1100 ,, ... ... ... ... | 1·047 ,, |
| 1100 ,, 1300 ,, ... ... ... ... | 0·997 ,, |
| 1300 ,, 1500 ,, ... ... ... ... | 0·946 ,, |
| 1500 ,, 1700 ,, ... ... ... ... | 0·896 ,, |
| 1700 ,, 1900 ,, ... ... ... ... | 0·846 ,, |
| 1900 ,, 2100 ,, ... ... ... ... | 0·795 ,, |
| 2100 ,, 2300 ,, ... ... ... ... | 0·745 ,, |
| 2300 ,, 2500 ,, ... ... ... ... | 0·695 ,, |
| 2500 ,, 2700 ,, ... ... ... ... | 0·645 ,, |
| 2700 ,, 2900 ,, ... ... ... ... | 0·595 ,, |
| 2900 ,, 3100 ,, ... ... ... ... | 0·545 ,, |
| 3100 ,, 3300 ,, ... ... ... ... | 0·495 ,, |
| 3300 ,, 3390 ,, ... ... ... ... | 0·445 ,, |

and from this series he concludes that at a depth of 5,170 feet the increase will be *nil*, because, as he says, "the end of the increase will come when the last increase of 0·445° R. is absorbed by the deduction of 0·05° R., therefore after $\frac{0·445}{0·05}$ or 8·9 strata of 200 feet, and therefore 1,780 feet deeper than 3,390 feet,* and he adds that even if the diminution of the increase of heat with depth took place at the rate of only $\frac{1}{100}$° R. instead of $\frac{5}{100}$° R., the region of constant temperature would be reached at 13,500 feet.

A similar diminution of the increase of heat with depth was observed in the case of the boring at Grenelle; but here the depth reached was far less, and the diverse character of the rocks passed through caused doubts to be entertained as to the accuracy of the result.†

In these results Prof. Mohr finds a strong confirmation of all the objections that have been urged from other sides against the Plutonistic theory. "The cause of the increasing heat in the interior of the earth," he says, "must lie in the upper strata of the earth's crust. . . . The theory of volcanoes must of course adapt itself to the above results, and the fluidity of the lavas is not a part of the incandescence (no longer) present in the earth, but a local evolution of heat by sinkings which have always been produced by the sea and its action upon solid rocks, as indeed all volcanoes are situated in or near the sea. This local superheating of the volcanic foci contributes greatly to the internal heat of the earth. For the internal nucleus of the earth can lose but little heat outwards on account of the bad conductivity of the siliceous and calcareous rocks, whilst, in the lapse of ages, it must propagate uniformly all the heat-effects of the volcanoes, and thus a constant elevated temperature must prevail in the interior, and therefore we come to the conclusion that increase of heat in the interior of the earth which is everywhere met with is the result of all preceding heat-actions, uniformly diffused by conduction in the internal nucleus of the earth." Further causes of terrestrial heat are, according to Prof. Mohr, the formation of new crystalline rocks from sun-warmed, infiltrated fluids, and also chemical processes such as the evolution of carbonic acid by the contact of oxide of iron with the remains of organisms, the formation of pyrites and blendes by the reduction of sulphates in contact with organic matters, the decomposition of lignite and coal, &c.

## SCIENTIFIC SERIALS

THE *Journal of Anatomy and Physiology*, which in future will appear quarterly instead of twice a year, and has two additional editors, both physiologists, Dr. Foster and Dr. Rutherford, contains several important memoirs. The first is by Mr. Frank Darwin, on the primary vascular dilatation in acute inflammation, in which, from a study of the effect of irritants on the web of the frog's foot, he concludes, in opposition to Cohnheim, and in accordance with Schiff, that local irritants produce these effects on vessels by acting on the peripheral terminations of the vaso-motor nerves; that they do *not* cause dilatation by direct paralysis of the tissues of the arteries, and that when the vaso-motor nerves include both inhibitory and constrictor fibres, both are stimulated by them, the attendant alteration in the calibre of the vessel being the result of the victory of the one set over the other.—Mr. F. M. Balfour has an important article on the origin and history of the urinogenital organs of Vertebrates, in which the independent discovery by Semper and himself of the segmental-organ condition of the primitive Wolffian bodies and kidneys in Elasmobranchiata is fully described, and the mode of development of the Mullerian duct explained. The way in which the segmental organs, opening externally in Annelids, have a ductal termination in Vertebrates is discussed. It is analogous to the manner in which the gill-sacs of Petromyzon, opening externally; those of Myxine have a single external orifice. The paper deserves careful perusal.—Dr. Ogston writes on articular cartilage, and illustrates his observations with six plates. After a description of healthy cartilage, the changes developed in scrofulous arthritis and chronic rheumatoid arthritis are discussed. The paper is more pathological than physiological.—Mr. W. H. Jackson and Mr. W. B. Clarke describe elaborately the brain and cranial nerves of the Shark *Echinorhinus spinosus*, from two specimens transmitted from Penzance to the Oxford Museum, to which are appended accounts of the digestive and urogenital organs.—Mr. J. Priestley demonstrates that the so-called corneal cells described by Dr. Thin as being brought into view by the action of saturated caustic potash solution at 110° F. are, in reality, those of the corneal epithelium.—Mr. E. C. Baber repeats Tillmann's observations on the fibrillar nature of the matrix of hyaline cartilage, confirming them, but differing as to the reagents which best demonstrate them.—Prof. Turner has an important memoir on the structure of the diffused, the polycotyledonary, and the zonary forms of placenta, which contains the substance of his course of lectures on that subject at the Royal College of Surgeons last summer.—Prof. Rutherford replies to Mr. Lawson Tait's comments on his freezing microtome, satisfactorily demonstrating the value of the instrument. —Dr. Stirling describes his way of preparing skin for histological examination by the rather crude method of partial artificial digestion.—Finally, Mr. J. N. Langley writes on the action of Jaborandi on the heart, discussing its slowing action, which he was the first to determine.—Dr. Stirling's Report on Physiology concludes the number.

THE current number of the *Quarterly Journal of Microscopical Science* commences with an illustrated memoir, by Mr. D. J. Hamilton, "On Myelitis, being an experimental inquiry into the pathological appearances of the same," in which the effect of traumatic injury of the cord is investigated microscopically.—The second paper is an abridged translation by Dr. W. R. M'Nab, of a paper by Dr. Oscar Brefeld, from his "Botanische Untersuchungen über Schimmelpilze," Heft. II., on the life-history of Penicillium.—This is followed by an article "On the Resting-Spores of *Peronospora infestans*, Mont, by Mr. Worthington Smith, with photographic illustrations.—After this Dr. Klein describes the Structure of the Spleen. He finds "that the pulp of the spleen of the rat and the cat is similar to that of the dog, whereas that of the monkey is similar to that of man; also that in the pulp the matrix, instead of being composed of fine fibres, has the appearance of honey-combed membranes, which only when seen in profile have the appearance of fibres. All the author's observations support the view of the splenic circulation adopted by W. Müller, Frey, and others, that the venous radicles represent merely a labyrinth of spaces in the splenic parenchyma. He agrees with those who find that there is a gradual passage from the matrix of the pulp to that of the adenoid tissue of the arterial sheaths and the Malpighian corpuscles.—Mr. C. H. Golding-Bird describes a simple differential warm stage by which a fairly uniform temperature may be maintained for a long time. To the central copper stage proper are fixed a tongue of copper and an iron wire, round both of which, for part of their extent, bell-wire is wound.—Mr. W. H. Poole describes the effect of the double-staining of tissues with hæmatoxylin and aniline. The nuclei stained by hæmatoxylin are made of a richer colour by the second reagent, whilst the protoplasm surrounding them is much bluer than the nuclei themselves.—Mr. J. M'Carthy makes some remarks on Spinal Ganglia and Nerve-fibres.—Dr. Klein has a note on a Pink-coloured Spirillum (*Spirillum rosaceum*).—The last paper is by Mr. Frank Darwin, on the Structure of the Proboscis of *Ophideres fullonica*, an orange-sucking moth, in which the peculiar conformation of the apex of that organ is described and figured, as is the interlocking of the two halves of its component maxillæ.—Notes, chronicle, and proceedings of Societies complete the number.

THE *Transactions of the Linnean Society of London* will in future be published, like the *Journal*, in two series, Zoological and Botanical. Three parts have recently been issued. The third and concluding part of vol. xxix. completes the account of the Botany of the Speke and Grant Expedition, by Prof. Oliver and Mr. J. G. Baker, and is illustrated by sixty-four plates, making 136 for the whole volume. The first part of the first volume of the second series (Zoology) includes Mr. W. K. Parker's paper On the Skull of the Woodpeckers; Dr. Willemoes-Suhm's, On the Crustacea of the *Challenger* Expedition; and Prof. Allman's, On the structure and systematic position of *Stephanoscyphus mirabilis*, the type of a new order of Hydrozoa: and the first part of the new Botanical series is occupied by Mr. Miers's papers on *Napoleona*, *Omphalocarpum*, *Asteranthos*, and on the Auxemneæ. An account of all these papers was given at the time of their delivery before the Society.

THE *Geological Magazine*, Nos. 133, 134, 135.—The principal original articles are instalments of long articles on volcanoes, by Mr. Judd; on *Cretaceous aperrhaïdæ*, by Mr. Starkie Gardner; on meteorites, by Dr. Walter Flight. Carl Pettersen contributes a sketch of the geology of Northern Norway, in No. 135. A list of previous writers is given. Five groups of stratified rocks are recognised: 1. The primitive; 2. The Tromsö mica slate group, probably the equivalent of the Cambrian; 3. Slates

* In this calculation Prof. Mohr seems to have made a slight slip. If the increase of heat diminishes at the rate of 0·05° R. per 100 feet, it is hard to see why strata of 200 feet should be taken as the units in the calculation. Taking 100 feet as the unit of space, the zero point should be reached at 4,280 feet.

† See Vogt's "Lehrbuch der Geologie," Bd. I. p. 29.