the greater importance in connection with their relative merits as lighthouse illuminants.

The final conclusion of the experimenters was, that, for the ordinary necessities of lighthouse illumination, mineral oil is the most suitable and economical illuminant, and that for salient headlands, important land-falls, and places where a very powerful light is required, electricity offers the greatest advantages.

METAL-WORK OF THE BURMESE.

Both Burmans and Shans are expert blacksmiths, says the Journal of the Society of arts. The latter forge all the *dahs* ('native hatchets') used by themselves and their neighbors in the Hotha valley; and they annually resort to Bhamo, and the villages in the Kakhyen hills, for the purpose of manufacturing them. Their bellows are of the most primitive stamp, consisting of two segments of bamboo, about four inches in diameter and five feet long, set vertically, forming the cylinders, which are open above and closed below, except by two small bamboo tubes, which converge and meet at the fire. Each piston consists of a bunch of feathers, or other soft substance, which expands and fits tightly in the cylinder while it is being forcibly driven down, and collapses to let the air pass as it is being drawn up. A boy perched on a high seat or stand, works the two pistons alternately, by the sticks serving as piston-rods. Charcoal is used for fuel.

The casting of large and small articles in brass, bronze, and other alloys, is much practised, always adopting the method known as *à cire perdue*. First a clay model is made, and coated with beeswax to the thickness of the intended cast, and again covered with an outer skin (two inches thick) of clay mixed with finely chopped straw; this latter coat is provided with funnel-like holes, for pouring in the molten metal, at intervals of four inches, and with straw-holes for letting out imprisoned air. Holes are also provided at the bottom for the escape of the melted wax.

THE GREAT SILVER-MINES OF THE WEST.

Valuable indeed have been the scientific results which geology has incidentally received through the great mining undertakings of the west. The studies of von Richthofen, of King, and of Zirkel, on the rocks of the Washoe, have been equally welcome to geologists at home and abroad as contributions to the general principles of their science.

The importance of a thorough and detailed geological investigation of regions possessed of great mineral wealth is at once apparent. The geologist may afford the prospector and the capitalist just that information which is most needed; while, in turn, the shafts and tunnels of the latter supply him with sections and exposures of the rocks, which he could never otherwise hope for. How keenly the advantages of such a combination are appreciated by the government geological survey is abundantly proven by the recent elaborate monographs by Becker on the geology of the Comstock Lode, and by Irving on the copper-bearing rocks of Lake Superior; while others of a similar nature are now in course of preparation on the silver districts of Eureka and Leadville by Messrs. Hague and Emmons. Nor may we pass without mention, in this connection, the extremely important contribution recently made by Messrs. Hague and Iddings to what we know of the influence of heat and pressure in conditioning the structure of an eruptive rock. No such conclusive evidence that the holocrystalline structure of an igneous mass depends upon the slowness with which it solidifies, had ever before been discovered as that which they found in the microscopic study of the rocks displayed in the hundred and eighty miles of shafts and galleries at the Comstock.[1]

But the value of such technical papers can at most be appreciated only by a few. Specialists in the same field of scientific inquiry, or the prospector or miner who consults them in hope of some practical suggestion, will be their only readers, even though the results which they contain are broad and far-reaching in their significance.

Nevertheless there is connected with the development of a vast mining industry very much to awaken a popular interest. The accidental discovery of rich mineral treasures in the heart of a mountain wilderness; the rushing thither in hordes of men of every type, all eager to secure the largest prize; the human ingenuity and energy displayed in overcoming the vast obstacles which nature has placed in the way of transportation; the story of successes and disappointments, of fortunes made and lost, — all this gives scope for the display of the strongest human passions, and contains the elements of a tale whose truth is more romantic and more exciting than fiction.

In a volume[2] quite different in its character

[1] *Bulletin No.* 17 *of the U. S. geological survey.* On the development of crystallization in the igneous rocks of Washoe, Nevada.

[2] *Monographs of the U. S. geological survey.* Vol. iv. Comstock mining and miners, by Eliot Lord; vol. vii. Silver-lead deposits of Eureka, by J. S. Curtis. Washington, 1883, 1884. 4°.

from the other monographs which have thus far emanated from the geological survey, Mr. Lord has given an extremely interesting story of the discovery and development of what is doubtless the richest mineral lode in the world, as well as a vivid picture of the life in the town which sprung up with such surprising rapidity beside it. The book is one which can but be read with enjoyment and profit by all, no matter what their idea is of the proverbial dryness of government reports.

On the 15th of May, 1849, William Prouse, a young Mormon, travelling up Carson valley, made the first discovery that gold existed in what is now western Nevada. The region is a barren desert, occupying the eastern slopes of the Cordilleras, too arid to support more than the barest vestiges of life; and yet the report of the few grains of yellow dust discovered there by Prouse was sufficient to attract into it hosts of eager men from already overcrowded California. For ten years prospecting went on in and about what was early named Gold Cañon, with varying success. Sands were washed for gold with profit in many places, but no one as yet suspected the mine of wealth which lay at their very door. In June, 1859, Henry Comstock, a Canadian miner, secured a claim on the side of Sun Peak (now Mount Davidson), and thus impressed his name forever on the richest silver-lode ever opened. Still it was supposed that only gold was to be found, until a fortunate assay of some of the black gangue, which the miners had always thrown away as worthless, showed that it contained $3,000 in silver and $876 in gold to the ton. From this discovery (July, 1859) the development of the real richness of the Comstock may be said to date.

Nothing more was needed to start a vast tide of emigration from California to the Washoe. Over the almost impassable mountain-trail struggled, in the early spring of 1860, the wild rushing mass of humanity, without proper food or clothing. Freight-transportation was almost impossible, and into the desert they hurried, with no thought but to be first at the pile of treasure which all imagined must be awaiting them.

For a picture of the wild life of the mining-camp; of the endless litigation over claims; of the rapid growth of camp to town, and of town to city, as the mines developed; of the almost superhuman feats of energy and endurance in struggling with fire and water and in competition with each other, — we must refer the reader to the work itself. The lode proved richer at every point than the most sanguine prospector had at first imagined. Millions were spent for machinery and in draining and ventilating the mines, and yet the supplies of riches seemed endless.

In 1869 a railroad was actually constructed to this mountain fastness; and just about this time the mines, which had been increasingly productive for ten years, showed their first signs of exhaustion. Many of the old ore-bodies had almost ceased to produce. In 1872 a panic in Washoe mining-stocks ensued, which caused them again to change hands and as rapidly to bring fortune to their possessors. In 1873 was discovered the so-called 'Big bonanza.' No other such enormous mine of wealth has ever been uncovered in the earth's crust. The shafts were sunk lower and lower, but the ore only seemed to increase in richness with the depth. The silver production of the lode, which was fourteen millions in 1866, and six millions and a half in 1870, rose to over thirty-eight millions in 1876.

But of the details of this wonderful tale there is no space to enter here. For its romance and its fact alike we must refer the reader to the vivid descriptions and the statistical tables of Mr. Lord.

The work of Mr. Curtis on the silver deposits of Eureka, which lies to the eastward of the Comstock Lode, in central Nevada, is altogether different in its aim and scope from that of Mr. Lord. It is no story of mining and miners, but a clear discussion, from an engineer's point of view, of the nature and origin of the deposits, and an account of the methods by which they are worked. Only enough geology is borrowed from the forthcoming report of Mr. Arnold Hague to make the occurrence of the ore intelligible.

The deposits are large, irregular masses embedded in a limestone of Cambrian age. This is accompanied by other limestone and quartzite beds of the same and later age, and by acid eruptive rocks. The ores are mainly sulphurets of lead and silver, the former of which, however, has been oxidized down to a certain depth. The deposits occupy caverns in the limestone which they never completely fill.

The author thinks it probable that the rocks were first disturbed by dynamic forces, which crushed the limestone more than it did the other beds. Into this penetrated heated alkaline solutions, coming from below, which deposited the silver and lead sulphides as soon as the conditions of heat and pressure necessary for their solution were removed. There seems to be no evidence that the ore was derived in any way from the surrounding rocks. The only reason why it is found in the limestone is because the more shattered condition of this rock offered more opportunity for the circulation of the mineral solutions. The author also thinks that the cavities now occupied by the ore did not exist before its deposition, but that they were formed by a removal of the

limestone simultaneously with the precipitation of the metallic salts.

In chapter vi. a very interesting comparison is drawn between the silver-lead deposits of Eureka and those of Leadville and other localities in America and Europe, but no exact counterpart of these remarkable ore-bodies is anywhere discovered.

SEWERAGE AND HEALTH.

MR. ERWIN F. SMITH, in the Annual report of the Michigan state board of health, has shown the beneficial effects of thorough systems of sewerage on the health and mortality of cities. The work is based upon a large amount of data, chiefly drawn from European cities owing to the paucity and imperfection of American statistics. The author accepts the system of water-carriage as altogether the safest and best. A comparison of fifteen large cities without sewerage, with as many sewered, shows a remarkable difference in mortality. Thus in the first series the average death-rate was 35.8 per thousand inhabitants, while in the latter it was only 26. One of the most striking instances is that afforded by Chicago, where the death-rate has fallen off from 37.91 to 21.40, with the use of good water-sewerage. In the majority of cases, like results have been observed, and in only a few has the mortality remained unchanged. In England the decrease within late years in general mortality has been, perhaps, most noticeable, and in no country does sewerage receive greater attention. Most especially is there a direct connection observed between good sewerage and typhoid-fever and cholera. In Munich the mortality from the former of these causes has decreased from 1.82 to .17 per each thousand inhabitants. In Berlin, since 1879, the typhoid mortality has fallen off two-thirds; and it was further found, that, out of every 43 non-sewered houses, there was one death, as against 137 houses that were sewered. New York and Brooklyn have the best water-supply and general sewerage system of any of our large cities, and the death-rate from typhoid-fever has been correspondingly low, — in New York, during the last decade, only .28; and in Brooklyn, .15. Contrasting these figures with those of some large non-sewered cities, a remarkable difference is apparent. In Palermo and Turin, with defective water-supplies, the deaths from this cause were as many as 1.2 and .8. In St. Petersburg, without any proper disposition of sewage, the mortality was 1.06 in 1883, and .93 in 1884. It may be well to mention, that, in general, Russian mortality is frightfully high, in some provinces reaching 62 per thousand. With cholera similar results bring the conclusions that unsewered cities suffer severely, while sewered cities escape, and that localities subject to typhoid-fever are the ones likely to be visited by cholera. This last is especially significant, and behooves the earnest attention, at the present time, from American cities where the known typhoid mortality is great. As regards diphtheria, the author concludes from the study of abundant data that there is no direct relation between them. Finally, the author concludes that "it is entirely within bounds to say that the general introduction of proper sanitary measures, meaning thereby the provision of an abundant supply of pure water and the proper disposal of excreta, would reduce the annual loss in the United States from one single cause, the preventable typhoid-fever, in money value, at least $25,000,000 a year, — enough, in the course of a few generations, to sewer every city and village from the Atlantic to the Pacific."

The influence of sewerage and water-supply on the death-rate in cities. By E. F. SMITH. Lansing, *State*, 1885. 8°.

ABBOT'S SCIENTIFIC THEISM.

DR. ABBOT'S purpose is to expound a theory according to which the universe is the direct manifestation of the indwelling thought of God, — "a universe in which the adoring Kepler might well exclaim in awe unspeakable, 'O God! I think Thy thoughts after Thee,' — a universe which is the eternally objectified Divine Idea, illumining the human intellect, inspiring the human conscience, warming the human heart" (p. 214). This theory he regards as the best expression of the outcome of scientific thought, and he accordingly seeks to present his doctrine in close relation to the facts of scientific experience. Science, namely, discovers in the world objective relations, and finds these relations united in more or less completely understood groups or systems; science therefore, thinks Dr. Abbot, properly concludes that the world as a whole must be one rationally comprehensible system of relations. But a comprehensible system of relations is, he affirms, inconceivable apart from an intelligence that creates the system or that expresses itself in this system: hence the world must not only be intelligible, but intelligent; and therefore "the universe *per se* is an infinite self-consciousness" (p. 155). This, in the briefest summary, is Dr. Abbot's positive doctrine.

Organic scientific philosophy. Scientific theism. By FRANCIS ELLINGWOOD ABBOT, Ph.D. Boston, *Little, Brown & Co.*, 1885. 16°.