The figure now given of the species may be therefore considered as representative.

While staying with Mr. Wood, I had an agreeable excursion to the lead-mines of Old Gang, in the higher and wilder parts of Swale-Dale, being guided over this really wonderful district by its proprietor, Sir George W. Denys, Bart. The excessively steep and rugged combs which characterize this dale afford some exceedingly fine geological sections in the Mountain-limestone series, but are so trying to the *physique*, that I must be pardoned if I brought away few notes beyond a general sense of the remarkable characters of the lead-bearing rocks. Galena is the ore worked, in lodes of very variable richness. The distance of the mines from any railway, and the necessary expenses of cartage, are against them; else I scarcely know a lead-bearing district in England which might compete with this, were the veins fully explored, and were there such facilities of carriage for the ore (or smelted metal) as a railway passing the district would give.

Much has been said about the occurrence of copper in the Mountain-limestones of the North Riding. I fear that any copper-ores worked within the acknowledged geological limits of these rocks, will bring but little of the nobler metal to the pockets of their owners; but as an amateur mineralogist, I was greatly interested in a splendid specimen of chrysocolla, of very pure quality, obtained shortly before my visit by Sir G. W. Denys from his mines at Roughten Gill, Calbeck. It more nearly resembled in colour and lustre the chrysocolla of Siberia than that of Cornwall.

ABSTRACTS OF FOREIGN MEMOIRS.

Mineral Waters considered in their Relations with Chemistry and Geology.

Les Eaux Minérales, etc. Par H. Lecoq.—(*Continued from page* 116.)

The temperature of mineral waters varies extremely. Some are cold,—probably (according to M. Lecoq) cooled in rising; most of them are warm. Some are boiling, bursting out at the bottom of the sea, and bubbling up at the surface. At a small depth below the earth's surface the temperature of some thermal springs is far above the boiling-point of water. The Auvergne springs do not rise above 82° C. (180° F.), but they are believed by M. Lecoq to have been higher when the volcanos were active. In the Pyrenees the hottest springs do not exceed 78° C. (172½° F.). M. Daubrée has estimated the quantity of heat emitted by 45 French springs, whose volume is approximately known, as sufficient to melt a film of ice, at the temperature of 0° C. (32° F.), having a thickness of 0^{m}·00000324 (·0001275 inch.). This is certainly a very small quantity, but M. Lecoq speculates on the much greater influence of hot springs during earlier geological periods.

The contents of mineral waters vary also both in nature and

quantity. Some contain hardly any appreciable residue, others more than 100 grammes a litre (nearly 20 ounces a gallon). By chemical investigation, and above all by spectral analysis, they have already been found to contain all the metalloid elements except selenium and tellurium, and 21 of the metallic elements. The quantity of solid matter brought to the surface by the mineral springs of the central plateau of France in one year is upwards of 8,000 tons.

Of the gases contained in mineral waters, two (oxygen and hydrogen) are the constituents of water. Both are common; but neither of them occurs in a simple state. Nitrogen is also very common. M. Lecoq is inclined to refer the origin of these to the distant epoch when, as he believes, the springs were much more abundant than they now are. Ammonia and carbonic acid are both present, separately and combined. Sulphur and sulphurous acid, often combined with hydrogen, are also common. These sulphurous combinations are believed to have an organic origin, but they are referred, as usual, by our author to his great subterranean laboratories beneath the zone of primitive rocks, where, as he believes, the water is mineralized.

Tellurium, chlorine, iodine, chromium, fluorine, phosphorus and arsenic, either native or in combination, are next specified, and examples of their presence given. Most of them are common. Boron (boracic acid) is also familiar; and silicon is universal. The phenomena accompanying the presence and deposit of silica are carefully described, and the same remark applies to carbon and carbonic acid. Most of the facts have been previously recorded; but they are here conveniently grouped, and the theoretical views of the author are again brought in. He believes that the first important (?) introduction of carbonic acid dates from the deposit of the Carboniferous Limestone (p. 123). The term *grauwacké*, now almost extinct, serves to include the whole of the vast Devonian, Silurian, and Laurentian series; and in these limestones are practically ignored by our author. In a subsequent chapter bitumens are considered. With these and other hydro-carbons, M. Lecoq seems chiefly familiar so far as his own district of Central France is concerned; but he gives an outline-account of the discovery of oil-wells in America, and their development up to 1861.* Like other substances rising from the earth in springs, bitumens are here referred, not to an organic source, but to the great depths of the earth for their origin.

Potassium, lithium, rubidium, cæsium, thallium, glucina, have all been obtained either from mineral waters, or from positions that render their presence in such waters almost certain. Potassium is very common; the others, until lately, were rare or unknown. Lithium is now very generally recognized by the aid of spectrum-analysis Many of the salts of sodium, besides the chloride (common salt), are met with. They are among the substances most generally distributed in water, both on and beneath the surface. The carbonate, nitrate, and sulphate of soda are those chiefly noticed. The

* The exports from American ports now amount to about twenty million gallons annually.

circumstances under which rock-salt and various combinations of salt are found are carefully described (ch. xiii.). Emanations from the interior of the earth (whatever and wherever that may be) are believed to be the sources of salt as well as of other contents of springs. In another chapter M. Lecoq expresses his belief that the sea was originally fresh, and has become salter as time advanced.

The salts of lime and magnesia naturally occupy a considerable space in any account of mineral waters and their operations. They are universally distributed, and in various forms. We do not, however, observe anything of novelty in reference to this subject. The salts of aluminium are also found in water; and as these are largely deposited in various forms, often very complex, wherever hot water has passed, they admit of very interesting exemplification. The work done by Deville, Daubrée, and other chemists, is quoted; and the subject, which is one of great interest, is treated in reference to mineral veins.

Of the metals proper, a considerable number are found in mineral springs. M. Lecoq quotes several localities where salts of manganese occur; and iron is well known to be almost universal. Cobalt and nickel have been found at Boulou. Zinc and cadmium are probably present in mineral waters near deposits of calamine; and the same may be said of chromium. Molybdenum, tungsten, and vanadium are not rare; and antimony is occasional. Tin, titanium, copper, lead, silver and gold, have all been detected in water; and some of them are common in thermal springs.

Organic matter has been found in mineral waters: it has been recognized under various names—*barrègine, glairine,* &c.; its properties being different from different springs. M. Lecoq finds in this substance additional evidence in favour of his view that mineral waters proceed from beneath all stratified and other rocks forming the crust of the earth; for he regards these organic bodies as remains of the earliest forms of life introduced upon the globe. According to M. Filhol, who has examined these substances, they are most abundant in the hottest springs. A spring at Arles is estimated to yield 754 kilo. (1,663 lbs.) a day of organic matter; another at Thuies 2,800 kilo., 6,176 lbs. (55 cwt.) a day. These results cannot be altogether depended on. The source of this organic matter is by no means clear; and the phenomenon is one of extreme interest.

Mineral springs are not without changes. Their temperature, although generally constant, is subject to modification; for some have increased, some have diminished, within the limits of observation. Earthquakes have not unfrequently affected hot springs. The volume of water delivered also changes in some cases with alterations of the pressure of the atmosphere, and more frequently or markedly by earthquakes. Periods of long intermission in the running of such springs are not unknown; and alterations in the mineral contents have been observed in some very remarkable cases.

That mineral waters produce very important results on the rocks they traverse, has long been known. They often disintegrate, and sometimes decompose, even porphyries and granite; they change

jaspers into earthy minerals of very different appearance, and silicify wood and other organic bodies. In the same way, water has certainly produced very considerable and special deposits in mineral veins, being indeed the chief agent in their metamorphism. There can be no doubt that water has had much to do in all phenomena connected with the deposit of minerals in crevices and veins.

Distinct relations may often be traced between mineral springs and volcanic disturbances; and M. Lecoq sees in this something to confirm him in his view, often expressed, that lavas proceed from below all metamorphic rocks, including granites. In finally treating of the origin of mineral springs, he recapitulates some of the principal points alluded to in the early chapters of his book, and quotes M. Pissis and his observations on the Andes as confirming the views he has expressed concerning the Auvergne district. He concludes with a brief *résumé* of his arguments. We must leave our readers to examine these for themselves, if they are inclined to do so. The book is interesting, though much of the matter has already appeared; and the theory, if not original, is pertinaciously advocated. There is no doubt, however, that a careful and exact study and record of the main facts concerning important groups of mineral springs would be very valuable, both immediately and as a standard of comparison hereafter. Such a record is commenced in France, and should be made in other countries also.—D. T. A.

REVIEWS.

ELEMENTS OF GEOLOGY; OR, THE ANCIENT CHANGES OF THE EARTH AND ITS INHABITANTS, AS ILLUSTRATED BY GEOLOGICAL MONUMENTS. By Sir CHARLES LYELL, Bart., F.R.S., &c. Sixth Edition, greatly enlarged, and illustrated with 770 Woodcuts. 8vo. pp. 794 London: MURRAY. 1865.

THE first edition of this work was an expanded form of one of the chapters of the author's 'Principles,' and was termed the 'Elements of Geology;' it subsequently, in several editions, was enlarged more and more as the 'Manual;' and now, having absorbed the several Supplements published since its Fifth Edition in 1855, it again comes before us as the 'Elements,' carefully elaborated by its distinguished, experienced, and enthusiastic author, especially in his own lines of research. We do not see much alteration in the first nine chapters; but the 'Tabular View of the Fossiliferous Strata,' pp. 102–106, has been re-planned, with some improvements. Chapters x.–xiii., which follow, treating of 'Recent and Post-Pliocene Periods,' and including Fossil Man and the Antiquity of the Human Race, Lake-dwellings, History of Caves, Glacial Conditions, and all the interesting facts and questions thereto belonging, are re-written, and full of valuable material, which the author has collected with care and judgment, and conscientiously verified by personal research. In his well-known 'Geological Evidences of the Antiquity of Man' (in three