Conclusion.—In this, and a preceding paper already referred to, I have endeavoured to point out, firstly, what are the actual forms of certain volcanos, and secondly, the principal causes which produce and subsequently modify these forms.

Taken as a whole, these causes are very varied in their character. If we examine them singly, we can but barely form an idea as to the nature of their actions, and when we remember that, not only are they irregular in themselves, but that they act irregularly in their relations to each other, we see that the task of unravelling their complications becomes quite hopeless. In cases like this mathematical investigation helps us to obtain a clearer idea of an action, but it is seldom that it can be made to measure it. All that we can do is to fall back upon opinions, observations, and common-sense, the ordinary weapons which build up or destroy geological hypotheses.

NOTICES OF MEMOIRS.

I.—Coal and Iron in South Africa.[1]

(From the "Friend of the Free State," etc., Bloemfontein, August, 7, 1879.)

THE following extracts from Mr. G. W. Stow's Geological Report on the Orange-River Free State show what immense supplies of coal and iron-ore await the arrival of the miner in that region :—

Taking the road to *Rietvlei*, before reaching the homestead of Fieldcornet Stoffel Bosman, the old partially metamorphosed sandstones[2] are again met with, cropping up above the surface. Here they are pinkish-white, fine-grained, and dip to the W.S.W. at an angle of 54° to 55°. The most important feature connected with their appearance at this spot is the great beds of iron-ore associated with them. These become distinctly visible immediately in the rear of Mr. Bosman's house. I was first struck in finding fragments of these ferruginous rocks employed in building portions of the fences round the land and kraals. Once upon their trail they are easily traced for miles. At one spot, about a couple of miles from the homestead, three beds are most clearly exposed. They are as follows :—On the top of a high bank the first bed is exposed on the surface for a breadth of about sixty feet, with a westerly dip of about 60°; about 450 feet from this a second bed makes its appearance, with a surface exposure of 45 feet, continuing towards a lower bank on the right about 750 feet distant; a third, but smaller, bed next crops out, with a surface exposure of about 25 feet. The dip of these last is similar to the first. These beds, therefore, run parallel one to another, and are regularly interstratified with the sandstones. The true thickness of the respective beds is : first bed, 50 feet; second bed, 40 feet; third bed, 20 feet; making a total thickness of 110 feet. A considerable quantity of magnetite, or magnetic iron-ore, is found in them, which quickly makes itself

[1] Kindly communicated by Prof. T. Rupert Jones, F.R.S.

[2] See Quart. Journ. Geol. Soc. vol. xxx. p. 624, etc.

known by its influence on the compass. In a mile's length, the two largest of the iron-ore beds must contain in a breadth of 300 feet on the surface of the plain a mass of ore equal to 5,280,000 tons; in a breadth of 600 feet, a mass of ore equal to 10,560,000 tons; in a breadth of 1,000 feet, a mass of ore equal to 17,555,000 tons or 52,800,000 tons at 600 feet in a length of five miles.

Outcrops of these beds show themselves at intervals as far as the farm Klipdrift, on the banks of the Lower Rhenoster River, a distance of more than fifteen miles. There is, therefore, every reason to believe that they are continuous for that distance.

The value of iron-ore, delivered at the smelting furnace, is about £1 per ton; but, however large the quantity of iron-ore may be, it is valueless unless fuel can be obtained for smelting within a convenient distance. Thus, the excellent iron-ore in Griqualand-West is unavailable at present for this reason. That of the Free State is found under more favourable circumstances. The outcrop of these metalliferous rocks on the high ground, near Klipdrift, is within a few miles of a sixteen-inch seam of coal cropping out near that river-valley at two separate places, both above and below where the iron-ore is found. While the greater outcrop at Rietvlei is within 20 or 30 miles of the great coal-bed, and so situated that any train or railway which may hereafter be constructed for the conveyance of the coal to such great centres of consumption as the Diamond Fields, must of necessity pass within a very few miles of the place where the largest quantity of iron-ore is exposed, and will thus bring the fuel and the ore almost into juxtaposition. This is an advantage which cannot be over-estimated; but I must leave others to decide the important bearing a discovery of this kind must have upon the posperity of the State, when these buried treasures are properly utilized, and the inhabitants avail themselves of such resources.

Mr. Stow, F.G.S., reports that the following useful materials occur in the Free State:—

1. Nodular limestone, such as used in other countries as cement-stone, scattered over various parts of the State.
2. Great beds of old crystalline limestones (siliceo-calcareous rocks).
3. An immense area of country filled with porphyritic rocks, which would vie with granite for durability and beauty.
4. An abundant supply of magnetic and other rich iron-ores, within a convenient distance of the necessary fuel for smelting.
5. A great coal-bed.

In a former report he stated that, judging from the excavations made in the Sand River district, the coal underlying that portion of the country would, at a low estimate, amount to some 145,800,000 tons. We can now safely state that in the new coal-field, since discovered in the Vaal River valley, the minimum quantity would be some 350,000,000 tons; making a total, in the two coal-beds, of 495,800,000 tons, which, at five shillings a ton, would represent a money-value of more than £123,900,000. If, however, instead of

taking a minimum quantity, we take an average, we should find, even leaving the Sand River coal out of the calculation, that in the Vaal River coal-bed alone there must be some 1,225,120,000 tons awaiting the miner—a quantity of coal which, at the same low rate as that before mentioned (5*s.* per ton), would represent a value of £300,000,000.

From calculations based on those used in England, Mr. Stow finds that the Free State coal-supply would be sufficient to allow of a yearly consumption of more than 6,000,000 tons for a period of 1,200 years!

It is not improbable that, as great outcrops of coal in this portion of South Africa show themselves in the Free State, along the Vaal Valley, and also in the Transvaal, west of the Drakensberg, associated with the rocks dipping eastward, and as they again appear in the Utrecht Division of the same province, as well as at Biggarsberg (Newcastle) in Natal, to the east of the same great range, these are all parts of the same great coal-field; the Drakensberg mountains occupying their synclinal trough. If, after proper investigation, such should prove to be the case, the supply of South-African coal will be enormous, throwing the figures above quoted, vast as they appear, completely in the shade.

The Free-State coal has not yet been analyzed; but, as a rule, the amount of "ash" in this South-African coal is much greater than that imported from Europe. Some of the duller kinds leave "clinkers" when burnt; but all those I have tried, says Mr. Stow, give out an intense heat. Mr. North, the Colonial Engineer, in his excellent Report upon the subject, considers that with specially constructed furnaces and movable fire-bars, the objections raised against Cape coal may be overcome; while Mr. A. N. Ella, who consumes large quantities of fuel for steam-purposes, considers that a ton (of 2000 lbs.) of Indwe coal at 40*s.*, would be cheaper than two loads of firewood at the same price, besides the labour saved in chopping up the latter.

In the present Report Mr. Stow has not touched upon the additional scientific knowledge gained during this geological survey; but the facts collected fully bear out, he believes, the deduction to which he was led by a study of similar rocks in Griqualand-West.

Although much work has been done, a reference to the map of the Report will show that much of the Free-State has yet to be examined; and it is to be hoped that the completion of this important Survey will be fully carried out.

II. — Description de deux nouveaux genres de Crinoïdes du terrain Dévonien de la Mayenne, par M. D. Œhlert. (Bull. Soc. Géol. de France, 3e. série, t. viie. pp. 6–10.)

INTERCALATED with the beds of shelly Devonian Limestone at La Baconnière, Saint-Germain and Saint-Jean (in the Department of Mayenne), are some layers of black schist. These schists contain but few fossils, the following, excepting the subjects of this paper, being the only species yet found:—*Spirifer Rousseau, S.*

lævicosta, Terebratula sub-Wilsoni, Chonetes sarcinulata, Tentaculites Velaini, and a few Polyzoa.

The Crinoidal remains that M. Œhlert has been so fortunate as to discover in these beds are, he thinks, sufficiently complete to establish the existence of two new genera, each represented by a single species.

For these our author proposes the respective names of *Thylacocrinus Vannioti* and *Clonocrinus Bigsbyi*.

The genus *Thylacocrinus* comes nearest in its formulæ to *Rodocrinus*, Miller, and *Eucrinus*, Angelin; whilst *Clonocrinus*, we are told, greatly resembles Angelin's figure of *Melocrinus spectabilis*.

This last-named species M. Œhlert is inclined to consider has been erroneously referred by Angelin to the genus *Melocrinus* as founded by Goldfuss, and he ventures to suggest that it might, perhaps, be more properly classed as another species of this new genus, *Clonocrinus*. (The Plates are not given.) B. B. W.

REVIEWS.

I. —The Geology of New Hampshire. By C. H. Hitchcock, State Geologist, and Assistants. Vol. II., Part 2, Stratigraphical Geology; Vol. III., Part 3, Surface Geology; Part 4, Mineralogy and Lithology; Part 5, Economic Geology. Accompanied by a Folio Atlas of Maps and Illustrations. (Concord, 1877–78.)

THESE two volumes, published in 1877–78, conclude the report on the Geology of New Hampshire, and give the results of the exploration of that State, under the direction of Mr. C. H. Hitchcock. Filling more than 1,200 pages, they contain a detailed account of the geology of the different districts of the State, preceded by a brief notice of the relations of the geology of New Hampshire to that of the adjacent territory. The second volume, on the Stratigraphical Geology, is mostly due to the labours of Mr. Hitchcock, chapters ii. and v. and parts 3 and 4 being supplied by his assistant, Mr. Huntington. There are no formations in the State of later date than the Lower Helderberg, save the surface deposits. The stratified groups comprise in descending order—1. The Cenozoic,—include the glacial and modified drifts, about 450 feet. 2. Palæozoic,—Lower Helderberg, Coös group and Cambrian Slates, 15,800 feet. 3. Strata doubtfully referred to the Palæozoic, 11,600 feet. 4. Eozoic, comprising, Upper Huronian, 12,129 feet, Labrador system, Montalban, 11,370 feet, Laurentian, 34.900 feet.

The Labrador system is in very limited amount, and recent investigations make it difficult to say that the Labrador rocks are not of eruptive character, and whether (as at Waterville) they really represent the Labrador system of Canada. With regard to the Montalban rocks, Mr. Hitchcock differs from Dr. Sterry Hunt as to their position, and from the observations of the former we are led to the view that they *underlie* and not *overlie* the Huronian, though the precise relationship is not beyond controversy (p. 669). The eruptive