*Didymodon Vauclusianum*, Blake (portion of lower jaw).—*Eocene*, Vaucluse.—Geologist, 1863, Vol. XI. p. 8, pl. 2.

*Cervus tarandus*, Linn. (cranium).—*Cavern*, Berry Head, Devon.—Owen, Brit. Foss. Mam. p. 481, f. 198.

*Camelus Sivalensis*, Falc. and Cautl.—*Miocene*, Sewalik Hills, India.—Asiatic Researches, 1836, vol. xix. p. 120, pl. 20, f. 3, 4, 6; pl. 21, f. 8, 11–13; Fauna Ant. Siv. pl. 86, f. 2–5; pl. 87, f. 1–11; pl. 88, f. 1–6; pl. 89, f. 1–14; pl. 90, f. 1–15.

*Sivatherium giganteum*, Falc. and Cautl.—*Miocene*, Sewalik Hills, India.—Asiatic Researches, 1835, vol. xix. p. 1, pl. 1; Fauna Ant. Siv. pl. 91–2.

*Bison priscus*, Bojanus (cranium).—*Pleistocene*, Eschscholtz Bay.—Beechey, Voy. of 'Beagle,' 1831, vol. ii. p. 593, pl. 3.

—— *priscus*, Bojanus (metatarsal).—*Pleistocene*, Clacton, Essex.—Owen, Brit. Foss. Mam. p. 497, f. 207.

*Bos frontosus*, Nielson (cranium).—*Pleistocene*, Bawdsey Bog, Suffolk.—Mackie, Geologist, 1862, Vol. V. pl. 15.

—— *primigenius*, Bojanus (cranium).—*Pleistocene*, Atholl, Perthshire.—Owen, Brit. Foss. Mam. p. 498, f. 208, 209.

*Bubalus moschatus*, Owen (cranium).—*Pleistocene*, Maidenhead.—Quart. Journ. Geol. Soc. 1856, vol. xii. p. 127, f. 1–3.

*Balænodon physaloides*, Owen.—*Red Crag*, Felixstow.—Brit. Foss. Mam. p. 536, f. 219, 226, 227.

*Phascolotherium Bucklandi*, Brod. sp. (lower jaw).—*Great Oolite*, Stonesfield.—Owen, Trans. Geol. Soc. vol. vi. p. 58, pl. 6, f. 2; Foss. Mam. p. 61, f. 20; *Didelphys*, Zool. Journ. vol. iii. p. 408, pl. 11; Buckland, Bridgw. Treat. pl. 2, f. A.

*Thylacoleo carnifex*, Owen.—Phil. Trans. 1859, pl. 11, f. 1; pl. 13, f. 1, 6–8; Owen, Palæontology, 2nd edit. 1861, p. 432, f. 173.

*Diprotodon Australis*, Owen.—*Pleistocene?*, Australia.—Palæontology, 2nd edit. 1861, p. 430, f. 171.

*Nototherium Mitchelii*, Owen.—*Pleistocene?*, Australia.—Quart. Journ. Geol. Soc. 1859, vol. xv. p. 176, pl. 9, f. 1, 2, 4, 5.

II. BIRDS.

*Halcyornis toliapicus*, König, sp.—*Eocene*, Sheppey.—Owen, Brit. Foss. Mam. and Birds, p. 554, f. 234, 235; *Larus*, König, Icones Foss. Sect. 1825, f. 193.

*Archæopteryx macrura*, Owen.—*Lithographic stone* (*U. Oolite*), Solenhofen, Bavaria.—Phil. Trans. 1863, p. 33, pl. 1, 3, f. 1; pl. 4, f. 1, 7, 8; Woodward, Intellectual Observer, 1862, vol. ii. p. 313; Mackie, Geologist, 1863, Vol. VI. p. 1, pl. 1.

*Dinornis giganteus*, Owen.—*Modern deposits*, Middle Island, New Zealand.—Trans. Zool. Soc. 1856, vol. iv. p. 159, pl. 47, f. 2, 3; Paléontologie, p. 330, f. 111.

—— *elephantopus*, Owen (entire skeleton).—*Modern deposits*, Middle Island, New Zealand.—Trans. Zool. Soc. 1856, vol. iv. p. 149, pl. 43–47, f. 1; Paléontologie, p. 330, f. 111.

*Eggs of Birds.—Paludinen Kalk* (*U. Eocene?*), Wissenau, near Mayence.—Leonhard and Bronn, Jahrbuch, 1849, p. 69, pl. 3.

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## CORRESPONDENCE.

### *Ancient Climates.*

Dear Sir,—The readers of the 'Geologist' must, I believe, have all been as gratified by the perusal of the late articles from your hand as I have

been myself, suggesting, as they do, ideas out of the beaten track. Indeed from the editorial remarks which have appeared in several of the recent numbers, I perceive that to turn aside from the footprints of the *Schools*, and to tread in the stranger paths that point towards discovery, is an idiosyncrasy of your mind.

But my object in addressing you is not to point out that which must be patent to all your readers, but rather to offer some remarks on the ideas which the articles referred to express. My remarks are principally made with reference to the note on "Ancient Climates."

Before I come to a consideration of your own more immediate views upon the subject, as contained in the latter part of the paper, perhaps I should explain my opinions as regards what you rightly term one of the enigmas of geology—the maintenance on the earth's surface of a high temperature.

Let us for a moment carry ourselves back in imagination to those early stages of the earth's existence to which science is unable to assign even a probable date, and endeavour to appreciate, in the mind's eye, some of the conditions under which it laboured, when, glowing hot, it was first projected from the anvil of nature into those regions of the illimitable which were destined to be the scene of its career. I say glowing hot, because, although you imply that there is some reason to doubt its ever having suffered any great degree of heat, I for one have never entertained any opinion but that such was its state at one period.

From the burning, seething mass arises a dark and dense atmosphere, of which carbon and carbonic acid formed the great ingredients, presenting as effectual a screen against the entrance of the sun's rays as it did to the escape of heat from the body of the planet it surrounded. Though the sun occupied its place as the centre, its attributes—light and heat—as far at least as our planet was concerned, were not experienced, "and darkness was upon the face of the deep."

Gradually the external surface of this cloud-mantle radiated its heat into space—a very slow process, and one that might have taken ages to get rid of five degrees of temperature—and allowed the large overplus of carbonic acid to be deposited in the forms of limestone and mineral coal. The earth was now no longer "without form," but void.

Let us suppose so long a time to have elapsed that already the fervid body of our globe has cooled down to a comparatively low temperature—the dense mantle that once shrouded her has partially dissipated itself, but a gloomy obscurity still hangs over her, calculated to hold heat in an eminent degree. Water appears next *as* water, that before formed an element of the atmosphere only; in short, the waters were divided from the waters. The "firmament," as the early historian deseribes it, was not the cerulean expanse we are accustomed to see, but one of cloud scenery, through which the struggling sunbeams can with difficulty penetrate earthwards, obedient to the mandate of the Creator, "LET THERE BE LIGHT." After the appearance of land from out the waters which had been precipitated over the entire surface, vegetation made its way; but was it at all like the vegetation of the present day? I am inclined to think not. The part in nature that the vegetable world was to play had not been called on; other scenes were taking place on the great stage from which the curtain had but just gone up; the *Deus ex machinâ* of creation had not come on, and the full strength of the company was not yet required. I conceive this early vegetation to have been of a very luxuriant, though, generally, of a *fruitless* character, making up in mass of leaf and limb what it lacked in flower and fruit. This the large proportion of carbonic still in the atmosphere, and the dampness of the air, together with its high

temperature, was calculated to bring about and to foster in the greatest degree. In this manner our coal-beds might have been stored; for it is hardly possible to conceive their formation under circumstances such as now exist. I conceive, moreover, that such a growth as I have described would have been highly necessary, in order to make a vegetable mould to mix with, and assist in the disintegration of the inorganic soil that must at first have formed the surface of the ground.

But the world was not destined to be the scene of the life and death of vegetation merely; and everything tended but to that higher purpose.

The cooling proceeds to a yet lower temperature; the large amount of vapour which before had shrouded the earth began to be deposited freely; the sky often exhibited its blue tint; and, generally, meteorological processes were more in accordance with what they are at the present time. Vegetation now was required for the food of animal life, and therefore the *sun-light*, as well as heat and carbon, was necessary for its higher development. I conceive that it was at this epoch the two great *lights* were created which were to rule the day and night; for, although the sun was doubtless present when the rest of the system was made, the little light that penetrated the earth was only sufficient to *distinguish* day from night.

It is not necessary that I should follow up step by step the gradual cooling down of the atmosphere till it reached its present average temperature, which point it arrived at when the state of the sky no longer permitted the retention of heat, but, on the other hand, offered no resistance to the entrance of the radiated heat from the sun. The earth then derived its heat from the sun alone; a supply that is continually being received and given off, so keeping up a proper balance over the whole globe.

These notes on ancient temperatures are merely thrown out as *suggestions*, and not as final results, the product of any close investigation into the subject; I therefore beg that they will be received as such.

I had intended to offer some remarks on the latter portion of the paper, "the grand physical operations" that you conceive to have been at work in bringing about changes in the condition of our planet, but I fear that I have already extended my note beyond prudent limits, and therefore will defer any further observations, and remain, Sir, faithfully yours,

HENRY C. CRISWICK.

*Greenwich, February*, 1864.

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## PROCEEDINGS OF GEOLOGICAL SOCIETIES.

ROYAL INSTITUTION.—*January* 29.—"On the Glacial Epoch." By Professor Frankland, F.R.S.—Amongst the circumstances that have profoundly influenced the present physical condition of our earth, the action of ancient glaciers upon a scale of almost inconceivable magnitude has been gradually but irresistibly forcing itself upon the notice of philosophers since their attention was first called to it by Venetz and Esmark. There are few elevated regions in any quarter of the globe which do not exhibit indubitable evidence of the characteristic grinding and polishing action of ice-masses, although at present, perhaps, they are scarcely streaked by the snows of winter. In our own country the researches of Buckland, and especially of Ramsay, have clearly shown that the Highlands of Scotland, the mountains of Wales and Cumberland, and the limestone crags of York-