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**PHILOSOPHICAL JOURNAL,**

EXHIBITING A VIEW OF  
THE PROGRESS OF DISCOVERY IN NATURAL PHILOSOPHY,  
CHEMISTRY, NATURAL HISTORY, PRACTICAL MECHANICS,  
GEOGRAPHY, NAVIGATION, STATISTICS, AND THE FINE  
AND USEFUL ARTS,

FROM  
APRIL 1. to OCTOBER 1. 1820.

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CONDUCTED BY  
DR BREWSTER AND PROFESSOR JAMESON.

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*TO BE CONTINUED QUARTERLY.*

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The fact that presents itself to our notice here, of so distinct a difference of crystalline form, produced by a change in the proportions only of the elements of the crystallised body, will tend to confirm the intimate relation that subsists between the chemical and crystallographical characters of minerals; and it appears to disprove M. Beudant's conjecture, that only the secondary forms of crystals are affected by a change in the proportions of their constituent chemical elements.

It is remarkable, too, that lead should alone present so many instances of a single base combining at the same time with two acids.

LONDON, 13th May 1820.

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ART. XXII.—*Account of the Earthquake at Kutch on the 16th June 1819.* Drawn up from published and unpublished Letters from India.

THE western coast of India has been visited by an earthquake, which has spread desolation and panic over a great extent of country; and whose destructive effects will be seen and felt for many years to come. This tremendous convulsion of nature was experienced from Bombay to beyond the tropic of Cancer; but the centre of the concussion seems to have been in the province of Kutch, which has severely suffered. In describing this alarming occurrence, we shall select, from a variety of letters which have been received on this subject, the most important particulars.

The first and greatest shock took place on the 16th of June 1819, a few minutes before seven in the evening. The day had been cool and showery; Fahrenheit's thermometer ranging from 81° to 85°. The monsoon had set in mildly, without much violent thunder and lightning; and there was nothing unusual in the state of the atmosphere at that season that could afford any ground for apprehension. The wind, which had been blowing pleasantly towards evening, at the commencement of the concussion fell into a dead calm, and in a moment all was consternation and horror. The wretched inhabitants of Bhooj were seen flying in all directions to escape from their falling habitations. A heavy appalling noise,—the violent undulatory motion of the

ground,—the crash of the buildings,—and the dismay and terror which appeared in every countenance, produced a sensation horrible beyond description. The shock lasted from two to three minutes, and during that short period the city of Bhooj was almost levelled with the ground. The walls, from the sandy nature of the stone, were crumbled into dust; nearly all the towers and gateways were demolished; and the houses, which were left standing, were so shattered as to be uninhabitable. The fort, which stands at some distance from the city, is so breached as to be rendered useless as a place of defence. It is calculated that nearly 2000 persons have perished in Bhooj alone. Among the sufferers is the mother of the deposed Rajah, who was buried in the ruins of the palace. The surviving inhabitants were obliged to forsake the city, and encamp outside of the walls on some sandhills. Their situation was truly distressing. Bruised, maimed, and in sorrow, they resorted daily to the city to extricate the mangled remains of wives, children, and relations. In this melancholy labour, they were nearly exhausted by the stench arising from the putrid bodies of their friends, and from the carcases of the cattle, which had perished in great numbers. At the date of the last accounts, between 1000 and 1500 persons had been dug out of the ruins.

The devastation was general throughout Kutch. From Luckput Bunder to Butchao, in every town and village, more or less lives were lost by the falling in of the houses; and in the towns of Mandavie, Moondria, and Anjar, very extensive damage has been sustained. Accounts from Anjar state, that the fort wall was almost completely destroyed, not 100 yards of it remaining in one spot, and guns and towers hurled in one common mass of ruin. Scarcely a fourth part of the town is standing, and the houses that do remain are considerably injured. “In one word,” says the writer of the account, “a flourishing population has been reduced in one moment to wretchedness and misery; and I fear we shall have to lament the loss of upwards of 100 people, besides those hurt.”

The destruction occasioned by this terrible visitation was not confined to Kutch. From Ahmedabad, the capital of Guzerat, we have the following description: “This city is justly celebrated for its beautiful buildings of stone and other materials, and for the famous shaking minarets, which were ad-

house was considerably agitated, the furniture all in motion; a small table close to me kept striking the wall, and the lamps swung violently. I ran down stairs, and got out of my house as fast as possible. On getting on the outside, I found a number of people collected, gazing with astonishment at my house, which stands alone, and was so violently agitated that I expected it to fall down. The earth was convulsed under our feet." Another thus writes from Broach: "Such of the houses as are elevated, and at all loosely built, creaked like the masts and rigging of a ship in a gale; the venetians and window-frames rattling violently, and the buildings threatening immediately to fall; a considerable lateral motion was impressed on every thing that admitted of it. After this more violent concussion had lasted a minute or upwards, it was succeeded by an oscillatory motion, of a more equable character, which continued for more than a minute and a half, making the whole period of the convulsion nearer three than two and a half minutes." An intelligent native residing in Iseria gives the following account: "Yesterday in the evening a noise issued from the earth like the beating of the *nobut*, and occasioned the trembling of all the people: it appeared most wonderful, and deprived us all of our senses, so that we could not see, every thing appearing dark before us; a dizziness came upon many people, so that they fell down."

Besides the great concussion on the evening of the 16th, frequent slight shocks were experienced during the night, and throughout the following day. One occurred a little before ten in the morning, which shook the houses, and caused the windows and doors to rattle violently. It continued, however, only for a few seconds. Another, rather more severe, took place on the 23d, at midnight. Some houses were thrown down, but no lives lost. Indeed, daily vibrations were sensibly felt in the camp before Bhooj for more than a month after. The same unpleasant sensations which were experienced during the first shock, also continued for several days. A giddiness, and slight sickness, accompanied with pains in the knees, and an inclination to lie down rather than sit or stand. This is attributed to the rocking or rolling motion of the earth, which, though not observable, was in constant action. The inhabitants of Kutch, however, were much relieved from the dread of farther convul-

mired by every stranger. Alas! the devastation caused by this commotion of the earth is truly lamentable. The proud spires of the great mosque, erected by Sultan Ahmed, which have stood nearly 450 years, have tumbled to the ground, within a few yards of the spot where they once reared their heads! Another mosque of elegant structure, which lies to the left of the road leading to the Shahee Bagh, has shared the same fate. The magnificent towers, forming the grand entrance into the citadel, have been much shaken, and cracked in several places, especially the one in which the flag-staff has been placed. Many private houses have been reduced to ruins; but it is most fortunate, amidst all our disasters, that not a single life has been lost, and but few accidents." We learn from Jelilsheer, that "the earthquake was severely felt in that place, and the loss of lives terrible. The fort and town are reduced to ruins. Many of the people killed were already out of doors, which is usually considered a situation of comparative safety. A marriage was about to be celebrated in a rich man's family, and the casts had assembled from various distant quarters: the shock occurred when they were feasting in the streets, and upwards of 500 of the party were smothered in the ruins of the falling houses."

The effects of this earthquake have indeed been so extensive, that we cannot pretend to enumerate the more minute disasters. We have confined ourselves to the most prominent of them; and we now proceed to give some account of the sensations felt by the individual sufferers during the continuance of the concussions. In the British camp, which was pitched in a plain between the fort and city of Bhooj, the general feeling was an unpleasant giddiness of the head, and sickness of stomach, from the heaving of the ground; and during the time the shock lasted, some sat down instinctively, and others threw themselves on the ground. Those who were on horseback were obliged to dismount, the earth shook so violently that the horses could with difficulty keep their feet; and the riders, when upon the ground, were scarcely able to stand. At Ahmedabad, "all the disagreeable sensations were experienced of being tossed in a ship at sea in a swell; and the rocking was so great, that every moment we expected the earth to open under our feet." One gentleman writing from Surat, where the earthquake began at twenty minutes past seven, says: "The vibration of the couch I was lying on was so great, that I was glad to get off it: the

sions, by the circumstance of a volcano having opened on a hill about thirty miles from Bhooj; and about ten days after the first shock, a loud noise, like the discharge of cannon, was heard at Porebunder. The sound came from the east, and was supposed to indicate the bursting of one or more volcanoes in that direction. Undulations of the earth had formerly been felt in this district, but had never been accompanied with any distressing effects. About two years ago, several of the British officers encamped in the neighbourhood of Bhooj experienced a slight shock; but it was so slight that others of them were not sensible of it. It is to be hoped, however, that none will ever be attended with such a horrible catastrophe as the one we have been describing; for the distress occasioned by it is represented by almost all the writers as beyond their ability to describe.

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ART. XXIII.—*Remarks on Professor Hansteen's "Inquiries concerning the Magnetism of the Earth \*."*

THE properties of magnetism, though interesting in themselves, and presenting an immediate application to the practical purposes of life, have not been investigated with the rapidity or success which might have been expected. From the times of Pliny and Lucretius, by whom the power of the loadstone to attract iron, and to attract or repel another loadstone, is mentioned as a fact well known since the remotest times, above a thousand years elapsed before its polarity was detected, and applied to navigation †. Three centuries after the compass came into

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\* *Untersuchungen über den Magnetismus der Erde*, von Christopher Hansteen, Professor der Angewandten Mathematik an der Norwegischen Universität, übersetzt von P. Freschow Hanson, Königl. Norw. Department-vollmachtigen und Landcadetten-Lehrer. Erster Theil: die mechanischen Erscheinungen des Magneten. 4to, pp. 502. Christiania, 1817.

† Not only the author, but the date of this invention, seems to lie hid in impenetrable darkness. Guyot de Provins, and other trouvères or troubadours, have been quoted, to shew that it was familiar to Europeans about the middle of the 12th century: some expressions of an Icelandic historian appear to carry it farther back at least fifty years. "Are Frode," (says Mr Hansteen), "by whom the *Landnamobok* of Iceland, or the account of the discovery of that island was written, mentions, (Part I. chap. 2. p. 7.), that Floke Vilgerdarson, a renowned viking, or pirate, the