

and Rankine. The lecture on Energy is followed by one on the Dynamical Theory; which embraces to some extent the relations of different forces, and the "varied modality" of chemical, thermal, and electrical action. The next lecture relates to Molecular Dynamics. Then in succession:—Electromotive force produced by Chemical Action, by Heat, by mechanical means, and by Induction. Mutual action of Currents and Magnets, Terrestrial Magnetism, Polar Auroræ; Atmospheric Electricity; Diamagnetism; Rhumkorff's Coil; Winds; Marine Currents; the Sun; the Doctrine of La Place; the Doctrine of Lyell; Thermogenesis; Atmolysis and Osmosis; Capillarity; the Doctrine of Mayer. The second course treats of electricity, undulations, sonority, musical timbre, echoes, photometry, dispersion and the spectroscope, chromatism, vision, luminous undulations, diffraction, polarisation, radiant heat, action of electricity on organic bodies, the muscular current, electrical nervous phenomena, electrical fishes.

The arrangement is really wonderful. What can possibly warrant the following order for lectures:—diamagnetism, Rhumkorff's coil, winds, marine currents; or again—thermogenesis, atmolysis, capillarity? One lecture ends with "Che così mirabilmente si svolgono dall'evoluzione Darwiniana;" and the next commences "E impossibile proseguire un corso di Fisica e più ancora quella parte, che tratta delle azioni senza prima definire le parole, atomo, molecula." The Prof. Pozzo can scarcely be expected to lecture on all science: to pass from the sun to an atom, from Darwinism to electro-dynamics, from geology to elliptical polarisation. If he is, the system is a bad one, and his students may get a smattering of many things, and know nothing well. Mechanical philosophy seems to be almost ignored. The book is devoid of mathematics, and without woodcuts; and we imagine the youth of Perugia must yawn over it; and, if the lectures are as dry as the book, spend much of the time which ought to be given to physics in saying "felicissima notte" to each other. G. F. R.

#### LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

##### Proposed Alterations in the Medical Curriculum

THE remarks made in your number of December 18 by my friend Prof. Balfour are founded on the mistake he has made in supposing that it is proposed to abolish the regulation requiring attendance on the courses of lectures on Botany and Zoology. There is no question raised between mere examining boards and teaching institutions, between compulsory and optional attendance on professors' lectures. It is simply that the candidate for medical degrees be allowed to take the examination in Zoology and Botany earlier than is at present permitted. At present the examination in these subjects in Edinburgh University is fixed by ordinance at the end of the second of the four years of medical study, and in this University, while the Botany comes at that time, the Zoology is actually not till the end of the third year, so that our case is even worse than that of Edinburgh. Prof. Balfour says, "The student might be encouraged to take his science examination at an early period of his curriculum, say at the end of his first year of study." That is exactly the result practically aimed at here, and I am quite at one with him on the subject. But why prevent the student from taking the examination in Botany and Zoology before entering on his medical curriculum proper, if he has attended the professor's class and is ready for it? Very few would at present do so, as it would imply a preliminary year of attendance at the Universities to obtain the courses of Zoology and Botany. But is it not a very desirable thing, from every point of view, to encourage this? So far from lowering the standard in these subjects, or promoting cramming, it would do exactly the reverse. It would enable real study to take the place of the cramming which is inevitable when these subjects are left over to be mixed up with medical studies proper.

For some time there has been a strong feeling here that the examination in Zoology and Botany should take place not later than the end of the first year, and the Lord Rector of our University in taking this matter up, instead of tinkering as to particular dates, has announced the sound general principle that the student should be encouraged to take the subjects of Botany and Zoology before beginning his medical curriculum proper, with the view both of promoting a more real study of these sciences, and of clearing the subsequent medical curriculum for a more real study of the subjects which belong to it. I see nothing in the resolutions which our distinguished Lord Rector has laid before the University Court either suggesting or implying abolition of compulsory attendance on the professors' courses of Zoology and Botany, and Prof. Balfour might well have taken it for granted that the mere fact of the proposal emanating from Prof. Huxley is security enough that the object could not possibly be to lower the position of the natural sciences or to promote cramming instead of real study. Our Lord Rector has as yet only intimated his resolutions, but when the oracle speaks we shall no doubt hear such good reasons for them that even so enthusiastic a botanist as Prof. Balfour will have his alarm turned into joy.

Will any of those who are so strong on the point of compulsory attendance on courses of Zoology and Botany tell us why they do not say a word for Natural Philosophy? Including such subjects as heat, light, electricity, hydrostatics, pneumatics, optics, acoustics, it is surely of more importance than either of the other two, whether regarded educationally or in its bearing on modern medicine. Yet in the Scotch Universities there is no compulsion to attend a course of lectures on Natural Philosophy, and it is relegated to the preliminary examination in general education. The day is past for laying on additional compulsory courses of lectures, but it is surely not too much to say that the student might be allowed to profess and be examined in Natural Philosophy instead of one of the other two.

Aberdeen University, Dec. 20

JOHN STRUTHERS

##### The Distribution of Volcanoes

SOME of the correspondence in your paper has latterly been so caustic, that timid people may be pardoned for shrinking from writing letters which bring down upon them the hammers of scorn and contempt so vigorously.

Notwithstanding this, the discussion between Mr. Mallet and Dr. Forbes about volcanoes tempts me to write to you on a side issue of that controversy in which I have been interested for some time. What I have to say may not be new, although I believe it to be so. At all events it is not commented upon in the books accessible to me. I will premise that, caring little for laurels of any kind but a good deal for instruction, that if it be discovered that what I say is stale and old, I hope I may be treated as an ignorant scholar, willing to learn, and not as a rival to be crushed, and further, that my results having been obtained independently, they support and make more sure the position of my predecessors.

You were good enough, some months ago, to print some letters of mine on the current elevation of the circumpolar regions of the earth. I have since accumulated much new matter on this subject, which will be shortly published in part in the *Journal of the Geographical Society*. The general result of my inquiry is, that all the large land surfaces of the earth, the large continental and insular surfaces, are more or less in process of gradual or rapid elevation. There are a few small areas of depression on the outskirts and borders of the great land-masses, but these are very local and unimportant. And with this slight exception the continents of North and South America, Asia, Europe, Africa, and Australia, are all more or less rising. This rise of the land-surfaces necessitates a corresponding sinking, either an absolute or a relative sinking, in the surfaces covered with water. It is comparatively easy to test where a land surface is gradually protruding from the water. It is not such a simple matter always to know whether this rise is relative or absolute, for the same effect may be produced by the sinking of the sea-floor as by the actual rising of the land. One thing only we know, that when our measure is water, there must be a corresponding sinking either relative or absolute where there is a rising elsewhere. Direct evidence of the sinking of the sea-bottom is not very easy to find, but such does exist. Students are familiar with the facts collected by Darwin and others, showing from the growth of coral islands, &c., that the Pacific is an area of depression; other evidence consists in the disappearance of well-known rocks, the

vigias of navigators in different parts of the greater oceans. From this and other evidence, I am very well satisfied that not only the Pacific, but also the North and South Atlantic and the Indian Oceans, are areas of depression.

Having thus roughly mapped out the world, it becomes an interesting problem to correlate the distribution of volcanoes with that of the rising and sinking land. If the older theory of volcanoes be the true one, that they are the direct results of the eruptive forces of the interior of the earth, we ought surely to meet with them in profusion in those large areas where we know the earth to be relatively rising, where in fact the eruptive force of which volcanoes are the supposed violent proofs is concentrated. Is this so? On the contrary; and it is this that forms the burden of my present letter. The fact is that we shall search in vain among the large areas of upheaval except along their boundaries and fringes for any active volcanoes. Take the northern circumpolar region, the most typical area of rising land in the world, and there is absolutely no volcano in it. The Iceland volcanoes and Jan Mayen happen to be outside the area of upheaval, and in a part of the Atlantic which is notoriously sinking. North America, another large area of rising land, is similarly bare of volcanoes. So is South America, save on the very verge of the Pacific, and that part of the Pacific which I believe to be sinking most rapidly. Australia is probably now rising faster than any area in the world save Spitzbergen, and there we have no volcanoes. Europe is similarly free except in that part of it which is sinking, namely, the Mediterranean border. Lastly, there is the vast continent of Asia, a large part of whose northern surface seems, from all the evidence we can collect, to have been quite recently under water and to be still rising. About Asia I wish to enlarge somewhat.

It was one of the peculiar fancies of Alexander Humboldt, the great authority on the Physical Geography of Asia, that there was a large active volcanic region in the Altai Mountains, &c., and he brought together a great deal of plausible matter to support this view.

As this volcanic region would be in the midst of one of the largest areas of elevation on the earth's surface, it would conflict materially with the evidence elsewhere and with the theory of the distribution of volcanoes for which I am arguing. Luckily for me it has been recently shown, so far as the negative results of those who have been to find Humboldt's volcanoes and have not found them, goes, that is, so far as the only scientific witnesses who have surveyed the region may be allowed to dogmatise, that Humboldt was entirely mistaken. I will quote the accounts of the Russian surveyors as they have been translated for the Geographical Society.

"It now remained for me," says Semenov, "to prove by actual observation the existence or otherwise of volcanic phenomena in Djungaria and in the Celestial Mountains, to which Humboldt in his works so often alludes. I started on my journey, firmly persuaded that I should find the conjectured volcanoes, or at all events some volcanic forms, and sought diligently (as Schrenck did on Lake Ala-kul) to establish the correctness of Humboldt's surmises with respect to the existence of volcanic phenomena in Central Asia, by which confirmation I knew a traveller would gain greater credit than by any incomplete refutation of the supposition. I was even aware that Humboldt was rather displeased with the researches of Schrenck, who clearly showed that the island of Aral-Tube on Lake Ala-kul was not of volcanic origin. The opinions entertained by Humboldt on the subject of the existence of volcanoes in Djungaria were favourite ones with him, and I regret that I was not able to confirm his cherished theory. Kullok Peak, another of Humboldt's mistaken volcanoes, was found to have no volcanic origin whatever. The hot springs and the non-congelation of Lake Issyk-kul were not accompanied by any volcanic forms in the Tian Shan; and furthermore, all the native accounts of phenomena which from their description might be supposed to be volcanic proved unfounded, and were at once disposed of on my examination of the localities where they were declared to occur. The result, therefore, of my researches on this point was that I became convinced of the complete absence of volcanoes, typical volcanic phenomena, or even volcanic forms, throughout the Celestial Mountains. It is true that there existed in Djungaria at one period some solfatara, or smoking apertures, from which there was a discharge and deposit of sulphur, and that some of these fissures, out of which the Chinese obtain sulphur, emit smoke even at the present day. But a careful inspection of one of the extinguished pits satisfied me that, at all events in that case, there was no volcanic affinity. In the neighbourhood of the pits discovered by

me in the Kater Mountains and in the Ili Valley, I could trace no volcanic forms. . . . The whole process of the formation of sulphur can then in my opinion be reasonably explained by the combustion of some coal seams in this basin, which would at once set at rest the question of supposed volcanic agency. . . . The observation of a single portion of the Tian Shan visited by me cannot serve as positive evidence of the absence of volcanoes and volcanic forms in other parts of this mountain chain. My conclusions on this question generally have already been made public in the letter referred to, but I must likewise observe in addition that all Asiatic accounts of phenomena which might be volcanic in appearance should be treated by men of science with great circumspection, as many of these accounts have already proved fallacious. I would here also remark that the impression produced on me personally by Djungaria and the Tian Shan leaves great doubts in my mind as to the existence of volcanoes in this part of Asia; and as I am the only traveller who has visited the Tian Shan, I cannot accept the belief in their existence as an axiom requiring no proof or confirmation. My conclusion on this point, though only negative, is one of the most important results of my journey." ("Djungaria and the Celestial Mountains," by P. P. Semenov, *Journal of the Royal Geographical Society*, 35-213.) Again, I will quote a later traveller, Mr. Severkof. He says—"There are no volcanic formations in the western portions of the Tian Shan which I surveyed. From eastern sources, Humboldt refers to evidences of volcanic action farther south in the Ak-tan, but even these are doubtful. Fire may be produced in the mountains even by the ignition of the seams of coal as well as of the carburetted hydrogen gas filling the caverns of the seams. This conjecture is supported by the circumstance that Messrs. Bagaslouski and Lehmann discovered, on their journey to Bockhara, a burning seam of coal in the mountains of the upper Zaraphan, a little to the south of the Ak-tan. Speaking generally of volcanic action in the Tian Shan and the surrounding regions, the geological surveys hitherto made from Khan-tengir (east of Issyk-kul, near the sources of the Tonta, Djergalan, Tekes, and Kegen) to the extreme western limits of the system, have given only negative results. To the east of Khan-tengir there are again seams of coal—for instance, at Kulджа, and perhaps also at Urumchi—the ignition of which is quite sufficient to create explosive gases. Whether the seams of coal were ignited at Urumchi by volcanic agency, or accidentally at their denudations, is a question that cannot be settled without close observation. It can only be said that the demonstrations in favour of volcanic action adduced by Humboldt are not sufficient proof of the volcanic origin of the Tian Shan, excepting only as regards the lava which, according to Chinese records, flowed from the Peshan mountain during the 6th century. But a single crater—even if the fact of its existence in an extensive mountain system extending, as the Tian Shan does, for 3,000 versts, can be proved—does not make the whole of the range volcanic. (Severkof's "Journey to the western portion of the Tian Shan," *Royal Geographical Journal*, 40, 395-6.)

This evidence, to my mind, completely refutes Humboldt, and makes it very clear that his volcanic region is non-existent. With the disappearance of this, disappears the only exception I know to the rule that volcanoes, instead of being found chiefly on areas of elevation, are invariably found in areas of depression, or on or close to the boundary lines which separate them from the areas of elevation. The meaning of this lesson, as I read it, I will reserve for another letter.

In conclusion, I wish to thank one of your correspondents in Tasmania for the fact he communicated to you about the rise of that island. I shall be very grateful to anyone who will send me other facts about areas of upheaval and subsidence, and their communications shall be cheerfully acknowledged when I publish them.

Derby House, Eccles

HENRY H. HOWORTH

#### Spectra of Shooting Stars

It may interest observers of shooting stars who attempt to obtain views of their spectra by the use of suitably adapted meteor-spectroscopes to indicate a peculiarity which seems to distinguish the larger meteors of the December star-shower, radiating annually from the direction of a point near  $\theta$  Gem-norum on the nights of the 10th, 11th, and 12th of December. Two such small bolides of this stream which appeared to me on December 9th, 1864, and on Thursday night last, the 11th inst., were characterised by a beautiful pale-green colour, like that of