dicularе or lamina papyracea. Putting aside the references elsewhere made to this point in the course of the descriptions of the bone, we must praise the very full account that is given of its relations in the different classes of birds, proving not only that the means of investigation at Dr. Magnus's disposal are extensive, but that he has made excellent use of them.

As an example of the second point, on which we have ventured to criticise Dr. Magnus's work, we may refer to the entire section on the bone to which he has applied the term Paukenbein, or Tympanic, bone, which, in part at least, corresponds to Mr. Parker's Basi-temporal, and the relations of which the latter writer has worked out so well. Its nature is essentially misunderstood by Dr. Magnus, who appears to have drawn his conclusions from heads examined at too late a period of development, whilst he scarcely makes any reference to its homologies, so important in determining a difficult and disputed relation of this kind. H. P.

OUR BOOK SHELF

The Elements of Plane and Solid Geometry. By H. W. Watson, M.A. (Longmans, Green, and Co.)

THIS is one more Text-book of Geometry. It adopts completely the general principles of the geometrical reformers in England, in the classification of the rems according to their subjects, the free use of super-position, the separation of problems from theorems, the art from the science, and the avowedly arithmetical treatment of proportion. It is distinguished from most that have preceded it by its greater length, especially in its treatment of ratios, by its somewhat wider range of illustration, and its comprehending the elements of solid geometry. But the book is disappointing. A well-trained and well-read mathematician, with plenty of experience in teaching, and we imagine plenty of leisure for writing, ought to turn out a better book. In a text-book which does not profess to be original in its matter, the arrangement and manner are of the first importance; and in both these respects the book in our judgment fails, and fails openly. The large number of miscellaneous propositions with which several of the books open give a real confusion to the whole volume. And it would be easy, if space permitted, to show that the arrangement is unnatural in some important points. Moreover, some of the demonstrations are very inelegant, such as Book I., pp. 11, 17, and Book II., pp. 12, 13; indeed the latter pair are more than inelegant.

On the whole, therefore, we believe that the book before us, though not without merit, is not a very valuable addition to geometrical reform. It seems to show very clearly what the reformers must aim at, and take infinite pains to achieve: the establishment and recognition of a standard syllabus of geometry. When this is agreed upon, we shall see better text-books than have yet been written.

Victoria. (1) *Mineral Statistics of Victoria for the year* 1870. Presented to both Houses of Parliament by his Excellency's command. (Melbourne: By authority: John Ferres, Government Printer.)—(2) *Reports of the Mining Surveyors and Registrars.* Quarter ending March 31, 1871. (Melbourne: By authority: John Ferres, Government Printer.)

THESE reports are models of what such statistical reports should be; the tables are methodically arranged, easy of reference, and apparently exhaustive; the printing would be creditable even to a London printer. In the former, besides the interesting summary and the appendices, there are fifty-three admirably constructed tables, setting forth the statistics, from every possible point of view, of the mining operations in all the districts, divisions, and subdivisions of Victoria for the year 1870. Of course the statistics relate mainly to gold, the metal most sought after; but all obtainable information is likewise given with reference to whatever other mineral produces are found in the province—silver, tin, copper, antimony, lead, cobalt, manganese, coal, &c. Every means has been taken to make the statistics reliable, and the result, with regard to gold, is that there has been a falling off of the produce in 1870, as compared with 1869, to the extent of upwards of 40,000 oz., which decrease is largely accounted for by the heavy and unprecedented floods of 1870 interrupting the mining operations, the decrease in the number of mines, and the falling off in the yield of gold from several of the deeper alluvial mines. It is stated that during 1870 several scientific gentlemen volunteered to deliver to the miners gratuitously lectures on subjects connected with mining, but received no encouragement from the district authorities, who seem not to have thought it worth their while to provide a room. The interests of science are, however, by no means neglected. We learn from these reports that during last year more than 800 groups of minerals, rocks, and fossils, were added to the collection of the mining department. Efforts have also been made to obtain specimens of the mineral products of other countries in exchange for native products. Another colony is now likely to reap a rich reward, as already many specimens have been sent both from Europe and America. We are glad to learn that Dr. Von Mueller is preparing a report on the large collection of native fossils which has been made. The second report, for the quarter ending March 31, 1871, is considerably more interesting than the former, in a scientific point of view. Besides full and valuable mining statistics, there are two appendices: (A) "Notes on the Rocks and Minerals of the Owen's District," with a sketch map, by Mr. E. J. Dunn, containing much valuable information on the geology of the district; (B) an interesting paper containing succinct observations on what the author, Ferd. Von Mueller, Director of the Melbourne Botanic Garden, considers a new genus of Fossil Coniferæ, to which he has given the name *Spondylostrobus.* It is allied to *Cupressinites* of Bowerbank. We are sorry we have not space to copy the author's description. The validity of the genus, Mr. Mueller declares, rests chiefly on the extraordinary development of the columella, if so it may be called; this columellar portion forming indeed the main body of the fruit, the so-called new genus differing in this respect from all other cupressineous genera living as well as extinct. The paper is illustrated by a beautifully executed lithograph, containing several coloured figures, natural size, of the fossil, and also by a plan of the field, and sections of the strata in which it is found. We have much pleasure in commending these interesting, and on the whole, encouraging reports, to the notice both of statisticians and geologists.

LETTERS TO THE EDITOR

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

Pendulum Autographs

HAVING read with much interest Mr. Hubert Airy's communication to NATURE (No. 94), on "Pendulum Autographs," I wish to say a word on the compound pendulum long ago devised, I believe for the first time, by Prof. Blackburn, of Glasgow.

I construct the pendulum as follows:—A piece of soft iron wire, about $\frac{1}{40}$th of an inch diameter, is fastened by its ends to two points in the ceiling, and a heavy bob is hung from its middle point. A second wire of the same length is similarly attached to the ceiling and to the bob, so that the wires form two superposed isosceles triangles with the line between the suspension points for their common base. A light deal rod about the same length, more or less, as the distance of the suspension points, has a fine saw cut about $\frac{1}{8}$th of an inch deep, made lengthwise at both ends. The wires which form the sides of the first triangle are put into one cut, and those of the second triangle into the other; and the rod may then be slid up or down along the wires, to different heights, so that when the pendulum is at rest the rod is horizontal, forming the base of one isosceles triangle, with sides of double wire, and its vertex down at the bob, and also of other two isosceles triangles, equal and similar to one another whose sides are of single wire, and whose vertices are the points of suspension in the ceiling respectively.

It is now evident that the rod is rigorously constrained to oscillate in a plane perpendicular to the line joining the suspension points, while the vertex of the triangle below the rod, which is the point of suspension of the bob, is free to move, at any instant, only in a plane at right angles to the plane of motion of the rod. As the amplitudes of the oscillations are practically made small compared with the lengths of the component pendulums, we thus obtain, with almost any desired degree of exactness, the composition of two simple harmonic motions of different periods of adjustable ratio, and in rectangular directions. It is easy also to see how, by making the wires of unequal length, and dividing them proportionally at the point of suspension of the bob, the simple component motions may be adjusted to different inclinations. In order absolutely to prevent the bob from creating indeterminate motions about its point of suspension, it would be needful to substitute, for the wires below the suspended rod, stiff pieces rigidly attached to the bob. But with due care in swinging the pendulum no very sensible motion of the bob, relatively to its suspending wires, need occur.

To record the motions of the pendulum, I have most frequently adopted the old plan of sand running out at a fine hole at the bottom of the pendulum bob. But for class experiments at the University of St. Andrews, I have also made the following arrangement:—A heavy bob of lead, in metallic connection with its suspending wires, has a metal point projecting from its lower end. Wires from an induction coil are connected, one with either of the suspension points in the ceiling, the other with a sheet of a tin foil which rests on a table, and over which is placed a sheet of paper, all but touching the point projecting from the bob. The pendulum having been first got to swing steadily, the induction coil is put in action, and the sparks, passing from the pendulum point to the tin foil, trace on the paper, if it be suitably prepared, a record of the pendulum motion. I used one of Ruhmkorff's original coils, which, with a single Grove's cell, was quite sufficient. The rheotome acted automatically, and with considerable regularity. The dots on the paper made by the sparks showed distances varying from one element of the pendulum track to another, and thus exhibited in a very interesting manner the variation in the velocity of the pendulum bob.

WILLIAM SWAN

Ardchapel, Dumbartonshire, Aug. 24

PERMIT me to state that the diagrams in No. 94 of the 17th June to Mr. Hubert Airy's "Pendulum Autographs," are identical with the "Kinematic Curves" by Mr. Perigal, drawn by him upwards of thirty years ago, and discovered by Mr. Sang of Edinburgh two years previously (On the Vibration of an Elastic Spring, Ed. Ph. Tr.), autographic copies being in the possession of the Royal Society, Royal Institution, and Royal Astronomical Society. *Vide* my application of the Binomial Theorem to Perigal's Bicircloids (Lond. Phil. Mag. 1849-1850). Mr. Perigal calls these curves, Lemnoids, Paraboloids, &c.

August 28 S. M. DRACH

Thickness of the Earth's Crust

THE question in debate is not a mathematical one. Accepting Archdeacon Pratt's calculations as correct, they would show that certain facts in the earth's motion are what they would be if the earth were a rigid mass, or nearly so. But this at present is not disputed. What is disputed is the soundness of the inference drawn from these facts respecting the fluid or solid state of the earth's interior, for it is contended that in either case the movements in question might be practically the same, provided only they were slow enough. I do not think this is replied to by Archdeacon Pratt in his letter in NATURE, August 31.

Whatever the disturbing forces may be, they amount to a motive impulse given to some portion of the mass of the earth. This impulse may have two effects: either it may alter the shape of the mass by causing part of it to move in some direction faster than the rest can follow, or it may alter the position of the mass by causing the whole to move together. If the portion which receives the impulse is able to move the rest as quickly as it moves itself, the whole will move together; and where there is any cohesion at all, there must be a degree of slowness at which this condition is attained.

Mr. Pratt's rope of sand, if dealt with here, is a system of particles between which there is no cohesion. They are not able, by attractive power, to move each other at all. But if hung out in free space, they would certainly assume a definite shape as a whole, and would retain it with complete "rigidity" in spite of any applied force which was not able to move any of them faster than they could move each other.

Suppose the earth were projected bodily along the line of its axis towards the pole star, what would happen to a loose stone lying on the surface at the south pole? If the earth moved northward ten feet in a second, the stone would, at the end of the first second, be still upon the surface. If the earth moved twenty feet in a second, the stone, at the end of the first second, would be a yard behind it, but before the end of the next second it would be on the surface again. Are not the relations between the rigid, the fluid, and the elastic states all illustrated here? What would be the real cohesive force in a molten earth, as compared with a congealed one, is another matter. "Molten" does not necessarily mean "limp," and the question, if determinable, has not, I imagine, been determined. The molten earth would no doubt be less compressible; and this, in some cases, may be equivalent to an increased cohesion. Let me add that I have no theory as to the earth's interior. A. J. M.

Sept. 5

Spectrum of the Aurora

MAY I call your attention to an error which has occurred in the engraving of the Spectrum of the Aurora which I sent you last week. The lines are marked in strength exactly the reverse of what they should be. Thus: No. 1 is the strongest, and is a sharp line easily seen, and in the drawing it is the weakest; and so with the others. No. 1 is the brightest, No. 5 is the faintest.

47, Brook Street LINDSAY

Transparent Compass

I BEG leave to draw your attention to a contrivance that I think very suggestive, of improvements in getting up compasses for iron and wooden vessels. This I propose to effect by using glass globes with transparent needle-cards, and thus making a transparent mariner's compass, visible in all directions, that may be either supported or suspended by very simple and compact fittings wherever most convenient.

In iron vessels this transparent compass can be readily placed beyond the local attraction of the iron. In appearance like a pearl, and in good taste.

Please draw attention to this very simple remedy for so many real or alleged complaints of the deviation of the compass on board of iron vessels. GEORGE FAWCUS

North Shields, Sept. 4

A Substitute for Euclid

SINCE Prof. Tait has given the weight of his authority to the attack for some time past directed against Euclid, I, and perhaps some others who like me have sons whom they wish to educate as mathematicians, would be much obliged to Mr. Wilson, or any other of your correspondents, who would recommend a book which is suited to lay the foundation of geometry in the future.

A FATHER

Monolithic Towers of Cement Rubble for Beacons and Lighthouses

IT occurs to me to suggest the trial of common rubble set in Portland or other equally good cement in the construction of beacons and seamarks, as also for lighthouses. The advantages of employing cement rubble, not in prepared blocks but by continuous building, are the following:—

1. The dispensing with all squaring or dressing of materials.
2. The suitableness for such work of any stone of hard quality, thus rendering it unnecessary to bring large materials from a distance, or to open quarries for ashlar.