the author not only knows his subject thoroughly, but understands how to deal with it in a way that shall be readily intelligible. His main object has been to direct attention only to important facts and principles, and to bring out the various links by which they are logically connected with one another. There are eleven chapters, in which he treats of thermometry, dilation of bodies, calorimetry, production and condensation of vapour, change of state, hygrometry, conduction, radiation, thermo-dynamics, terrestrial temperatures, aërial meteors, and aqueous meteors. Few changes have been made in the present edition, but the author has introduced a collection of elementary problems, which, as he says, may be "advantageously solved in connection with the subject-matter to which they appertain."

LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

Aurora.

THERE was a fine aurora visible in this locality on Saturday night, April 23. It was seen at intervals, whenever the clouds broke away, until after midnight. This display is specially interesting, because it forms the continuation of a series of recurrences, at the precise interval of twenty-seven days, which began in December, the dates being as follows: December 9, January 5, February 2, February 29, March 27, and April 23. Some of these displays have been brilliant, and all of them have been well defined. In the table of auroras which I have constructed, based upon a periodicity corresponding to the time of a synodic revolution of the sun—namely, twenty-seven days, six hours, and forty minutes—there was, for several years preceding the sun spot minimum in 1889 and 1890, a return each spring of series of recurrences associated with the same part of the sun as that above described. A corresponding systematic tabulation of the records of solar conditions shows that this association bears a direct relation to reappearances at the eastern limb of an area which has been much frequented by spots and faculæ, and which has been located persistently south of the sun's equator. In like manner there are other areas located in the sun's northern hemisphere which have been much disturbed, and whose reappearances at the eastern limb have been attended year after year by series of recurrences of the aurora, in the autumn months chiefly, if not exclusively. From this it would appear that, in order that a solar disturbance may have its full magnetic effect upon the earth, it is necessary that it should be at the sun's eastern limb, and as nearly as possible in the plane of the earth's orbit. It appears, also, that the disturbances which recur upon certain parts of the sun so persistently year after year have greater magnetic effect than those of comparatively sporadic character located elsewhere.

Lyons, N.Y., April 25. M. A. VEEDER.

The White Rhinoceros.

IN my "Naturalist in the Transvaal" (p. 5), I recently deplored the supposed fact that a perfect skin or skeleton of *Rhinoceros simus* was unknown in any Museum; and I relied for my information on the interesting communication in your columns made by Dr. Sclater (vol. xlii. p. 520).

I have just received a very welcome letter from Dr. Jentink, the Director of the Leyden Museum, stating that there are two skins to be found in that collection, "one in a rather bad state, but the other a beautiful stuffed specimen, measuring more than 3½ metres."

Dr. Jentink had published this information in *Notes from the Leyden Museum* (October 1890), a communication I had not seen when I returned from the Transvaal and wrote on the matter.

This is a most gratifying fact for all zoologists, and the Leyden Museum appears to have a unique treasure.

Purley, Surrey, May 3. W. L. DISTANT.

The Line Spectra of the Elements.

IN Prof. Runge's article on the spectra of the elements in last week's issue of NATURE (p. 607) he refers to my explanation of double lines in the spectra of gases ("Cause of Double Lines in Spectra," Trans. of the Roy. Dublin Soc., vol. iv. 1891, p. 563); and says:—"I do not understand the decomposition of the arbitrary curve" [rather, of the actual motion of the electric charge within the molecules of the gas] "in a series of superposed ellipses" [rather, into a series of pendulous motions in ellipses]. "For the movement is supposed not to be periodical" [rather, is not known to be periodical], "and Fourier's theorem then would not apply, at least the periods of the superposed ellipses would not be definite, as long as there are no data except the arbitrary curve itself" [rather, no data except those furnished by the positions and intensities of the spectral lines].

Prof. Runge will pardon me if I say that this objection seems to me to be of the same kind as a doubt with respect to the value of tables of logarithms on the ground that many logarithms are incommensurable with integer numbers, and therefore cannot equal decimal fractions.

Take, for example, a simple vibratory movement of an electron within the molecules, represented by

$$x = a \sin\left(2\pi\frac{mt}{j}\right) + b \sin\left(2\pi\frac{\pi mt}{j}\right), \quad . \quad . \quad . \quad . \quad (1)$$

which would give rise to two lines in the spectrum with oscillation-frequencies m and πm in each jot of time. This, Prof. Runge objects, cannot be analyzed by Fourier's theorem, because it is not periodic. But

$$x = a \sin\left(2\pi\frac{mt}{j}\right) + b \sin\left(2\pi\frac{3\cdot14159\, mt}{j}\right), \quad . \quad . \quad . \quad (2)$$

$$x = a \sin\left(2\pi\frac{mt}{j}\right) + b \sin\left(2\pi\frac{3\cdot141593\, mt}{j}\right), \quad . \quad . \quad . \quad (3)$$

$$x = a \sin\left(2\pi\frac{mt}{j}\right) + b \sin\left(2\pi\frac{3\cdot1415927\, mt}{j}\right), \quad . \quad (4)$$

&c., &c., &c.,

being periodic, can be so analyzed. The motion represented by the first of these (Equation 2) approximates for a certain time to the actual motion which is represented by Equation 1. The motion represented by the next (Equation 3) approximates more closely and for a longer time; and so on. So that Fourier's theorem can be applied to motions which approximate to the non-periodic motion represented by Equation 1, in any assigned degree and for any assigned time; just as a decimal can approximate in any assigned degree to the value of log 8, although no decimal can equal that logarithm.

G. JOHNSTONE STONEY.

9 Palmerston Park, Dublin, May 1.

On a Proposition in the Kinetic Theory of Gases.

IN last month's *Philosophical Magazine* there is a paper by Lord Rayleigh criticizing a demonstration by Maxwell of the equality of the products $dp_1 \ldots dp_n$, $dq_1 \ldots dq_n$, and $dP_1 \ldots dP_n$, $dQ_1 \ldots dQ_n$, where the p's and P's are the momenta, and the q's and Q's the co-ordinates, of a system at the beginning and end of any interval of time.

Lord Rayleigh correctly points out that the assumption of E, the total Energy, as an independent variable, vitiates the proof, and he suggests the substitution of Hamilton's principal function S for the characteristic function A, with t, the time, as an independent variable.

Prof. Boltzmann took a similar objection to Maxwell's demonstration in a paper to the *Philosophical Magazine* in the year 1882, in the course of some comments on my use of the proof in a small treatise on the kinetic theory of gases, and I then privately suggested to him the substitution of S for A, with t independent, as proposed by Lord Rayleigh. But unfortunately, as I now see, the proposition $dp_1 \ldots dq_n = dP_1 \ldots dQ_n$, with t independent, although doubtless true, has no application to the particular problem in the kinetic theory of gases to which I was applying it.

My object was to abbreviate and simplify the proof of a fundamental theorem in the subject originally given by Boltzmann, and which may be fairly well illustrated by the following simple case:—

Suppose that in the plane of a projectile there are two infinite