distribution of leaves around the stem. The latter part of this valuable paper consists of an attempt to show that the modes of phyllotaxy which result from the use of the different forms of the fraction are either directly serviceable to the plant by affording the best distribution, either for absorbing the sap from the roots or for exposing it to the action of air and light, or have been so at some period of the ancestry of the plant, when its structure was of a simpler character. The typical or unique angle of the theory of phyllotaxy the author regards to be the goal towards which the special forms tend, by the action of the principle of natural selection, rather than as the origin of the spiral arrangements.

A. W. B.

LETTERS TO THE EDITOR

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

The Law of Total Radiation

IN NATURE for April 25 Captain Ericsson attacks the calculation of Pouillet as to the sun's temperature, as being founded on an erroneous law of radiation. Had he contented himself with saying that the extension of Dulong and Petit's law so far beyond its experimental foundation to temperatures approaching that of the sun was "mere theory," and inconsistent with his own experiments, his position might have been impregnable. But not satisfied with this, he goes on to question the applicability of Dulong's law even below the boiling point of mercury, and asserts that Newton's law is much nearer the truth. The only objection that he gives to the method of the French experimenters is that they erroneously confuse the surface temperature of their thermometers with the average temperature of the contained mercury. The observed radiation is really due to the first, though attributed to the second. Now, without asserting that the objection is entirely without force, I submit that, if Newton's be the real law of radiation, it is impossible in this way to account for the observations.

In the first place, if the rate of cooling for a body at a variable temperature t , surrounded by another at a fixed temperature t_0 , be proportional to $t - t_0$, it follows from the theory of exchange (than which there are few things better established) that the radiation between two bodies at any temperatures t, t' , is proportional to $t - t'$. The rate of cooling of the thermometer contained in an enclosure would thus depend only on the excess of temperature, in flat contradiction to Dulong's observations. Nor would this result be altered, even though the material of the thermometer were so badly conducting in relation to its size as to allow the surface temperature to fall considerably below that of the interior. Whatever may be the relative temperatures after a given time of a system composed of a conducting mass, originally at a uniform temperature of 100° , surrounded by an enclosure maintained at 0° , the same after the same time will be the differential temperatures of the corresponding parts of another similar system, whose interior mass had originally a uniform temperature of 200° , with a case maintained at 100° . In fact, according to Newton's law, and with a constant conductivity, the superposition of any constant temperature over the whole system alters none of the conditions.

If it be objected that in the interior of a thermometer heat is distributed, not merely by conduction, but is convected by currents in the mercury, even this, I believe, will make no difference. The convection currents are a consequence of differences of density, and these are approximately proportional to the differences of temperature. The addition of a constant temperature to the whole alters nothing.

Judging from the evidence at present before us, it is impossible to avoid the conclusion that within the limits of Dulong's experiments Newton's law of cooling cannot be even approximately true. If Capt. Ericsson, by bringing forward fresh experiments, and by proving the fallacy of old ones, can establish the truth of Newton's law, he will lay Science under a great obligation. Speaking as a mathematician, I could even wish him success.

With regard to high temperatures it seems certain that Dulong and Petit's law fails; for it is impossible to believe that the sun

is no hotter than $1,500^\circ$ Cent., at least if the estimates hitherto made of terrestrial temperatures are substantially correct. It must be remembered, however, that according to Fizeau the sun is only about $2\frac{1}{2}$ times brighter than the electric arc, which does not even imply a higher temperature; because, while the sun must give us nearly the whole radiation due to his temperature, the electric arc is probably transparent.

J. W. STRUTT

Terling Place, Witham, April 29

Solar Halo

THIS morning, at 9.20, I observed a strongly-marked halo round the sun. Roughly extemporising a sextant with a post-card and paper-vector, I took three observations on the semi-diameter, and found the mean to be $22^\circ.6$. So I conclude this to be the ice-halo, whose deviation is 23° , being formed of hexagonal crystals. Two facts render the halo noteworthy—(1) the morning (after a heavy gale from the south) was exceptionally warm; (2) the halo exhibited the extreme colours in the proper order. I am told halos do not exhibit colours. Surely they ought to; and if not, why not? Let some of your readers answer me this. The halo was visible till nearly 10 o'clock.

Bournemouth, April 26

C. M. INGLEBY

Help us to save our Birds

ALL praise be given to those who have made a stand for the preservation of British birds. With a spirit of patience they have had to encounter the crass prejudice that sometimes saturates even the rural mind, and to prove that if the small bird takes its toll from, it also greatly assists in preserving the store of, the farmer. They have had to combat the sporting instincts of the excited townsman, so joyous with his escape from the smoky labyrinths of his brick-built prison that even a feathered shuttlecock would almost seem like game. Last and greatest feat, they have had to question the right to worship the national idol—gain, and to teach people, that even if, by the wholesale slaughter of feathered tribes, some persons scraped up gold, still that occupation, however praiseworthy, was against the general good. Truth at last dawned on the mind of the people, and so Parliament shielded, amongst other fowl, the pretty kittiwake from destruction, and preserved fashionable women from one more barbarism.

Those who have thus worked to educate the public need not rest on their oars for lack of employment, let them look farther afield, let them fearlessly step across national boundaries, and lend their strength to assist in arresting the impending destruction of many species of the most beautiful and interesting orders of animated nature in any quarter of the globe.

New Zealand, so long left by science to slumber on the calm bosom of the Pacific, has disclosed, amongst her birds, forms that have surprised the naturalist as much as they have excited the speculation of the philosopher. The remains of birds, of orders other than the gigantic Struthionies, giving us hints about strange lost forms of animal life that have lingered in these islands, perchance, almost to our own times, are now and then exhumed from the hidden shores of swamp and morass. We raise a cry for help in behalf of the mass of birds that yet remain near us (we had almost said *with us*), in the hope that the attention of naturalists in Europe may be called to the peril of extermination that hangs over many interesting indigenous species. For the preservation of our birds we require some assistance from abroad, our time is so crowded with occupations of many kinds, that without some pressure from without, little attention would be likely to be paid to the subject. This is said not without reason, not without some experience; in 1868, in Parliament, the writer tried to secure the conservation of our magnificent forests, a resolution was passed by the House to that effect, official inquiries were made;—*cui bono*? Our forests are now being damaged and destroyed, where not protected by climate, in so ruthless a manner, that no further evidence is needed to prove our wasteful style of settlement. Will not some one having authority in such matters speak a word in due season for our birds? I believe nearly every living species that we number could be preserved with proper care. If that is a fact, is it not interesting enough to naturalists to induce them to stimulate us to efforts more likely to give better results than our present legal enactments?

We encourage planting, the labour and capital therein expended may yield returns after the lapse of generations; we, at the same time, allow timber, the growth of ages, to be swept by fire by any one who owns a box of matches, and looks on firing as the best means of subduing the wilderness. We import with great difficulty insectivorous birds, and allow the Apteryginæ and other insectivorous genera to be destroyed without mercy.

Fearing to occupy too much space, I will only glance at our worst raptorial from which our birds suffer. First, the *bond fide* settler in his "new chum" phase, before "he has eaten his tutu" (as we say); next, the digger, who kills kivi, kallapo, kalla, and pigeon, without any respect to season; his dog, like that of the settler, being a more fatal enemy to birds than himself. Lastly, the collector, the provider of rarities for museums, &c. There is no fence month with him; if spring or summer plumage is interesting, so also is that of winter; eggs, young, the adult, alike he preys on all. He is heedless of the Mosaic promise; he cares not to have his days prolonged, so that he gets good specimens.

Could we be persuaded to try and avert what will some day be a great reproach to this country, the destruction of so many species of our feathered tribe, D'Urville's Island might be found most useful. Wingless species, and birds of feeble powers of flight, might there find a refuge for some of their representatives. Resolution Island might be placed under tapu from molestation by dog and gun.

THOMAS H. POTTS

Ohinitahi, New Zealand, February 2

The State and Science

FROM the position taken by Mr. Gladstone with regard to the Dublin University Bill, from Mr. Lowe's speech at Halifax, and from other indications, it would appear to be the policy of the Government, not to render accessible to all, without sectarian distinction, the professorships and other endowments of the Universities, and to assign to modern culture a fair share thereof, but to abolish all such endowments, and to withdraw all State aid from both literature and science. In favour of such a policy it has been urged not only that it is in accordance with sound political economy to leave every pursuit to seek for itself its own reward, but also that the system of endowment and artificial aid has proved a signal failure. Now, if by this last argument it is meant that the large rewards which have been given for classical knowledge and for mathematical attainments have not been productive of numerous Bentleys, Porsons, and Newtons, the truth and validity of the argument must be admitted. The rewarding of mere acquired knowledge was little likely to show its results in original work. The capacity for acquisition, literary, mathematical, or scientific, is a very different thing from the power of original production, or of extending the boundaries of human knowledge. Probably in some cases the latent spark of genius has even been stifled and smothered by the load of "cram" necessarily superimposed to meet the requirements of exacting examiners. It would be, however, I think, a mistake not to allow some considerable reward to more exact knowledge. But it is with regard to original work and the proved capacity for doing it that external encouragement and reward is absolutely necessary. Such work, in most departments of literature and science, cannot possibly, in a commercial sense, pay. It is this work, however, which confers especial honour and advantage on the State. Therefore it is in accordance alike with justice and sound policy that the doing of such work should be munificently encouraged and rewarded by the State. Such a policy might be reasonably expected to issue in results very different from those which have attended the endowment of "cram." Previous failure cannot be objected, for the attempt can scarcely be said to have ever been made. It behoves, therefore, literary and scientific men to look to it that, in any redistribution of the University or other endowments, the true interests of both science and literature—and especially the encouragement and reward of original research—are duly regarded by the Government. But a certain superficial political economy may object that such a policy would be of dangerous tendency, inasmuch as it would recognise the existence of the State as a unity, which, being honoured and benefited, should encourage and reward. The man of original thought and the discoverer of Nature's secrets must be left, each for himself, to seek such recompense as he can in the ordinary market. Sir Isaac Newton would not be rewarded by the present Government with the Mastership of the Mint. They have abolished that office. No, they would guard

him in his enjoyment of the copyright of the "Principia!" Such, it would seem, according to Messrs. Lowe and Gladstone, is the dictate of common sense, of justice, and of the "sound political economy" of

ADAM SMITH

Brilliant Meteor

I NOTICED in your number for last week the account of a brilliant meteor, observed in Cumberland on April 19. Now I had reported to me a very similar meteor at nearly the same time (about 8.40 P.M.), an account of which I forwarded, with my other results of the night's watch, to Mr. A. S. Herschel, who would gladly receive any further report of the same; unfortunately, I have not that number of NATURE at hand, and therefore cannot make a personal application to your correspondent. On the same evening, about 10.7, I myself saw an exceedingly brilliant meteor, which fell to a point just S. of Vega. It is curious that both of these come from the radiant situated about R.A. 155, D + 47, or rather from one of the group of radiants there situated, M₃ of Heis, 56 and 52 of Schiaparelli. It would be an interesting point of investigation whether the meteors from that radiant are of peculiar brightness.

20, Bootham, York, April 30

J. EDMUND CLARK

EXPERIMENTAL ILLUSTRATIONS OF MUSICAL TONE

REFERENCE was recently made in these columns to an educational lecture on "Musical Tone," delivered by me on March 14, at the Taunton College School. Among the experiments, several were specially arranged in connection with this lecture, and these I should be glad to put on record as simple and inexpensive means of illustrating important points.

For the purpose of displaying the relation between the "quality" of musical tones and the kind of vibration producing them, a series of magic-lantern slides were shown. These were prepared in the ordinary way, being smoked glass plates on which vibration-lines were traced by points attached to tuning-forks, piano-wires, &c. Each tone being sounded as its vibration-line was shown, the audience was enabled to appreciate clearly the difference between the simple tone of the tuning-fork and the clangs of a stringed instrument, played on musically and also made to shriek and rasp. For an extreme illustration, to show the relation of an irregularly discordant clang to an irregularly bent and jagged vibration-line, a toy popularly known as a "Bismark's Whistle" was made, larger than the usual size. It consisted of a tin-plate canister, near the centre of the bottom of which a piece of gut, knotted at the end, was passed through a small hole. Well-resined fingers drawn with a tight grip along the gut caused this infernal machine to emit a hideous sound, the vibration-line of which was shown as taken off on the smoked glass from a pointed wire soldered to the bottom of the canister.

The pictorial representation of a beat is of course indispensable to explain Helmholtz's theory of harmony and dissonance. As, however, neither the plan used by Prof. Helmholtz of taking off the beats of two organ pipes by means of a vibrating membrane, nor the splendid arrangement of Lissajou's method employed by Prof. Tyndall, were readily available, I found it necessary to contrive a simpler and coarser method. Accordingly, two stout piano-wires were stretched side by side on a board about three inches apart, and connected near the middle by a bent yoke of thinner wire, terminating upwards in a point. The two wires being tuned so as to give beats at a convenient rate, the alternate phases of addition and subtraction of the vibrations of the two wires, corresponding to the beats, were well