of communicating to the Royal Society of London *six* years ago.

2. I am also very glad that Prof. Langley has proved by his most refined and crucial observations on the direct radiating powers of spot, penumbra and photosphere surface, combined with the continuous register of the amount each day of the spotted portion of the sun, that sun-spots have no sensible power in themselves for producing any notable change on terrestrial climate; because, Sir, in that paper of six years ago, and still in the hands of the Royal Society, I deduced that sun-spots were consequences, rather than causes, of the great periodical waves of heat which come upon the earth from without; and I proved that conclusion three times over, or for three successive cycles of the eleven-year sun-spot period.

3. As we are now on the commencement of another of those cycles, I must regret that the chief speakers seemed to intimate that almost all their idea of further investigation into the origin of those mysterious heat-waves received by the earth from without and apparently from the sun, centred in causing to be made *more sun-spot observations*; for, Sir, not only did it sound very much like proposing to lock the stable-door as soon as it should be announced that the horse is no longer therein, but there are further features accompanying those occasional great heat-waves, showing that they must originate in something much more intense, violent, and complicated than those comparatively harmless little phenomena, the dark spots. PIAZZI SMYTH,

Edinburgh, December 5 Astronomer Royal for Scotland

Radiant Points of Shooting Stars

BETWEEN October 13 and November 28, watching for forty-nine hours, I observed 367 shooting stars, 306 of which were well seen and their paths registered. On going carefully over them some thirty-five radiant points are shown, about twenty-five of which are good positions, while the remainder are open to more or less doubt. The following are the twelve principal ones:—

Dates.	Position of Radiant Point.		No. of Meteors.	Notes.
	in	at		
		R.A. Decl.		
1. Oct. 21–Nov. 20 ...	Taurus	$60^\circ + 19^\circ$	25	Many fine meteors, mean of three showers.
2. Sept. 17–Nov. 8 ...	Pisces	15 + 11	17	Mean of two showers, very slow meteors.
3. Sept. 20–Oct. 25 ...	Musca	46 + 26	19	Small rapid meteors.
4. Oct. 13–Nov. 28 ...	Lynx...	125 + 47	17	White rapid meteors, mean of two showers.
5. Sept. 18–Nov. 8 ...	Cassiopeia ...	15 + 52	20	Small meteors, mean of two showers.
6. Oct. 25–Nov. 8 ...	Gemini	110 + 22	11	Mean of two showers, very swift meteors.
7. Nov. 20–28	Leo Minor ...	155 + 36	21	A fine A.M. shower.
8. Nov. 20–28	Ursa Major ...	208 + 43	12	Just before sunrise, small, short meteors.
9. Nov. 7–8	Camelopardus...	69 + 66	10	An evening shower.
10. Sept. 17–Nov. 20...	Lacerta	345 + 43	10	White rapid meteors, mean of two showers.
11. Nov. 22–28	Auriga	78 + 43	9	White rapid meteors.
12. Oct. 17–25	Orion...	88 + 17	8	A well-known Oct. shower.

Several of these positions are the mean of two showers, one seen in October the other in November, and evidently identical. No. 7 in the list is possibly new, and was a very active shower from near Leo; the meteors were rapid and white, leaving phosphorescent streaks. No. 8 is quite new, and three other radiants found on the mornings between November 19 and 28 are new. They are:—

	Position.	R.A.	Decl.	
1.	Near τ Leonis ...	170 +	4 ...	6 meteors, very swift.
2.	In Sextans... ...	153 S	1 ...	6 meteors.
3.	α Boötis	212 +	18 ...	7 meteors.

The positions given are in most cases very accurate, and each of them represents a well-marked shower. The new radiants are visible preceding sunrise, and this may account for their having previously escaped detection.

Generally the meteors of October–November were very small. The magnitudes of the 306 registered were:—

× or = 1st mag.		2nd mag.		3rd mag.		4th mag.		5th mag.		6th mag.		Total.
19	...	49	...	61	...	107	...	65	...	5	=	306.

I have lately found meteors very much more frequent after midnight than before it. In November, $13\frac{3}{4}$ hours watching, P.M., gave 79, while 12 hours watching, A.M., gave 133. Thus I have noted about double the number in the mornings than in the evenings. I found a similar difference in October, though have made no special comparisons to find if it has also been shown in the other months of the year. I usually find meteors show a progressive increase in numbers as the night advances, being at a minimum early in the evening hours and at a maximum just before the morning twilight.

Ashleydown, Bristol WILLIAM F. DENNING

The Atlantic Ridge and Distribution of Fossil Plants

IT has occurred to me that the discovery of the narrow belt of suboceanic highlands extending in a sinuous course down the length of the Atlantic, as shown in the *Challenger* chart, removes a difficulty that has been present to students of fossil botany. When the area was land these hills would probably form a ridge sufficiently high to have a temperature cool enough to explain the migration across the tropics of plants living in a temperate or even cooler climate. M.

Antedon Rosaceus (Comatula Rosacea)

THE letters of your correspondents with reference to the above, seem to me to fail to prove that there is any public recorded instance of its capture in the stalked (brachial) form at Torquay before the instance noted by the Birmingham Natural History and Microscopical Society in 1873. Of course if Prof. Allman took a specimen in the pre-brachial stage there in 1863, and Mr. Gosse the adult animal in 1864, the stalked form (brachial) must have been there as well, but was probably overlooked.

As to the change of name to which Mr. Thomas R. R. Stebbing objects, I certainly think that Dr. Carpenter, in his monograph before referred to, has deduced ample reasons for the substitution of *Antedon* for *Comatula*, "on the grounds of priority, in accordance with the rules of zoological nomenclature, and in concurrence with the views of Dr. J. E. Gray, Sir Wyville Thomson, and the Rev. A. Merle Norman."

Birmingham, December 10 W. R. HUGHES

"Towering" of Birds

MY experience goes to show that the towering action, although most frequent in the gallinaceous birds, is by no means confined to them. In the first case which came under my notice the bird was the common godwit. It was feeding on the border of a marsh, and I being very young at the time, committed the unsportsmanlike act of firing at it on the ground. Immediately on being hit the bird rose perpendicularly to a height of about 30 feet, then turned over on its back and fell dead almost on the spot from which it started.

Since then I have seen the same movement in the dunlin and some other species of *Tringa*, in the sanderling, the whimbrel, and, if I recollect rightly, in the lapwing plover, but in no other birds, excepting of course those mentioned by Mr. Romanes.

I have never seen a towering shore bird, after being struck, fly any considerable distance before towering, and those which have towered directly on being hit have always received a slight wound at the base of the brain, but there is little doubt that pulmonary hæmorrhage is the principal cause of this curious action.

December 12 F. W. MILLETT

THE SPECTRUM OF THE NEW STAR[1]

NOTWITHSTANDING the bad weather and the feeble light (4th to 5th mag.), I have been able to investigate pretty completely the spectrum of the light

[1] Sur le spectre de l'etoile nouvelle de la constellation du Cygne. Note by M. A. Cornu, read at the Paris Academy of Sciences, December 11.

of this new star with the Eastern Equatorial of the Paris Observatory. On the first evening of observation I was only able to establish the presence of bright lines in the spectrum, two days after the atmospheric conditions enabled me to make a more thorough examination, and to take measurements as exact as the feeble light of the star permits. The following is the result of the spectroscopic investigations :—

The spectrum of the star is composed of a certain number of bright lines standing detached on a sort of luminous background, almost completely interrupted between the green and the blue, so that at first sight the spectrum appears to consist of two separate parts. In order to study it qualitatively, I made use of a spectroscopic eye-piece, specially constructed, which utilises the greatest portion of the light, and allows us to vary its concentration. For the measurements I employed a Duboscq direct-vision spectroscope, fitted with a scale visible by means of lateral reflection. The accompanying sketch gives an idea of the appearance of the spectrum, and represents the position of lines measured according to the readings of the auxiliary scale, in the most complete series of measurements.

I have only noticed bright lines; the dark lines, if they exist, must be very fine and must have escaped me on account of the very feeble light of the star. The order $\alpha \beta \gamma \ldots \theta$ is that of their intensity, taking into account the visibility of the colour. The following figures are the divisions of the scale which define their position :—

α	δ	γ	β	ζ	η	θ	ϵ
30	44	60	66	73	81	100	113

The flame of a spirit lamp, observed immediately after, gave the line D at the division 42; but a slight obliquity of the slit relatively to the lines of the scale, introduces a constant difference of one to two divisions in the direction of the re-establishment of the coincidence with the line δ.

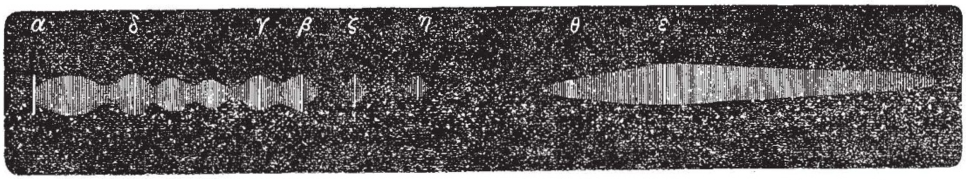
The sky being covered soon after that measurement, I left the spectroscope in position without touching it, and next morning I compared the position of the Fraunhofer lines visible with the light of the clouds :—

C	D	b (mean)	F	G
31	43·5	65·3	79·5	116

This is the spectroscope which I employed to observe the spectrum of the Aurora Borealis of February 4, 1872. The relative distance of the lines C, D, F, was the same, 21, 33, 69. There may easily be deduced from these data the correspondence of the divisions of the auxiliary scale with the scale of wave-lengths. The following are the results calculated for the bright lines observed, as also a table of bright lines of various elements expressed in millionths of a millimetre :—

	α	δ	γ	β	ζ	η	θ	ϵ
Observ. ...	661	588	531	517	500	483	451	435
Hydrogen ...	656(C)	—	—	—	—	486(F)	—	434
Sodium ...	—	589(D)	—	—	—	—	—	—
Magnesium...	—	—	—	517(b mean)	—	—	—	—
Line in Solar Corona ...	—	—	532	—	—	—	—	—
Line in Chromosphere..	—	587	—	—	—	—	447	—

This comparison shows that if we take into account the small apparent displacement caused by the obliquity of the slit (which makes all the numbers a little too large), and the inevitable uncertainty presented by measurements of such feeble lights, it may be admitted that the lines α, η, ϵ, coincide with that of hydrogen, δ with that of



sodium, and β with the triple line b of magnesium. The feeble dispersing power of the spectroscope used did not enable me to distinguish whether the bright line was single, double, or triple, for any of the three cases may occur (*Comptes Rendus*, t. lxxiii., p. 332).

But the most curious coincidence, which I give here with much reserve, but which it will be interesting ultimately to verify, is the coincidence of the line γ, very bright in the spectrum of the star, with the green line $\lambda = 532$ (1474 of Kirchhoff's scale), observed in the spectrum of the solar corona and in the chromosphere; the feeble band θ corresponds also to a band $\lambda = 447$ of the chromosphere; one is thus led to think that the line δ corresponds rather to the bright line of the chromosphere $\lambda = 587$ (helium), than to that of sodium, 589. If this interpretation be accurate, the bright lines of the spectrum of the star comprehend exclusively the brightest and most frequent lines of the chromosphere. The following, in fact, according to Young's Catalogue of the Chromospheric Lines (*Phil. Mag.*, November, 1871), is the designation of the brightest lines and their relative occurrence :—

Wave-lengths	656(C)	587	532	517(b)	486(F)	447	434
Relative frequence ...	100	100	75	15	100	75	100

All the other bright lines have a relative frequency lower than 10, with the exception of the fourth bright line of hydrogen $\lambda = 410$ (h), to the extreme violet, whose frequency is represented by 100. I believe, moreover, that I have often seen this line without always being able to measure it.

To sum up, the light of the star appears to possess exactly the same composition as that of the solar envelope known as the chromosphere. Notwithstanding the great temptation there exists to draw from this fact inductions relative to the physical condition of this new star, its temperature, the chemical reactions of which it may be the seat, I shall abstain from all comment and all hypothesis on this subject; I believe the facts necessary to arrive at a useful conclusion are wanting, or at least at a conclusion capable of verification. Whatever attractions these hypotheses may have, it is necessary not to forget that they are unscientific, and that, far from serving science, they greatly tend to trammel her.

JUST INTONATION

DR. STONE'S lectures on "Sound and Music," just published, lead one to expect that notwithstanding the formidable appearance of some of the key-boards exhibited at South Kensington, the cause of scientific music and of just intonation in particular will be materially advanced by the Loan Exhibition.

Certainly we may look for something practicable and little short of perfect in the "Natural Finger-board" of Mr. Colin Brown, the Euing Lecturer on Music in the Andersonian University, Glasgow. As supplementary to the descriptions given by Dr. Stone and by Mr. Brown himself, I trust the following remarks will help to elucidate the construction of the instrument, and to make still more obvious its simplicity and "naturalness."

The vibration numbers of the diatonic scale being represented by—

$$1, \frac{9}{8}, \frac{5}{4}, \frac{4}{3}, \frac{3}{2}, \frac{5}{3}, \frac{15}{8}, 2,$$

if we build the scale upon the dominant $\frac{3}{2}$ the vibration numbers will be—