Mohl's statement, that the pollen of *Mimulus moschatus* and *Mimulus luteus* takes several forms, before writing his letter. I may inform him that the figure—in the "One Thousand Objects"—to which he alludes was *not* copied from the "Micrographical Dictionary," as he states. Had Mr. Smith first taken the pains to read what so excellent an authority as Dr. Hugo Mohl has written on pollen, and seen his figures, perhaps his remarks would have taken a different form. He may have observed but one form or one aspect of the pollen grains of *Mimulus* differing from the figures criticised, yet botanists will hesitate to accept his interpretation in opposition to so excellent a physiologist as Dr. H. Mohl, on the faith of his *ad captandum* observations.

M. C. COOKE

## *OUR ASTRONOMICAL COLUMN*

VARIABLE STARS.—Amongst the stars which deserve attention on account of probable variability, the following may be mentioned; we take them in order of right ascension.

1. λ Eridani, first suspected by the late Capt. Gilliss, of the U.S. Naval Observatory, Washington. It has been variously estimated between mag. 4 (Lalande, Argelander, Heis) and 6 (Gilliss, Santini).

2. 33 Herculis. The variation of this star hardly admits of doubt. It is called 6 mag. by Flamsteed, Bradley, Piazzi (who observed it nine times), Taylor, and Robinson, and is so entered on Wolfers' Chart; Lalande calls it 7, and this is the magnitude assigned in the Radcliffe observations 1867-68. Bessel and Argelander (in the "Durchmusterung") considered it only 8; Gilliss also drew attention to this star.

3. Lalande 31384. In the "Histoire Céleste," p. 291, this star is called 6½. Sir John Herschel, in his third series of observations with a 20-ft. reflecting telescope, estimated it 5, and remarked that it is not in Piazzi. Bessel and Santini, who has four observations, call it 7; it is 5·5 in the "Durchmusterung," and 6 on Bremicker's Chart.

4. 41 ι Aquilæ looks suspicious; D'Agelet has four observations, 6, 4·5, 6, 6; Lalande two, 3½, 4; it is 5 in Piazzi, 4·2 in "Durchmusterung."

5. Piazzi XXI. 21. D'Agelet, who observed this star twice, calls it 8 on one occasion, and 9·10 on the other. It is 8 in Piazzi, 6 and 6½ in Lalande, 9 in Bessel, and 7·5 in Argelander (Durch.)

6. 17 ι Andromedæ. This star has been variously estimated between 3·4 and 7. Flamsteed says 4, Bradley 7, D'Agelet 3·4 in 1783, and 6 in 1784; Lalande twice calls it 5, and once 4; Piazzi, who has ten observations, 7; it is 4 in the Atlases of Argelander and Heis, and 3·9 in the first Radcliffe catalogue. Bradley and Piazzi compared with the Oxford catalogue, in which much attention was given to magnitudes, appear to certify the variability of light.

Piazzi I. 4, 16 Leonis Min., and 32 Vulpeculæ, one of Gilliss's suspected stars, also deserve attention, and observations of χ (Bayer) Cygni are especially desirable, great perturbations having been exhibited in the times of maxima of late years, which, with others previously indicated, it has not yet been found possible to represent satisfactorily by any formula. The variable is the true χ Cygni, Flamsteed having affixed this letter to his No. 17 in this constellation; the cause of it is now understood, Bayer's χ having been faint at the dates of Flamsteed's observations. The var. has (1875·0) R.A. 19h. 45m. 46s., N.P.D. 57° 24'.

Prof. Schönfeld, in his new catalogue, enters the Rev. T. W. Webb's variable in Orion, as *S* Orionis, and places it (for 1855) in R.A. 5h. 21m. 51s., and N.P.D. 94° 48'·7. As a first rough approximation to elements, he fixes a minimum to the beginning of December 1872, and assigns a period of from thirteen to thirteen-and-a-half months, the limits of variation 8·3 to less than 12·3.

OCCULTATION OF ANTARES, 1819, April 13.—We refer to this occultation on account of an interesting observation made by Burg at Vienna. He records the emersion on the dark limb of the moon at 12h. 3m. 22s. or 23s. apparent time, but remarks that at 12h. 3m. 17s·1 he noted the emergence of a star of from sixth to seventh magnitude, which after nearly five seconds suddenly appeared as a star of the first magnitude; and, writing to Bode, he suggests that Antares might be a double star, with the companion so close to the principal star, that good telescopes had not shown it. Bode's explanation was not a happy one. In a note he remarks: "Antares is no double star," and he goes on to attribute the phenomenon witnessed by Burg to the intervention of a lunar atmosphere. The Vienna observation, however, proves that the small star was then separated from the large one by a measurable quantity. It may be remembered that at the emersion of Antares in the occultation of 1856, March 26, which was observed by the late Rev. W. R. Dawes, at Wateringbury, and Mr. Whitbread, F.R.S., at Cardington, both observers noted the interval between the appearance of the small blue star and its bright neighbour as seven seconds; the difference of colour was very marked on this occasion; Burg does not refer to it. Occultations of Antares are coming on again, but no one of them is visible in this country up to the end of the year 1878.

ENCKE'S COMET.—From M. Stéphan's observations at Marseilles on January 27 and 29, published in M. Leverrier's *Bulletin International* of the 11th inst., it appears that Dr. von Asten's ephemeris gives the comet's place with great precision; indeed, the error on the 29th (the best observation) was less than fifteen seconds of arc. M. Stéphan remarks:—"La comète offre l'apparence d'une petite tache laiteuse, à peine perceptible, produisant sur la rétine plutôt des pulsations intermittentes qu'une sensation continue." We are able to add, that on the 31st ult. it was the *extremum visibile* with a 7-inch refractor. The following positions are for 8 P.M. Greenwich time:—

| | R.A. h. m. s. | N.P.D. ° ' | DISTANCE from the Earth. |
|---|---|---|---|
| Feb. 21 | 0 10 25 | 81 5·3 | 1·818 |
| ,, 23 | 0 14 33 | 80 41·0 | 1·798 |
| ,, 25 | 0 18 49 | 80 16·1 | 1·776 |
| ,, 27 | 0 23 13 | 79 50·7 | 1·754 |
| March 1 | 0 27 45 | 79 24·7 | 1·730 |
| ,, 3 | 0 32 26 | 78 58·2 | 1·705 |
| ,, 5 | 0 37 16 | 78 31·1 | 1·678 |

WINNECKE'S COMET.—Prof. Oppölzer considered that the error of his predicted time of perihelion passage in the present year would probably not exceed two hours. We find, on comparing the Marseilles observation on the morning of the 2nd inst. with his elements, that the error is likely to be within this limit, or about 0d·0764, the predicted time too late. With this correction the error in geocentric longitude disappears, and that in latitude is very trifling.

## *MR. HAMILTON'S STRING ORGAN*

IN the *Philosophical Magazine* for February there is a paper by Mr. R. Bosanquet on the mathematical theory of this instrument, in which, however, as it appears to me, the principal points of interest are not touched upon. As the remarks that I have to offer will not require any analysis for their elucidation, I venture to send them to NATURE as more likely than in the *Philosophical Magazine* to meet the eyes of those interested.

The origin of the instrument has led, as I cannot but think, to considerable misconception as to its real acoustical character. The object of Mr. Hamilton and his predecessors was to combine the musical qualities of a string with the sustained sound of the organ and harmonium. This they sought to effect by the attachment of a reed, which could be kept in continuous vibration by a stream of air. Musically, owing to Mr. Hamilton's immense enthusiasm and perseverance, the result appears to be a success, but is, I think, acoustically considered, something very different from what was originally intended. I believe that the instrument ought to be regarded rather as a modified reed instrument than as a modified string instrument.

Let us consider the matter more closely. The string and reed together form a system capable of vibrating in a number, theoretically infinite, of independent fundamental* modes, whose periods are calculated by Mr. Bosanquet. The corresponding series of tones could only by accident belong to a harmonic scale, and certainly cannot coexist in the normal working of Mr. Hamilton's instrument, one of whose characteristics is great sweetness and smoothness of sound. I conceive that the vibration of the system is rigorously or approximately simple harmonic, and that accordingly the sound emitted directly from the reed, or string, or from the resonance-board in connection with the string, is simple harmonic. On the other hand, it is certain that the note actually heard is compound, and capable of being resolved into several components with the aid of resonators.

The explanation of this apparent contradiction is very simple. Exactly as in the case of the ordinary free reed, whose motion, as has been found by several observers, is rigorously simple harmonic, the intermittent stream of air, which does not take its motion from the reed, gives rise to a highly compound musical note, whose gravest element is the same as that of the pure tone given by the string and resonance-board. One effect of the string, therefore, and that probably an important one, is to intensify the gravest tone of the compound note given by the intermittent stream of air.

The fact that the *pitch* of the system is mainly dependent upon the string, seems to have distracted attention from the important part played by the stream of air, and yet it is obvious that wind cannot be forced through such a passage as the reed affords without the production of sound. A few very simple experiments would soon decide whether the view I am advocating is correct, but I have not hitherto had an opportunity of making them properly. I may mention, however, that I have noticed on one or two occasions an immediate falling off in the sound when the wind was cut off, although the string and reed remained in vibration for a second or two longer. A resonator tuned to one of the principal overtones was without effect when held to the string, but produced a very marked alteration in the character of the sound when held to the reed.

It will be seen that according to my explanation the principal acoustical characteristic of the string—that its tones form a harmonic scale—does not come into play, the office of the string being mainly to convey the vibration of the reed itself (as distinguished from the wind) to the resonance-board and thence through the air to the ear of the observer. A second advantage due to the string appears to be a limitation of the excursion of the reed, whereby the peculiar roughness of an ordinary reed is in great measure avoided.

I should mention that I have not seen anything of the instrument for the last six months, in which time I understand great progress has been made.

RAYLEIGH

* In the *mechanical*, not the *musical* sense

## ICE PHENOMENA IN THE LAKE DISTRICT

DURING the severe frost at the close of last year, some excellent opportunities were afforded of observing various phenomena in connection with the formation and fracture of large sheets of ice. After the ice had attained a thickness of some inches on Derwentwater and Bassenthwaite Lakes, the continued cold—with the thermometer for several days eight or nine degrees below the freezing-point (Fah.), even at mid-day—caused such shrinkage in the ice that cracks of great length were now and then produced with a noise almost like the firing of a small cannon. These cracks frequently passed quite across the lake, and presented many points of interest, especially to the geologist. In some cases two cracks met at an angle, as in Fig. 1; sometimes three cracks radiated from a central point, as we may often see in a cracked plate; and occasionally one long and wide crack would appear to have shifted others crossing it, just as a fault shifts beds or veins, as in Fig. 2, where the portions were shifted about two inches, and in the same direction in the case of several distinct cross cracks.

Some of the cracks were so much as two inches wide, and presented curious and interesting vein-structures. One class of crack was vertically veined, presenting the appearance of a number of thin sheets of opaque ice placed on end close to one another. Such cases reminded me strongly of vertically banded felstone dykes occurring a little north of Wastwater. Their formation may be explained thus:—The crack when first formed is exceedingly fine, but water soon finds its way into it, and freezing *quickly*, becomes a thin vertical seam of opaque ice. A second and a third opening of the crack occurs, and a new vertical sheet is formed each time. Thus the whole crack becomes filled, as it widens, with successive vein-like sheets of ice. At one spot on Bassenthwaite Lake I observed two of these veined cracks crossing one another, as in Fig. 4; the one of less width ran for about one foot in the direction of the other, and then passed out, maintaining the same general direction as it previously had. Here then was another example of what occurs so frequently among rock-veins, the newer vein conforming for a short distance with the direction of the older, and thus at first sight giving the appearance of its having been shifted by the latter. In this connection compare Fig. 4 with Fig. 2; in the latter case the smaller cracks seemed certainly to have been the first formed. At some spots quite a plexus of intersecting cracks were seen, and it was of interest to notice how frequently this combination resembled the faults laid down upon a geological map.

Another circumstance, suggestive on a small scale of geological phenomena, was the curious way in which the ice for about a mile and a half over the course of the Derwent, as it flowed into Bassenthwaite Lake, was raised into a low and broken anticlinal. For some time after the ice had formed over the greater part of the lake, a line, first of open water and then of thin ice, followed the river course for some distance, until its waters lost their distinctness in the general body of the lake. In the meantime, from the dryness of the weather and the continuance of the extreme frost, the ice subsided with the waters, and produced a gentle upheaval over the course of the river, which upheaval, however, seemed generally to have resulted in a more or less sharp ridge usually fractured in the direction of its length, and but seldom showing cracks of any size passing quite through from one side to the other.

Cracks showing a vertically veined structure have already been mentioned; these seem in all cases to have opened little by little, and to have been quickly filled with successive thin sheets of opaque ice; they probably never stood open and full of water for any length of time, but were the results merely of the contraction of the ice under the extreme cold. Another class of cracks, however, seem to have been wide and gaping during a thaw, and to have been suddenly sealed up by the freezing of the liquid contained between the sides. It is well known that as a general rule the more quickly a body solidifies from a liquid condition the greater the number of cavities—liquid and gaseous—it will contain, the liquid being frequently