sidering them as representing separate notes, and arranging them in regular order, counting the original generator as No. 5, we get the following scale—major, minor, and chromatic—of F♮, or *green*:—

					(Tonic)						
5	6♭	6	7♭	7	1	2	3♭	3	4	4♯	5
C	D♭	D	E♭	E	F	G	A♭	A	B♭	B	C
Grey.	Lavender.	Violet.	Indigo.*	Blue.	Green.	Red.	Orange.	Chrome.	Yellow.	Lemon.	White.

* Indigo is, I think, a misnomer: it should be purple between blue and violet.

On the same system it is easy to construct an enharmonic scale on the principle employed by M. Chevreul. The double flats and sharps sometimes give ternary compounds. For example, 4♯♯ equals green + red + red, and its inversion 5♭♭ would give red + green + green. Some of the neutral greys, olives, slates, browns, &c., which would not appear in a table so constructed and calculated at a normal pitch, are produced by lowering the diapason.

From the above very brief explanation of the system of inversions, the following results may be suggested:—

1. That a table of colours of all gradations, with their complementaries, may be musically expressed in numerical notation with the greatest exactitude.

2. That, contrary to scientific opinion, it does not follow that because the red ray has the lowest degree of refrangibility, &c. &c., or perhaps because it happens to be at the bottom of the series of prismatic colours, it should necessarily be the initial note on the tonic of a scale.

3. Even if the red ray be the tonic, it does not follow that the scale of the spectrum should be *major*, as is too frequently given in elementary works on optics. By the system of inversions of numbers here presented, the scale of the spectrum appears, by disjoining the conjunct tetrachords, to consist of one tetrachord major and one minor, corresponding to the descending minor scale in use, of F♮ minor, supposing C♮ to represent the normal pitch of the dominant No. 5 corresponding to any given intensity of white light. Moreover, one conjunct tetrachord of the spectrum appears in *ascending* and one in *descending*, both tetrachords *converging* on the tonic.

4. If the analogy be true so far, there is only one colorific key. Modulation through a series of colorific keys, as in *modern* music, is impracticable. The reasons I have not space to explain.

——— J. G.

MR. SEDLEY TAYLOR has, it seems to me, written his criticism on my letter published in NATURE, Feb. 10th, far too hastily. I do *not* compare the diameter of the rings with one another, but *their cubes*, otherwise we should be led in establishing the musical analogy to the absurd equation $\sqrt[3]{3} = \frac{1}{2}$. It would perhaps have been better to have said, that the ratios of the spheres described on the diameters of the rings, taken successively from red to violet, two and two together, the 1st to the 2nd and the 2nd to the 3rd, &c., give a series of fractions identical with those expressing the relative lengths of the musical chords from D to C, ascending and taken in like manner. As Mr. Taylor doubts Prof. Zannotti's accuracy, I will quote the following passage from Biot's "Precis Elémentaire de Physique," 3rd Ed., Vol. ii. Paris, 1824, p. 400, *et seq.* Speaking of Newton, "Il mesura les diamètres des anneaux simples *de même ordre*, dans la partie intérieure et dans la partie extérieure de leur périmètre, et en les considérant successivement aux limites des diverses couleurs du spectre a commencé par le violet extrême. Suivant sa méthode constante, il prit soin de lier ces resultats par une loi mathématique qui les représentât avec une suffisante exactitude. Il trouva ainsi que les diamêtres, soit intérieurs, soit extérieurs, étaient sensiblement entre eux comme les racines cubiques des nombres $\frac{1}{2}$, $\frac{9}{16}$, $\frac{3}{5}$, $\frac{2}{3}$, $\frac{3}{4}$, $\frac{5}{6}$, $\frac{8}{9}$, 1, lesquels représentent les longueurs que doit avoir une corde de musique pour produire toutes les notes d'une gamme mineure; c'est-à-dire, que si l'on représente par 1 le diamètre intérieur d'un certain anneau, lors qu'il est formé par les rayons rouges qui composent la partie la plus extrême du spectre, $\sqrt[3]{\frac{8}{9}}$ exprimera le diamètre intérieur du même anneau, quand il sera formé par les rayons qui sont la limite du rouge et de l'orange, et ainsi de suite jusqu' à $\sqrt[3]{\frac{1}{2}}$ qui représentera le diamètre intérieur du même anneau quand il sera formé par les derniers rayons violets pris à l'autre extrémité du spectre."

I can only add, that if Mr. Taylor doubts also the accuracy of M. Biot, he can easily refer to Newton's own treatise on colour.

Rome, March 16 W. S. OKELY

The Barlow Lens

I HAVE found the addition of a double concave lens to my telescope and microscope of so much service that I am anxious to call the attention of your readers to this simple application for increasing and improving the working power both of telescopes and microscopes. The application consists in the introduction of a biconcave lens in the adapter, which holds the eye-piece of the telescope, at a distance of two or three inches from the field-lens; as the focal length of the instrument is thereby increased, it is necessary to adjust the distance of the lens from the eye-piece according to the length of the adapter, so that the latter still admits of being drawn out sufficiently for focussing. A friend procured me several lenses of different powers at the ridiculous price of a shilling a-piece from an optician and spectacle-maker at Brighton, which answer admirably.

The chief advantage obtained by the use of this lens is the great increase of magnifying power without a corresponding loss of light. This is a great desideratum in looking at a planet, but it is equally important in separating double stars. With a low eye-piece of 60, my refractor (one of Cook's with a 3½in. object glass, and the addition of the Barlow lens) shows the Companion of Rigel beautifully.

I first became aware of this useful application many years ago, in reading Admiral W. H. Smyth's "Cycle of Celestial Objects." In page 343, vol. i., he states: "On receiving it, I directed the telescope upon a watch-plate fixed on a distant chimney, which quickly proved the power of the lens in enlargement, with scarcely any obscuration of light. While the image expanded under each progressive eye-piece, I was surprised at the additional advantage of its simultaneously flattening the whole field of view; and though the magnifying power became double on distant objects, the apparent magnitude of the spider-lines diminished in an equal ratio: a property which, with all powers above three hundred, is of considerable benefit to operations upon close double stars, and the finer micrometric desiderata. I afterwards raised the discs of the Satellites of Jupiter, and examined several double stars, with equal facility and advantage, the definition being quite distinct, and the stray light rather subdued than increased. After a little practice, I came to the conclusion that the achromatic concave lens will render the instrument to which it shall be applied equal to two telescopes for particular cases; for if a set of observations be made *with* it and another set *without* it, the errors of vision will be in some degree neutralised, or even done away with."

In spite of this strong recommendation I never gave it a trial until a few weeks ago, when a paper in the Polish language by Prof. Piotrowsky passed through my hands. It remains to this

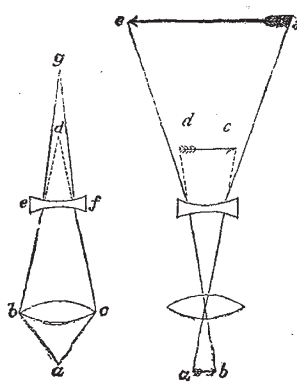

Fig. 1. *b c*, object glass; *e f*, Barlow lens; *d g*, foci of *b c*, with and without Barlow lens.

Fig. 2. *a b*, object; *c d*, image, with convex lens alone: *e f*, image, with Barlow lens.

day a sealed book to me, but the two annexed figures taken from it leave no doubt in my mind that the paper treats on the same subject of which Admiral Smyth speaks so favourably. The result of my own trial made me regret having foregone for many years an advantage which I have every reason to congratulate myself on now possessing; but this circumstance it is also which induced me to ask for a small corner in NATURE for these remarks, when other more interesting subjects are less pressing than usual.

Walham Grove F. d'A.