was surprised to find the skin so firm and tough; I almost expected to spoil it in handling; the delicate colours seem as if they might be tender like the bloom of a grape. With the smooth, but not sharp, edge of a knife I scraped the surface somewhat vigorously without damaging the lovely play of blue and green light.

Two or three weeks elapsed before I could examine dried pieces of the skin with a microscope. There did not appear to be any orderly markings which could lead to diffraction; nor could I find a flaking tendency which would suggest thin plates. The glancing of the colours from blue to green is lively, but I should think it is not due to wave interference. Pigments can be greatly modified by a change in the angle of incident light, according to the qualities of lustre surfaces as described by Helmholtz, and the polarisation principles worked out by Jamin. These two considerations form the basis of an important portion of the comprehensive discussion given by Michelson.

W. B. CROFT.

Winchester College, November 13.

The Weather of 1911.

WITH reference to Sir Edward Fry's letter in NATURE of November 16 in regard to the weather of 1911, without presuming to reply on behalf of meteorologists to his question as to whether any real cause can be assigned for the brilliance and heat of its summer and autumn, may I be allowed to suggest that the relatively high temperature of the North Atlantic, during the period, presumably conducted to warmth and sunshine? Since April the surface temperature of the North Atlantic has been, for the most part, above the average, and during the months of June to September, inclusive, largely above. Not only through the agency of winds from seaward has air temperature over our islands been raised by the abnormal warmth of the ocean, but also, it seems probable, through the diminution of cloudiness, and the corresponding increase of sunshine attributable to the small difference, thus ensuing between the temperature of the sea and that of the air above it.

Moreover, during a bright summer, the heat which the earth receives through solar radiation may be greatly in excess of that which it parts with at night by terrestrial radiation.

CAMPBELL HEPWORTH.

2 Amherst Road, Ealing, W., November 18.

ROTATION PERIOD OF THE SUN.¹

SINCE the introduction of the Doppler-Fizeau principle one of its most interesting and important applications has been to the determination of the velocity of the sun's rotation by the investigation of shifts of the spectrum lines corresponding to various points on the solar limb. Much of the pioneer work in this direction was done by Vogel, Young, Langley, Cornu, and Dunér, the results obtained by the latter at Upsala from 1888 to 1903 serving as the standard for future workers. Dunér's determinations referred to points between the solar equator and 75° north and south heliographic latitude, the observations being made at intervals of 15°. During 1903-6 Halm made a series of observations at Edinburgh, employing the same differential method as Dunér.

All these observations having been made by visual methods, it was considered of importance that the photographic method should be tried, and this was commenced on the completion of the Snow telescope on Mount Wilson in the spring of 1906. In June, 1907, the tower telescope, with vertical spectrograph of 30 feet focal length, was completed, and thenceforward the observations for rotation were made with it, the spectra being of such greatly increased resolving power that the investigation was considerably facilitated.

¹ "An Investigation of the Rotation Period of the Sun by Spectroscopic Methods." By W. S. Adams and J. S. Lasby. Washington D.C., Papers of the Mount Wilson Solar Observatory. Vol. II, part I. (The Carnegie Institution, 1911.)

Five series of observations have been made—two dealing with lines selected from the spectrum of the general reversing layer, two with the H α line of hydrogen, and the fifth with the blue line of calcium at λ 4227. As the lines of hydrogen and calcium give results differing widely from those obtained for the reversing layer, the various sections are treated separately in the discussion.

The 1906-7 series of observations were made in conjunction with the Snow telescope, having a spectrum scale of 1 mm.=0.71 Å, on a list of lines selected as being representative of the different strata involved. Those made in 1908, with the tower telescope and spectrograph of 30-feet focal length, are with a spectrum scale of 1 mm.=0.56 Å. For the reversing layer photographs twenty-two standard solar lines were selected for observation, representing the elements La, Cr, Zr, Fe, Mn, Ni, Ti, and the compound CN.

In the general discussion it is shown that the two series of observations are in substantial agreement for latitudes between 0° and 50°. Above 50° the

FIG. 1.—Curves showing variation of angular velocity with latitude for sun-spots, faculae, calcium flocculi, reversing layer, λ 4227, and H α . To facilitate comparison the curves are all reduced to the common origin of 14.50°. Differences in the amount of equatorial acceleration are indicated by lack of parallelism in the curves.

1908 observations give slightly smaller values, the greatest difference being about 0.039 km. at 70°. It is surmised that these small differences may be partly due to small systematic errors in the earlier series, and partly to actual proper motions in the vapours constituting the sun's reversing layer.

The general results do not indicate any definite variation of the sun's rate of rotation, except it be of long period. This conclusion is emphasised by the close agreement of the Mount Wilson results with those given by Dunér.

One of the most notable results brought out clearly by these observations is the fact that the lines of different elements give different values of the rotation velocity. Thus lines of lanthanum and cyanogen give low velocities, while certain lines of manganese and iron give comparatively high velocities. A table is given showing the residuals on forming the differences in the values of the angular velocity for each line from that of the mean of all the lines. The systematic variation is at once rendered evident by the marked preponderance of positive or negative residuals. The results corresponding to the different elements are, on