

minge with  $K_2$ , it seems to me risky to base certain reasonings on the appearance of the resulting spectroheliograms. Accepting Prof. Hale's interpretation, given now many years ago, that  $K_2$  represents the highest level and  $K_3$  an intermediate one, I submit that the Meudon plates are more likely to represent the true spectroheliographic aspect of the sun. It may be, as Mr. Evershed says, that the dark concentrations called flocculi are entirely due to variations in the intensity of the narrow absorption line (or, in my opinion, rather the other way about); but is not this variation due, if not entirely, at least to a great extent, to the presence or absence or degree of intensity of the  $K_2$  radiations on either side of  $K_3$ ? A study of M. Deslandres' spectroheliograms taken on the sectional principle leads one irresistibly to think so. From the preceding remarks anyone can gather why I considered, and still do, the assumption of alternating appearance and disappearance of the large flocculus covering the range of prominences during March and April, 1910, rather unlikely.

As regards the points raised by me about absorptively acting clouds seemingly cutting off the range of prominences sharply at one common level, I must adhere to my statements. They are the result of repeated direct observation, and the phenomenon was strikingly on view again only as recently as April 26, when a fine range of prominences on the north-east limb showed it fairly well. I have given in *The Observatory* recently a summary of my observational experiences up to date, and amongst other matters also refer to the often seen phenomenon of dark matter being interposed between solar prominences and the observer at levels attained by the luminous portions of the prominences themselves. Such observations have by no means remained unique, and I possess, through the kindness of Mr. Slocum, a pair of excellent photographs depicting it in a case of some fine prominences seen during October, 1910. As regards my several visual observations of apparently overlying flat and dark clouds (darker than the general dark tint of the surrounding sky) abruptly stopping the bright upwards flowing prominence vapours, I feel certain that if Mr. Evershed had been at my side at the time his practised eye would not have failed him to see what I saw, but whether he would have been able to record it on a photographic plate in monochromatic light ( $H\alpha$ ) without an eclipse I hesitate to say. I hope, however, that the hypothetical overlying cloud will not be taken as of the nature of "smoke" over a fire. In my opinion it is more a case of the rather abrupt entry of rising hot vapours into a well-defined, more or less horizontal, stratum of considerably less temperature, and that at a comparatively abnormally low solar level. I readily admit that the cases are few where the circumstances necessary for the phenomenon favourably combine with the all too rare cases of the equally necessary perfect definition.

ALBERT ALFRED BUSS.

"Barrowdale," 22 Egerton Road, Chorlton-cum-Hardy, Manchester, May 13.

If it is true, as Mr. Buss suggests, that variations in the intensity of the components of the emission line  $K_2$ , on either side of the absorption line  $K_3$ , are sufficient to account for the dark markings occasionally found in spectroheliograms, then the Kodaikánal plates should show them as conspicuously as those taken with a high dispersion instrument, which isolates the central line. Yet this, as Mr. Buss has himself pointed out, is not the case. In studying high dispersion spectrum photographs of the solar disc, one occasionally discovers places where the  $K_2$  line is abnormally dark, and the same thing may also be well observed in the line  $H\alpha$ . When the spectroscope slit chances to cross one of these linear markings, an intensely black spot is seen on the absorption line, and this will usually remain visible or run along the line if the solar image is moved slightly. In the case of the lines H and K, the components of the emission lines  $H_2$  and  $K_2$ , are, I think, always weak at the points of greatest darkness in the absorption lines, and for this reason they may possibly contribute somewhat to the final result in our plates.

The intermittent character of the absorption marking described by me in *The Astrophysical Journal* for January is, I think, demonstrable from a careful study of our

spectroheliogram negatives, notwithstanding the fact that these plates are of a somewhat composite character, representing the sun in  $K_2$  and  $K_3$  radiations. The disappearance of the enormously extended marking between March 25 and 26, 1910, could be accounted for, it is true, on the supposition that in the interval between these days there was a development of velocity in the line of sight exceeding 15 kilometres per second; this would alter the wavelength sufficiently to throw the dark  $K_2$  line entirely off the camera-slit. But such motion in a prominence usually, if not always, presages a complete dissolution.

Instances of the rapid disappearance of these curious absorption markings are not infrequently met with in  $H\alpha$  spectroheliograms, which show them so much more clearly than do the low dispersion calcium plates. Since completing the construction of the new auto-collimating spectroheliograph of this observatory, I have obtained a nearly continuous daily series of  $H\alpha$  plates during April and May of this year. These are taken with the camera-slit adjusted on the central portion of the line, and represent the highest levels on the sun. The images show most of the prominences as absorption markings on the disc, and some of them are so dark as to appear like clear glass in the negatives. Already in this short series several cases have been noted of the disappearance within twenty-four hours of very large masses of absorbing material.

An interesting example was photographed on May 27 at 2h. 28m. and 2h. 53m. a.m. G.C.T. The disc of the sun in these plates appears to have had a large letter S engraved upon it with great distinctness. If drawn out into a straight line, the S would measure more than 150,000 miles in length. On the following morning we examined the plates with great curiosity to see what the next letter might be! The main portion of the marking had, however, entirely disappeared, and only a few small patches remained. This marking came into being with equal suddenness, for an excellent plate taken on May 26 shows no trace of it.

While agreeing with Mr. Buss as to the occasional presence of small patches of absorbing matter interposed between a prominence at the limb and the observer, I am sorry that both our visual and photographic records are entirely at variance with him with regard to the supposed absorbing clouds overlying certain prominences, which appeared to Mr. Buss to be cut off at one common level. I have before me the K-line negatives and the drawings in  $H\alpha$  of the prominences of March 17 and 18, 1910, and April 26 and 27, 1911, both of which Mr. Buss has cited as instances. These prominences were observed here and photographed under almost as good conditions as can be had at 7700 feet altitude, and the photographs show a mass of detail in the higher parts, especially in the prominence of 1910. Yet there is no trace of any such appearance as Mr. Buss has described; the highest filaments rise to many different altitudes, both on the drawings and photographs.

I may perhaps mention that reproductions of our photographs of the 1910 prominence, as well as some of the solar disc showing the absorption markings, have been sent as an exhibit to the Indian Section of the Festival of Empire.

J. EVERSHEED.

Kodaikánal Observatory, June 12.

#### Hamilton and Tait.

THOUGH I did not miss the passage in his Life of Tait to which Dr. Knott refers in NATURE of July 20 (p. 77), I forgot about it when I wrote my review. The point as to Hamilton's activity in quaternionic work is not of very great importance, but my statement is borne out by Graves's Life of Hamilton, which I read long ago, and have again referred to, as well as by the published correspondence. Tait's introduction to Hamilton took place in 1858; Graves states (vol. iii., p. 97) that Hamilton allowed himself to be diverted in 1857 from quaternions—the task, he says, of writing the "Elements"—by the subject of definite integrals. According to Dr. Knott, Hamilton did not begin the composition of the "Elements" until a good deal later, and this view would appear from Dr. Knott's statement, and from Hamilton's own language in his letters, to be correct.

A. G.