

already known, with some additional facts obtained by the observation of himself and his brother missionaries. There is a map and a few good illustrations.

*Three Months in the Soudan.* By Ernestine Sartorius. (London : Kegan Paul and Co., 1885.)

MRS. SARTORIUS spent most of her three months in 1883-84 at Suakim, of which her husband, Gen. Sartorius, was Commandant. Her book deals chiefly with the events which culminated in the disaster of El-Teb. It is mostly a pleasant, gossipy record of the daily life of the town, and of the alarms created by the attempted raids of the rebellious natives in the district around. It affords a good idea of the character of the town and its immediate surroundings.

*Lectures on Agricultural Science and other Proceedings of the Institute of Agriculture, South Kensington, London, 1883-84.* (London : Chapman and Hall.)

THIS volume contains abstracts of lectures delivered by a considerable number of well-known authorities upon agricultural matters. Mr. Carruthers and the late Prof. Buckman give their experiences upon grasses and farm seeds ; Prof. Wrightson has a paper upon land drainings ; dairy management and farm crops are treated of by Professors Hulton and Fream and Mr. Bernard Dyer ; Mr. Henry Woods contributes lectures upon Southdown sheep and ensilage ; while Mr. Warrington has a contribution upon the nitrogenous matter in soils ; and Mr. Worthington Smith gives some good observations upon corn mildews. The names of the authors of the various lectures are a sufficient guarantee of their soundness and worth.

#### LETTERS TO THE EDITOR

- [The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.]
- [The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

#### Sir William Thomson's Baltimore Lectures

As it is possible that some of your readers may have obtained copies of the Papyrograph Report of my Lectures on "Molecular Dynamics," delivered at Baltimore during October 1884, I should be obliged by your giving publicity to the following corrections :—

Page 34, lines 18 and 19.—Delete "we may call it a dynamox but not a paradox." I have no recollection nor can I imagine what the word was that I suggested as more logical than "paradox"!

Page 59, line 14.—For "Distortional" substitute "Condensation."

Page 296.—In the two expressions for  $\psi$ , given in equation (17), insert "tan  $i$ " before " $\frac{(\mu^2 - 1)^2}{\mu^2 + 1}$ "; also, in the expressions for "tan  $e$ " and "tan  $e_1$ " of equation (20) insert "tan  $i$ " before " $\frac{(\mu^2 - 1)^2}{\mu^2 + 1}$ ."

The formula from which these expressions are deduced is correctly given at the foot of page 295.

Page 296.—In line 13 from the top of the page, and in the left hand members of equations (19) and (21), for " $\omega$ " and " $\omega_1$ " read " $\bar{\omega}$ " and " $\bar{\omega}_1$ " respectively.

WILLIAM THOMSON

The University, Glasgow, February 27

#### Civilisation and Eyesight

It would take too much of your space to discuss at length the theoretical limit of resolving-power as depending upon aperture. The reader may be referred to some papers in the *Philosophical Magazine* for 1879 and 1880, where he will also find references to the work of other investigators. I will only say that (as indicated by the word *fairly* in my statement) resolution admits of various degrees. Doubtless a practised observer would judge a

star to be double whose components subtend a decidedly smaller angle than two minutes, but he would not see them separated. I purposely rather understated the case. The higher the visual power of civilised men, the less room is there for savages with eyes of equal aperture to surpass them.

With respect to my short-sightedness in a bad light, I shall be glad if you will publish the accompanying two short papers from the *Cambridge Philosophical Proceedings*. They will show how I was led to make the discovery.

RAYLEIGH

"The Use of Telescopes on Dark Nights." By Lord Rayleigh. (From the *Camb. Phil. Proc.*, March, 1882.)

In *Silliman's Journal* for 1881 Mr. E. S. Holden, after quoting observations to a like effect by Sir W. Herschel, gives details of some observations recently made with a large telescope at the Washburn Observatory, from which it appears that distant objects on a dark but clear night can be seen with the telescope long after they have ceased to be visible with the naked eye. He concludes, "it appears to me that this confirmation of Herschel's experiments is important, and worth the attention of physicists. So far as I know there is no satisfactory explanation of the action of the ordinary night-glass, nor of the similar effect when large apertures are used."

It is a well-known principle that no optical combination can increase what is called the "apparent brightness" of a distant object, and indeed that in consequence of the inevitable loss of light by absorption and reflection the "apparent brightness" is necessarily *diminished* by every form of telescope. Having full confidence in this principle, I was precluded from seeking the explanation of the advantage in any peculiar action of the telescope, but was driven to the conclusion that the question was one of apparent magnitude only,—that a large area of given small "apparent brightness" must be visible against a dark ground when a small area would not be visible. The experiment was tried in the simplest possible manner by cutting crosses of various sizes out of a piece of white paper and arranging them in a dark room against a black background. A feeble light proceeded from a nearly turned-out gas-flame. The result proved that the visibility was a question of apparent magnitude to a greater extent than I had believed possible. A distance was readily found at which the larger crosses were plainly visible, while the smaller were quite indistinguishable. To bring the latter into view it was necessary either to increase the light considerably, to approach nearer, or lastly to use a telescope. With sufficient illumination the smallest crosses used were seen perfectly defined at the full distance.

There seems to be no doubt that the explanation is to be sought within the domain of physiological optics. It has occurred to me as possible that with the large aperture of the pupil called into play in a dark place, the focussing may be very defective on account of aberration. The illumination on the retina might then be really less in the image of a small than in the image of a large object of equal "apparent brightness."

"On the Invisibility of Small Objects in a Bad Light." By Lord Rayleigh. (From the *Cambridge Phil. Proc.*, Feb., 1883.)

In a former communication to the Society (March 6, 1882) I made some remarks upon the extraordinary influence of apparent magnitude upon the visibility of objects whose "apparent brightness" was given, and I hazarded the suggestion that in consequence of aberration (attending the large aperture of the pupil called into operation in a bad light) the focussing might be defective. Further experiment has proved that in my own case at any rate much of the effect is attributable to an even simpler cause. I have found that in a nearly dark room I am distinctly short-sighted. With concave spectacles of 36" negative focus my vision is rendered much sharper, and is attended with increased binocular effect. On a dark night small stars are much more evident with the aid of the spectacles than without them.

In a moderately good light I can detect no signs of short-sightedness. In trying to read large print at a distance I succeeded rather better without the glasses than with them. It seems therefore that the effect is not to be regarded as merely an aggravation of permanent short-sightedness by increase of aperture.

The use of spectacles does not however put the small and the large objects on a level of brightness when seen in a bad light, and the outstanding difference may still be plausibly attributed to aberration.

MR. CARTER's recent paper on "Civilisation and Eyesight" has called up interesting remarks from Lord Rayleigh and Mr