action of radiation on the concave side, and that the double speed with which the fly moves when no screen is interposed is the sum of the attractive and repulsive actions.

14. *Radiometer.*—A two-disc, cup-shaped, aluminium radiometer, lamp-blacked on the concave surfaces. In this instrument the usual action of light is reversed, rotation taking place, the bright convex side being repelled, and the black concave attracted. When the light shines only on the bright convex side, no movement is produced, but when it shines on the black concave side, this is attracted, producing rotation.

15.—*Radiometer.*—A cup-shaped radiometer similar to the above, but having the convex surfaces black and the concave bright. Light shining on this instrument causes it to rotate rapidly, the convex black being repelled. No movement is produced on letting the light shine on the bright concave surface, but good rotation is produced when only the black convex surface is illuminated.

16. *Radiometer.*—A multiple-disc, cup-shaped, turbine radiometer, bright on both sides, working by the action of warm water below and the cooling effect of the air above.

17. *Radiometer.*—A four-armed metallic radiometer with deep cups, bright on both sides.

18. *Radiometer.*—A four-armed radiometer, the vanes consisting of mica cups, bright on both sides.

19. *Radiometer.*—A four-armed radiometer having clear mica vanes. The direction of motion being determined by the angle formed by the mica vanes with the inner surface of the glass bulb.

DROUGHTS AND FAMINES IN SOUTHERN INDIA[1]

THE paper on this subject, noted below, a copy of which we have just received, will no doubt awaken much interest, not only on account of its scientific bearings but also from its bearings on so very practical a subject as the famines of India. It is most gratifying to see that the subject has been taken up by one who gives evidence on every page of rare capacity as a scientific statistician. There is throughout an absence of straining the facts before him beyond what they may legitimately bear, and a skill in combining them so as to eliminate, as far as possible, what is merely accidental from the results ultimately arrived at in their relation to the sun-spot period.

The data discussed in Dr. Hunter's paper are the amounts of the annual rainfall at Madras from 1813 to 1876, and the relative number of sun-spots from 1810 to 1876. The results of the inquiry are given in the following six propositions :—

1. That no uniform numerical relation can be detected between the relative number of the sun-spots and the actual amount of rainfall.

2. That although no uniform numerical relation can be detected between the relative number of sun-spots and the actual amount of rainfall, yet that the minimum period in the cycle of sun-spots is a period of regularly recurring and strongly marked drought in Southern India.

3. That, apart from any solar theory, an examination of the rain registers shows that a period of deficient rainfall recurs in cycles of eleven years at Madras ; that this period consists of the eleventh and second series of years in the cycle ; which two series also contain six out of the seven years of minimum sun-spots falling in this century up to 1878.

4. That after the period of minimum rainfall in the eleventh and second series of years in the cycle, the rainfall rises to a maximum in the fifth year ; after which it again declines to its minimum period in the eleventh and second years.

5. That, apart from any solar theory, the statistical evidence shows that the cycle of rainfall at Madras has a marked coincidence with a corresponding cycle of sun-spots ; that in this cycle of eleven years both the sun-spots and the rainfall reach their minimum in the group consisting of the eleventh, first, and second years ; that both the rainfall and the sun-spots then increase till they both reach their maximum in the fifth year, after which they decline together till both again enter their minimum period in the eleventh, first, and second series of years.

6. That while the statistical evidence discloses a cycle of drought in Southern India, coincident in a marked manner with a corresponding cycle of sun-spots, it also tends to show that the average rainfall of the years of minimum rainfall in the said cycle approaches perilously near to the point of deficiency which causes famine. That the average is, however, above that point ; and that, while we have reason to apprehend recurring droughts and frequent famines in these cyclic years of minimum rainfall, the evidence is insufficient to warrant the prediction of a regularly recurring famine.

It will be observed that these results are strongly confirmatory of the general conclusions arrived at by Meldrum and others, who have examined the question from data collected from a large area, and embracing an extended series of years, the only noteworthy point of difference being the larger rainfall of the first year of the cycle, as compared with the eleventh and second years which immediately precede and follow it. It is perhaps only to be looked for that such an anomaly should be met with in dealing with the rainfall of only one place, embracing a period of sixty-four years, seeing that the accidental occurrence of one or two cyclones, accompanied with unusually heavy local rainfall, would be sufficient to produce the anomaly in question. The anomaly would in all likelihood have disappeared if the area of observation had been wider or the time of observation longer. It is scarcely necessary to do more than point out the absolute necessity of establishing physical observatories in order to obtain the data for the investigation of the connection between the state of the sun's surface and the state of terrestrial convection currents, it being only through their cosmical relations that we may reasonably hope to solve many of the more difficult problems of meteorology, some of which lead to intensely practical issues.

[1] "The Cycle of Drought and Famine in Southern India," by W. W. Hunter, LL.D., Director-General of Statistics to the Government of India.

OUR ASTRONOMICAL COLUMN

MR. GILL'S EXPEDITION TO ASCENSION.—In an address to the Royal Astronomical Society on April 8, 1857, "On the means which will be available for correcting the measure of the sun's distance during the next twenty-five years," the Astronomer-Royal directed attention to a method of making observations for parallax, not applicable to the planet Venus, but applicable to Mars, namely, by "observing the displacement of Mars in right ascension when he is far east of the meridian, and far west of the meridian, as seen at a single observatory," and he particularised the advantage of this method, and expressed his opinion that it is "the best of all." The observations are not attended with the very great expense which is involved in the efficient observation of a transit of Venus, indeed if made at an established observatory need entail little or no cost ; they may be conducted by a single observer or series of observers, in the latter case with a due regard to personal equation, and each observatory co-operating in the work, will furnish a result quite independent of the rest, so that the observer has the satisfaction of knowing that by the method recommended his own observations alone will give a value for the most important unit of measure in astronomy. The Astronomer-Royal confined his remarks to the observation of differences of right ascension, recommending as of the first consequence a firmly-mounted equatorial, and as advantageous though not absolutely necessary the chronographic method of transits first introduced by the American astronomers. The oppositions of Mars in 1860 and 1862 were referred to with regard to their relative advantages for such observations.

Mr. Gill has taken a further and an important step in the direction of utilising observations of Mars for the determination of the solar parallax. Encouraged by Lord Lindsay's liberal offer of the loan of the heliometer employed in the expedition to the Mauritius for the observation of the transit of Venus, Mr. Gill proposes to leave England this month for the island of Ascension, and to apply the heliometric method of measurement of distances instead of observing differences of right ascension, as suggested in the Astronomer-Royal's address, and as was stated