Cumulative Temperatures

IN reference to my letter upon the above subject, which was published in your columns of February 21 last, I have received from Prof. de Candolle, of Geneva, a communication dated March 11, in which he calls attention to the fact that in his "Géographie Botanique raisonné," which was published as far back as the year 1855, he recorded the suggestion (made by himself some ten years previously) of the employment of an uncompensated pendulum fitted with a suitable registering apparatus for the determination of cumulative temperatures in connection with the application of meteorology to agriculture and to the geography of plants.

In the above work (vol. i. pp. 58 and 59) the following passage occurs :—

"Les chiffres les plus importants à connaître pour les applications de la météorologie à l'agriculture et à la géographie botanique sont, pour chaque localité, les sommes de température au dessus de + 1°, + 2°, de + 3°, etc., par année, saison, mois ou fraction de mois.

"Pourrait-on obtenir ces valeurs directement par un instrument spécial, qui dispenserait de recourir à des calculs compliqués, souvent impracticables, dans le système actuel des observations météorologiques ? C'est une question que je soumets aux physiciens. Elle m'a préoccupé depuis longtemps, mais je suis loin de posséder les connaissances théorétiques et pratiques nécessaires pour arriver à une solution. J'entrevois la possibilité de construire deux sortes d'instruments qui répondraient aux conditions désirées ; je les mentionne sans pouvoir indiquer les détails d'exécution.

"L'un de ces instruments serait la pendule-thermomètre de M. Edmond Becquerel, modifié de telle sorte que les battements par une température inférieure à 0°, ou ceux inférieures à + 1°, à + 2°, etc., ne seraient pas comptés."

"Un autre système serait celui de thermomètrographes marquant les températures supérieures à tel ou tel degré, et seulement celles-là."

To this the following foot-note was added :—"Il y a plus de dix ans je fis des démarches auprès de deux astronomes, M. Gautier, à Genève, et M. Arago, à Paris, pour appliquer la pendule à la mesure des températures. Je proposais une pendule aussi dilatable que possible sous l'action de la température et un compteur adapté à l'instrument. . . . Les honorables savants auxquels je m'étais adressé pensèrent qu'il serait trop difficile de soustraire l'instrument à diverses causes d'erreurs."

From the above, which was written twenty-three years ago, it is clear that to the eminent botanist must be accorded the merit of priority not only of the suggestion but also of the publication of the idea of the method of averaging temperatures by observations of the pendulum, while to Mr. Stanley must be given the credit of embodying that idea in a practical form and constructing an instrument based upon the principle.

St. Leonards-on-Sea, March 16   CONRAD W. COOKE

The Wasp and the Spider

I HAD anticipated in my own mind Mrs. Hubbard's suggestion, and only the great pressure on your space prevented my meeting it in my previous letter. In the first place, my recollection is that the spider was of a kind that spins no web ; like our own grey hunting spider, familiar in the summer on walls and palings. In the next place no species of spider, except the gossamers, habitually leaves this fine line behind it. It is in all cases a voluntary act, preceded by a perceptible pause, and pressure downwards of the extremity of the body to attach the end, whether for suspension, or in the process of forming the web. Even the gossamers are no exception to this rule ; only in their case the line, in summer and autumn, is more continuously run out as a point of departure for their mysterious aërial flights. A house-spider, for instance, as he runs across the floor or across your hand, leaves no fine line behind him. The tiny gossamer has an amazing command of the material, but in the larger, web-spinning kinds it is far from inexhaustible, and, at all events, an apparently useless waste is not in the ordinary economy of nature. Moreover, in the case in question the spider was keenly aware he was pursued, and would not willingly leave so fatal a clue on his track. Mr. Merlin, who is on the list for 1878 as our consul for the Piræus, is, however, a competent observer, and could settle the question.   HENRY CECIL

Bregner, Bournemouth, March 23

SUN-SPOTS AND RAINFALL

BY the overland mail which arrived here on January 12, I received, through the courtesy of Dr. W. W. Hunter, two copies of a pamphlet on "The Cycle of Drought and Famine in Southern India," a copy of the *Nineteenth Century* for November, and a copy of a letter on "The Rainfall in the Temperate Zone in Connection with the Sunspot Cycle," published in NATURE (vol. xvii. p. 59).

Having previously read notices of the pamphlet and being desirous to see it, I requested its author to favour me with a copy. His rainfall cycle for Madras was, so far as I could learn from newspaper reports, identical with a cycle which I had discovered long before. In my official report for 1875, which was printed and circulated in 1876, I gave a *résumé* of the results at which I had arrived from 1872 down to the close of 1875, and stated that an examination of returns from 144 stations in different parts of the world, as well as of the variations in the levels of European rivers, had led me to the conclusion that there was a rainfall cycle of the same duration as the sunspot cycle and nearly coincident with it, both the sunspots and the rainfall attaining a minimum in the eleventh, first, and second years of the cycle, and a maximum in the fifth year. Hence when I learned from an abstract of Dr. Hunter's results for Madras that in his "cycle of eleven years both the sunspots and the rainfall reach their minimum in the group consisting of the eleventh, first, and second years, and that both the rainfall and the sunspots there increase till they both reach their maximum in the fifth year," I was curious to know how his cycle had been made out ; for although I had not the Madras rainfall for each year from 1813 to 1872, yet from the falls in the years of maximum and minimum sunspots which I got in the *Proceedings* and *Transactions* of the Institution of Civil Engineers (vol. xxxii.), I inferred that the Madras rainfall was not quite so favourable to my hypothesis as the rainfalls of some other places. As, however, I might be wrong, I applied for a complete table of the Madras rainfall, but without success.

A remarkable rainfall cycle for Bombay, nearly coincident with the sun-spot cycle, had been previously ascertained, and a similar cycle, though not so well marked, had also been found by comparing the yearly mean rainfalls of Anjarakandy, Bombay, Calcutta, and Nagpur with Wolf's relative sun-spot numbers.

I have now the whole history of the Madras cycle before me. The author of the pamphlet says that after many experiments he hit upon a method of working out a cycle. This method consisted in commencing with 1876, taking backwards, as far as the register extended, periods of eleven years each, and then finding the mean rainfall for each series of years in the common period.

The results obtained for Madras by this method are to a considerable extent in conformity with those which I had found for different countries ; but there are discrepancies, one of the most remarkable of which is that the rainfall in the second year of Dr. Hunter's cycle is greater, instead of less, than the mean rainfall. Still there is a certain amount of coincidence. But as the method used by Dr. Hunter—and I would call special attention to this point—is different from the one by which I found my cycle, his results and mine are not comparable.

The sun-spot cycle being one of about eleven years, and the maximum epoch occurring, on an average, 3·7 years after the previous minimum, and the next minimum 7·4 years after the maximum, I found by experience that the best way of comparing the rainfall and the sun-spots was to start either from a maximum or a minimum year, and then to take the proper number of years before and after the epochal year. Commencing with a maximum year, for instance, I took five years before it and seven