Climatological Literature and Research.

PROF. R. DeC. WARD'S recent paper, entitled "The Literature of Climatology",[1] deserves to be brought to the notice of English readers. It is an attempt, in so few as eighteen pages, at a survey of the various lines along which climatological research has been carried out, and of the literature available in each branch. There are a number of branches of science—for example, biology, medicine, and engineering—in which a research worker is sometimes confronted with the need for information about the climates of different parts of the world, and the precise kind of information required varies with the nature of the research work that is being done.

Prof. Ward tells us that the number of inquirers seeking the kind of information that his survey attempts to supply is greater among workers in subjects not obviously connected with climatology than among meteorologists and climatologists. Their special requirements are many. In agricultural science, soil temperature, the water content of soils, the extent to which the moisture present in the air as invisible vapour falls below the amount required to produce saturation, and the desiccating power of the air, may all be of particular interest. It is important for the inquirer to know whether any or all of these items have been studied, and, if so, where the necessary books of reference are to be found. The anthropologists, with their curiosity about past climates, must follow up a different branch of climatology with a literature of its own.

Prof. Ward is known on the eastern side of the Atlantic for his excellent work on American climates; he may become even better known if he will call in the aid of the official librarians of different countries, and produce the comprehensive survey of which his present paper might well form the nucleus. In an addendum to the paper, the author admits the consciousness that he has done his work with a certain degree of sketchiness—that is a feature of the paper that most meteorologists will undoubtedly notice. But until the thorough cataloguing of the available literature has been done in combination with a judicious weeding out of the unreliable or unsuitable works, few are likely to judge of the extent to which this fault is present.

A recent paper by Dr. C. Braak[2] is an example of meteorological literature of importance outside climatology. The requirements of horticulture have no doubt influenced the course of meteorological study in Holland, and most of the information given in Dr. Braak's paper is of practical importance to nurserymen, who are very much concerned with minimising frost damage, and must take advantage of any available knowledge about the average annual march of temperature both in the air and in the ground, and of the abnormalities of this seasonal march that may be expected to occur in particular years. Dr. Braak's paper is supplementary to an earlier paper by Ch. M. A. Hartman, No. 24 of the same series of publications, in which air temperature alone was considered. Dr. Braak deals, however, with earth as well as air temperature.

In regard to air temperature, the author's discussion is on the customary lines. He does not omit to give statistics in regard to the earliest and latest dates of frost. There is little that calls for criticism in these studies, unless one may be allowed to cavil at a minor point of interpretation of certain statistics in relation to the amount of water vapour in the atmosphere and to the occurrence of night frosts. Dr. Braak found that the average vapour pressure on nights of frost at each of thirteen representative stations was greatest for stations nearest to the coast, and diminished on passing inland. For example, the mean value was 5·6 millibars at Winterswijk and 7·1 millibars at Katwijk, the first named being an inland station, and the last named a coastal one. This is cited as evidence that the distribution of water vapour is of importance in determining the distribution of frost frequency.

Now it is well established that dryness of the atmosphere up to a considerable height favours a rapid fall of temperature at night under a clear sky, but it seems doubtful whether these statistics can be said to prove it. If the interior had sharper frosts than the coast for some other reason, would not the greater fall of temperature ensure a lower vapour pressure as measured near the ground through the greater condensation of hoar frost or fog? It must be remembered that on still and initially clear nights temperature generally falls below the value corresponding with the dew-point at sunset, and condensation of some kind invariably takes place, provided that the sky remains clear and the wind light. The condensed moisture is partly derived from the air, and the water vapour is thereby reduced.

The section dealing with earth temperature gives far more information on this subject than is to be found in most text-books of meteorology. Using the equation

$$a_p = a\, e^{-p\sqrt{\frac{\pi}{kT}}}$$

where a_p is the amplitude of the periodic variation of period T at a depth p in the ground, and k is the thermal diffusivity given in terms of the depth of soil which can be warmed 1° C. by the heat passing in unit time (here 1 minute) through a layer of soil 1 cm. deep across which a constant difference of 1° C. is maintained, the thermal diffusivity of different soils at De Bilt, Wageningen, and Groningen are examined. The results are compared with similar information given for soils of the same type in Hann's well-known "Lehrbuch". The agreement is not close, but the Dutch observations are reasonably consistent among themselves, and the above-mentioned divergences may safely be referred to probable differences between the soils in the two sets of observations. The well-known effect of æration of the soil is brought out clearly: for a mixture of sand and peat, k was found to be 0·086 cm. at Groningen, and at the same place for a relatively compact and air-free mixture of clay and sand, k was 0·482. For peat and sandy clay, Hann gives 0·133 and 0·816 respectively. It is generally recognised that the conductivity of a particular soil is greatly affected not only by the amount of air contained in it but also by its water-content and by other factors, which provide additional sources of divergence when closely similar soils are compared at different times.

In conclusion, attention may be directed to interesting curves of air and soil temperature in the severe frosts of January–February 1917 and February 1929, on page 55. It is notable how, when the soil is frozen to some depth, the action of the latent heat of fusion of ice during a thaw destroys the normally good general agreement between curves of air temperature and soil temperature at a depth of less than 1 foot, and excellent examples are to be found in these curves. The same applies when freezing is taking place.

[1] *Annals* of the Association of American Geographers, March 1931.

[2] Koninklijk Nederlandsch Meteorologisch Instituut. No. 102, Mededeelingen en Verhandelingen, 33; Het Klimaat van Nederland. B (vervolg): Lucht- en grondtemperatuur. Door Dr. C. Braak. Pp. 78. (Amsterdam: Seyffardt's Boekhandel, 1930.) 1.00 f.