magnitudes are always those derived by Dr. Peters; and the identification with modern star designation, a tabulation of the errors found, and the comparison with the Harvard photometric magnitudes have been added. The fact that Ptolemy lived at Alexandria, four degrees south of Rhodes, the site of Hipparchus's observations, and yet did not include any more southern stars than did the latter, is one point of evidence against a new series of observations by Ptolemy. Hipparchus is supposed to have observed 1,080 stars. The work of identification involved the reduction of modern star places back to the respective epochs of the old observations, and, with this, the computation of the probable errors of the old measures. These had been recorded in fractions of a degree, and the fact that much confusion arose in transcribing these fractions in the Greek has added to the uncertainty of some of the identifications. Many of the manuscripts in existence are evidently copied from some particular original, and the errors of that original would be reproduced, in addition to new mistakes of transcription.

After the death of Dr. Peters, in 1890, the collection of material made by him was sent to Mr. Knobel, who has enlisted the support of astronomers and public-spirited men in having the results of their joint labors properly recognized by the publication in permanent form. The volume contains an excellent portrait of Dr. Peters, and some photographic reproductions of the pages of the two oldest copies of the "Almagest."

R. H. Tucker

Lick Observatory,
March 21, 1916

Flora of the Northwest Coast. By Charles V. Piper and R. Kent Beattie. Published by the authors, Washington, D. C., November 10, 1915. Pp. xiii + 418. Price $1.50.

Students of the flora of western North America will welcome Piper and Beattie's "Flora of the Northwest Coast." The authors are to be congratulated for bringing to fruition the labors of their earlier years for the botany and botanical education on the Pacific coast. Their new work will contribute greatly to the knowledge of the plant life in the northwest and, as they themselves express the hope, will "stimulate a greater activity and interest in the flora."

The area covered by the manual is that lying west of the summit of the Cascade Mountains from the headwaters of the Willamette River in southern Oregon to the 49th parallel of latitude. This is a natural geographic region characterized by its magnificent coniferous forests which form the dominating plant formations over nearly the entire area below 5,000 feet altitude. "The only break in this coniferous cover consisted originally of a series of prairies extending from the Upper Willamette Valley northward to Vancouver Island. North of the head of Puget Sound, however, the prairies are small and limited in the main to the extremities of points and portions of the islands in the Sound."

In a forested region such as the northwest the lignescent flora naturally attracts attention, and it is interesting to note that, although the forests are largely composed of a few species of conifers, there is a comparatively large variety of trees and shrubs, approximately 9½ per cent. of the total flora. Of the 155 species of woody plants described, 47 are trees, 105 shrubs and 3 woody climbers. The genera with more than two species of trees are, *Pinus* 6, *Abies* 6, *Salix* 5, and *Acer* 3. The genera with five or more species of shrubs are, *Salix* 14, *Ribes* 10, *Spiræa* 5, *Rubus* 6, *Ceanothus* 6, and *Vaccinium* 9.

A summary of the flora is given in a table, from which we learn that there are described, 100 families, 550 genera and 1,617 species and subspecies, distributed as follows: Pteridophyta 7 families, 22 genera and 61 species; Gymnosperms 2 families, 10 genera and 22 species; Monocotyledons 15 families, 111 genera and 412 species; Dicotyledons 76 families, 407 genera and 1,122 species. The composition of the flora may be brought out a little more fully by listing a few of the prominent families and genera. The families containing more than 60 species are: Poaceæ 46 genera and 116 species, Cyperaceæ 7 genera and 95 species, Cruciferæ 28 genera and 69 species, Rosaceæ 28 genera and 61 species, Leguminosæ 13 genera and 72 species, Compositæ 66 genera and 89 species. The genera containing more than 15 species are: *Agrostis* 18, *Poa* 22, *Carex* 73, *Juncus* 23, *Salix* 19, *Polygonum* 20, *Ranunculus* 19, *Lupinus* 19, *Trifolium* 20, *Epilobium* 18, *Erigeron* 17 and *Senecio* 17. All of these genera with the exception of *Trifolium* and *Lupinus* are common not only throughout the cooler parts of North America, but of Europe and Asia as well. In fact, while there are many endemic species, the general floral element is that of the Boreal Realm, just as we would expect, since the region lies within the Arctic to Transition zones. Very few of the typical American genera of the arid regions of the west are represented.

The text is supplied with keys to families, genera and species, but the descriptions of the species are often meager, too much so we fear in some cases for certain identification. But in the reviewer's mind the most disappointing feature of this admirable work is the extremely meager and indefinite distributional notes. It is to be regretted in this respect that the authors did not follow the excellent example set by the senior author in his "Flora of Washington," and give the zonal distribution. Two additional words would have been sufficient, and these with a little fuller definition of each zone in the preface would have been of great service to the student of plant distribution.

LEROY ABRAMS

NOTES ON METEOROLOGY AND CLIMATOLOGY

FROST

PROFESSOR ALEXANDER MCADIE and Mr. William G. Reed have each recently presented several papers on the meteorology of local frosts, the causes of frost damage to plants and methods of protection, the dates of occurrence of frost, and bibliography of frost in the United States.

The meteorology of frost formation is discussed by Professor McAdie in an article entitled "Temperature Inversions in Relation to Frosts."[1] Two laws of frost formation are enunciated as follows:

(1) Where the air is in motion, there is less likelihood of frost than where the air is stagnant; (2) frost is more likely to occur when the air is dry (and dustless) than when it is moist.

The first is true because local frosts are connected essentially with local "air drainage." Soon after sunset, cold and dense air, cooled chiefly by radiation to the ground, drains slowly down the slopes into the valleys and low places. Strong winds mix the air and so prevent the occurrence of local frosts. The second law is based on the retardation of temperature change due to moisture in the air. The water vapor strongly absorbs the heat rays from the earth, acting in this way as a blanket. If condensation occurs, there is further retardation of the cooling by the liberation of latent heat. Since dry air is denser than moist air at the same temperature, a loss or gain of moisture as well as a change in temperature affects the rate of "air drainage." To obtain a continuous record of the weight of water vapor in grams per cubic meter of air, Professor McAdie has devised a "saturation deficit recorder." This instrument is essentially a hygrograph mounted on the pen of a thermograph. The thermograph indicates the maximum weight of water vapor possible in the air at the temperature prevailing, and the hygrograph indicates the percentage of saturation.

Protection of plants from injury by frost involves the conservation of the earth's heat with covers, the addition of heat to the air, or the use of some agency with high specific heat, such as water, to prevent cooling. Preventable damage often results from too rapid defrosting in the morning; fortunately, the same agents which keep the temperature from falling retard its rise.

Mr. Reed treats the subject of protection as a whole in an illustrated article, "Protection from Damage by Frost."[2] The methods most successful commercially depend upon the com-

[1] *Annals*, Harvard College Observatory, Vol. 73, pp. 168 to 177, 4 pl., Cambridge, 1915; or see *Scientific Monthly*, December, 1915, pp. 293 to 301.

[2] *Geographical Review*, February, 1916, pp. 110 to 122.