valleys or lowlands, therefore the records of rainfall represent the valleys and not the hilltops. This is a very serious matter in mountainous countries, and especially in those portions of the United States where it is important to know the quantity of water available for irrigation.

Mr. F. H. Brandenburg, of Denver, has labored with great success to overcome this difficulty in Colorado. By his unceasing efforts he has secured a large number of rain and snow observations at high altitudes where the rainfall is many times as great as in the valleys. It is now necessary to make a special effort of similar nature with reference to California, Arizona, and New Mexico, and, in general, for the whole arid and Plateau regions. Cases have occurred in western Montana, where the flow of water from a small stream was two or three times as great as the rainfall on its watershed, so far as that could be inferred from a few rainfall stations in the lower valley. Evidently these latter gave no idea whatever as to the rain and snow on mountain tops, from which the river derived its great excess of water. There can be no proper determination of the amount of water available for irrigation, and no explanation of the variable heights of water in the rivers unless we have a sufficient number of gages at high and low stations. Every opportunity to secure a new rainfall observer should be gladly embraced.

PHYSICS AND METEOROLOGY IN THE UNIVERSITIES.

The progress of meteorology depends not merely upon the observer and the compiler of daily weather maps, but more than anything else upon the education of the physicists who are attracted to this branch of science. The study of physics embraces every detail of the many ways in which force acts upon matter. The study of heat, light, or electricity, is the study of the phenomena that are manifested when molecules and atoms interact upon each other. The study of projectiles, the flow of water in the rivers, the motions of the atmosphere, or the tides of the ocean is the study of the action of larger masses of matter under the influence of such forces as the attraction of gravitation, the repulsion due to heat, the centrifugal force due to inertia. We may experiment upon small quantities of air and aqueous vapor in the physical laboratory, and thus learn some of the details as to the physical properties of the atmosphere; but the meteorological phenomena on a large scale can only be studied by means of the daily weather map and with the help of mathematical formulæ, or equivalent graphic methods peculiar to hydrodynamics and thermodynamics. It is evident, therefore, that important progress in meteorology is not to be hoped for from those who only frame hypotheses and speculations as to possible laws that may control atmospheric phenomena. Such hypotheses are often important; it is well said that even the clear statement of a difficulty, or of a problem, is already a long step toward its solution. But the solution is the final step that meteorology demands, and the one that is absolutely essential in order that we may really make true progress. Meteorology presents many unsolved problems, and many more will be recognized as time goes on. The successive steps involved in resolving these problems usually consist of (1) a series of successive hypotheses; (2) the testing of each hypothesis by comparison with observation and the laws of physics; (3) the modification of the hypotheses until we attain one that harmonizes with all that is known on the subject. This process involves a training in mathematics and physical experimentation, and a development of an insight into the ways of nature that does not come naturally to every one. Sir Isaac Newton is an example of those who, by persistent thought and carefully checking every step by comparison with nature, at last penetrate into some of nature's secrets.

Most of us must be content to be good observers, computers, and workers. A few may become bold and successful forecasters, but it is not likely that important additions to our knowledge of fundamental points in meteorology will be made by any except those who have gone through a severe training in the physical laboratories and methods of original research. Therefore, those interested in the progress of our science must look about with some solicitude inquiring what is being done in our American universities to turn the thoughts of earnest students toward meteorology as a branch of physics. Universities are distinguished from colleges in that they offer young men and women special opportunities for original research. They do not usually confer the degree of doctor of physics (Ph.D.) or doctor of science until the student has prepared one or more papers based on his own studies and work, and containing some substantial additions to our knowledge. A slight examination of the titles of these theses during the past few years shows that scarcely one has taken for his subject any problem that is strictly meteorological. This is probably not due to a want of interest in our science on the part of the student or the general public, but may often be traced back to the teacher himself. The universities generally prefer to consider meteorology as a rather insignificant division of the physical sciences; some of them class it with astronomy, others with geography, but in general none of them give it any prominence in the curriculum of studies, or have any special conveniences for instruction therein.

As many of our readers are turning their attention strongly toward meteorology, and inquiring as to courses of study and the attainment of the post graduate degree of Ph. D. in this science, we recommend them to examine the "Graduate Handbook" for 1899, which is published by the Federation of Graduate Clubs, and is intended to show the present condition of graduate instruction.

THE CLIMATE AND CROP SERVICE IN PORTO RICO.

The Porto Rico Section of the Climate and Crop Service of the Weather Bureau was established in the summer of 1898, and its publications have hitherto consisted of weekly bulletins, showing especially the condition of the crops. It was, of course, very desirable that the monthly reports of this section should be printed in quarto form, conformably to the general plan of publication adopted for all of the forty-five sections of this service. But both the difficulty and the expense of such a publication in Spanish and English have hitherto stood in the way, and at first it did not seem possible to overcome these. But now an arrangement has been made by which the composition, chalk-plate work, and printing are done by Mr. E. A. Evans, Section Director at Richmond, Va., while the manuscript is supplied by Mr. R. M. Geddings, the Section Director at San Juan. It is, therefore, to the cooperation of these two directors and to their proverbial enthusiasm that we owe the publication of the report of the Porto Rico Section for May, 1899, as Volume I, No. 1 of the series. Possibly, the report for December, 1899, may be followed by a summary of the whole year so complete as to represent all that the Weather Bureau has done since the summer of 1898.

This first number gives, as usual, full page sketch maps of Porto Rico, with the mean monthly temperature, wind, and rainfall for May, 1899. The isotherm of 80° F. probably skirts the greater part of the southern and northern coast lines; it cuts off a small portion of the eastern end of the island and a much larger portion of the western end. A small area of mean temperature of 82° F. exists in the south-