of Education examination, and if the exercises are performed under the supervision of a teacher, none of its minor defects will cause the beginner to gain wrong impressions.

*Ministère de l'Agriculture. Direction Générale des Eaux et Forêts. 2e partie. Eaux et Améliorations Agricoles.* Service des Grandes Forces hydrauliques dans la Région des Alpes. Résultats des Etudes et Travaux à la Fin de 1911. Tome v., 1912. Pp. 530.

THE present volume is the fifth of the series published by the French Ministry of Agriculture since the inauguration of the Service of the Great Hydraulic Forces in Alpine regions, and it brings the account of operations down to the end of the year 1911. Of the 530 pages of which the volume consists, 487 are devoted to a tabulation of the results obtained from observations in the basins of the Arve, the Fier, the Isère, and the Drôme. A series of nine charts also accompanies the report, covering the regions of the Arc, the Breda, the Durance, and the Guil.

It is interesting to note the expedients and devices by which an investigation, demanding for its most effective development the employment of expert scientific observers, has been enabled to be carried on to a large extent by voluntary workers and local auxiliaries, for the most part untrained and indifferently coordinated. Such agencies in many cases have had to be relied upon for the collection of data, and as there is a constant change of personality in the assistants, the difficulties in the way of securing trustworthy records are sufficiently obvious.

"However," concludes the prefatory note, "in spite of defects, of which we more than anyone are conscious, we are convinced that the study of hydraulic forces, so far as circumstances permit, constitutes none the less a real utility"—and a cursory glance through the pages of statistical matter, carefully annotated and compiled, bears incontestable witness to the patient labour and exactitude of those engaged in the French hydrographical service and of M. de la Brosse, its chief engineer.

*Weather Bound.* By R. T. Smith. Pp. 319. (Birmingham: Cornish Bros., Ltd., n.d.) Price 15*s.* net.

THE author gives, in great detail, summaries of results of twenty-seven years' observations at five stations situated to the west of Birmingham, in a series of tables and diagrams occupying 170 pages. He adds a diary, "Weatherwise and Otherwise," for the same period, which occupies sixty pages, and explanatory text (seventy-two pages). He also gives a diagram of the normal course of the meteorological elements throughout the year, which is unintelligible owing to want of explanation. The amount of industry displayed is worthy of praise, and most of the tables appear to contain climatic data of real value, but the author's exposition cannot be recommended to the attention of serious students of meteorology.

R. C.

## LETTERS TO THE EDITOR.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

### Radio-activity and the Age of the Earth.

IN his letter in NATURE of June 26, Dr. Schiller quotes with disapproval Mr. Holmes's deduction that the "heavy metallic core" of the earth "must be completely destitute of radium"; for this deduction, in Dr. Schiller's opinion, "involves the improbability that the heaviest metal of all, uranium, has not gravitated to the 'metallic core,' and does not explain why this core should be destitute of radio-active substances."

In the next paragraph, however, Dr. Schiller suggests a possible escape from the difficulty with the words, "it is possible that under the physical conditions obtaining in the interior uranium does not dissociate, or does so much more slowly."

Last autumn, as a sequel to certain speculations into the effects of pressure on the mineralogical constitution of the earth's crust at great depths, I was led to a consideration of this very question of the dissociation of elements when subjected to the high temperatures and pressures that prevail at such depths.

So far as I was able to discover, no determination of the specific gravity of radium had then been made, presumably for lack of sufficient material; but, judging from its chemical relationship with barium, the atomic volume of radium must be much greater than that of uranium. Heat is known to be evolved during the disintegration of radium, so that the break-up of this element is an exothermic change. I am writing this letter whilst travelling, and am, consequently, unable to verify my impression that heat is also evolved during the conversion of uranium into radium. But in any case, the passage of uranium into radium may be expressed in a general way by some such equation as the following:—

$$U = Ra + m + e,$$

where $m$ indicates the loss of mass due to liberation of helium in the successive stages of disintegration, and $e$ the loss of energy represented by the various manifestations of energy. Since radium has a higher atomic volume than uranium we see that the progress of this reaction from left to right means an increase in volume and an evolution of energy, part of which is doubtless speedily transformed into heat. In fact, it is exactly the kind of reaction that would be inhibited by high pressure and temperature conditions.

That high pressure should be able to prevent the disintegration of uranium seems reasonable, if one accepts the electronic constitution of the atom. Judging from the extreme length of the half period of disintegration of uranium under surface conditions, the constituent electrons of an atom of uranium perform on the average a vast number of revolutions before the system arrives at the position of instability that permits the escape of a helium atom. In fact, the uranium atom is evidently stable during an enormous number of revolutions or vibrations. And if, when the electronic system arrives at last at an unstable configuration, a sufficiently powerful counterbalancing force can be applied from without, then the system will be helped past the danger point and be able to commence another long cycle of movements before the dangerous configuration is again assumed.

In view of the experiments of Humphreys and Mohler upon the displacement of the spectral lines, and the work of Richards on the com-