path suggested no doubt by his long and successful experience as a teacher.

We would call especial attention to the fact that the author has planned this course 'especially as a basis for ecology.' In some quarters there is a feeling that ecology should be one of the first things brought to the young student's attention, and so we have a swarm of elementary books for secondary school children in which 'ecology' figures prominently. We are in full sympathy with the author when he says, "More than one recent writer has described ecology as at present mostly a series of guesses; and so will much of it continue to be until given logical precision and a firm foundation in exact physiology." Evidently ecology must come *after* the student has prepared himself for it, and *not* as an introduction to botany.

Dr. MacDougal's work is the first American text-book of plant physiology of advanced grade to be published. It is intended for and adapted to the demands of such students as have already made considerable progress in the study of plant activities. In fact, we apprehend that to a large extent it will be the handbook for the teacher, rather than for the student. However used, it must do much to stimulate physiological inquiry in colleges and universities. The aim of the work is thus defined in the preface, "The chief purpose of the author is to present practical directions for the demonstration of the principal phenomena of the physiology of the plant, and also details of experimental methods suitable for the exact analyses requisite in research work."

The sequence of topics is considerably different from that usual in works on the physiology of plants. Thus the author takes up in order, 'The Nature and Relations of an Organism,' 'Relations of Plants to Mechanical Forces,' 'Influence of Chemicals upon Plants,' 'Relations of Plants to Water,' 'Relations of Plants to Gravitation,' 'Relations of Plants to Temperature,' 'Relations of Plants to Electricity,' and other forms of energy, 'Relations of Plants to Light,' 'Composition of the Body,' 'Exchanges and Movements of Fluids,' 'Nutritive Metabolism,' 'Respiration,' 'Fermentation and Digestion,' 'Growth,' 'Reproduction.' It is difficult to specify chapters in a work in which there is so much to commend, but to us the most interesting is that on the 'Composition of the Body' (IX.), in which the treatment, though not extended, is especially satisfactory. Here the principal topics are 'Substances found in Plants,' 'Carbohydrates,' 'Fractional Extractions,' 'Estimation of Tannins and Glucosides,' 'Determination of Sugars and Dextrins,' 'Starch,' 'Cellulose,' 'Proteids,' 'The Fats,' 'Determination of Organic and Inorganic Matter,' 'Enzymes.' We venture to say that the general introduction of the matter of this chapter into plant physiology will revolutionize much of the teaching of this subject in this country. There has been too little of the study of what plants actually are in the physiology of the past, so far as this country is concerned, and it is just here that American botanists have been weakest. This book will serve as a corrective, and it is to be hoped that it will turn the attention of students in physiological laboratories to this much-neglected aspect of their work.

CHARLES E. BESSEY.

NOTES.

THE American Institute of Mining Engineers will, as we learn from the *Railway and Engineering Review*, publish two volumes as follows:

1. 'The Genesis of Ore-Deposits,' comprising the famous treatise of the late Professor Franz Posepny, with the successive discussions thereof by Le Conte, Blake, Winchell, Church, Emmons, Becker, Cazin, Rickard and Raymond (all of which were published in Volumes XXIII. and XXIV. of the *Transactions* of the Institute, and subsequently in the special 'Posepny Volume,' issued by the Institute); also, later, papers by Van Hise, Emmons, Weed, Lindgren, Vogt, Kemp, Blake, Rickard and others, and the discussion of these papers by De Launay, Beck and many others (all of which will be published in Volumes XXX. and XXXI.); also a complete bibliography of the Institute papers and discussions on this subject from 1871 to the present time. The volume now in press will be an octavo of about 825 pages, bound in 'book-linen.' This book will be sent, postpaid,

for $5 to members or others who subscribe for it before its issue.

2. 'The Evolution of Mine-Surveying Instruments.' This will be a volume of about 400 pages, issued in the same style as the foregoing, and containing the original paper of Mr. Dunbar D. Scott on that subject (*Transactions*, XXVIII.), first published in 1898, together with later papers continuing the same subject, and discussions thereof, by Hoskold, Lyman, Davis and many others. Subscriptions will be received for this volume in advance of its issue at $3, under the conditions already stated above.

DISCUSSION AND CORRESPONDENCE.

WEATHER CONTROL.

A CHARACTERISTIC of storms which meteorologists do not perhaps sufficiently consider is that they are the falling down or collapsing of unstable states of the atmosphere. Such phenomena in thermodynamics are called reversible processes; let us call them *sweeping processes* or simply *sweeps*. The trend of a sweeping process may be affected to any extent, however great, by a cause, however insignificant, provided the cause acts at the critical initial stage of the sweep. For example, a mere breath may determine whether a brick chimney shall fall harmlessly into a vacant lot or with unmeasured calamity into an adjacent factory, or, to take an example from meteorology, an unstable state of the atmosphere over the United States may lead to a cyclonic movement the effects of which may differ enormously according to the time and place that the unstable state begins to break, and in the limiting case the flight of a grasshopper in Colorado or Montana may be the determining factor.

If the cyclonic movements of the atmosphere which have so much to do with the distribution of rainfall are ever to be controlled by the infinitesimal means at the disposal of man it must be by the proper application of these means during the early and exceedingly sensitive stages of these vast sweeping processes. How, when and where to apply our puny power is a matter of detail, of experiment and study.

We must study the initial phases of cyclonic movements in their relations to subsequent trend and character, and we must devise means for inaugurating these initial phases in a way which will lead to desired results. This study has been pursued by the scientists of the Weather Bureau for many years and is the basis of the weather forecasts issued daily by this great scientific department of the government. As to the means for inaugurating at will the storm movements of the atmosphere the smoke-ring cannon of Burgomaster Stiger is the most rational that has yet been suggested, as will be explained later.

Weather control is, however, not so simple a matter as would appear from the above statement. It is a well-known fact that two cyclonic movements initially alike may have very great differences of trend and character. The explanation of this fact will be made clear by considering a simple mechanical analogy. Imagine a great number of dominoes to be stood on end not in a simple row but in a very complicated network of rows and imagine slight disturbances to be produced over the entire system; for example, a number of grasshoppers might be turned loose into the dominoe enclosure! Now there might be one particular region where the dominoes are more sensitive than elsewhere so that collapse would usually start in this region and spread over the system, but the ultimate trend and character of the collapse would depend not only upon its initial phases but quite as much upon whether a particularly vigorous grasshopper had happened to kick over a dominoe or two in regions remote from the starting point of the main collapse. The driving energy of the dominoe storm at any given place is derived from the falling of the dominoes at that place and not at all from the remote source of the storm, and if we could imagine the spreading dominoe storm to gradually make the dominoes just ahead of it taller and taller then there would be local displays of excessive violence as these tall dominoes fall. It is scarcely necessary to alter the wording of the above statement, so evident is its application to a vast stretch of atmosphere over a sun-heated continent. The dry arid regions where the sun beats down without hindrance are the regions in which the atmosphere