means of advancing the purposes of the society which now are entirely beyond our reach. The question of publication, for example, might present quite a different aspect under such conditions. The offering of prizes for the investigation or literary discussion of specified topics, the recognition by medal or otherwise of specially deserving investigations, even small grants in aid of research, loom up dimly on the horizon of possibility, but can not be further discussed here.

I am well aware that these suggestions may appear revolutionary. I have little faith in revolutions as a means of progress, but they have occasionally been unavoidable. We may as well frankly face the fact that for several years our society has been groping for a mission and that its meetings have been supported more or less from a sense of duty. I am not so presumptuous as to assume that I have found that mission. If my words serve to stimulate discussion and reflection concerning the functions of the society, they will accomplish all that I have any right to hope. True, we should beware of losing the substance while grasping the shadow, but, on the other hand, tradition should not blind us to the changed conditions confronting us. Are we not imperatively called upon to attempt in some way to make the work of this society such that the leaders of agricultural progress shall feel it worth their while to contribute to it liberally of their time and energy? If we can solve this problem we need have no apprehensions regarding the promotion of agricultural science.

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SCIENTIFIC BOOKS.

Soils. Their Formation, Properties, Composition and Relation to Climate and Plant Growth, in the Humid and Arid Regions. By E. W. HILGARD, Ph.D., LL.D., Professor of Agriculture in the University of California and director of the California Agricultural Experiment Station. The Macmillan Company. 1906. 8vo. Pp. xxvii + 593; 89 figures, including 37 photographic illustrations. $4.00 net.

In the production of this volume on soils Dr. Hilgard has enriched agricultural science throughout the domain of its most basal problems, and to a very notable extent. Moreover, its appearance at this time is extremely opportune, coming as it does with the initiation of more rigid research work by the agricultural experiment stations, before the Bureau of Soils has been able to fully discern what should be its own precise problems, and when the materials for agricultural education have yet to be definitely brought together in proper pedagogic form. It is now more than fifty years since Hilgard began the application of rigid research methods to the elucidation of the processes and principles which underlie and determine the productive power of soils. During most of this long period soil problems have been uppermost in his mind and have drawn from him, to their illumination, a large measure of his research effort. With mental traits of the highest research type; broadly and thoroughly trained at Zurich, Freiberg and Heidelberg before the days of extreme specialization in education, he entered upon this, his life study, with the best of equipment. Thrown directly into the field upon the humid, washed and leached soils of the south, from 1856 to 1872, in his agricultural and geological survey of Mississippi; then transferred to the glacial soils of Michigan from 1873 to 1875; and finally, for more than thirty years, studying the arid soils of the Pacific slope, during which time he was also attached to the agricultural division of the Northern Transcontinental Survey, and again brought back to reconsider the humid soils of the south when making his extended report upon cotton production for the tenth census, it is doubtful if any man living has been brought so persistently, widely and intimately to the personal study of soil types and soil conditions as he. And when it is

understood that throughout all of these extended studies soils have been considered broadly (1) from the standpoints of geology and climate; (2) from that of their physical composition, condition, moisture and aeration; (3) from that of chemistry and plant nutrition; (4) and finally from that of the correlation of native vegetation to virgin soil conditions as indicative of relative productive power a very important contribution to agricultural science may well be anticipated as the outcome of such preparation, especially when, as is the case here, the author fully avails himself of other investigations in setting out the subjects discussed.

Another feature which must give special importance to Hilgard's views as guardedly presented in this volume is the fact that throughout his half century of study he has been able to deal almost entirely with soils in their unfertilized or entirely virgin condition, whereas the whole of the soil literature of Europe had grown up on fields centuries old which had been long fertilized before the studies began; and what is more significant, our author, from the outset and throughout, was keenly alive to the fact that he was dealing with fundamental conditions which must be widely different from those which European students have met and from which they have drawn their conclusions.

The author groups his subjects into four parts: (1) the origin and formation of soils, covering 79 pages; (2) physics of soils, to which is devoted 237 pages; (3) chemistry of soils, appropriating 131 pages and (4) soils and native vegetation, to the consideration of which are given 62 pages. Those who have been in the habit of attributing to Hilgard the view that physical properties and conditions of soils play but a small part in determining their productive capacity will be surprised at the amount of space devoted to soil physics. This is done, not because of any change of views on the part of the author, for throughout all his writings no one has been more insistent regarding the greatest importance being attached to proper physical conditions as the first essential to a productive soil; and no one in America has done as much as he to establish the causes of the physical differences in soils which are productive and which are unproductive, and to point out practicable methods for correcting evils when they are known to exist. It has been his strong insistence during these later years, when it has become a fashion to ignore chemical differences, that these too are very important in influencing productive capacity, that has given the impression to some that Hilgard regards physical differences as of comparatively slight moment.

In Chapter I. the physical processes of soil formation are discussed, followed in the second by a presentation of the chemical, which includes the exchanges of bases in zeolites and the action of plants and their remnants in soil formation. Next come two chapters treating first of the major soil-forming minerals and then of the chief soil-forming rocks, where special stress is laid upon the nature, origin, determination and importance of colloidal clay as greatly influencing both the physical and chemical nature of soils; while in the last chapter of Part I. the minor minerals and ingredients of soils are treated, including those used as fertilizers and also those which are unessential or are injurious.

Part II. begins with the physical composition of soils and 'since clay is the substance whose functions and quantitative proportions influence most strikingly the agricultural qualities of land' it is first discussed. Then follows an important characterization of sands in humid and in arid regions, showing why the latter are usually and naturally so much more productive; the chapter closing with the methods, purposes and importance of mechanical analysis of soils. Chapters VIII., IX. and X., treating of soils and subsoils from the standpoints of causes and processes of differentiation; of organisms influencing soil conditions; of their relations to vegetation, and of the origin, nature and distribution of humus, will be found among the most luminous, important and suggestive, to both the student and the investigator, of all the valuable presentations which the book contains. Especially instructive is Fig. 27, contrasting a type of eastern soils with two of those of

California, showing the great differences in depth of the soil proper, thus giving a basis for understanding the possibility of deep humification, nitrification, root feeding and high duty of soil moisture which distinguish arid from humid soils, making them relatively more productive and more enduring. Chapters XI., XII. and XIII., in all 78 pages, are devoted to the water of soils, placing the greatest emphasis upon the problems of semi-arid and arid regions, while the remaining three chapters of this part deal with the absorption of solids from solution, and gases, the color of soils and climate.

Part III. is an extremely cogent and clear presentation of the author's and others' observations and conclusions regarding the legitimate functions, possibilities and utilities of chemico-physical investigations of soils in regard to crop production. A careful study of these chapters will be found a speedy and complete antidote for that miasma which rose up out of Maryland, infected the national capital and, on the wings of publicity, is developing 'toxic' symptoms at widely separated centers. The first chapter of this part, among other matters, gives a brief historical review of soil investigations; calls attention to advantages for soil study offered by virgin lands; points out the physical and chemical conditions of plant growth; discusses the solvent action of water upon soils; the ascertainment of immediate plant food requirements and chemical tests of immediate productiveness. The second chapter treats of the analysis of virgin soils by extraction with strong acids, the limits of adequacy of the several plant-foods in virgin soils and the influence of lime upon soil fertility, wherein it is held that 'a lime country is a rich country.' The next two chapters are given over to a very fruitful comparison of the soils of arid and humid regions, in which tropical soils, so far as data are available, come in for their share of consideration. The last two chapters of Part III., on alkali soils and the utilization and reclamation of alkali lands, all very comprehensive and practical discussion of those problems which must prove very helpful to agents of the reclamation service and to actual and intending settlers on those lands, 62 pages being very wisely given over to these important matters.

Soils and Native Vegetation is the title of Part IV. Quoting, but not consecutively, the author says:

> In newly settled countries, and still more in those yet to be settled, the questions of the immediate productive capacity, and the future durability of the virgin land are among the burning ones since they determine the future of thousands for weal or woe. This need has long ago led to approximate estimates, made on the part of the settler, by the *observations of the native growth, especially the tree growth.* * * * Thus in the long-leaf pine uplands of the Cotton States, the scattered settlements have fully demonstrated that after two or three years cropping with corn, ranging from as much as twenty-five bushels per acre the first year to ten and less the third, fertilization is absolutely necessary to farther paying cultivation. * * * Corresponding estimates based upon the tree growth and in part also upon minor vegetation, are current in the richer lands also. The 'black-oak and hickory uplands,' the 'post-oak flats,' 'hickory bottoms,' 'gum bottoms,' 'hackberry hammocks,' 'post-oak prairie,' 'red-cedar prairie' and scores of other similar designations, possess a very definite meaning in the minds of farmers and are constantly used as a trustworthy basis for bargain and sale, and for crop estimates. * * * Since the native vegetation normally represents the results of secular or even millennial adaptation of plants to climatic and soil conditions, this use of the native flora seems eminently rational. * * * It seems singular that such well and widely understood designations and important distinctions should not long ago have been made the subject of careful investigation and precise definition by agricultural investigators. For apart from their practical importance as guides to the purchaser of land, or settler, this correlation of land values and natural vegetation is of the utmost interest in offering an opportunity for researches on the factors which determine the choice of these several trees and their corresponding shrubby and herbaceous growths. * * * Only very fragmentary and casual observations in this line are on record thus far. * * * Yet, to ascertain by the physical and chemical examination of soils what are determining factors of certain natural vegetative preferences, which are invariably followed by certain agricultural results, should not be an unsolved

problem and its practical importance should justify its most active investigation.

The author gives in some detail, fully illustrating his thesis, the results of his early studies in Mississippi along these lines, presenting in Figs. 79, 80 and 81 the most striking illustrations of how individuals of one and the same species of post-oak, black-jack oak and deciduous cypress persistently differ in both stature and habit of growth when they recur on the same soil types in different localities throughout the state; finally extending the discussion to observations in the United States at large and to Europe. I can not do better, in closing the review of this valuable work, than to quote again the author where he is discussing the influence of lime in the soil on the character of floras.

> What is a calcareous soil? The definition adopted for this volume has been given in a previous chapter; viz., that a soil must be considered calcareous so soon as it naturally supports a calciphile flora—the lime vegetation so often referred to above and named in detail. Upon this basis it has been seen that some (sandy) soils containing only a little over one tenth of one per cent. of lime show all the characters and advantages of calcareous soils; while in the case of heavy clay soils, as has been shown, the lime-percentages may rise to over one half per cent. to produce native lime growth.

At first thought it may appear to some that the adoption of such a definition is a subterfuge to make observations harmonize with theory, but it is not so. Every one will agree that a moist soil, defining it from the standpoint of plant nutrition, is one which will yield moisture to a plant as rapidly as it is needed. On this basis a sandy soil containing 4 per cent. of moisture is as moist as a clay soil carrying 20 per cent., the physiological difference being determined chiefly by the relative amounts of internal soil surface in the two cases.

This volume should be introduced to a much wider circle of students than those of the agricultural colleges generally. It will be found well suited to serve as the foundation of important seminars in chemistry, in geology and especially in plant physiology and ecology.

F. H. King.

October 30, 1906.

Hatch and Corstorphine's Geology of South Africa.[1]

The visit of the British Association to South Africa was the occasion for the appearance of two noteworthy books on the geology of that region: Rogers's 'Geology of Cape Colony,' and Hatch and Corstorphine's 'Geology of South Africa.' The latter is the more general of the two, as it treats of much the larger area; the former is somewhat more detailed, as all of its space is devoted to the formations that occur in the single colony with which it is concerned.

The small geological map, scale, 1:5,000,000, which serves as frontispiece to Hatch and Corstorphine's book, provides a good introduction to the problems considered in the text. The greater part of the area described is occupied by the nearly horizontal beds of the Karróo system, a vast body of continental deposits which has shared the fate of other stratified formations not containing marine fossils in having been explained by earlier observers as a lacustrine deposit, but which is now recognized as of mixed origin. Its lowest member is the famous Dwyka glacial conglomerate, or 'tillite,' as Penck has suggested it should be called, unquestionably of glacial origin. The overlying members of great thickness are probably of mixed fluviatile and lacustrine deposition, as they contain beds of coal and fossils of reptiles, as well as numerous dikes and sheets of dolerite. This great body of continental formations occupies a geosynclinal basin, some 600 miles east and west by 400 miles or more north and south. It is obliquely truncated by the seacoast on the southeast; there the ancient lands from which the basin deposits were derived, appear to have been lost in the Indian Ocean. On the south, the Karroo system and the underlying formations are folded in long east-and-west anti-

[1] Macmillan, 1905, 348 pages, 2 geol. maps, 89 figures and plates. $7.00.