nent. I shall therefore make further mention only of the cyclones and cyclonic storms concerning which the information is full and important. It may be recalled that Redfield early recognized the general occurrence of cyclonic whirls, seeing that high velocities were in no wise essential in their circulation, and that our ordinary changes of weather and shifts of wind were to be regarded as closely related to the hurricanes of the West Indies and other tropical regions. There has been and still is a conservative hesitation to accept so large a generalization, an illustration of which is commonly seen in the slowness of weather services in general to use such a term as "cyclonic" in connection with the "lows," "areas of low barometer," "barometric depression," "barometric minima," and other paraphrases in current use. The demonstration of the occurrence of relatively gentle cyclonic storms in India, and at seasons hitherto regarded as exempt from them, is therefore of particular interest not only as a fact, but also in the historic development of the science.

As regards the cyclones themselves, little is here said in the way of theory. For that the reader should go to the excellent studies on individual cyclones, chiefly by Eliot, in the memoirs of the Indian meteorological department. But the incurvature of the storm winds is clearly stated; and, while full justice is done to the tireless labors of Piddington in earlier decades, the errors into which he was led by following the "eight-point rule," or circular theory of storms, are explicitly pointed out. The true seasons of occurrence, the relative rarity of these storms, their extreme violence, their tracks and moderate progressive velocity, their general failure to cross even the southern point of India, and the advances lately made in announcing their approach, are all well treated. Until within a few years, it was only the violent cyclones of the May and October seasons, originating on the Bay of Bengal, that were understood when Indian cyclones were mentioned; but with the establishment of a system of observing stations, and, still more, with the preparation of daily weather-maps, it has become apparent that cyclonic storms occur in India at other months also, and of moderate intensity. Blanford recognizes the essential identity of the two in origin and constitution; but he thinks it advisable to distinguish them as cyclones proper and cyclonic storms, in order to avoid misapprehension as well as to emphasize their differences. While the former are practically limited to the late vernal and autumnal months, and not more than two violent ones occur in an average year, the latter occur in frequent succession all through the rainy summer monsoon, and also bring the winter rains to northern India. Curiously enough, the cyclonic storms of summer advance toward some point between west and north, while the winter storms move eastward, or even a little south of east. Here is certainly a new characteristic of this interesting region, and, as far as I know, it is not matched in any other part of the world. It is presumably an effect of alternation from a torrid to a temperate position in the general circulation of the atmosphere. Two of these storms are illustrated by weather-charts of several successive days, in which the central barometric depression and the general spiral movement of the surface winds are clearly indicated. In one of the winter cyclonic storms — that of late January, 1883 — there was a distinct sequence of weather changes with the eastward advance of the storm-centre, precisely of the kind that we know so well in these latitudes,— in the front, warm, damp, southerly winds, clouds, and rain or snow; in the rear, north-westerly winds, clear sky and low temperature, a veritable "cold-wave," giving some hill stations their lowest thermometric records. If this sort of thing is typical of Indian winters, it is likely that our term "cold wave" will go into use there, as their term "cyclone" has come to be so valuable with us.

Again, as to the conditions permitting rainfall. While it is understood that rain often occurs independently of cyclonic conditions, — as, for example, the diurnal summer rains of Florida or of mountain-peaks, — it appears, from the weather-maps of this country and Europe, that most of our precipitation is cyclonic, either in widespread rains or snows, or in local thunder-showers, whose opportunity is in good part dependent on cyclonic winds and contrasts of temperature thus induced. Now, the same thing appears in India. Rain there also may be independent of cyclones and cyclonic storms, as at Cherrapunji, on the foot-hills of the Himalaya north of the Bay of Bengal, where the annual rainfall is nearly fifty feet deep, where from April to September there are on the average twenty-five rainy days in a month, and where 40.8 inches of rain have been collected in twenty-four hours (June 14, 1876). Here much of the rain may be "topographic," a re-action of the mountains on the winds; but, as a rule, Indian rainfall is, like ours, cyclonic. The "bursting of the monsoon" is an accompaniment of a summer cyclonic storm; and the alternation of rain, showers, and occasional rainless days in July and August, is but the expression of the passage of a series of summer cyclonic storms. This gives an entirely new aspect to the monsoon rains. All the excessively heavy rains, for which northern India is remarkable, are cyclonic rains, even though recognizable in their true character only when synoptic weather-charts are constructed.

Sind, a dry district in the far north-west, with an annual rainfall only from five to ten inches, and with only from thirteen to thirty rainy days in the year, also is dependent on the cyclonic storms. Rain falls only when, in the summer monsoon, a cyclonic storm comes in from the eastward, and travels as far as Sind before it is broken up; or when, in the winter, one forms in Sind, or passes eastward across it from Baluchistan.

This is certainly a most significant extension of Redfield's acute suggestion. Disturbances in the general atmospheric circulation tend to take the form of convectional whirls, and give forth rain. If the conception of the whirl is rigid and artificial, it will be of little advantage; but if it admit the unsymmetrical irregularities so abundantly illustrated on our weather-maps, it must come to be one of the most significant generalizations that meteorology has brought forth.

Recalling what the meteorological department of India has become under Mr. Blanford's direction, and remembering the high value of his writings on meteorological subjects, we can but wish that his future leisure might be directed to a general work on meteorology, of scope as broad as Schmid's "Lehrbuch," but with the statistical flavor of that book replaced by the physical flavor that characterizes modern meteorology. There is no such work in English, although such a work would have many English readers.

W. M. D.

Numbers Universalized: An Advanced Algebra. By DAVID M. SENSENIG. New York, Appleton. 12°.

THIS volume will eventually form the first part of a higher algebra, soon to be completed, being intended as an advanced elementary algebra. The object in issuing it separately, as we are informed in the preface, is "to meet the wants of such schools as have arranged a higher course in algebra than is outlined and treated in the author's first book, 'Numbers Symbolized,' and yet have not time enough to devote to this branch of mathematics to complete a full course in higher algebra." The book is well adapted to meet the requirements of schools in which students are prepared for entering college, as well as of advanced classes in high and advanced schools.

In his treatment of the subject, the author, who is professor of mathematics in the State Normal School at West Chester, Penn., has aimed to carefully keep intact the logical sequence of thought, avoiding unnecessary difficulties in the discussion, on the one hand, and too great simplicity, on the other. The definitions are well arranged, and concisely expressed in language unusually simple and exact; and illustrations are given only when required by concepts not sufficiently clear without them. The work as a whole is in line with the best school methods now in use, and should be acceptable to students as well as teachers.

AMONG THE PUBLISHERS.

THE supplement to *Harper's Weekly* of July 24 is devoted to the progress made in electric lighting in New York City, the subject being ably treated by Schuyler S. Wheeler, electric expert of the Board of Electrical Control. Mr. Wheeler discusses and explains the subject under the heads of "Generating and Distributing," "Lamps," "Systems of Distribution," "The Alternating Current," and "Construction of the Lines." The article is fully illustrated.