tality from the forming kernels. They were rapidly blighting the grain; and, unless some friendly hand were raised against them, the wheat-crop would be utterly ruined. Even then, when the lice were countless in numbers, and when the winged forms were rapidly spreading to the oat-fields, the hand of deliverance was easily discerned in the comparatively few but wondrously prolific enemies of the lice, which had already sounded a halt in the march of destruction. A week later, and the enemies of the lice were in the ascendency; and to-day the lice are nearly exterminated, and the wheat-crop is rescued and the oat-crop saved. Close observation easily demonstrates these truths. Even the careless eye can see the savage insects dining on the lice, or the fatal egg laid which dooms the louse which receives it.

The fact that farmers are noticing these insects friends, and have now an object-lesson which should be rightly understood and carefully studied, leads Professor A. J. Cook, the Michigan State entomologist, to send out a bulletin on the subject of the enemies of the plant-lice. Some weeks ago he was receiving scores of letters asking about the lice: to-day he is receiving as numerous inquiries regarding these friends. That instruction is opportune is evident from such questions as this: "Are these insects going to complete the destruction so actively begun by the lice?"

There are two groups of these insect friends, — predaceous and parasitic insects, — both of which are well illustrated on the heads of wheat of Michigan fields to-day. Predaceous insects are such as devour their prey, much as the cat or weasel devours the mouse. Parasitic insects are those that lay their eggs on or in their victims. When these eggs hatch, the larval parasite proceeds to feast on its host, which thus serves it for both home and food. In the case before us, as soon as the parasite has devoured the viscera of the louse, it uses the skin or crust as a sort of cocoon. These gray, circular cocoons are now thick among the kernels of every head of wheat, and must have been noticed by every observer who has taken pains to examine. A tiny black fly is by far the most important of these little friends that have come to the farmers' rescue, and saved the wheat, barley, and oat crops.

The lice that are the victims of these eager parasities are easily distinguished. They are short, rounded, and gray in color. After the larva disembowels the lice, it uses the dry, thick skin as a cocoon, in which it changes to a pupa. Very soon the mature insect comes forth from a small round hole in the upper, hinder part of the abdomen, and very soon mates, and commences to lay its many eggs in new victims. Of course, these parasitic larvæ fairly swim in the rich nutritious blood of the lice, and so are rapidly developed. Thus we see how it is that the parasites are too much for the lice. Prolific as are the lice, and rapid as they are in development, yet the parasites are even more so, and thus it is that in ten days the parasites have so outnumbered the lice that the latter have been routed and driven from the field. The little flies are just about one-tenth of an inch in length; but, tiny as they are, they will save millions of dollars to the farmers of Michigan and adjacent States during this single year.

The lady-bird beetles are also very active and most efficient aids in the work of ridding the grain-fields of the *Aphides*. Both as larvæ and as mature insects, they feed on the plant-lice, and rapidly deplete their ranks. The beautiful rounded beetles, usually dressed in yellow or orange, and often adorned with black dots and markings, are known and admired by all. Few insects do more good than do these lady-bird beetles. The larvæ of these are elongated, dark-colored insects, usually dotted with gray, yellow, or orange, according to the species. So the insect not only does well, but looks well. There are also four rows of black dots which extend longitudinally, which are easily seen without a glass. Other species of lady-beetle larvæ are duller in color, and so less conspicuous, yet equally active and voracious. If any doubt the good work of these insects, especially the larvæ, he has but to enclose them in a box with louse-infested wheat-heads, or with plant-lice from any plant. The rapid disappearance of the lice will quickly convince the most sceptical of the valuable service of these predaceous friends. These lady-bird beetles are hardly second to the parasite first described, in the work of ridding our grain-fields of the lice. Professor C. M. Weed believes they take a first place in Ohio in this important service.

By close watching in the wheat or oat fields, one may observe a large number of very rapid flying two-winged flies. Not only are these very quick, but many are lined with yellow bands, and are very beautiful. These flies, for food, only sip the sweets from flowers, but they lay their eggs on the plants among the lice, and the maggots that hatch from these are perfect tigers. These syrphus-maggots seem to be veritable gourmands, as the number of plant-lice that one will suck bloodless is surprisingly great. These maggots look some like leeches or blood-suckers. The posterior end is large and truncated, while the mouth end is pointed. The color of the young ones is olive green, while the older or more mature maggots are gray, brown, or purple. There are light-brown transverse bands on the back, and one longitudinal one on each side. These maggots creep along in a slug-like manner, ever reaching into every crevice for the lice. The energetic zigzag motion of the head is very interesting. When it first finds a louse, it stabs him with its sharp mouth-parts, and quickly sucks him bloodless. As the louse shrinks, the maggot swells up. No sooner is one louse victimized than another is seized, and thus these voracious maggots will often destroy a half-score of lice in quick succession. Students have often suggested that these maggots must have India-rubber stomachs. From their great numbers and ravenous appetites, we must conclude that these syrphus-maggots are little, if any, behind the Braconid fly and the lady-bird beetles in their good services in helping to save the grain-crops.

Then the chrysopa-flies, with their beautiful green lace wings and their brilliant golden eyes, are no mean factor in this warfare against plant-lice. The handsome flies do not feed on the lice, but the larvæ do; and, as they have insatiable appetites, they do excellent execution. These flies lay their minute white eggs on the ends of short hairs attached to wheat-stems, twigs of fruit-trees, in short, to any plant that is harboring plant-lice. The larvæ have strong, sharp jaws, and have well earned the name "aphis-lion," which has been aptly applied to them. These and the syrphus-fly maggots work in confinement, or while we are holding the aphis-infected plant in our hand. The Braconid fly and the lady-bird beetles, on the other hand, are more timid and quite easily disturbed; and so, to see them at work, we must approach them with care, and handle them without the least jar. Thus in these beneficial insects Professor Cook describes the little friends that have come to the aid of the farmers, and banished disaster.

BOOK-REVIEWS.

A Practical Guide to the Climates and Weather of India, Ceylon and Burmah and the Storms of the Indian Seas. By HENRY F. BLANFORD, F.R.S. London, Macmillan. 8°. $3.50.

THE leisure following Mr. Blanford's retirement from the meteorological department of the government of India, which was developed in his charge, has been employed in preparing a general account of the climates and weather of that vast empire; and students of meteorology the world over are to be congratulated on having such a work from so competent a hand.

The book is divided into several parts. Part I. treats of the elements of climate and weather, with particular reference to their Indian features, under such headings as "Temperature," "Barometric Pressure and Wind," "Dampness and Dryness," "Clouds, Rain, and Storms." Here we recognize the same simple directness of statement and rational physical explanation of processes that characterize the author's "Indian Meteorologists' Vade-Mecum." The second part treats of the climatic divisions of the peninsula, giving a brief description of the several areas, such as the hills, — under which respectable mountain-ridges of 5,000 to 7,000 feet are included, — the plains, the plateaus, and the coasts. This is followed by an account of the weather-maps issued daily from Simlá on the basis of nearly one hundred telegraphic reports, the storms of the Indian seas, and the relation of Indian rainfall to water-supply and drainage. Several appendices contain tabular climatic statistics for 92 stations, lists of storms in the Bay of Bengal, and rainfall at 114 stations.

It is difficult to select material for extracts where all is so perti-

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.