2. *These Conditions extend far above our Highest Mountains.*— We find the fluctuations of air-pressure on the advance of these conditions the same at mountain stations as at the base, except that the changes occur later at the summit, for reasons which have been fully set forth in the "Report of the Chief Signal Officer for 1882." The temperature changes, both the rise on the advance of a storm and the fall in its rear, after the diurnal range has been eliminated, are greater on a mountain than at the base, and they occur several hours earlier at the summit. The form which a storm or high area assumes is that of a disk with a height of five to ten miles, and a diameter of one thousand, and it may extend to the limits of the atmosphere.

3. *There is no Marked Movement of Air or Moisture-Particles by Heated Currents from the Earth upward.*— The best proof of this, perhaps, is in the fact that the velocity of the horizontal currents is markedly increased as we rise in the atmosphere, and hence such a movement would be rapidly disintegrated and brought to nought.

4. *There is no Whirl in Either of These Conditions a Few Thousand Feet above the Earth.*— Observations on Mount Washington (6,300 feet) have shown this fact. Unfortunately we have not the data to show just how high the gyratory circulation which we observe at the earth's surface extends, but the limit is probably 3,000 feet. This fact is a most important one to determine, and there is no better region to establish it on the whole earth than the isolated mountain-peaks of New England. Greylock, Ascutney, Killington, Mount Washington, Green Mountain, and a score of others, are all situated right in the path of our storms and high areas, and, it is believed, are destined to aid most materially in solving the riddles which now confront us on all sides.

5. *Their Motion is Independent of the Wind.* — To those familiar with weather science this will be self-evident, but it may be well to simplify this proposition slightly. Let us consider the case of a storm condition moving at thirty miles per hour between two points (*A* and *B*) six hundred miles apart. Let the wind have a velocity of fifteen miles per hour. In twenty hours the exact changes of the wind, pressure, temperature, etc., which took place at *A* will take place at *B*, provided the storm remains constant; but if we had put in the wind at *A* a bit of cotton, or some substance which would go exactly with the wind, at the moment the storm-centre was at *A*, we would have found it just half way between *A* and *B* at the moment the storm-centre crossed *B*. This shows plainly that all the conditions which accompany a storm are practically independent of the wind. The wind blows cold, but it is because a cold wave has passed that way. This may be made still clearer by considering an enormous sphere a thousand or two thousand feet in diameter, and highly heated, at a few thousand feet above the earth. If this were stationary, our thermometers, if delicate enough, would show its pressure, and the wind would transport the heat at its velocity; though it is evident that there would be an exceedingly rapid dissipation of this heat if there were no method of renewal. Suppose this sphere were transported horizontally at thirty miles per hour, and its heat could affect our thermometers instantly: it is evident that there would be a miniature warm wave travelling across the country at thirty miles per hour; but this would be independent of the wind, though it would have a tendency to modify that.

6. *Their Motion is Independent of Air-Currents at any Elevation.* — This proposition will be the most difficult of all to accept, and yet it seems to be abundantly borne out by the facts. During the passage of a storm, the air-current gradually increases in velocity as we rise in the atmosphere. After a certain height is reached, the velocity of this current is diminished. Again, during the passage of a high area the velocity of the current itself is markedly diminished, and, as I have shown, it is half that of the high area at the height of Mount Washington, while during the passage of a storm it is nearly double the storm velocity. Now, it is plain that any condition having any height in the atmosphere would be entirely disintegrated by the varying velocity of the different strata of the atmosphere; and also its motion cannot be due to that of the strata, since this velocity is far greater than that of the storm, and is only half that of a high area. It has also been shown that the direction of motion of storms and high areas is very different from that of the strata far above the earth. One other consideration may be presented. It frequently occurs that storm conditions seem to be transferred through the air without a corresponding depression at the earth's surface, and at a velocity which appears to be far higher than the air strata can have.

This whole subject is exceedingly complicated; and it must be confessed that we must continue to grope rather in the dark until we can obtain the facts which shall enable us to lay the first stone of a consistent theory of these conditions, which are so familiar to us, but of which we know next to nothing. I cannot do better than to close this discussion, without further comment, with the remarkable views of two specialists eminent in this line of research. These views are entirely at variance with the facts observed in this country, and cannot possibly be accepted as an explanation of the phenomena in question. I have already shown, that, owing to the peculiar position of European mountains far to the south-east of the path of storms, we can hope for but little assistance from observation at their summits in elucidating these complex problems.

Dr. J. Hann of Vienna, in a recent publication, has said, "The forces which are in activity in the winter in the air circulation of the higher latitudes arise from the heat of the tropics; that is, from the heat difference between the polar regions and the equatorial zone. Storms and high areas are merely secondary phenomena in the general atmospheric circulation."

Dr. W. Siemens of Berlin has written as follows: "Minima and maxima of air-pressure (storms and high areas) are consequences of the temperature and velocity of air currents in the higher atmospheric strata."

H. A. HAZEN.

Washington, March 9.

BOOK-REVIEWS.

Constructive Steam-Engineering. By J. M. WHITHAM. New York, Wiley. 8°. $10.

THIS descriptive treatise covers pretty thoroughly a rather extensive field, embracing as it does engines, pumps, and boilers, with all their accessories and appendages. The scope of the work is limited, as indicated by the title, to constructive features, design not being discussed. But this does not lessen the value of the book, as nearly every form of engine or boiler that has won recognition in modern steam-engine practice is fully described, illustrated, and discussed. Steam-engine design, as a separate subject, was ably treated in a previous work by the same author, noticed in these columns a year or more ago.

In the preparation of this work the author has had ample resources to draw upon; and he has exercised notable discretion in sifting out essentials from non-essentials in dealing with the mass of material placed at his disposal by the current literature of the subject.

The plan of the work is as follows. A brief classification of the various types of engines comes first. This classification may be summed up as (1) condensing and non-condensing; (2) non-expansive and expansive; (3) simple, compound, triple-expansion, and quadruple-expansion; (4) single-acting, double-acting, and rotary; (5) rotative and reciprocating; (6) stationary, portable, locomotive, and marine. Less important is the further classification into (7) horizontal, vertical, inclined, and oscillating; and (8) erect vertical, inverted vertical, direct-acting, indirect-acting, and beam engines. Exception may be taken to the author's statement, in this introductory chapter, that compound, triple, and quadruple expansion engines have respectively two, three, and four cylinders. Some of them have, as shown in a subsequent chapter, at least one extra cylinder; that is, two low-pressure cylinders instead of one larger one. This, of course, is a small matter; but it would be well to classify the engine in this respect by the number of expansions instead of the number of cylinders.

The second chapter, a very important one, is devoted to heat and steam, embracing a discussion of thermometers and calorimeters. Then comes a chapter in which the constructive details of an engine are illustrated and discussed; after which comes a lucid presentation of the indicator and its uses, and a chapter on the

use, operation, and setting of the slide-valve and independent cut-off, followed by a discussion of the various forms of valve-gears, and of automatic cut-off and throttling engines. A chapter treating of compound and triple and quadruple expansion engines comes next, after which condensers, pumps, and pumping-engines are considered. Next is given a chapter on the miscellaneous attachments and minor details of an engine, embracing stop-valves, throttle-valves, and relief-valves, stuffing-boxes, belting, lubricators, etc., followed by a chapter on the management of engines and pumps, engine trials, and dynamometers.

When the subject of boilers is reached, a chapter is devoted to the theory of combustion and the various types of boilers in use, and another to their constructive details and strength. The concluding chapter of the book treats of the appendages and accessories of boilers, their decay, management, etc.

At first blush, after a hasty glance through the pages of this bulky volume, the price of it would seem too great; but, after a careful examination, that impression disappears. True, the material from which the author evolved the work was abundant and ready to hand, but the illustrations alone (and they are many) "came easy." The labor of working over the material, — putting it "into perspective," as it were, effectively, discriminatingly, and judiciously, — and welding the whole together into a book suitable alike to the needs of the student, the engineer, and the miscellaneous seeker for information, must have been enormous. That the work is well done is certified to by the reputation of both author and publisher.

AMONG THE PUBLISHERS.

THE Forest and Stream Publishing Company announce a new and enlarged edition of "Fly-Fishing and Fly-Making for Trout," by J. Harrington Keene. The book has as illustrations actual specimens of the silk, feathers, and other materials used in fly-making.

— A "Flora of Palestine" is in progress, edited by the Rev. G. E. Post, and is now completed as far as the end of the order *Umbelliferæ*. Several new species are described.

— Among the contents of the *New England Magazine* for March, we note "The Early History of Electricity in America," by George Herbert Stockbridge; "Window-Gardening," by Mrs. Henrietta L. T. Wolcott; "The Indian-Corn as our National Plant," by Sarah Freeman Clarke; "The Problem of the Unemployed," by William M. Salter; and "The History of Historical Writing in America," III., by J. F. Jameson, Ph D.

—Messrs. Ginn & Co. announce "The Industrial Primary Arithmetic," by James Baldwin, Ph.D., to be published in April. This work possesses many features which distinguish it from others of its class. Theory gives place to practice. The pupils