the human mind that should be acclaimed among the capital events of these days. The proposal that they should bear the name of their discoverer is one upon which his brother-scientists should insist. The power of these rays to pass through six feet of solid lead has suggested the name "penetrating rays," and the fact that they are immigrants upon this vapor sphere has suggested the name "in-coming rays"; but they would more appropriately bear the name of the penetrating mind that passed through the miles of space to the far frontiers of our atmosphere and there met these strange forces of the universe coming out of space—the mind that lived among them for years to learn their ways, and at last brought us word of their mysterious existence. "Millikan rays" ought to find a place in our planetary scientific directory all the more because they would be associated with a man of such fine and modest personality.—New York *Times*.

SCIENTIFIC BOOKS

The Climates of the United States. By ROBERT DECOURCY WARD, professor of climatology in Harvard University. Ginn & Company, 1925; 21 by 15 cms, 518 pp., 1 map in color and 145 figures in the text; price $4.00.

THIS book differs from the usual run of text-books, though a college text-book it unquestionably is. It is cleverly camouflaged in appearance and content; and nine out of ten old graduates will not suspect its real character, while eight out of ten eagle-eyed undergraduates, always suspicious of a professor's offering, will after reading the book admit that it is good stuff. And that is high commendation from critical, calculating youth.

The book will appeal to the general reader for various reasons. One is the absence of tables. When in a treatise on climatology extensive tables of mean temperatures, maximum, minimum, mean maximum, mean minimum temperatures, relative humidities, pressures and wind directions are suppressed, it is a sure sign that the author cares little for show and much for the story back of such data. This is one reason why the book is positively entertaining.

Instead of loading paragraphs with details, Professor Ward has kept these within bounds (wisely, we think); but he furnishes numerous footnotes and extensive references.

The opening chapters on the development of climatological work, major climatic controls and the climatic provinces of the United States are presented in a readable manner, details coming in later chapters. The fourth chapter takes up the weather element in our climates; and we are given a full discussion of weather types, which varying seasonally and regionally make up the average sum-total known as climate. There are sixteen figures of storm paths and typical disturbances ranging from winter storms over the northern Plains to the hurricane on the South Atlantic Coast. It would have been a step in the right direction if pressure values in these illustrations had been given in units of force. These take less room in printing and make for clearer conceptions of the magnitude of the pressure gradient. For example, in the typical hurricane (see page 60) instead of 29.30 inches at the center and 30.20 inches at the border of the "high," there might have been printed −8 and +22. Then the student at a glance appreciates the steepness of the slope. He sees a depression of 0.8 (of one per cent.) contrasted with an excess 2.2 per cent. In other words from north to south there is a gradient of three per cent. of a standard atmosphere. Also it would have been an improvement if Professor Ward had broken away from Fahrenheit temperatures. True, the slow-moving people of these United States cling to the scale devised by the German instrument maker in 1714; yet no German today uses that scale; and there are some seven hundred million people in the world—not counting our own chemists, physicists and men of science generally—who have scrapped it.

The chapter on temperature, the longest in the book—fifty pages—is a mine of information. We must, however, call attention to the charts of lowest and highest temperature ever observed (Figs. 47 and 48). These are based upon the climatic charts of the United States, official but inaccurate and misleading. Professor Ward in the text gives records which contradict the chart values. Following the discussion of temperature, we have rainfall and prevailing winds. In the diagrams of types of rainfall, values are given in millimeters as well as in inches; which is in accord with British practice. We wish our Weather Bureau would get in step with the rest of the world.

The use of correlation coefficients in the discussion of rainfall is avoided. Of late this method has been somewhat overworked. It has been shown, for example, that there is a high correlation between the rainfall at Jerusalem and the growth of the Sequoia gigantea in California. This has been discussed elaborately in some treatises on quaternary climates; yet who can believe for a moment that there is any direct causal relation between these two sets of data?

Snowfall, humidity, sensible temperature, sunshine, cloudiness and fog are treated at some length. There is an interesting paragraph on dark days; and we are told the incident of the interruption of proceed-

ings in the legislature of Connecticut on May 19, 1780, when the doughty Davenport of Stamford protested against adjournment:

> Either the day of judgment is at hand or it is not. If it is not there is no cause for adjournment. If it is, I wish to be found in the line of my duty. I wish candles to be brought.

As a loyal son of Harvard, the professor might have stretched space a little to tell of that good President Wigglesworth who on this same day read his Bible by a window. There had been thunder and rain in the morning. At 11 o'clock fowls went to roost. At 12:21 Mr. Wigglesworth, the darkness still increasing, could not read the running title of the large Bible. Candles were lit. At 1:12 the degree of light was the same as at 11 o'clock, which was determined by Mr. Wigglesworth's reading. So the day wore on. Observations of pressure and temperature were made every hour. A detailed account of the happenings on this day was kept by Nathan Read, a student at Harvard, and is now in the possession of the Essex Institute.

Tornadoes, cold waves, northers and blizzards are discussed; also hot waves, sunstroke weather and the Indian summer.

Concluding chapters deal with climate and health and climate and crops; and the final chapter is on the climates of Alaska. We are pleased to note the plural. It is well to have an authoritative word on this, because of the popular impression that rigorous weather is the rule. Indeed, one of the world flyers lately, when asked about the climate of Alaska, answered that there were only two seasons—this winter and the next. On the contrary, notwithstanding great contrasts, there are many localities where climate is not essentially different from that of our North Pacific states.

General Greely's "Handbook of Alaska" (third edition, 1925) will be found of great value to those interested in this matter.

Professor Ward has done a good service to all university instructors in climatology and economic geography by assembling in one convenient volume the essential facts of climatic conditions in the United States. His twenty-five years' experience as a teacher has enabled him to meet the needs of teachers and students primarily; but also he has given us a volume which agriculturists, medical men, business men and others may profit by reading.

The book deserves and probably will have a wide circulation.

ALEXANDER MCADIE

BLUE HILL OBSERVATORY

SPECIAL ARTICLES

FLAMES OF ATOMIC HYDROGEN

A STUDY of the heat losses from tungsten filaments at very high temperatures in an atmosphere of hydrogen led the writer to conclude in 1911[1] that hydrogen is largely dissociated into atoms at temperatures of 2500°K or more. The total heat loss from the filament after subtracting that due to radiation increased in proportion to the 7th power of the temperature at temperatures over 2700°K, whereas the normal heat loss by convection, as determined for example in nitrogen, should have increased with the 1.8th power of the temperature. Further work showed[2] that by heating a platinum or tungsten filament above 1300°K in hydrogen at low pressures, atomic hydrogen was formed which had very remarkable properties. It would dissolve at ordinary temperatures in platinum and would be condensed on glass surfaces at room temperature and at this temperature combined instantly with oxygen, phosphorus and reduced oxides such as WO_3, CuO, Fe_2O_3, ZnO or PtO_2. More accurate measurements of the heat losses from tungsten filaments in hydrogen at various pressures[3] gave 90,000 small calories as the heat of combination of 2 grams of atomic hydrogen, and showed that the degree of dissociation at atmospheric pressure increased from about 2 per cent. at 2400°K to about 34 per cent. at the melting point of tungsten.

In attempting to obtain the Balmer spectrum of hydrogen without contamination by the secondary spectrum, R. W. Wood[4] built very long vacuum tubes in which he passed currents of amperes through moist hydrogen at a few millimeters pressure. He observed many remarkable phenomena. Short pieces of tungsten or platinum wire mounted in a side tube became heated to incandescence, although no electric current flowed through this tube and the glass walls near the wires were not heated strongly. These effects were nearly absent when the hydrogen was carefully dried. In correspondence with Professor Wood, the writer suggested that these effects were due to high concentrations of atomic hydrogen which could accumulate in the tube because of the effect of water vapor in poisoning the catalytic activity of dry glass surfaces that otherwise destroyed the atomic hydrogen. With moisture present the atomic hydrogen diffused through

[1] Langmuir, Trans. Amer. Electrochem. Soc. 20, 225 (1911) and Jour. Amer. Chem. Soc. 34, 860 (1912).

[2] Langmuir, Jour. Amer. Chem. Soc. 34, 1310 (1912); Freeman, Jour. Amer. Chem. Soc. 35, 927 (1913).

[3] Langmuir and Mackay, Jour. Amer. Chem. Soc. 36, 1708 (1914), 37, 417 (1915) and 38, 1145 (1916).

[4] R. W. Wood, Phil. Mag. 44, 538 (1922).