this admirable work and hope that more is in store for us.

We, who are about to be shelved, used to live in this country, peacefully under the constitution and we were quite happy in our simplicity. One day a man by the name of Einstein came along and mixed that constitution up. We were told that it had long been an antiquated document anyway. There were difficulties, but eventually we managed to fit in; for they had left us, at least, with the doctrine of energy. Now, I read that the classical law of the conservation of energy must also go, that at best it is only statistical like the second law of thermodynamics. Truly these young bloods are Balkanizing the whole of physics and our ancient constitution has gone the way of the mark.

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SCIENTIFIC BOOKS

Trees of Indiana. By CHARLES C. DEAM, State Forester of Indiana. First revised edition. 317 pages; 137 plates. Publication 13 of the Department of Conservation, State of Indiana. April, 1921.

THE forerunner of the present work, under the same title and by the same author, was issued in 1911. So great was the demand for that book that the edition of 10,000 copies lasted only three years, while a second edition, printed in 1919, was exhausted within five days of publication. The present "first revised edition" is fundamentally a new work, with new illustrations and completely rewritten text.

During the past decade numerous "tree books" have been issued by various state organizations, but it is doubtful if any of these contain more original matter than the present work. Certainly none of them contain more local color. The botanical descriptions are based on Indiana material, and the illustrations are photographed from Indiana specimens, while the distributional peculiarities in Indiana of the various species are treated in gratifying detail. It is in this latter particular, perhaps more than any other, that the book will prove of service to the general botanical public. In the course of his studies of the flora of Indiana, the author, within the last ten years, has traveled more than 27,000 miles, by auto, and has visited every county and traversed practically every township in the state. As a result he is able to present, at first hand, a wealth of detail in regard to local tree distribution, not to mention various other observations which bespeak intimate familiarity with the tree flora of the state. The attention given to the ecological relations of the different species is especially worthy of note, and this feature alone will recommend the work to a wide circle of readers.

GEORGE E. NICHOLS

NOTES ON METEOROLOGY AND CLIMATOLOGY

SKY BRIGHTNESS AND DAYLIGHT ILLUMINATION

What is the relation between sky brightness and the electric light load carried by the central lighting plant? How much sky-light will be cut off by a row of buildings on the opposite side of the street These questions and many others may be solved by studies of the brightness of the sky and daylight illumination such as have been carried out by Dr. H. H. Kimball, of the Weather Bureau at Washington. The practical utility of such investigations is attested by the interest shown by illuminating engineers, architects and electrical engineers. A paper, recently appearing in the *Monthly Weather Review*,[1] summarizes with considerable detail a report submitted to the Illuminating Engineering Society, of whose committee on sky brightness Dr. Kimball is chairman.

The observational program which has been followed in making the measurements has been to make photometric readings with a Sharp-Millar photometer at elevations of 2°, 15°, 30°, 45°, 60°, 75° and 90° above the horizon on vertical circles at azimuth intervals of 45° beginning with the sun's vertical and proceeding half-way around the horizon. Only half the sky is measured because it is assumed that the

[1] Kimball, H. H., and Hand, I. R.: Sky brightness and daylight illumination measurements. Sept., 1921, pp. 481-488.

brightness distribution is symmetrical about a vertical semicircle passing through the sun. Such measurements were made on days that were (1) perfectly clear, (2) overcast with thin clouds or dense haze, (3) completely overcast with clouds or dense fog, so that neither sun nor blue sky could be seen, (4) overcast with clouds from which rain or snow was falling, and (5) partly overcast, in an irregular manner.

On clear days it was found that the sky brightness at Washington has somewhat the following distribution: The brightest part of the sky is, of course, that close about the sun. The darkest part is that in the solar vertical about 90° distant from the sun. In general, the sky increases in brightness toward the horizon, although there is a "dark valley" extending from the dark point in the solar vertical to a point about midway between the sun and the horizon. This distribution agrees closely with that observed by Dorno at Davos, Switzerland, except that the Swiss sky is brighter than that at Washington. This difference in brightness is probably the result of secondary reflection of light from the Alpine snows. In comparison with observations made at Chicago University and on the roof of the Federal Building in "Loop" district of Chicago, it was found that the distribution there is much the same, except that the horizon opposite the sun is darker at Chicago than at Washington. This is attributed to smoke, from which the Washington atmosphere is particularly free.

The brightest type of sky measured at Washington is that completely overcast with thin clouds or dense haze. With clouds from which rain is falling, the distribution is about the same as with thin clouds, but its intensity is only half as great.

Measurements of the illumination on horizontal and vertical surfaces were made at Washington and at the two Chicago stations mentioned above. It was found with respect to the variations with change of solar altitude that the illumination on horizontal surfaces increased markedly with increase of solar altitude; but in the case of illumination on vertical surfaces the difference between a surface facing the sun and one oppositely directed grows less with increase of solar altitude. Moreover,

> The daylight illumination on a vertical surface facing opposite the sun, and with an unobstructed exposure to the sky, in the Loop district of Chicago under summer conditions as regards smoke, averages only about two thirds as intense as illumination on a similarly exposed surface at Washington under similar sky conditions with respect to clouds, except when the sun is more than 40° above the horizon and the sky is clear.

The equation,

$$\text{Tan } \theta = h/w\sqrt{1/(1 + \tan^2 x)},$$

is given for computing the shading effect of buildings on the opposite side of the street. θ is the angular height of a building as seen from the center of a window across the street, the width of the street being w. The horizontal angle between a normal to the window and a line joining a point p on the building opposite is x, and h is the height of the obstructing building above the point p. The author gives a table showing the relation between x and θ for various values of h/w. Attention is directed to the fact that the horizon is the most effective illuminating agent for vertical surfaces, hence buildings and other objects on the horizon are the most serious obstacles in the question of illuminating rooms through vertically placed windows, especially with a clear sky.

Two interesting examples of the relation between electric light load and sky brightness are given. At Washington, on July 15 and 29, 1921, there occurred thunderstorms about 2:30 p.m. and noon, respectively. On the former occasion, the daylight intensity fell rather quickly to about one foot-candle and the sudden increase in electric light load caused by the nearly simultaneous turning on of thousands of electric lights was sufficient to put the power plant out of commission. The statistician for the company states that

> During the day in the business section a sudden increase in current consumption occurs when the day light illumination intensity falls below 1,500 foot-candles. The lower the intensity, the higher the current consumption, but fluctuations in intensity above 1,800 foot-candles have only a negligible effect.

It appears that some arrangement whereby power companies supplying large cities could have recourse to observations of daylight illumination, especially during the thunderstorm season, would be of decided benefit to them, for the falling off of this illumination would afford an index as to the proper time to prepare to supply additional current.

This sketch is sufficient to indicate the character of the important work being done by Dr. Kimball and to suggest some of the industrial benefits to be derived from the study of daylight under various types of cloudy and smoky sky.

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ON STEREOTROPISM AS A CAUSE OF CELL DEGENERATION AND DEATH, AND ON MEANS TO PROLONG THE LIFE OF CELLS

IN former investigations we have shown [1, 2] that amoebocytes of Limulus have the tendency to move and to spread out in contact with solid bodies. We thus found another instance of a reaction which is common to many kinds of cells and which we observed and analyzed in 1897 and subsequent years and which we designated as stereotropism of tissue cells [3].

We further found that the blood cells of Limulus, as a result of this stereotropic response and the concomitant spreading out of their protoplasm along the surface of the solid body, underwent degenerative changes; they lost their granules, became hyaline and gradually motionless and then died. There was some indication that this spreading out of the cells was accompanied by a taking up of fluid from the surrounding medium and that this led to processes of solution which initiated the retrogressive changes. [1, 2, 4]

In order to prolong the life of these cells it was therefore necessary to retard this exaggerated stereotropic response which led to a spreading out of the cell in contact with the solid body. We found previously that this can be done not only by keeping the cells at a lower temperature, which retards other activities as well as the stereotropic reactions and is therefore not specific, but in a specific manner by enabling the cells to rest on a surface previously covered with a thin film of paraffine or vaseline. [4] In contact with such a surface the spreading out of the cells is considerably retarded and the life of the cells and the duration of their amoeboid movement is prolonged. In carrying out these experiments, we make use of the experimental cell fibrin (amoebocyte) tissue, a small piece of which we place on the prepared surface and surround with the desired kind of fluid.

Last summer at the Woods Hole Marine Biological Laboratory we continued these experiments with the cooperation of Mr. K. C. Blanchard [5] and found an additional method of preventing the extension of the cells and thus to prolong their life and activities. This can be accomplished by making the medium into which the cells enter from the piece of tissue very slightly acid, an observation which agrees with our previous finding according to which the cells perish in a neutral solution of isotonic sodium chloride, but are preserved in such solutions after addition of a very small amount of either acid of alkali.[2]

In our recent experiments we found that in such slightly acid media the cells leave the tissue in dense masses and continue to move for a considerable period of time; they are preserved, their spreading out is much retarded and their motor activity in consequence much prolonged. In alkali the cells are likewise preserved for some time, but they begin to spread out and become dissolved much earlier than in acid.

It is possible to grade the effect of acid upon the cells. If the acid used is too strong and

1 Leo Loeb, *Journal Medical Research*, 1902, II 145. *Virchow's Archiv.* 1903, Vol. 173, 35.

2 Leo Loeb, *Folia Haematologica* 1907, IV 313. *Pflüger's Archiv.* 1910 Vol. 131, 465.

3 Leo Loeb, *Archiv. f. Entwickelungsmech.* 1898 VI 297. *Anatomical Record* 1912, VI 109.

4 Leo Loeb, *Washington University Studies* 1920 VIII 3. *American Journ. Physiol.* 1921, Vol. 56 140.

5 These experiments will be more fully described by the writer and Mr. K. C. Blanchard elsewhere.