all organisms, plant or animal, the direction of evolution, *i.e.*, whether from simple to complex or from complex to simple, haunts us. Hutchinson is a believer in the hypothetical views of the origin of the higher plants which was put forward by Arber and Parkin some years ago, which hypothesis would derive the flowering plants from the complex Mesozoic cycadophytes, hence simplification of floral parts (reduction) always characterizes derivative groups and complexity of floral organization characterizes primitive groups.

As a general principle this may well be doubted, and it certainly loses much of its cogency when other than floral structures are considered. But taxonomists started with flowers and the millennium will doubtless be in the offing before they can make intelligent use of the rest of the plant. I would not wish to imply that reduction is not often the mode of evolution, *e.g.*, Hutchinson is obviously right in considering Najas reduced and not primitive, as it has frequently been considered.

Hutchinson has found it necessary to reshuffle the Liliaceae and Amaryllidaceae, and this I can not commend too highly. The old criterion between the two families—superior ovary in the former and inferior ovary in the latter, is boldly discarded. His criterion is largely the type of the inflorescence. Thus the Amaryllidaceae get the tribes Agapantheae, Allieae and Gilliesieae; the tribes Trilliaceae, Smilacaceae, Ruscaceae, Xanthorrhoeaceae, Alstroemeriaceae, Velloziaceae, Hypoxidaceae and Agavaceae are given family rank, as indeed many of them have in previous taxonomic schemes. There is also considerable shifting of genera back and forth.

The actual geological history of the Monocotys is for the most part unknown. Certainly too little is known to afford any check on the conclusions of the present work. Pondweeds, palms, grasses and sedges are already present in the Mid-Cretaceous, so that if evolution has proceeded, as outlined by Hutchinson, we are obliged to visualize an unsuspected antiquity for the lilies and buttercups.

I could wish that the climatic regions were more sharply drawn, *e.g.*, Tillandsia is hardly confined to the tropics and subtropics, and some of the most striking genera of the Bromeliaceae occur in the temperate altitudinal zone in the Andes. More of the excellent distributional maps would have added to the text, and there are minor points that might be criticized; thus I can not conceive southwest Australia as the original home of anything primitive, *cf.* Anarthria of the Restionaceae.

The book represents a tremendous amount of intelligent work and I find it extremely stimulating and very useful. I do not see how any botanist, except the most narrow, can but derive a great deal of pleasure and profit from it. I hope that it will be provocative of much more discussion than I believe it will, human beings being what they are. The author is to be congratulated in having formulated a much more consistent and better scheme for the Monocotyledons than that of any of his predecessors, in spite of what the ultimate fate of his views may be.

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METEOROLOGY

Physical and Dynamical Meteorology. By DAVID BRUNT. xxii + 411 pages, with 112 figures. Cambridge, England: At the University Press. New York: The Macmillan Company, 1934. $7.00.

SOME twenty-two centuries ago meteorology already was accounted an important science; so important indeed that the discriminating Aristotle wrote a sizable and excellent book on it. Then for two millennia the rains came and the winds blew with never an explanation of how or why—curiosity was inhibited by faith and inquiry estopped by authority. Slowly came a drowsy awakening, with a few observations and the foreshadowing now and then of some meteorological fact; and in the midst of this awakening a galvanic shock to alertness by the invention of the telegraph, by means of which a vessel, a fleet or a community could be warned of a coming storm many hours before its arrival. Finally, at the beginning of this century, all the world became air- and weather-conscious, since when the science of meteorology has been going faster and faster on the wings of the flying machine.

Not long ago meteorology was a descriptive subject that required no preparation to study and but a few weeks' time to master, whereas to-day it ranges nearly the whole field of classical physics with all the mathematics that implies. The now formidable state of this science is convincingly illustrated by the book under review, though it ranges but half the field implied by its title, omitting atmospheric electricity and meteorological acoustics. Applied meteorology of every kind and climatology also are omitted, and indeed are no proper parts of the subjects under discussion.

After a brief account of descriptive meteorology, as a background of facts, the author develops neatly, and with many equations, the thermodynamics of both dry and humid air, including, of course, the necessarily tedious discussion of the temperature and pressure changes in a rising mass of air through its dry (precondensation) stage, rain stage and snow stage. Entropy is illuminatingly discussed and wet-bulb temperatures shown to be full of valuable information when treated with proper mathematical respect.

The next topic is of the utmost importance, exceed-

ingly difficult and, as yet, but imperfectly understood, namely, radiation, both solar and terrestrial, and absorption, including their various effects on the atmosphere. Here the author is dealing with one of his favorite subjects and the result is correspondingly excellent, even though his widely distributed castigations may seem a trifle severe. Then the subject changes to a discussion of the motions, both horizontal and vertical, of a compressible fluid over a rotating sphere and the interactions of passing discrete currents of this fluid upon each other. These problems give pause to the beginner, but they have the advantage of being more fully solved than almost any others in the whole field of meteorology.

Following this are 61 pages on atmospheric turbulence and associated problems, pages which fortunately, and despite their importance, not many practical meteorologists have to master before entering upon their work. Sixteen pages of mathematical reasoning are given to the transformations of energy in the atmosphere. After this the problems of the genesis and maintenance of the cyclone and anticyclone are discussed. This leads quickly to a consideration of discrete air masses and their fronts, in which all that has been done in "air mass analysis" is given a friendly but unstampeded judgment.

The last chapter discusses with equal frankness the general circulation of the atmosphere, about which, physical geographies and elementary works on meteorology to the contrary notwithstanding, astonishingly little is really known.

A few brief but useful tables make up an appendix, and there is a good index. But what of the errors? There aren't any, worth mentioning.

Many a meteorologist will find this book hard reading, but it is so valuable that he should keep it, like Shakespeare and the Bible, close at hand for appearance's sake, at least.

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SPECIAL ARTICLES

FURTHER OBSERVATIONS ON THE POTENTIAL RHYTHMS OF THE CEREBRAL CORTEX DURING SLEEP

IN a previous communication[1] we have reported certain observations made on human subjects whose brain rhythms have been recorded as they appeared between two electrodes placed on the forehead and crown of head. The record of each subject was usually of seven hours' duration, starting as the subject retired. Customarily the subject's pulse rate, respiration rate and any movements made during the night were also recorded. The outstanding discovery was that trains of regular waves of a particular character could be produced when certain sounds were made while the subject was asleep. The same sounds produced no waves when the subject was awake.

Since the previous communication the installation has been extended so that the rhythms from two parts of the head could be recorded simultaneously by means of two matched amplifiers and recorders. These were checked, prior to each run, against sinusoidal potentials of known frequency and voltage. The three electrodes were placed on the midline: one on the high forehead, the second on the crown and the third on the occiput. The region between the first and second electrodes will be referred to as the "front area" and that between the second and third electrodes as the "back area." Eleven persons ranging in age from 5 to 48 years have been investigated either during an all-night sleep or an after-lunch nap.

[1] SCIENCE, 81: 597, 1935.

We have distinguished at least four characteristic types of waves which have appeared in both areas. Fig. 1 shows typical examples, which we have named for convenience of description (E) spindles, (D) trains, (C) saw-tooth, (B) random.

When an adult subject first retired for the night, "trains" appeared in both areas in great number. These continued after the subject had fallen asleep for some time, gradually becoming less numerous, shorter and of lower amplitude, finally changing to the "random" type. This change is illustrated in Fig. 1-A. If the subject awakened during the night the "trains" usually appeared at once and then changed gradually to the random type as he sank into deep sleep again. The impression was gained that a change in the level of consciousness was connected with this change in type of wave. Children and young persons in very deep sleep showed the random type predominantly with only occasional trains or spindles. A sudden change from the random type to trains could be caused by speaking to a drowsing subject. In every case observed both areas have changed in the general type of wave simultaneously.

On the other hand, when trains and spindles were appearing in both areas, the individual trains and spindles usually showed no correspondence in time of appearance. They might appear in the front area with none in the back, and *vice versa,* or they might appear simultaneously in both but last for a shorter time in one, or their frequency might be different. All possible degrees of correspondence as regards