orous and interesting papers and addresses is a fact to encourage other octogenarians not to let their faculties rust. Dr. W. W. Keen, who is in London now to attend the meeting of the International Surgical Society, took part in what he calls the "horrible surgery" of the American Civil War, and has lived to be able to contrast it with that of the world war of 1914–1918. He himself was a pioneer of antiseptic surgery in America, and the longest article in the book is appropriately entitled "Before and after Lister." In other papers he denounces antivivisection, and advocates abstention from alcohol. But the book is not confined to professional subjects. In an address delivered in 1913 in connection with the hundredth anniversary of peace between Great Britain and America, Dr. Keen tells how, a few days before he spoke, he had been one of the signatories to an address beautifully engrossed on vellum, to be presented to the German Emperor, congratulating him on the fact that on June 15 of that year he would complete a twenty-five years' "reign of unbroken peace." Alas! in the following year the Emperor plunged into the great war, and Dr. Keen italicizes his conclusion that the world's hope lies in the amity, cooperation and solidarity of all the English-speaking peoples.

Medical ceremonials seem to have an attraction for Dr. Keen, and he gives pleasantly readable accounts of some graduation and other celebrations in which he has taken part—at Edinburgh, St. Andrews and Upsala. He also tells the story of the early years of Brown University of which he is a graduate. Though the author is now eighty-six years old, his outlook is rather that of a young man, and he concludes his book with a "message of hope" to the sufferers from malignant disease, if only they will seek advice and treatment early. Some of his cases were enjoying life fifteen and twenty years after operation, and he holds that there is a great field for X-rays and radium. Long may he himself continue to write reminiscently for the edification of the generation which is still in the fighting line of medical and surgical duty.—*The British Medical Journal.*

SCIENTIFIC BOOKS

The Preparation and Significance of Free-air Pressure Maps for the Central and Eastern United States. By C. LEROY MEISINGER, Monthly Weather Review Supplement 21, Washington, 1922, 4to, 77 pp., incl. tables, 31 diagr. and 22 charts.

THIS monograph is a milestone in the progress of American barometry. The last milestone was Frank H. Bigelow's "Report on the barometry of the United States, Canada and the West Indies" (Report of the chief of the Weather Bureau, 1900–1901, vol. II). The foundation of the daily weather map for forecasting purposes has always been the distribution of pressure at sea-level. Sea-level was the natural choice, because the forecasting began as storm warnings for navigators of the ocean. With the spread of the network of meteorological stations over the United States to elevations greater than 1,000 feet, the addition of fictitious air columns of great height in order to get "sea-level pressure" was recognized as a serious source of error. Bigelow very ingeniously patched over this difficulty, in part, but a satisfactory result was not attainable for the elevated western half of the country. Bigelow made an attempt at reducing pressures to levels 3,000 and 10,000 above sea-level, but his temperature argument, based on average temperature gradients of all weather, was too great a source of error. He had done enough, however, to make meteorologists hope for results helpful in forecasting, if accurate maps for levels in the free air could be made. Our weather occurs in the air, not at sea-level underground.

The long-needed revival of free-air pressure maps came as a result of the demands of aerial navigation during the war. Ocean navigation required forecasts from maps of sea-level conditions: now aerial navigation needs forecasts from maps of flying-level conditions. The widely separated observations by means of kites were wholly inadequate for the construction of synoptic free-air pressure maps. But the information gained as to temperatures at different heights provided the data necessary for the construction of reduction tables which could be used at other stations throughout the central and eastern United States. Dr. Meisinger found that for any month the vertical gradient in temperature up to 2 km. over any kite station was practically the same on every occasion with the same wind direction at the ground. He found also that the transitions between kite stations were so smooth that interpolations gave values sufficiently approximate for use over stations where free-air temperatures had not been observed. Thus, the construction of free-air pressure maps for levels such as 1 and 2 km. above sea-level was possible, merely from surface temperatures and wind directions, when based on average temperature gradients interpolated from the kite stations.

The laborious steps by which this possibility was developed into a practicability were, briefly, as follows: First, Dr. Meisinger determined for each kite station the vertical gradient in temperature to 1 km. and to 2 km. above sea-level, with each of the eight wind directions at the ground, in each of the twelve months. These he expressed in terms of the difference between the surface temperature and the mean temperature of the air column to each height. Second, these differences were mapped for each level for each wind direction for each month, lines of equal

difference being carefully interpolated between the kite stations. Third, about thirty Weather Bureau stations were chosen and the values for each determined from the maps, due consideration being given to the altitude of the station as compared with those of the kite stations. Given the surface temperature and wind direction at any station, an approximate mean temperature of the air column could now be obtained, which on substitution in the hypsometric formula would give the pressure at the required level.

Now Dr. Meisinger tested the accuracy of his results by constructing free-air pressure maps from the surface observations at the selected stations and comparing these with observations made at kite and pilot-balloon stations. In spite of errors to be expected from departures of actual from average gradients, owing to (1) the length of time the wind had been blowing from the observed direction, (2) the strength of this wind, (3) the prevalence of unseasonable weather, *e.g.*, March weather in April, (4) the presence of an unusual condition aloft, (5) errors of interpolation and (6) local influences on surface temperature and wind direction, 72 per cent. of the computed barometric values were within 0.05 inch of the observed values, and maps based on computed values were in most cases practically identical with those based on free-air observations made at the time.

From December 1, 1922, to February 28, 1923, 29 stations, each supplied with different barometric reduction tables, made daily postcard reports of computed pressures at 1 and 2 km. above sea-level. Dr. Meisinger checked and mapped the data as they arrived. The forecasters of the central office followed the new maps with interest, and have been considering whether they could be used in daily forecasting sufficiently to justify having the values made a part of the regular morning telegraphic message.

Aeronautical meteorologists and aviators, however, have long since made up their minds, and are asking for upper-air maps as a daily background for the more or less scattered and intermittent indications of winds at flying levels given by pilot balloons and by clouds. At the April 16, 1923, meeting of the American Meteorological Society the troubles of two aviators on the preceding day were cited. In two airplanes they attempted to fly from Moundsville, West Virginia, to Washington, D. C., along the Model Airway. In doing so, however, both had to fly through clouds in winds of unknown speed and direction. One soon descended on a field from which he could not rise. The other, after some very trying hours in the cloud, landed in the vicinity of Quantico, Virginia. A map of winds aloft, computed from maps of pressures at the 1 and 2 km. levels, would probably have been sufficient in the one case to prevent the mishap, and in the other to reduce the anxiety and prevent going beyond the destination. Pilot balloons are useful wind indicators in clear weather, and clouds in partly cloudy to cloudy weather, but computations serve in all weather. Daily telegraphic maps of computed pressures and winds checked by simultaneous pilot balloon and cloud observations are within reach and can provide the entire eastern half of the United States with fairly reliable indications of winds at flying levels in even the thickest weather.

As our forecasters now forecast the distribution of surface pressure, winds and temperature, so also they can forecast the winds at flying levels 12, 24 or 36 hours in advance. The new barometric reduction tables can be applied to these forecast values to predict the distribution of pressure at the 1 and 2 km. levels, and hence of wind direction and velocity over any part of the central and eastern United States.

The long standing barometric reduction problem of the elevated western states may be attacked along the same lines as in the east, as soon as kite stations are established and records obtained. The computation of pressures at heights greater than 2 km. should also prove practicable by the methods evolved by Dr. Meisinger.

CHARLES F. BROOKS
CLARK UNIVERSITY

Magnetic Declination in the United States for January 1, 1920.[1] By D. L. HAZARD.

THE title of this publication only partly suggests the valuable material it contains. The magnetic declination in the United States, northern Mexico and adjacent waters, referred to January 1, 1920, as well as the present rate of its annual change, is graphically shown on an isogonic chart, scale 1:7,000,000. The 30 pages of text, however, contain matters of equal interest.

The early land surveys in the United States were made by compass, and boundaries in many old deeds are referred to compass bearings. In order to retrace these the surveyor must not only know the present variation, or declination, of the compass, but must be able to determine what it was at the time of the original survey. This paper contains a table of the values of the declination at one or more places in each state, 108 such places in all, for which the declination is given for each decade since the earliest available determinations, going back in some cases to the year 1750. It is not to be assumed that actual determinations were made at the selected points in each of the years named, but that the tables are made by process

[1] Washington, D. C., U. S. Dept. Comm., Coast and Geod. Surv., *Spec. Pub.* No. 90, 1922 (30 with chart). 23 cm.