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.

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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.

of grouping so that a mean result refers to a mean position. This is now possible by reason of the present state of knowledge of the general distribution of declination, and of the general nature of the movement of the secular-variation curves across the country.

The surveyor need not in general concern himself with questions of diurnal variation, but in careful work it should be considered. A table of the mean departure from the mean of day at different seasons at the five magnetic observatories operated by the Coast and Geodetic Survey for each hour of the day is given in convenient form.

A considerable space has been given to detailed methods of finding the true meridian by observations of the sun and of Polaris, so that a surveyor having quite simple equipment may determine for himself the declination at any desired station. Tables are provided so that any person, with nothing more than a plumb-line and simple carpenter's tools, may easily lay off a true meridian anywhere within the United States by observations on Polaris. The tables are extended to the year 1932. More precise methods are explained for those equipped with a surveyor's transit or its equivalent.

While intended primarily for the use of the land surveyor, the book will be found to contain much interest for students and teachers of physics and surveying, supplementing helpfully the rather inadequate chapters on terrestrial magnetism in most general text-books on these subjects.

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SPECIAL ARTICLES

X-RAYS AND CROSSINGOVER

WHEN two or more Mendelian characters which enter a cross from one parent are found to be associated in a greater number of the offspring than could be the case if they segregated independently, the characters are said to be linked. In such a cross the offspring in which the characters are not associated are said to owe their origin to crossingover, the term referring to a process believed to occur in the chromosomes. The percentage of the total offspring in which crossingover occurs is the crossover value for the two characters in question. A small crossover value means a close linkage of the characters and a large crossover value a loose linkage. When a normal, wild-type fruit-fly (Drosophila melanogaster), to take an actual example, is mated with a black-bodied, purple-eyed and curved-winged fly the heterozygous offspring obtain the factors for the three mutant characters from one parent. If now the daughters of such a cross are back-crossed to black purple curved males, a majority of their offspring will be either wild type or black purple curved, showing that these characters are linked (in this case in the second chromosome). There will be also a number of offspring in which the characters are not associated, *e.g.*, normal bodied, purple eyed and curved winged and black bodied, normal eyed and normal winged (crossingover between black and purple), normal bodied, normal eyed and curved winged and black bodied, purple eyed and normal winged (crossingover between purple and curved) and normal bodied, purple eyed and normal winged and black bodied, normal eyed and curved winged (double crossingover). The percentages of crossingover between the characters mentioned have been accurately determined independently by Bridges, Muller and Plough and a summary of their results is given by Bridges and Morgan.[1] They give as the weighted averages of all previous determinations for crossingover between black and purple, 6.2 per cent., the determination having involved somewhat over 50,000 flies, and for crossingover between purple and curved, 19.9 per cent., this determination having involved somewhat over 60,000 flies. It should be added that the determinations by the different investigators are in agreement.

The investigation to be described in the present paper included two experiments. In the first of these twenty sisters from the mating of a wild type female with a black purple curved male were used. Eleven were kept as controls and nine were X-rayed for 3 minutes and 15 seconds at a distance of 23.5 cm from the tungsten target, the Coolidge tube being operated at 50,000 volts and .05 amperes. Previous experiments had shown that the temperature in the X-ray box in which the flies were exposed did not vary from that of the room by more than 1° C. On the day after the X-raying all of the twenty females were mated to black purple curved males and placed in individual culture bottles. The pairs, control and X-rayed, were changed to new bottles every three days until the eighteenth day when they were killed. The offspring coming out in the bottles were counted daily until the seventeenth day after mating. The second experiment was performed in the same way with the following exceptions: the control contained eleven pairs and there were twenty-seven pairs in which the females were X-rayed. The X-ray treatment was the same except that the time was shortened to 3 minutes. The females were mated immediately after being X-rayed and were transferred to new bottles every three days until the twelfth day when they were killed. The flies coming out in the culture bot-

[1] Publ. No. 278 Carnegie Institute of Washington, p. 123.