public health is given first place in the enumeration of the practical applications of our science. There is need of general cooperation between medical men and meteorologists in the investigation of many problems as yet unsolved concerning the relations of climate and health. Few medical men have a sufficient knowledge of meteorology and climatology to enable them to make the most effective use of the available meteorological data, and very few meteorologists are competent to deal with physiological and medical relations. As one step in the direction of this much-needed cooperation, far more general instruction in the principles of climatology should be given in the medical schools of the United States.

The main features of a "good" climate are considered. No "perfect" climate can be found, equally good at all seasons, or for all seasons, or for all persons, either well or ill. The well-known health resorts have, in addition to their special climatic advantages, many other assets, such as good hotels, expert physicans, outdoor diversions, and the like.

The leading health resorts of the United States are grouped under the following divisions: I. The eastern United States; II. The Rocky Mountain and Plateau; and III. The Pacific coast. Each of these subdivisions has certain essential climatic characteristics which are peculiarly important in the treatment of special diseases. Thus, in the eastern United States, the southern winter resorts are favorable for convalescents; for those suffering from nervous debility, and for diseases of the organs of respiration. Colorado, Arizona, and New Mexico offer special advantages for the open-air treatment of tuberculosis of the lungs. The southern Pacific coast, with its equability, its short rainy season and its mild winters, has been wonderfully beneficial to many invalids who need a less stimulating climate, and one of fewer marked and sudden changes, than can be found in the northeastern part of the country.

COMPARISON OF TEMPERATURE AND HUMIDITY DURING 1920, WITH THE MEAN AND THEIR RELATION TO COMFORT, AT ANACONDA, MONT.

Being the local observer for the United States Weather Bureau, I recently summarized the data for Anaconda,

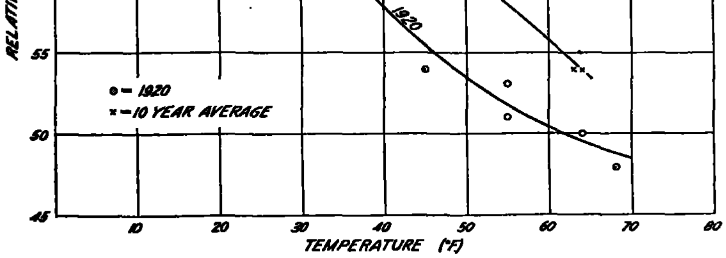

FIG. 1.—Temperature and humidity during 1920 and the mean for 10 years at Anaconda, Mont.

Mont., for 10 years past, and found that there is a very logical relation between our temperature-humidity figures during this year's mild weather season and the comfort of the season. A number of other men with whom I have talked agree that the past spring, summer, and early fall gave us the most pleasantly agreeable period that we have had for a long time, and I am convinced that the temperature-humidity relations, exhibited on the inclosed chart, largely account for this. Each point plotted for 1920 represents the average for a single month, February to September, inclusive. The form of the "10-year average" curve is very different.

The monthly figures are plotted in figure 1.

We are situated on a mountain valley, three-fourths of a mile wide, at an elevation of about 5,300 feet; and during the spring, summer, and fall commonly have breezes, of moderate velocities. Our wind records, from a recording anemometer, however, have no bearing on the comfort problem, as the instrument is placed at a high elevation above the town for special reasons.—*C. D. Demond.*

RELATION OF MALARIA TO TEMPERATURE.

[Reprinted from *The Meteorological Magazine*, London, Nov., 1920, pp. 225-226.]

A paper on the relation of temperature to the occurrence of malaria in England appears in the Journal of the Royal Army Medical Corps for August, 1920. The author, Maj. Angus Macdonald, O. B. E., R. A. M. C., has examined English temperatures records from 1763 to 1919 in conjunction with malaria prevalence, and estimated the probabilities of continuous endemicity of the disease in the past in this country and of its occurrence or recurrence in the present. It will be remembered that a disease is endemic when it continues without the importation of germ carriers from other localities.

The mean isotherm of 60° F. in the Northern Hemisphere has long been considered the northern boundary of recognized edemic malaria, and on the whole the disease increases in intensity toward the Equator. The observation of epidemics justifies the assumption that for the development of malarial infection in countries occupied by the anopheline mosquito, this mean temperature, 60° F., is necessary over at least 16 days. These mosquitoes are widespread in England. During the period 1763–1919, there has been no definite change in the temperature conditions in England; the mean of the whole differs little from means taken for casual decennia throughout. The four years 1856–1859 presented a seasonal malaria potentiality far beyond normal; on only 7 of the 50 years, 1841–1890, was the required monthly mean reached in each of the months June, July, and August, and of these, three were consecutive years, viz., 1857, 1858, and 1859. It was in these years that the last widespread and intense occurrence of malaria occurred of which we have record in this country. No other comparable record of continued high temperature existed, the nearest being 1825–26, when there was a marked occurrence of malaria, and 1808–9. Furthermore, 1860 wa a phenomenally cold year and official recognition of endemic malaria ended suddenly in that year. Greenwich records are used as representing the south of England and differing but little from those of the Fen district. Evidence of indigenous malaria north of the Humber is very rare.

The period of greatest importation of malaria carriers (i. e., persons already infected) in history was 1916–1919; the disease developed considerably in 1917–1919 in those months when the requisite thermal conditions obtained and in approximate proportion to the extent of these conditions. The outbreak was more severe in 1856–

1859, in spite of the smaller number of carriers, because of the more continuous high mean temperature of the summer months.

Elevation of temperature does not occur in England with the regularity and continuity necessary to maintain endemic malaria. When the necessary coincidence of carrier importation and high mean temperature occurs, both epidemic and endemic malaria may break out for a limited time in limited areas. Many other factors affect the disease, and the living conditions in England over 100 years ago may have been more favorable to its incidence, but the temperature factor is essential.

THE RATE OF ASCENT OF PILOT BALLOONS.

By Capt. B. J. SHERRY.

[Signal Corps, Washington, D. C., Dec. 14, 1920.]

The factors that control the rate of ascent of pilot balloons may be divided into two classes: (1) Those that relate to the kind and purity of the gas used, also to the shape, free lift, material and surface of the balloon, and (2) those that relate to the atmospheric conditions prevailing at the time of the ascension, with particular reference to temperature distribution and air movement. The air density, viscosity, etc., are considered only indirectly.

The factors included under the first class may be studied within doors. Dines, Hergesell, and others have made such studies. Some experiments along this same line have also been made by the Signal Corps, United States Army. The fact stands out, however, that in spite of much painstaking work by a number of investigators satisfactory information relative to the resistance encountered by large spheres in motion through air is not yet available.

The results of the experiments made by the Signal Corps indicate that, for the sizes of the balloons used, the air resistance to the motion of the balloons varies approximately as the 1.6 power of the speed and as the square of the diameter of the balloons. By making use of these results and comparing them with observations made by the two-theodolite method a formula was produced that gave the rates of ascent for pilot balloons that were in better agreement with observed results in the United States than any of the formulas heretofore used. An objectionable feature, however, to the experiments of the Signal Corps is that they were made by dropping weighted balloons instead of allowing gas-filled balloons to ascend.

Since the cube of the diameter of a balloon is proportional to its volume and, therefore, approximately proportional to its total lift, and the free lift of a balloon, ascending at a uniform rate is equal to the air resistance of the balloon, the terms "total lift" and "free lift" are used in the formulas instead of the cube of the diameter and the air resistance, respectively. Formulas for the rate of ascent of balloons are:

Signal Corps	Dines.	Rouch.	Hergesell.
$V=K\left(\frac{l}{L^{2/3}}\right)^{5/8}$	$V=K_1\frac{l^{1/2}}{L^{1/3}}$	$V=K_2\frac{l}{L^{1/3}}$	$V=f\left(\frac{l}{L^{2/3}-0.8L^{1/3}}\right)$

Where V is the rate of ascent; K, K_1, and K_2 are constants; 1 is the free lift, and L is the total lift of the balloons. The latest constant published for the Dines's formula is 84; for the Rouch formula 42. The value of f in the Hergesell formula is not given but a chart has been published showing the rates of ascent of balloons of various weights and free lifts. The Signal Corps, at first, adopted a value of 71 for the constant of the Signal Corps formula. This constant was, at the time, actually computed to be somewhat greater than 71. Additional observations indicate that a constant of 72 fits the data in hand somewhat better and has, therefore, been used in the latest work.

A comparison of these formulas for balloons weighing 50 grams with free lifts varying from 0 to 300 grams is shown graphically in figure 1.

It is a more difficult matter than it is ordinarily supposed to be to compare the rates of ascent as given by the formulas with the actual rates as determined in the free air by the two theodolite method.

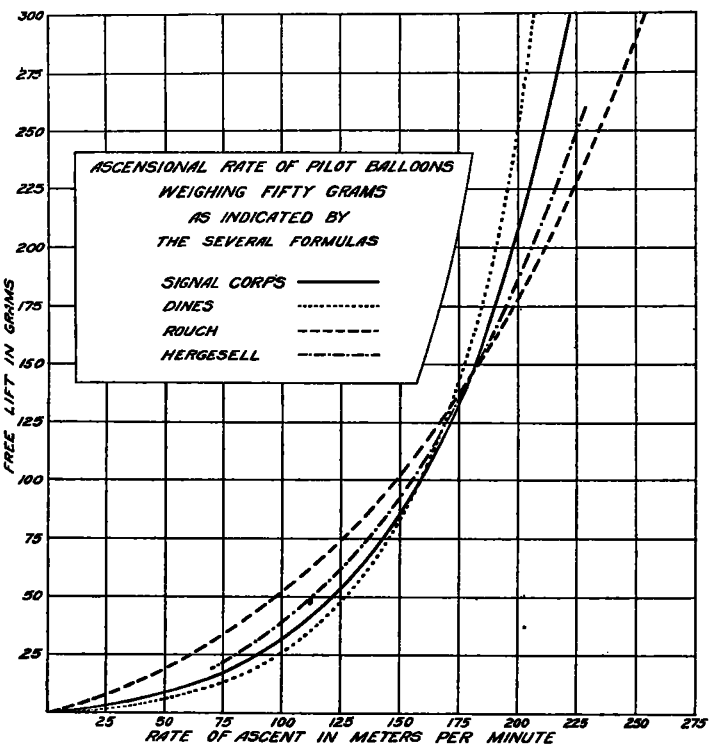

FIG 1.

Observations made in the United States indicate that the rate of ascent of a balloon may change considerably if there is a change in the shape of the balloon. It has been found that the hanging of small weights to the neck of a balloon usually increases its rate of ascent. This is probably due to the fact that balloons manufactured in the United States usually inflate to a somewhat oblong shape, the greatest diameter being through the neck of the balloon. The hanging of small weights to the neck of the balloon causes the balloon to ascend with its smallest cross section perpendicular to its direction of motion and thus with the least resistance for its size and speed. The hanging of weights to the neck of the balloon also tends to produce a streamline body and the resistance to the motion of the balloon is thus further decreased and the rate of ascent thus increased.

It was also found that the rate of ascent was further increased if the balloon was fastened into the large end of a paper cone. The balloon then ascended with the inverted cone hanging downward, thus holding the smallest cross-section area of the balloon perpendicular to its direction of motion and at the same time pro-