

of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau:

- Ciel et Terre, Bruxelles, 20me année.*
 St. Hepites. Climatologie du littoral roumain de la mer Noire. [Concluded.] P. 49.
- Comptes Rendus, Paris, Tome 128.*
 Gautier, A. L'iode existe-t-il dans l'air? P. 643.
 " Quantité maximum de chlorures contenus dans l'air de la mer. P. 715.
- Das Wetter, Berlin, 16 Jahrg.*
 Plumandon, J. R. Der Regen. [Concluded.] P. 65.
 Barthe, O. Synodischer Mondumlauf und Temperatur. P. 61.
- Journal of the Franklin Institute. Philadelphia. Vol. 147.*
 Haupt, H. The Problem of the Mississippi. P. 297.
- Meteorologische Zeitschrift, Wien, Band 16.*
 Hergesell, H. Ergebnisse der internationalen Ballonfahrten. P. 49.
 Kohlbrugge, J. H. F. Meteorologische Beobachtungen zu Tosari. (Java.) [Concluded.] P. 63.
 Streit, A. Wolkenstudien bei dem Hagelgewitter am 1 Juni 1898 über Wien. P. 76.
 Hann, J. Zum Klima der Anden von Argentinien. P. 83.
- Nature, London, Vol. 59.*
 Milne, J. Seismological Observatory and its Objects. Pp. 487 and 579.
 Callendar, H. L. Measuring Extreme Temperatures. P. 494.
- Naturwissenschaftliche Rundschau. Braunschweig. 14 Jahrg.*
 Schwalbe, G. Ueber die jährliche Variation der erdmagnetischen Kraft. P. 145.
- Philosophical Magazine. London. Vol. 47.*
 Rayleigh, Lord. Transmission of Light through an Atmosphere Containing Small Particles in Suspension, and the Origin of the Blue of the Sky. P. 375.
 Wood, R. W. Some Experiments on Artificial Mirages and Tornadoes. P. 349.
- Scientific American. New York. Vol. 80.*
 —Some New Kite Experiments at Bayonne. [Made by W. A. Eddy.] P. 213.
 Morton, H. Liquid Air as a New Source of Power—Another Engineering Fallacy. P. 245.
- Scientific American Supplement.*
 Meyers, C. E. Dirigible Air Vessels. P. 19,457.
 —The Mont Blanc Meteorological Observatory. P. 19,469.
- Southern Farm Magazine. Baltimore. Vol. 7.*
 McAdie, A. G. Frosts and Freezes. Results of Experiments on Protection of Citrus Fruit at the Bradish-Johnson Estate, Woodland, La. P. 12.
- Symons Meteorological Journal. London. Vol. 34.*
 Symons, G. J. Extremes of Temperature in London and its Neighborhood for 104 years.
- Terrestrial Magnetism. Cincinnati. Vol. 4.*
 Elster, J. und Geitel H. Beobachtungen über die Eigenelectricität der atmosphärischen Niederschläge. P. 15.
 Bauer, L. A. Physical Decomposition of the Earth's Permanent Magnetic Field. No. 1. The Assumed Normal Magnetization and the Characteristics of the Resulting Residual Field. P. 33.

UTILIZATION OF FOG.

By A. McL. HAWKS, Civil Engineer, Tacoma, Wash.

Before attempting to discuss this in a general way, let us look at it in some specific case. I spent March to May of 1898 in San Diego. The country was absolutely arid; no rain of import had fallen in eighteen months, the streams were dry, the huge reservoirs almost empty, ranches were barren, wheat fields burnt up, cattle driven out of the State, fruit trees dying for lack of water. And yet almost every evening (I think safely three out of five) tons upon tons of water rolled in from the ocean over the land; hung there all night long, only to evaporate in the a. m., with the parched land almost as thirsty as before its visit. Perhaps in that "almost" we will find the clue to the solution of the problem.

The diurnal cycle usually reads thus: At about 10 a. m. a sea breeze springs up, blowing 12 to 20 miles per hour from the west, with the sun shining as it only can shine in the arid countries; at 5 p. m. the breeze falls until by 6 p. m. it is usually gone so entirely that the sailors' method of licking a finger

to detect the direction of the wind fails to find any stirring. As the breeze dies down a bank of fog forms out over the ocean and rolls shoreward. This is usually about 500 feet deep, and when it strikes Point Loma dashes up into the air like spray from a rock. Long after the wind dies out the fog continues to roll inland until it finally reaches the hills at 1,000 to 1,500 feet elevation and 25 to 40 miles inland. Rarely in the early evening does it climb to the summits of these hills (2,000 to 3,000 feet elevation), though usually it rolls over them before morning.

By 8 p. m. the grass is quite wet (as if a shower of, say, ten minutes duration had passed over), the bushes commence to become damp, and various other objects compel condensation in various degrees. Shiny black painted iron is one of the best gatherers of moisture which I noticed; objects of the same kind varied according to their position. For instance, the house in which I lived was painted while I was there and immediately became a great moisture gatherer; the front steps had become "cupped" through the warping influence of the sun before they were dry; after painting they held a pool of water each morning. The banisters or hand rail (at an angle of, say, 30°) collected about as well as the steps, but the uprights scarcely at all. A foot inside the rail of the piazza no precipitation occurred. One's hair would collect considerable moisture, especially curly hair. Glass, upright, almost no effect; at an angle of 45°, on both sides of the glass. The bare earth almost no effect, and yet in little depressions often the surface would be quite damp and darkened by moisture. Does not this fog condensation follow similar lines to those observed and reported in the Journal of the Franklin Institute, about 1876.

All night long this fog bank lies over the land. Soon after sunrise, generally about 8 a. m., the breeze springs up from the west and by 10 a. m. the conditions are exactly the same as on the preceding day.

You have suggested in your comments (I think it was the MONTHLY WEATHER REVIEW for October, 1898, p. 466) that some mechanical means might be employed to condense or collect the moisture. It appears to me that would be too expensive and hardly practicable. Will not the same conditions obtain under the tree as under the piazza roof? In fact they do obtain to a great extent, as the soil near the base of a sizable citrus tree is never wet by the fog. If you could persuade the citrus to grow with its leaves all aslant downward, so as to collect and drip, something might be done. I do not believe any sort of upright surface would aid in collecting moisture.

With all the conditions as they are on these foggy nights, might not something of value be expected if liquified air were liberated? Engineering News figures out from Trippler's data that one gallon of liquified air could be manufactured (in considerable quantities, of course) for 15 cents; its chief difficulty at present is transportation; given the assurance of commercial success and every city with an ice plant will change the latter into a liquid air plant.

There may be two ways of utilizing this liquid: First, in a similar manner to the protection of gardens against frost by making a smudge and allowing the smoke to cover the ground. With everything so favorable that a slight condensation is already taking place, will not the additional cold liquid carry this work on more rapidly? The evaporation will take up the heat, but if simply allowed to evaporate it seems to me the cold area (from the expansion of the liquid air) will gradually spread. One gallon of liquid air equals about 100 cubic feet of atmosphere. If 100 gallons were expanded (at a cost of \$15) is it not reasonable to suppose it might cover an orchard of 5 acres? The second method is dependant upon an entirely different course; the facts are not ascertainable absolutely but are reasonably true. If there is a lower stratum

of warm air superposed by strata of cold air (which I surmise is the prevailing condition on foggy nights) the whole atmosphere is in a state of unstable equilibrium; if you can construct a stack leading from the cooler air down through the

warm air to the earth's surface, will not the cool air descend and spread over the surface, gradually lifting the warmer air it displaces, and will not that produce rain?

[See the Editor's notes on page 113.]

NOTES BY THE EDITOR.

WILLIAM H. HAMMON.

It is so rare that an official of high standing in the Weather Bureau resigns his position, that we are persuaded that the recent resignation of Prof. W. H. Hammon must have been the result of overpowering inducements and persuasive offers from other parties. We certainly hope that coming years will bring to him the profit and the pleasure that he evidently anticipates. By his acceptance of a position in the Philadelphia Gas Company at Pittsburg, Pa., Professor Hammon is brought back to his old family home and enters upon a business career of great promise, but the Weather Bureau loses one of its ablest men.

Mr. Hammon was born in Dicksonburg, Pa., and is a graduate of Allegheny University, and a post graduate of Cornell University. He entered the meteorological work of the Signal Service in July, 1882, and went for instruction to Fort Myer, Va. His first official assignment was as assistant at Charleston, S. C. In May, 1884, he was assigned to duty in connection with the physical laboratory of the Signal Office, where he assisted Prof. Thomas Russell and his successor, Prof. T. C. Mendenhall. Becoming interested in the exploration of the upper air, he volunteered to perform the meteorological work to be carried out in a series of balloon voyages during the first few months of 1885. This work, and the investigation of the apparatus incident thereto, was executed in an excellent manner, and his report, which could not be published at that time, afterward appeared in the American Meteorological Journal for February, 1891, Vol. VII, p. 498-528.

Mr. Hammon was subsequently in charge of stations at Ithaca, Cleveland, and St. Louis, and in May, 1894, was placed in charge of the San Francisco station and forecast district, the latter embracing the States of California, Nevada, Arizona, and Utah. By his administration of this latter charge, during the past five years, he has made for himself an enviable reputation for energy and efficiency. His forecasts of frosts and rains have been universally recognized as extremely reliable and timely. His latest bulletin "Frost: When to expect it and how to lessen the injury therefrom," shows that he has devoted much thought to this subject, and, in response to urgent demands, a large edition of it has been printed.

Mr. Hammon was appointed local forecast official in July, 1891; forecast official in August, 1894; professor of meteorology in January, 1899; his resignation takes effect March 31, 1899.

THE PACIFIC COAST DIVISION OF THE CANADIAN METEOROLOGICAL SERVICE.

It is probably known to only a few of our readers that in the summer of 1898 the Canadian service established a Pacific coast division, with headquarters at Victoria, B. C., where forecasts will be made by Mr. F. Napier Denison.

Mr. Denison expects to issue daily maps and forecasts for his division similar to those issued by the United States Weather Bureau officials at San Francisco and Portland, Oreg. A complete interchange of daily telegraphic reports takes place between these two branches of our respective national weather services, so that the information available to one is

also accessible to the other, the only difference being that reports coming in by mail are interchanged more slowly than those by telegraph. Through the kindness of Mr. Denison, the Editor has received a copy of the daily map prepared by him and the northwestern quarter of this map is reproduced on Chart X. The original base map extends from the Pacific coast eastward to the eighty-fifth meridian, and from latitude 30° N. to 70° N. This places the boundary between the United States and the Dominion of Canada nearly in the center of the sheet, 16 inches broad by 17 inches high. The polyconic projection is adopted, the scale being practically the same as that of the daily map published by the Weather Bureau in Washington and by the meteorological office in Toronto, respectively. In our present reproduction we have added, in dotted lines, the approximate courses of a few lines of telegraph, so that the reader may appreciate how rapidly this country is being opened up, and what are the immediate possibilities of a still further extension of the daily telegraphic weather map. As the upper left-hand corner of Mr. Denison's daily weather map embraces the lower portion of the Territory of Alaska, we have added the new Weather Bureau station at Eagle, and the post route at present adopted for United States mails. The following extract from Mr. Denison's letter will excite the most lively interest in the minds of those who realize how far the forecasts of weather in the United States depend upon by a knowledge of what is transpiring in that distant region.

This is certainly an ideal field for studying the various weather changes, which, as you know, are more difficult to anticipate here than further east, however, I am getting a grand insight into some of the complex problems, and I hope during this summer by studying last winter's charts, to be able to do some really valuable forecasting. As it is the public appreciates our work, and thinks we are doing very well. We are now using a new chart, specially designed for future expansion northward, even including Dawson, which most certainly will be made one of our telegraphic stations as soon as the projected wire communication is completed. I send you under separate cover a copy of one filled in, showing how after receiving Port Simpson by mail we are even now able to draw our isobars far further north than heretofore, and locate more accurately the true position of the north Pacific "highs" and "lows."

MIROBIA AND SEICHES.

In the MONTHLY WEATHER REVIEW for December, 1898, page 563, we have quoted a paper by Mr. F. Napier Denison, in which he states that the term *mirobia* was first introduced to English readers by Admiral Smythe as a word used at Malta as the name of regular recurring waves similar to the seiches of the lakes in Switzerland. Mr. Denison has been studying the same phenomena on the Great Lakes, and for fear least the Editor may have misunderstood Mr. Denison's position in this matter, the latter writes as follows:

You seem to think I have taken up the study of water undulations on both lakes and ocean as of more value in a meteorological point of view than the study of the atmospheric waves shown on the various barographs, which latter waves I have tried to prove set up the water undulations. Now this was never intended. I have been endeavoring simply to draw attention to the fact that as the water surface responds to the passage of atmospheric waves over it, therefore the records from tide gauges would often show marked undulations at stations where no barographs are; or even should the latter be also there, only the largest undulations will be seen, as the present instrument in common use gives a weekly curve which means too small a time scale and baro-

that at 93 feet above. But in fact there is always a strong radiation to the ground from a layer of cloud. The sun heats the upper surface of the clouds, and by convection the influence of this heat is felt at the lower surface, which latter is also warmed or cooled, as the case may be, by radiation between it and the ground. One may often notice how rapidly the ground dries up as the fog lifts, although the sun is still invisible. It is evident that something of this kind took place in the present case since the lower thermometer was warmer than the upper thermometer by a quantity that kept on increasing up to 3 p. m. and then rapidly diminished. The wind near the ground was too feeble to nullify the radiation from the lawn. It was much stronger at the 93-foot level. The upper thermometer gave the temperature of a general layer of wind; the lower thermometer had a temperature due to radiation from the lawn, and not necessarily the temperature of the lower air.

In conclusion we may say that this unusual difference of from 4° to 6° in a vertical distance of 90 feet, even if it were demonstrated by unexceptionable apparatus to really exist is not an *inversion*, as the observer called it, of the ordinary vertical temperature gradient. The ordinary gradient is defined as being a diminution of temperature with increasing height above ground, and that is what was recorded in the present case. An *inversion* is an increase of temperature with height above ground, such as occurs during a few hours in the early morning under a clear sky, and especially when hoar frost is deposited from still air.

When the vertical gradient is a diminution at the rate of 1° C. for 99 or 100 meters, or 1° F. for 183 or 187 feet, this is called the adiabatic gradient and the air is said to be in a state of neutral equilibrium, because a mass of it raised or lowered by any number of feet will be cooled by expansion or warmed by compression to such an extent as to have the same temperature as the surrounding air in its new locality; hence the air whose location has thus been changed has no tendency to move from the place to which it has attained. On the other hand, if the rate of diminution with ascent is greater than 1° for 187 feet, as in the present case, where it was, at 3 p. m., 1° for 16 feet, then the upper air has a tendency to descend, and the lower air a tendency to ascend and to keep on ascending or descending indefinitely, so that the air is said to be in a condition of unstable convective equilibrium, such as occurs in the hotter portion of every clear day near the surface of the earth.

If the rate of descent is less than 1° for 187 feet, and especially if it becomes negative, that is to say, colder below and warmer above, then the air is in a state of stable equilibrium, and if raised or lowered tends to return to its original position.

UTILIZATION OF FOG.

On page 101 of this number of the MONTHLY WEATHER REVIEW we publish an interesting article by Mr. A. McL. Hawks, C. E., of Tacoma, Wash., on the subject of the utilization of fog for irrigation on the coast of southern California. His communication was suggested by the remarks of the Editor, published in the MONTHLY WEATHER REVIEW for October, 1898. Mr. Hawks states very truly that expensive mechanical means for collecting the fog will not be practicable. Indeed, the Editor substantially said the same thing in October, and suggested that some simple method be devised for catching the fog and forcing it to drip to the roots of the plants as useful water.

The use of liquid air, as suggested by Mr. Hawks, would undoubtedly be one of the most expensive methods of catching the fog and there is room for grave doubt whether any

fog at all could be condensed by its use. Liquid air is the remarkable product of a powerful steam engine and appropriate apparatus. When manufactured, even on a large scale, it is not likely to cost less than 25 cents a gallon or to be sold for less than double that price. If one simply needs to have a cooling agent in order to condense the fog into drops, one might, far more economically, make use of artificial ice or the original brine bath and the ammonia coils of a refrigerating apparatus. The evaporation of liquid air back into the free atmosphere, which is the experiment that is now being daily shown to hundreds of people, does not produce the least sensible influence on the temperature of the audience chambers where the experiments are performed and would have still less effect over the orchards of southern California.

Mr. Hawks suggests a second method for attacking the problem, viz, the construction of a flue or smokestack leading from the cooler air above the fog down through the warm air to the earth's surface, in order that the cold air may descend through it to the ground. But the upper cold air really does not need any such conducting flue, it will descend of itself if the conditions are proper; otherwise, it can not be brought down except by the use of some extraneous expensive force and if brought down would be warmed up so much by the compression due to the greater barometric pressure near the earth's surface that it would not produce rain, but become a veritable warm, dry chinook.

But there is a third and most valuable suggestion in the letter of Mr. Hawks. He has observed that shiny black-painted iron or shiny freshly painted boards exposed horizontally are great moisture gatherers. It is evident from his statements that a concave painted board or a concave sheet or trough of painted iron will collect much moisture. If such a concave surface has a gentle inclination toward the ground, the moisture should drip in a steady stream all night long from the lower end, and can, therefore, be gathered in reservoirs or pails or led directly to the roots of the plants. This drip, as we stated in the October REVIEW, is that which maintains the verdure of Green Mountain on the Island of Ascension. It is well worth while for the agriculturists of southern California to follow out this line of experiment in the matter of utilizing the fog.

THE BLUE COLOR OF THE SKY.

The March report of the Montana section contains an interesting article by A. H. Thiessen, on the cause of the blue color of the sky. This was first explained by Rayleigh as probably due to the so-called selective reflection of the blue light in a beam of sunshine by the finest particles of aqueous vapor and dust. Mr. Thiessen gives a very simple statement of Rayleigh's explanation and we quote the following from his article:

On a cloudless day when looking away from the sun toward the sky we observe its blue color. We are then looking into space, but our line of sight is intercepted by a multitude of dust particles suspended in the air. The color of these particles is observed to be blue. This is due to their reflecting to our eyes the blue rays against which they form an effective barrier, while the red or coarser waved rays pass on.

The color of skylight is due then to the reflection of the shorter wave lengths to the eye. The air itself has no power to reflect light, but it contains innumerable dust particles which present a vast reflecting surface to the light waves. That the dust reflects back only the blue rays is due to their microscopic size. The finer the dust then the purer is the blue which is reflected or scattered. One may expect then to find the bluest skies in those places where the dust particles are smallest, and it is true that the blue of the sky as seen from the tops of mountains is deeper and purer than that seen from a lower altitude. This is due to the fact that the air is very rare at great heights and can only sustain the finer particles of dust, while the coarser particles abound at the lower levels. The sky of Italy is noted for its clearness. The blue is deeper, not because the dust there is finer than in the northern countries, but because in the countries of the north, due to the greater