the northeast; it will continue generally dry in the interior." Based upon our experiences, we would have said about as follows:

> As a movement of the prevailing high pressure area is not expected, dry still weather, and during the mid-day hours free from cloudiness, will continue for several days. The temperatures will reach noticeably high values with very low humidities about mid-day. The proof of the correctness of these views can be seen from the weather conditions. If these continue, then the dynamic heating of the air must proceed from below, while during the night, on account of the rapid cooling of the earth's surface, the heat will indeed be dissipated, but during the afternoon hours a direct foehn-like heating will be shown.

The observations of November 7 give just such a chart as we would expect. At 11 a. m. there was a surface temperature of 11° C. and a wet-bulb difference of 3.5° C.; at 220 meters the temperature was 7° C., and at 480 meters it was 5.4° C. Above the fog layer, at 600 meters, the temperature was 9° C. with 6° C. difference. On the preceding day the temperature of 9° C. was first noted at a height of 1,500 meters; therefore the warm, dry air settled about 900 meters during the course of twenty-four hours. In consequence of this settling, the overlying layers were somewhat heated, so that the highest temperature, 11° C., was noted at a height of 740 meters, and the temperature continued at this figure up to 1,100 meters. Above this level, as during the preceding day at 900 meters, began the regular decrease in temperature and humidity, so that at 2,400 meters the temperature was only 1.0° C. with a wet-bulb difference of 5° C. The pressure distribution already described persisted until November 10, and each day during this period the mid-day temperatures exceeded 15° C.

It is also interesting to note the behavior of the balloon under these temperature conditions. Usually if a weight of ballast equal to 1 per cent of the total weight of a balloon be expended, the balloon will rise about 80 meters, provided no other factors are involved. The balloons "Bamler" and "Elberfeld" each weighed about 1,000 kilograms as the outthrow of ballast began. At the beginning 1 per cent of this weight would equal 10 kilograms; but during the course of the ascension, after say 50 kilograms of ballast had been used, 1 per cent of the remaining weight would equal only 9.5 kilograms, and after 100 kilograms had been used 1 per cent would equal only 9 kilograms. To make the balloon rise 200 kilograms of ballast had to be expended, and according to theory the balloon should have then ascended 1,800 meters. In both cases the expenditure of ballast began above the fog layer, i. e., at about 700 meters. Therefore the maximum height reached should have been $700^{m} + 1,800^{m} = 2,500$ meters. As a matter of fact the height reached was only 2,400 meters. In a normal distribution of temperature, i. e., with constantly decreasing temperature, and with favorable insolation, the balloon should have reached a much greater height, for the sun rapidly warms the envelop and its contained gas, owing to the clarity of the upper air. Temperature differences as great as 30° C. between the contained gas and the surrounding air have been observed. Every degree of such a temperature difference raises a balloon filled with illuminating gas about 30 meters. Assuming that our contained gas was 20° warmer than the surrounding air, the balloon should have ascended 600 meters in consequence, making the maximum height 3,100 meters—an elevation that is often reached during similar ascensions. In our case, however, the cold gas was always advancing into warmer air layers [because of the inverted temperature gradient] and it was necessary, therefore, to use more ballast in the ascension than usually would have been required. Hence the moderate heights reached.

THE KITE STATION ON LAKE CONSTANCE.

By ERNST KLEINSCHMIDT, Ph. D., Director. Dated Friedrichshafen, September 23, 1908. Translated by C. F. Talman.

The kite station on Lake Constance has been in regular operation since April 1 of this year. Its task is to make daily observations, when practicable, of the atmospheric conditions over Lake Constance. The principal object is to measure the temperature, humidity, wind direction, and wind velocity at different altitudes in the air. For this purpose suitably constructed registering apparatus must be lifted by kites or captive balloons; free balloons would be too costly for daily use, and besides too much time would be required to make available the records obtained by them.

Special methods of investigation are required on account of the wind conditions that prevail in the interior of Europe. The wind is generally too weak for kites, but, on the other hand, it is often too strong for captive balloons, the latter being forced downward by strong winds. This difficulty can be overcome if the reel holding the steel wire used for the flights can be readily moved about, as, for example, when it is mounted aboard a swift boat having a sufficiently large body of water to maneuver upon. In flying kites, if the wind is too weak the vessel runs against the wind, thus strengthening its effect. In sounding with captive balloons the vessel moves in such a manner as to keep the balloon directly overhead. In the latter case we can deduce the direction and velocity of the wind at each altitude from the course and speed of the vessel. A boat offers the further advantage that when the wind is so strong as to threaten the destruction of the kites we can lessen its effect by running *with* it.

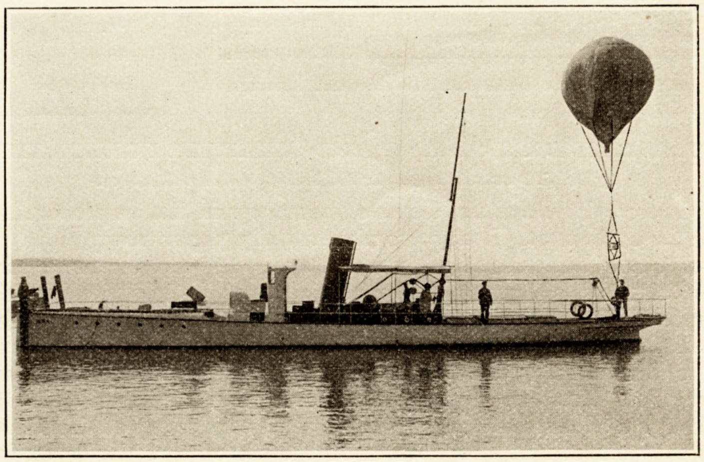

FIG. 1.—The German kite-boat *Gna*, Lake Constance.

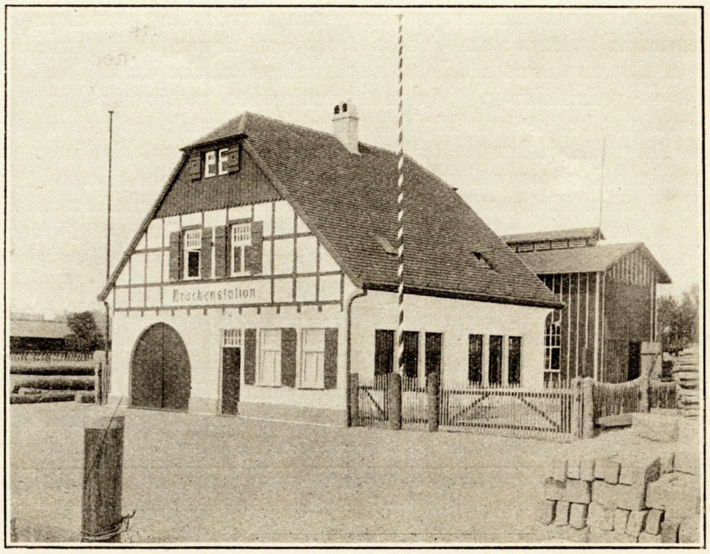

FIG. 2.—The German kite-boat station, Friederichshafen, Lake Constance.

The work of the station is carried on as follows:

Every day, before the flights are begun, the wind conditions as high up as possible are determined, either from the movement of the clouds or, preferably, by means of pilot balloons. We thus decide whether we had better send up a kite or a captive balloon; taking into account the fact that the boat must be run as short a distance as practicable, in order to economize coal. We also decide from what point on the lake the flight should be begun so as to have as much room as possible for the vessel to run in and not be obliged to abandon the flight prematurely on account of nearness to the shore. During the summer months we have, as a rule, used captive balloons of rubber-coated cotton or silk, and having a capacity of 30 to 50 cubic meters. As they have a vertical ascensional velocity of about 3 meters per second the ventilation thus produced fully suffices to prevent the effects of solar radiation. In many cases, however, a small electric ventilator is sent up with the apparatus. In winter we shall more often use kites of the Marvin and Hargrave types, having 5 to 7 square meters lifting surface. Our captive balloons have attained altitudes as great as 4,000 meters, but with kites we have not yet gone higher than about 3,000 meters.

The results of the ascents are promptly transcribed and telegraphed to the meteorological central stations of southern Germany (Strassburg, Karlsruhe, Stuttgart, and Munich), the Deutsche Seewarte at Hamburg, the Lindenberg aeronautical observatory, and several of the Public Weather Service centers in northern Germany. Our telegraphic reports have generally been early enough to use in making the weather forecast issued between 10 and 11 a. m.

The station owes its existence to the efforts of Professor Hergesell, who as early as 1901, in collaboration with Count Zeppelin, flew kites—without instruments, however—from a small motor boat on this lake. The station was erected and has been maintained by contributions from the Imperial Government and the governments of the four South German States, Bavaria, Württemberg, Baden, and Alsace-Lorraine. It is located at Friedrichshafen, in Württemberg, and is under the administration of Württemberg. The station building, see fig. 2, which includes workshops and the necessary offices, stands on the harbor front, close to the anchorage of the kite-boat. The latter is of the torpedo-boat type, is 27 meters long, 3.4 meters beam, and has an engine of about 350 horsepower. It has a maximum speed of 19 knots. The reel is driven by an electric motor. The vessel was especially designed for kite and balloon flights, was built in 1907 at the Schichau yards, in Elbing, and cost 72,000 marks, or $18,000. It is named *Gna*—after one of the messengers of the gods in the northern mythology.

THE REFLECTING POWER OF CLOUDS.

The following article is compiled from the note of May 27, 1908, recently distributed by Messrs. C. G. Abbott and F. E. Fowle, jr., from the Smithsonian Astrophysical Observatory at Washington, D. C.—*C. A.*

The diffused reflection and radiations from fog and cloud and even dusty air, are of appreciable importance in dynamic meteorology and even climatology. They are so analogous to those from solid matt surfaces that the formulas given by Abbott and Fowle must closely represent the natural intensity when the incident light is homogeneous and the cloud particles are much larger than the incident wave lengths.

A perfect matt surface may be defined as one which reflects diffusely the whole of the radiation incident upon it, in such a manner that equal solid angles observed on such a surface contribute equal amounts of reflected radiation, independent of the nadir distance.

Let AB, in fig. 1, represent an infinitely extensive plane of perfectly matt surface; let CD represent an infinitely extensive plane parallel to the plane AB. Let a, b, c, d, be four equal areas situated so that ac is normal to AB and the angles dac and bca are equal. Let them be represented by the symbol i. Let the zenith distance of the sun be Z and let K be the amount of radiation it sends to an area equal to a situated at right angles to the solar beam. Then the amount of solar radiation on a, or b, is $K \cos Z$.

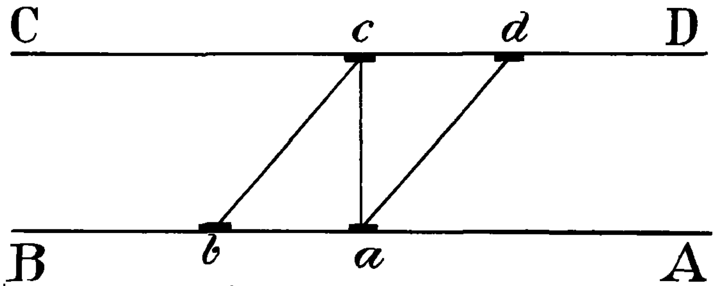

FIG. 1.—Reflecting power of clouds.

By diffuse reflection the area a sends the same amount of radiation to the area d that b sends to c. A ring drawn in the plane CD about c as a center, with a radius equal to cd would contain as many areas equal to d as a similar ring drawn about a as a center in the plane AB. For each such area situated in the upper ring in a given position with regard to a as a center in the plane AB. For each such area situated in the upper ring in a given position with regard to a, there is an area on the lower ring to which c bears exactly the same relation of position. From this it follows that the sum of all the radiation received by c is equal to the sum of all the radiation diffusely reflected by a; and this, since the surface AB is a perfect matt surface, is equal to the total amount of solar which falls on a.

Let Q be the amount of diffusely reflected radiation which a surface of the area c would receive if directed toward an area of the surface AB subtending a solid angle equal to that of the sun. Let a be the angular semidiameter of the sun. Then the angular area of the sun is πa^2.

For an element of angular area upon the plane AB at nadir distance i and azimuth A the expression is $\sin i . di . dA$. Such an element will reflect upon the horizontal area c the amount of radiation

$$\frac{Q \sin i . \cos i . di . dA}{\pi a^2}.$$

Hence, the total reflection upon c is

$$\frac{4Q}{\pi a^2} \int_0^{\frac{\pi}{2}} \int_0^{\frac{\pi}{2}} \sin i . \cos i . di . dA = \frac{Q}{a^2}$$

Hence,

$$\frac{Q}{a^2} = K \cos Z$$

and

$$Q = K a^2 \cos Z.$$

Then, neglecting the difference in height above sea level between the cloud and the observer, every area of a perfectly matt cloud subtending a solid angle equal to that of the sun, would reflect to the measuring instrument an amount of radiation $a^2 \cos Z$ times the amount of radiation received directly from the sun, provided both the direct and the reflected beams were observed at normal incidence. On August 22, 1906, a^2 was 0.0000206.

But an allowance must be made for the loss of intensity of the beam in its course from the level of the observer to the cloud and thence back to the level of the observer, and for the considerable difference of level of the cloud of August 22,