FIG. 1.—Main building of Samoa Observatory, Apia.

FIG. 2.—Instrument shelter at Samoa Observatory, Apia.

with broom and dust-pan at 7 a. m., to the delivery of the last bundle of weather maps at the post-office, about 11:30 p. m. The same well-systematized rush prevails as at the stations of our own Weather Bureau; and the same delays and hindrances occasionally supervene; when, as Herr Freybe puts it, "the temperature in the office not infrequently rises above the normal." The reports from the various European stations are transmitted from the Seewarte, at Hamburg, in two dispatches, which are received from the telegraph office by telephone and entered on the manuscript maps in twelve to fifteen minutes and four to five minutes, respectively.

A NEW CLOUD ATLAS.

From the Royal Observatory of Belgium comes a new cloud atlas,[2] designed to make familiar to the public, and especially to meteorological observers, a much amplified version of the International Classification of Clouds. This work distinguishes numerous varieties of each of the forms included in the International Classification, the Latin designations being mostly borrowed from the systems proposed by Maze, Clayton, Weilbach, Ch. Ritter and other cloud specialists. There are twenty-eight excellent half-tone illustrations.

Since Clayton published his exhaustive historical sketch of cloud nomenclature in the Annals of Harvard College Observatory, Vol. XXX, Part IV, (Cambridge, Mass., 1896), several elaborate systems of classification have been proposed, so that there is now quite a bewildering variety of names to choose from in designating the subdivisions of the simple types included in the International Classification. Fortunately, however, the latter classification alone answers the ordinary requirements of meteorological observation, and has been adopted by nearly all the meteorological services and independent observatories of the world.

COMPOSITION OF THE AIR AT HIGH ALTITUDES.

Ciel et Terre of October 1, 1908, contains a brief account of experiments carried on by M. Teisserenc de Bort to determine the composition of the air in the isothermal zone or "warm layer" of the atmosphere, especially with regard to its richness in the rare gasses, helium, argon, etc. A glass tube, exhausted of air and sealed at both ends, was attached to a sounding balloon. When the apparatus reached a sufficient height a small hammer, actuated by the meteorograph, struck one end of the tube and broke it, admitting the air. The tube was subsequently resealed by an electric current sent thru a platinum wire coiled around the tube at the broken end. The amount of air thus secured was too small to admit of quantative chemical analysis, but was studied qualitatively by means of the spectroscope. Two methods were followed in different experiments; in one all the elements of the air except helium and neon were removed thru absorption by carbon; in the other the argon was separated first.

Analysis revealed the presence of argon and neon in the samples of air taken at all altitudes, from 8 to 14 kilometers. Helium was found in most of the samples, except those taken at the greatest altitude attained, viz, 14 kilometers. Whether krypton was present in the samples could not be determined.

An account of these investigations also appears in the Quarterly Journal of the Royal Meteorological Society, July, 1908, p. 189–190.

METEOROLOGY AT THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

Among the many interesting papers presented before *Section B—Physics* of the American Association for the Advancement of Science at the summer meeting held in the Wilder Laboratory of Dartmouth College, Hanover, N. H., June 30, 1908, two seem to be of special interest to students in meteorology and climatology. The following abstracts of these papers appeared in Science, of August 21, 1908:

A study of overcast skies.—E. L. Nichols, Cornell University.

The spectro-photometric measurements which formed the basis of this paper were carried out, during the travels of the author in Europe, by means of a handy portable apparatus which gave the opportunity to compare the skies of widely different localities and at different times of day. The relative intensities of the individual color-components were very different with different kinds of sky. The radiation was rarely selective but almost always of the "black body" type. There is, however, almost

[2] Vincent, J. Atlas des nuages. Bruxelles, 1907. (Annales de l'Observatoire royal de Belgique. Nouvelle série. Annales météorologiques.)

always an absorption band in the violet during the middle of a bright day in the mountainous regions. Its development is coincident with the gathering of a slight mist.

The illumination from an unclouded sky is about the same as from a completely clouded sky. The most light, however, comes from a sky which is partly covered with clouds. The so-called "cumulus" clouds produce especially good luminosity.

The isothermal layer of the atmosphere.—W. J. Humphreys, Mount Weather Meteorological Observatory.

The temperature of the atmosphere decreases more or less uniformly with increase in elevation above the surface of the earth until an elevation of from 30,000 to 60,000 feet is reached, where the temperature is −50° to −60° C. From this elevation up as far as balloons have gone the temperature remains practically constant. This is explained as the result of radiation, mainly from the moisture in the [lower atmospheric strata which has] an effective radiating surface of great extent in comparison with elevations reached by balloons.

The means of locating this surface was considered. The relative proportion of the different constituents of the air is different at different elevations, the proportion of water vapor being relatively great in the lower layers. Calculation shows the temperature of this "effective radiating surface" to be about −33° C. (The calculations were carried through in detail before the joint session.)

This paper was afterwards (on August 27) read at the Put-in-Bay meeting of the Astronomical and Astrophysical Society of America, and again before the Philosophical Society of Washington, D. C. It will appear in full in the Astrophysical Journal for December, 1908. It is interesting to note that Professor Humphreys had anticipated by a few weeks only, the somewhat similar but wholly independent explanation offered for the same phenomenon by Mr. Gold at the Dublin meeting of the British Association on September 2, 1908.—*C. A. jr.*

THE ISOTHERMAL LAYER OF THE ATMOSPHERE.

[Reprinted from "Nature," London, of October 1, 1908, p. 550-2.]

The important discussion of which we give here a detailed account was organized by the committee of Section A of the British Association, and took place at the recent meeting at Dublin.

It was intended that M. Teisserenc de Bort should open the discussion, but he was unable to be present and sent the following communication:

Permit me to open the discussion on the isothermal layer and the inversions of temperature which are found there by recalling in a few words the results obtained during the past twelve years. Our experiments at Trappes have shown, in the first place, that the temperature ceased to diminish at a certain height after having passed thru a point of maximum rate of decrease about 3,000 meters lower down.

The altitude at which the diminution ceases changes with the character of the weather; it may descend as low as 8 kilometers at Paris during a cyclone, while it rises as high as 13 or 14 kilometers in high-pressure areas and in front of large cyclones.

I indicated these peculiarities for the first time in October, 1901, in a communication to the Luftschiffahrt Verein at Berlin, then in a communication to the Meteorological Society of France in March, 1902, and I developed these conclusions in a note to the Académie des Sciences in April, 1902.

A short time after, in the early part of May, 1902, Professor Assmann showed from the ascents of six rubber balloons that not only was there a cessation of the decrease in temperature, but also an inversion. This inversion had also been very marked in the first ascents by Hermite and Besançon, but Professor Assmann sought to explain it as being due to the effect of solar radiation on the thermometer while the ventilation produced by the rapid ascent of the balloon showed that it could not be referred to such an error in the thermometer record.

Having once demonstrated the existence of this isothermal layer for places in the neighborhood of Paris, we sought to find the evidence of it in other regions in order to show that it was a general phenomenon. Ascents made by us and our assistants in the winter of 1900-1, by M. de Quervain in Russia, by Mr. Eggeberger at Bath, England, in 1902, have made it evident that the phenomenon was a general one. On referring to the results of the international ascents made in different countries, it is seen that the cessation of the temperature decrease is found in the case of all the balloons sent up, and that it is impossible to refer it to insufficient ventilation, since the phenomenon was well marked in ascents made during the night. Since this time, ascents made on board the *Princesse Alice* by Professor Hergesell in 1905 have furnished evidence of the existence of the layer near the Azores; ascents made in the United States by Mr. A. L. Rotch have furnished evidence of its existence there with the peculiarities I have indicated, i. e., high up over high-pressure areas and low down over low-pressure areas.

The expeditions of the *Otaria*, organized in conjunction with my friend, Mr. Rotch, have proved the existence of the zone in the Tropics, and have shown it is further from the earth near the equatorial regions where the trade winds meet.

Finally, the ascents made at the end of the winters of 1907 and 1908 by the French-Swedish expedition organized by the Observatory of Trappes, with the support of Professor Hildebrandsson, have shown that near the Arctic Circle, at Kiruna, the layer exists and possesses general characteristics analogous with those found in these regions.

The results of series of daily ascents for eight, ten, or more days in succession in February, 1901. March, 1903, and May, 1904, have proved that the change of altitude of the point where the temperature ceases to fall is accompanied by changes of temperature of 10° C., 15° C., 20° C., in an interval of a day or two at heights between 9 and 13 kilometers, variations great enough to be felt near the surface during the same time.

Thus the equalization of temperature in the course of the year which had been supposed to be nearly complete at 8 or 9 kilometers altitude does not exist, but, on the contrary, sudden changes of temperature occur with the passage of cyclones and anticyclones which would furnish to an observer in those regions the chief evidence of the changes occurring at the surface.

Causes of the isothermal layer.—The summary of the observed phenomena has led me to this conclusion, that the cessation of the temperature diminution is due to the fact that there is at these heights no considerable vertical convection.

The fact that one meets with layers of air thousands of meters thick where the temperature increases and decreases rapidly, and others where it is stationary, is incompatible with the existence of motion of the air accompanied by pressure variations, which always tend to produce a vertical temperature gradient more or less near that for the adiabatic state. It does not follow that the movement in the isothermal layer must be horizontal, but that it takes place along the isobars without crossing these surfaces nearly in the manner in which a body rolls on an inclined plane.

These ideas have been developed in several communications, in particular at the Conférence d'Aérostation scientifique at St. Petersburg in September, 1904.

In the absence of M. L. Teisserence de Bort, Doctor Shaw opened the discussion. He explained what was the main feature of the phenomenon, and showed how it had been corroborated by *ballon sonde* ascents made in England. The temperature of the air decreases in the lower layers on the average at 5° or 6° C. per kilometer up to a height of about 10 kilometers. Above this height the temperature ceases to fall rapidly and falls very slowly indeed, or remains constant, or in some cases increases. It has been suggested that the phenomenon might be due to a change in the composition of the air at great heights. M. L. Teisserenc de Bort had succeeded in sending up balloons carrying vacuum tubes which were opened and resealed electrically at a height of 14 kilometers. The samples of air so obtained were examined spectroscopically, and the examination showed that there was no change in the composition of the air sufficient to account for the cessation of temperature diminution.

Remarks by A. L. Rotch.

Mr. Rotch said that the only *ballons sondes* which have been sent up in America were those dispatched by him. Since 1904 76 rubber balloons have been launched from St. Louis and all but one have been recovered. The majority of those which rose higher than 12,870 meters (8 miles) entered the stratum of relatively high temperature.

All the ascents occurred after sunset, so that there can be no question as to the effect of solar radiation. The instruments used were of M. Teisserenc de Bort's construction, and were verified for low pressures and temperatures before and after the ascents. The warm stratum, which was not isothermal but became warmer with increased height, was at its lowest level in summer, having a minimum temperature of −54.6° C. at 12,000 meters. During the autumn of 1907 the stratum of warm temperature was penetrated eight times, the mean minimum temperature of −60.5° occurring at 12,370 meters.