million such units would correspond to a barometer at 750.1 millimeters. One may use this value as a unit calling it "one small atmosphere," or, with Bjerknes and Sandström,[2] 1 *Bar*. Then 1 *decibar* represents the pressure of a layer of distilled water at its maximum density and under standard gravity, 0.98 meter deep, or 1 megadyne per square centimeter.[3] A *millibar* is almost $\frac{3}{4}$, or more exactly 0.75006 millimeter mercury. The abreviations for these terms are naturally b., db., cb., mb.,[4] in agreement with the other abreviations of the metric system.

Starting with the customary assumption of 760 millimeters for the average pressure at sea level, we find the new pressure unit of 1,000 *mb* (or 750.1 millimeters) at an altitude of 106 meters above sea level.

The question as to whether or not the meteorologist should adopt this new higher level instead of sea level as a plane of reference to which to reduce the observations, is quite independent of the question as to the introduction of this new pressure scale. However, there are many considerations which are in favor of such a change, e. g., the average sea level altitude of the German stations in the Weather Report (Wetterberichte) of the Seewarte is exactly 107 meters (omitting the summit stations whose pressures are not reduced to sea level in these reports); 17 of these stations lie below 100 meters, Frankfurt a/M is 103 meters, and only 11 are above 106 meters. Similar conditions prevail, on the average, over the rest of Europe and in the eastern half of North America. Thus the new plane of reference would lie above the majority of stations, and the calculated, reduced pressure would have a real meaning, whereas at present the plane of reference lies in the earth below all the stations where "atmospheric pressure" means merely *a calculated value*, and the temperature used in making the reduction to sea level has no real existence. In the case of the remaining stations (those that still lie above the new reference plane) the distortions resulting from the reduction are at least lessened; indeed we may well regret that the level of the pressure unit did not happen to fall somewhat higher yet, for the pressure distribution at a level several hundred meters above the earth's surface is a much truer expression of atmospheric conditions than is the pressure at the surface itself. Indeed the lower air masses of the low-lying plains [of northern Germany] are in large part dragged along with the higher masses, i. e., they receive their impulses to motion chiefly from air masses descending from some height, since the friction and resistance at the surface is too great.

Already the desire has been frequently expressed that barometric readings should be reduced to a somewhat higher plane than that of sea level. It could not be realized because there has been small prospect of a general agreement upon some wholly arbitrary plane. The above proposed level is not altogether arbitrary, since it is as truly *the average plane of the unit of air pressure* as is 760 millimeters the mean pressure [measure] at sea level. Since the choice of this latter figure may vary within rather wide limits, one is also at liberty to choose, for the sake of convenience, an even hundred meters instead of 106 meters as the vertical interval up to this new plane of reference.

[2] Beiträge z. Phys. d. fr. Atmosph., Strassburg, 1906, 2:1. Also Sandström and Helland-Hansen, Report on Norwegian Fish. and Marine Investig., 1902, 2, No. 4, p. 15; and Knudsen in Bul. trimest. Internat. Comm. f. Meersf., 1906–7, No. 1, p. 41, No. 2, Pl. 14; and elsewhere.

[3] For the physical geographer it would be convenient to adopt as the unit pressure the pressure of a column of water 1 meter high, i. e., to call the acceleration of gravity at latitude 45°=1000 instead of 981; but one would then depart from the strict C. G. S. system. Therefore the Scandinavian scholars, in their oceanographic studies, use the "dynamic meter" of about 1.02 meters length; and thus they express pressure, friction, and the terrestrial deflecting force in terms of the same rational unit.

[4] In the article in the Beiträge, referred to above, *mmbar* is mistakenly used for *mbar* or *mb*.

One of the chief purposes of Professor McAdie's proposal has to do with the general public. He states that the public would then acquire more easily an idea as to the pressure conditions than now, when at present the figure "760" seems to be wholly arbitrary; we may well add that it must seem all the more arbitrary since most people know only the aneroid "barometer" and never associate mercury with the instrument. If, however, the business man reads, for example, 1009, he understands at once without calculating that the pressure is 0.009 above its normal value.

It must not be forgotten, however, that this is only true for barometer readings which are reduced to sea level. If the pressures of our weather reports were reduced to 106 meters or 100 meters above sea level the advantage claimed by McAdie would also pertain to them should my proposal be adopted; while for direct readings to which no corrections have been applied numerically or graphically either method is extremely inaccurate, McAdie's method being better for stations below 50 meters altitude, and mine better for places above 50 meters altitude. If, however, the readings are corrected then it makes but little difference whether the number 1000 or some larger one is used for comparison. In any case, it seems to me that this matter is of small significance in comparison with the advantages to be derived from a rational scale adapted to both scientific and technical purposes.

The following table gives the equivalents of the proposed units, in the units now in use. It is very seldom that the pressures at sea level fall outside the limits of the range of 100 *bar.*, from 950 *mb.* to 1,050 *mb.*

Inches.	Mm.	Mb.	Inches.	Mm.	Mb.
5.91	150.0	200.0	29.53	750 06	1000 0
11.81	300.0	400 0	29.92	760.00	1013.3
17.72	450.0	600 0	31.01	787.60	1050.0
23.62	600 0	800.0	31 89	810.10	1080.0
28.05	712.5	950.0			

It is not probable that those countries which already measure atmospheric pressure in millimeters will change their present system without a strong external stimulus. The advantages of the new system over the existing ones are not pronounced strongly enough for this, and there will be no inclination to lightly overturn the comprehensive unification [of methods] that has finally been accomplished [by international conventions], neither will the inconveniences of the transition period be incurred without some compelling reason. However, should the countries employing the English scales advance in this direction and should there be a well-founded prospect that by accepting this proposal a unification of the meteorological scales of the whole world might be accomplished, then the countries using the metric system would probably be glad to undergo the inconveniences of such a change, regarding them as the price paid for such a great advance. But such could only happen in case a really rational uniform system be offered, it would probably be impossible to secure general agreement to a purely empirical aid.

This reform need be carried out, at first only within meteorology itself. The technologist as well as the physicist and chemist would also probably soon use it because of the many advantages which the new system would offer him, but this can be left to time and meteorology does not need to delay adopting the change until a general agreement among all these branches of science has been secured.

METEOROLOGICAL REGISTRATIONS IN SAMOA, 1902-1906. I. WINDS.

By Dr. OTTO TETENS, Ph. D. Dated Berne, Switzerland, January 15, 1909.

In the September, 1908, number of the MONTHLY WEATHER REVIEW Mr. C. Fitzhugh Talman gives a short illustrated notice of the Samoa Observatory, which is under the auspices of the Royal Society of Sciences at Göttingen. The volume referred to by him treats of the history of the geophysical observatory since its establishment in 1902. Volume 2, just published, contains the meteorological registrations for the years 1902–1906. Several figures, charts, and photographs accompany this volume.[1]

The observatory is situated about a mile northwest of Apia on the very extreme point of the Peninsula of Mulinuu. This spot was chosen as the basalt rocks of the interior of the island (Upolu) were here at the greatest distance and consequently their disturbing influence on the magnetic instruments was reduced to a minimum. The open and free location gave every possible advantage for the meteorological observations. The investigations are based on registrations of air pressure, temperature, humidity, and rainfall during a period of 50 months, of sunshine for 23 months, of wind for 12 months (November 1, 1902–December 31, 1906).

DIRECTION AND VELOCITY OF WIND.

In this part of the Pacific the trade winds generally blow from east-southeast to west-northwest, and thus their course is parallel to the direction of the Samoan group. Deviations of the trade winds from this direction are diminished on the northern and southern coasts of Upolu by the longitudinal range of mountains, which are 2,000 to 3,000 feet high.

Besides the air currents of the general circulation, the local land and sea breezes must also be considered. The land breeze at the observatory comes from the southern mountains and the sea breeze from a northerly direction. Owing to these local influences the trade winds are variable. At night and morning they are usually southeast, at noon and afternoon east-northeast.

The results of the wind registration are not conclusive, the collected data being for one year only. The apparatus used did not show wind velocities below 4 miles per hour, but lesser ones were recorded from the vibrations of the vane as shown on the direction apparatus. (The registration was affected by the influence of the tropical climate on the electric battery.) The anemometer was erected 50 feet above the ground, free from the surrounding cocoanut palms.

From the records obtained by this instrument hourly results have been derived. Table 1 shows the percentage of the different wind directions and calms and also the mean velocity in their annual variation.

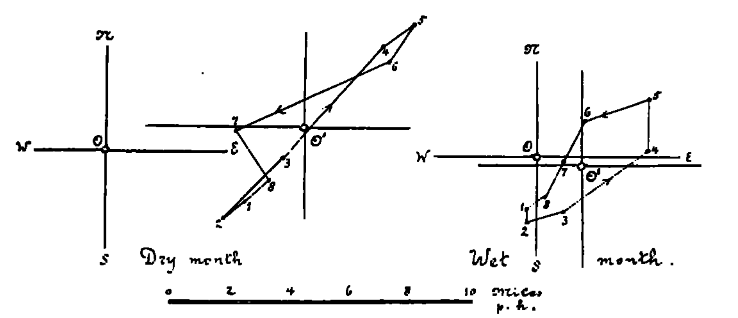

FIG. 1—Daily period of wind resultants, Apia, Samoa. The mean hourly wind resultants are represented by the points 1–8, as seen from the center O, each point showing the average for three hours. The intersection O′, represents the mean hourly resultant for the twenty-four hours. (See Table 4).

Table 1 shows that the trade wind blows 74 per cent of all hours. This average increases during the dry season (May to October) to 90 per cent and during the wet season still amounts to 59 per cent. Perfect calms seldom occur and then only during the night.

[1] Ergebnisse der Arbeiten des Samoa-Observatoriums der königlichen Gesellschaft der Wissenschaften zu Göttingen. II. Die meteorologischen Registrierungen der Jahre 1902–1906, von Otto Tetens und Franz Linke. Berlin, 1908. (Abhandlungen der königlichen Gesellschaft der Wissenschaften zu Göttingen, mathematisch-physikalische Klasse, Neue Folge, Band VII, No. 2.)

TABLE 1.—*Annual period of wind direction and velocity.*

1906.	Percentage of groups of winds. Northerly. NW.-NE.	Easterly. ENE.-SSE.	Southerly and westerly. S.-WNW.	Calms.	Mean velocity.
Wet season:	%	%	%	%	*M. p. h.*
January	10.6	55.9	34.8	0.2	4.4
February	7.2	36.0	52.3	5.2	5.4
March	23.4	49.1	23.7	2.4	5.8
April	14.5	64.7	19.4	0.4	6.1
Dry season:					
May	8.8	83.3	4.8	1.9	6.9
June	3.7	91.7	0.7	3.5	7.5
July	10.0	83.5	1.8	2.4	6.4
August	3.3	95.7	1.0	0.6	10.6
September	2.5	96.8	0.7	0.0	8.0
October	9.0	86.5	4 0	0.0	7.4
Wet season:					
November	13.6	73.1	13.2	0.0	6.1
December	14.3	72.4	11.5	0.0	6.2
Year	10.2	74.0	13.8	1.4	6.7
Dry season	6.3	89.6	2.2	1.4	7.8
Wet season	14.0	58.6	25.6	1.4	5.7

Table 2 gives the percentage and the mean velocity for each of the sixteen directions during the year and its two seasons. These data are sufficient for computing the mean movement of each wind direction in miles per month, as shown by the last columns of the table.

Table 2 clearly demonstrates the overwhelming predominance of the east and east-northeast winds during the dry season and the relatively even distribution of the different winds during the wet season.

The mean monthly wind velocity varied, in 1906, from 4.4 miles per hour (January) to 10.6 (August). The average during the rainy season was 5.7 and during the dry season 7.8 miles per hour.

TABLE 2.—*Annual wind directions and movements.*

Wind direction. 1906.	Mean wind velocity. Year.	Season. Dry.	Wet.	Percentage from each direction. Year.	Season. Dry.	Wet.	Mean wind movement per month. Year.	Season. Dry.	Wet.
	M. p. h.	*M. p. h.*	*M. p. h.*	%	%	%	*Miles.*	*Miles.*	*Miles.*
N	5.4	4.9	5.9	0.5	0.4	0.6	20	14	26
NNE	5.7	4.9	6.4	1.8	1.3	2.3	88	51	124
NE	7.1	8.0	6.3	4.8	3.6	4.9	224	216	234
ENE	9.9	11.6	8.2	16.9	23.8	10.1	1,266	1,934	597
E	8.7	9.3	8.2	17.0	25.2	8.9	1,142	1,770	513
ESE	5.8	5.7	6.2	13.8	15.6	12.1	563	606	519
SE	4.6	4.4	4.8	13.1	13.8	12.4	452	480	423
SSE	4.3	4.2	4.3	13.2	11.2	15.1	409	344	475
S	4.5	4.4	4.7	1.9	0.4	3.4	79	45	113
SSW	4.5	4.4	4.5	4.4	0.7	8.2	148	34	262
SW	4.9	4.7	4.9	3.1	0.5	5.8	113	13	213
WSW	4.6	4.2	4.8	1.9	0.3	3.5	66	9	124
W	5.2	4.8	5.5	1.4	0.2	2.7	67	29	106
WNW	5.6	5.2	5.7	1.1	0.1	2.0	43	4	82
NW	5.3	5.1	6.4	1.9	0.5	3.3	96	28	163
NNW	6.3	5.4	7.2	1.7	0.5	2.9	89	21	157

The daily course of the wind velocity is parallel to that of the temperature; the maximum velocity occurs at 1 p. m., the minimum before sunrise. The following are the formulas obtained for the daily wind velocity in miles per hour:

Wet season.... $5.7 + 1.8 \sin (236° + h) + 0.5 \sin (65° + 2h)$.
Dry season.... $7.8 + 2.8 \sin (245° + h) + 1.1 \sin (71° + 2h)$.
Year.... ..... $6.7 + 2.3 \sin (241° + h) + 0.8 \sin (70° + 2h)$.

Corresponding to the diurnal period of velocity there is also a diurnal variation in the direction. This is shown by Table 3.

From each of the two seasons a characteristic month has been taken as an example for computing the daily change of the mean resultant wind velocity and direction. Thus have been derived the resultants given in Table 4, and shown graphically in fig. 1.

TABLE 3.—*Diurnal period of wind direction and velocity.*

1906.	Dry season.							Wet season.						
	Direction.						Departure from average velocity.	Direction.						Departure from average velocity.
	Highest.		Second.		Third.			Highest.		Second.		Third.		
		%		%		%	*M. p. h.*		%		%		%	*M. p. h.*
0-3 a. m......	se.	26	sse.	22	ese.	19	—1.9	sse.	28	se.	16	ssw.	13	—1.4
3-6 a. m	se.	22	ese.	18	e.	16	—2.2	sse.	29	ssw.	17	se.	15	—1.6
6-9 a. m......	e.	27	se.	18	sse.	18	—1.1	s-e.	18	se.	14	ssw.	12	—0.8
9-12 a. m......	ene.	50	e.	27	ne.	15	+2.3	ene.	21	e.	18	ese.	15	+1.2
0-3 p. m......	ene.	54	e.	23	ne.	12	+3.4	ene.	26	e.	15	ne.	13	+2.2
3-6 p. m......	ene.	40	e.	33	ne.	5	+1.7	ene.	20	ese.	16	e.	12	+1.3
6-9 p. m......	e.	37	ese.	22	{ene. / se.	13	—0.9	se.	19	ese.	16	{e. / sse.	12	0.0
9-12 p. m......	se.	27	ese.	24	e.	24	—1.3	sse.	29	se.	16	ese.	15	—0.8

TABLE 4.—*Diurnal period of wind resultants.*

1906.	September. (Dry season.)		March. (Wet season.)	
	M. p. h.		*M. p. h.*	
(1) 0- 3 a. m.	4.9	n. 109° e.	1.7	n. 189° e.
(2) 3- 6 a. m.........	4.6	n. 120° e.	2.2	n. 187° e.
(3) 6- 9 a. m	6.0	n. 92° e.	1.9	n. 160° e.
(4) 9-12 a. m.........	9.9	n. 60° e.	3.7	n. 88° e.
(5) 0- 3 p. m.........	11.2	n. 68° e.	4.2	n. 62° e.
(6) 3- 6 p. m.........	9.9	n. 72° e.	2.0	n. 53° e.
(7) 6- 9 p. m.........	4.4	n. 81° e.	0.9	n. 97° e.
(8) 9-12 p. m	5.6	n. 100° e.	1.6	n. 166° e.

These figures clearly show the diurnal change, especially during the rainy season.

During the two seasons there seems to be a secondary daily wind maximum from 9 to 12 p. m.

The mean air movement and resultant direction are:

For the year............ 3,113 miles per month from N. 95° E.
For the dry season...... 4,675 miles per month from N. 90° E.
For the wet season...... 1,581 miles per month from N. 106° E.

The resultant mean winds, therefore, are due east during the dry season, and east-southeast during the wet season.

Effects of insolation on the diurnal wind period.

From seven bright and seven overcast days the results given in Table 5 have been derived. See also fig. 2.

TABLE 5.—*Effect of insolation.*

1906.	Departure from daily average.	
	7 bright days.	7 overcast days.
	M. p. h.	*M. p. h.*
0- 3 a. m.....	— 2.2	— 0.4
3- 6 a. m.....	— 2.3	— 1.3
6- 9 a. m.....	— 1.2	— 0.5
9-12 a. m.....	+ 3.3	+ 1.5
0- 3 p. m.....	+ 4.6	+ 1.6
3- 6 p. m.....	+ 1.6	— 0.3
6- 9 p. m.....	— 1.6	— 0.5
9-12 p. m.....	— 2.2	0.0

The difference between the highest and lowest mean hourly velocities is on the bright days, 7.5 miles, on the overcast ones only 4.1 miles. The daily average hourly velocity is 6.8 miles on the seven bright days, and 5.8 miles on the seven overcast days.

When the Besselian equations are formed, the following coefficients for the diurnal and semidiurnal terms of wind velocity result:

	Diurnal.	Semidiurnal.
	M. p. h.	*M. p. h.*
Year................................	2.3	0.8
Seven bright days....................	3.5	1.5
Seven overcast days..................	1.0	1.1

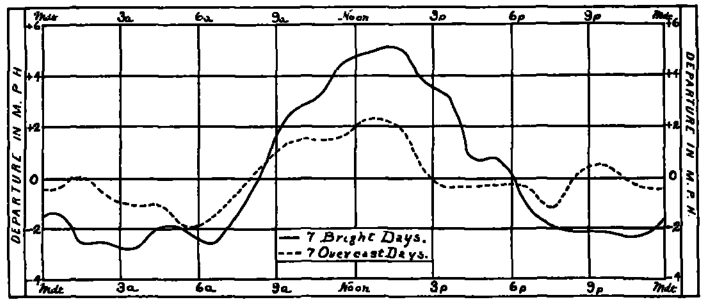

FIG. 2.—The effect of insolation on the daily wind period.

When referred to equal daily average velocity, the ratio of the daily terms is:

$$\frac{1.0}{3.5} \times \frac{6.8}{5.8} = 0.33.$$

The same seven bright and seven overcast days, when analyzed for temperature, give, for the corresponding ratio of the diurnal terms, the value 0.40. This close identity proves the diurnal variations of the velocity of the wind are mainly due to temperature.

The semidiurnal term, when examined in the same way, shows (contrary to the diurnal one) a remarkable independence of the thermal influence.

According to this result the secondary wind maximum mentioned before (9–12 p. m.), is to be expected, especially on overcast days, i. e., when the atmospheric equilibrium is more unstable than on bright days.

These conclusions may help to throw light upon the matter, but since they are based on fourteen days only, the results here derived will have to be confirmed by future observations in the Tropics.

METEOROLOGICAL OBSERVATORY AT TENERIFFE.

Solomon Berliner, American Consul at Teneriffe, reports under date of March 17, that a geophysical observatory[1] is being erected on the Cañadas, the plateau of the Peak of Teneriffe, at an altitude of about 8,000 feet (2,400 meters). This station will be known as the mountain or high-level station of Teneriffe (Höhenstation von Teneriffe).

The buildings, for which the foundations were already prepared at the time of the report, will be of asbestos and will accommodate both the instruments, apparatus, and members of the force employed at the observatory. The residence building is the gift of the Emperor of Germany, the money for the observatory building and the running expenses has been subscribed by the Prince of Monaco, by prominent citizens of the United States of America, and by German firms.

The high altitude of the station brings it above the level of the trade wind clouds so that the sky is almost perfectly clear throughout the year. This circumstance is particularly favorable to the principal object of the station, viz, continuous determinations of the intensity of the solar radiation. In addition to this and the very important studies of the trade wind by means of kites, magnetic and seismic records will be maintained and medico-biological studies will be instituted with a view to developing the hygienic value of the unusually sunny, dry climate and pure air of this peculiar plateau desert of the Canaries. The station will be under the general supervision of Professor Doctor Hergesell, of Strassburg, which is an assurance that its work and results will be of the highest order attainable.

Perhaps this station will furnish information about the northeast trade wind, as interesting as that about the southeast trade wind furnished by the anemometer on St. Helena.—*C.A., jr.*

[1] The corner stone of the observatory was laid by Professors Hergesell and Pannwitz, on March 21, 1909. See Zeitsch. Gesellsch. Erdkde., Berlin, 1909, p. 192.