and in the Pacific Ocean north of the equator, and there is a prospect that the French Navy will carry on work in the French West Indies. Other maritime nations, including the United States, have been invited to join in this important campaign. This international ocean work offers a fine opportunity for wealthy American owners of fine pleasure yachts to devote a little attention to the study of the atmosphere over the ocean.—*C. F. T.*

ABSTRACTS OF RUSSIAN METEOROLOGICAL MEMOIRS.

By Prof. ALEXANDER VOEIKOV. Dated St. Petersburg, December, 1907.

As the Travaux du Cabinet de Geógraphie Physique de l'Université Imperial de St. Petersburg, premier fascicule (Work of the Department of Physical Geography of the Imperial University of St. Petersburg) is out of print, I give herewith a short abstract of the articles therein; following this is a summary of a recent article by Chipchinskii and a note by myself.

I. *Temperature and precipitation of eastern Siberia. 32 pp. Ivitskii.*

I have given an abstract of these temperatures in Meteorologische Zeitschrift, 1900, p. 116, to which I here refer, and give now only a table of precipitation. (See Table 1.)

Everywhere, except in Kamtchatka, the west shore of the Sea of Okhotsk, and Sakhalin, the summer rains predominate enormously. In the two latter regions the rains of the monsoon of eastern Asia come but a little later, as in July the sea is yet too cold to yield much vapor. The same is partly the case in Vladivostok and St. Olga. Kamtchatka is entirely out of the region of the monsoon, and Petropavlosky has about the climate of northern Newfoundland, being very humid and rich in rain or snow during the whole year. The first six places of the table are in the region of the Asiatic anticyclone of winter, when calms largely prevail. Besides, the winter is so cold here that heavy precipitation is impossible. In summer the temperature is high for the latitude, vapor of water is abundant, and frequent cyclones are favorable to precipitation. So here also summer rains prevail enormously, tho the country is out of the region of the Asiatic monsoon, which only reaches to about 60° north latitude on the west shore of the Sea of Okhotsk.

TABLE 1.—*Precipitation in eastern Siberia.*

N. latitude.	E. longitude.	Height.	Name.*	Spring.	Summer.	Fall.	Winter.	Year.	Maximum. Amount.	Maximum. Month.
°	°	*Met's*		*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
62.0	129.7	100	Yakutsk	38	144	63	29	273	56	VIII
53.2	114.3	537	Blagovestchensk Priisk	51	146	81	51	329	57	VII
52.3	104.3	491	Irkutsk	56	192	75	46	369	73	VII
51.8	107.6	521	Verkhneudinsk	21	130	32	13	196	68	VII
50.4	106.4	782	Kiakhta	27	186	42	8	264	82	VII
51.3	119.6	657	Nerchinski Zavod	48	285	69	8	409	110	VIII
50.2	127.6	110	Blagovestchensk	84	327	101	4	515	136	VIII
48.5	135.1	77	Khabarovsk	107	262	105	25	499	140	VIII
52.4	134.1	915	Sofiiski Priisk	53	388	109	13	563	164	VII
53.1	140.7	35	Nicolaievsk	87	174	141	49	451	80	VIII
56.5	138.3	10	Ajan †	74	471	368	43	957	234	VIII
56.5	158.8	16	Petropavlovskii Kamtchatka	314	189	399	292	1193	170	XI
50.8	142.1	7	Alexandrovskii, Sakhalin	89	193	227	90	599	98	IX
50.8	142.9	125	Rykovskoye, Sakhalin	80	215	197	58	557	96	IX
46.6	148.8	26	Karsakovsky Post, Sakhalin	90	149	132	48	420	66	IX
43.7	135.3	45	St. Olga	160	379	270	60	859	190	VIII
43.1	131.9	17	Vladivostok	69	202	122	13	408	96	VIII

* The spellings of the atlases of the Encyclopedia Britannica and the Century Dictionary are adopted.
† At or near sea shore.

II. *Climate of Batum. 17 pp. Moskalskii.*

The following table gives the principal elements of the climate of Batum: (latitude 41.5° N. longitude 41.5° E.).

TABLE 2.

	Mean temperature.	Relative humidity.	Amount of cloud.	Precipitation. Amount.	Precipitation. No. of days with 40mm. or more.
	(1) °C.	(2) %	(3) *Tenths.*	*mm.*	(4)
I	6.3	76	5.6	251	1.2
II	5.9	79	6.1	188	0.8
III	8.8	81	6.5	154	0.4
IV	11.1	82	6.2	128	0.3
V	15.7	83	6.0	72	0.1
VI	20.3	81	4.7	143	0.1
VII	23.1	80	5.2	154	1.1
VIII	23.7	81	5.2	226	2.4
IX	20.4	82	4.7	314	2.6
X	17.0	81	4.2	205	2.1
XI	12.2	81	5.5	321	2.9
XII	9.6	75	5.5	253	1.7
Year	14.5	80	5.2	2408	16.4

(1) 15 years 1882–1896. Mean of observation at 7, 13, and 21 hours.
(2) 13 years 1884–1896. Same hours.
(3) 15 years 1882–86. Same hours.
(4) 15 years 1882–86.
The greatest quantity of rain in one day was 261 mm. in August, 1882.

The humidity of the air is great, especially in the warmer months, the rains very heavy, by far the heaviest of all on the shores of the Mediterranean and the seas opening into it. The contrast is very great with eastern trans-Caucasia and the shores of the Mediterranean where the summer is nearly rainless. Great quantities on one day are frequent at Batum, and these heavy rains often fall at night, without thunder and lightning, and with high barometric pressure. Especially is this the case from August to November. The high temperature, great humidity of the air, and abundant rains are favorable to a rank plant growth. In this respect the vegetation resembles that of the dampest parts of the Tropics, but the genera of plants are the same as in central Europe. The air is dryest in winter, when land winds predominate somewhat.

III. *The winds of Batum. Novitskii.*

The mountainous country around the city of Batum deflects the winds from their original course, and is thus unfavorable to a consideration of the relation of barometric gradients to winds. The sea winds are more frequent in the spring and summer, the land winds in winter. At all seasons, with partial exception of winter, there is a very marked daily period in the winds. In the middle of the day they come mostly from the sea; calms are not frequent, they predominate at the hours 7 and 21 local meridian time. Observations in the middle of the night would have shown a greater percentage of land winds than at these two hours.

TABLE 3.—*Percentage of winds at Batum.*

FOR FIFTEEN YEARS, 1882–1896.

	N.	NE.	E.	SE.	S.	SW.	W.	NW.	Calms.
Spring	7.3	5.0	13.3	7.5	7.6	23.9	5.4	8.5	16.1
Summer	4.1	2.1	13.7	6.2	8.1	25.6	10.1	11.6	18.3
Fall	6.1	6.2	15.7	9.5	11.1	16.6	7.6	6.1	13.1
Winter	6.3	8.4	22.5	14.4	10.3	19.9	3.5	3.8	13.9
FOR 7 A. M., 2 P. M., AND 9 P. M. FOR TWO YEARS, 1895–96.									
Seven hours	2.1	8.5	8.4	5.9	5.9	11.3	2.1	1.7	5.4
Thirteen hours	7.6	2.8	1.8	4.2	5.1	19.7	19.9	24.8	14.1
Twenty-one hours	1.5	2.2	4.5	4.5	3.5	11.1	2.8	0.7	69.2

The land winds, when strong, have the character of foehns; they bring a very high temperature (up to over 28° C.) in March and October and over 25° in December and a great dryness of the air, which are in great contrast to the moderate temperature and great humidity generally experienced. When such winds continue two to three days without intermission the vegetation suffers greatly. I give the following examples of foehn days:

TABLE 4.

Date.	Hour.	Temperature.	Relative humidity.	Wind.	
1883.		°C.	%	*Dir.*	*Vel.*
December 25.......	21	19.5	30	e.	6
26.......	7	18.9	49	e.	6
26.......	13	16.1	81	e.	2
1895.					
December 9.......	7	20.9	39	se.	8
9.......	13	25.3	29	se.	6
9.......	21	21.5	37	se.	6
10.......	7	14.3	86	ssw.	8
1888.					
October 22..........	7	28.5	30	se.	9
22..........	13	26.9	87	se.	10
22..........	21	24.1	51	s.	6
23..........	7	15.3	96	sw.	6
1887.					
March 18.	7	19.7	29	e.	2
18..........	13	28.1	24	se.	4

IV. *Climates of the heights of western Europe. A. Voeikov.*

As the memoir is rather long, I send a copy of it to the Library of the Weather Bureau and give no abstract of it. I need only state that the conditions at the summits of the Eiffel and Strasburg towers and at the French mountain stations were compared with those at the respective bases as to temperature, humidity of the air, and force of the wind. Some other mountain regions are compared with the mountains of France.

V. *Comparison of the intensity of the solar radiation at St. Petersburg and at Pavlovsk. W. Chipchinskii.*

(Work of the Department of Physical Geography of the Imperial University of St. Petersburg; 3d part, pp. 44–68; St. Petersburg, 1906).

The Observatory of Pavlovsk is 30 kilometers south of St. Petersburg, at the end of a large park, with very few houses in the vicinity. The nearest factories are at a distance of 8 kilometers. There is very little dust and smoke. The Imperial Central Physical Observatory at St. Petersburg is at the southwest extremity of the city, and surrounded by factories making use of bituminous coal. The conditions for actinometrical observations are thus excellent in the former place and bad in the latter. The method of observation gives strictly comparable results; at both places the current observations are made with the relative actinometers of Chwolson, and both instruments are generally compared monthly with the absolute Ångström-Chwolson pyrheliometer at Pavlovsk.[1]

[1] Insolation is the exposure, in general, to sunshine, either at the sea level or at any height in the atmosphere; the term is not restricted to a surface at the upper limit of the atmosphere, nor to plane or curved surfaces.

The duration of sunshine in time, its quality as to wave-length, and its intensity in calories per unit of time, per unit of surface, are distinct aspects of insolation.

The intensity per unit area on horizontal or inclined surfaces is often needed in meteorology, but the intensity for normal incidence on a unit surface at the station is the quantity measured in actinometry, and is that here given as θ_1 at Pavlovsk, and θ_2 at St. Petersburg.

From the local intensities of insolation observed at different hours during very clear days we compute the influence of the atmosphere as to absorption and diffuse reflection, and can thus infer approximately the intensity of insolation outside the atmosphere before any loss takes place; this final result is the so-called solar constant, or constant of solar radiation for a normal surface at the mean distance of the earth from the sun.

The rarity of fine, clear weather appropriate for actinometric work is illustrated by the following list of the number of days on which simultaneous observations were secured at St. Petersburg and at Pavlovsk:

1894......12 days.	1898...... 6 days.	1902...... 5 days.
1895...... 7 days.	1899.. ... 9 days.	1903......17 days.
1896...... 7 days.	1900...... 7 days.	
1897...... 9 days.	1901......10 days.	

A total of 89 days in 10 years. But the number of days on which the sky is equally fine during mornings and evenings, or with low sun and high sun, is far less than the above figures would suggest; so that determinations of the solar constant, reliable to within 5 per cent of its own value, have as yet been only very rarely attained. A few special mountain stations seem to be the only places appropriate for this work.—EDITOR.

The author found 62 days in which the observations were made within 10 minutes of time of each other, and the mean result is θ_1=1.20 calories, θ_2=1.03 calories, k=1.17; where θ_1 is the result at Pavlovsk, θ_2 at St. Petersburg, both in small calories per minute, and $k=\theta_1/\theta_2$ is the ratio of these.

Again, 88 observations at Pavlovsk and 92 at St. Petersburg, made simultaneously, or within 3 minutes of time, and on 44 days, gave the following means: θ_1=1.20 calories, θ_2=1.06 calories, k=1.13. Considering only the observations made when the sky was cloudless at both places, the means for 14 days are θ_1=1.27 calories, θ_2=1.15 calories, k=1.10. Hence k is considerably smaller in these cases, because the not infrequent days with haze at St. Petersburg (11 days in this case) have been excluded.

The author gives also the mean values for different directions of the wind. The buildings of the city extend continuously from the Central Physical Observatory 4 kilometers northward, 7 kilometers eastward, 3 kilometers southward, and 2 kilometers westward.

The resulting actinometric wind roses for the two stations are:

TABLE 5.

Winds.	θ_1	θ_2	k	Number of days.
North....	1.11	0.87	1.28	5
East......	1.21	0.96	1.26	17
South....	1.23	1.08	1.14	15
West.....	1.20	1.09	1.10	25

Except for north winds, which seldom occurred, the means are such as would be expected, greatest at St. Petersburg with west winds and smallest with east winds.

In thirteen cases θ_2 was greater than θ_1, that is to say, solar radiation was more intense in the great city; of these cases ten were with west winds and three with south winds.

As to the influence of the seasons Chipchinskii finds the averages given in Table 6,

TABLE 6.

Season.	θ_1	θ_2	k	Number of days.
Winter...	1.06	0.90	1.18	10
Spring...	1.30	1.13	1.15	30
Summer.	1.16	1.08	1.07	15
Fall......	1.06	0.73	1.45	7

The greatest number of days favorable for actinometrical observations and the clearest atmosphere on such days is found in spring, especially in early spring, and the worst conditions in the autumn.

The maximum values at Pavlovsk for each month, and the accompanying conditions of temperature, wind, and humidity, as selected from the whole record for ten years, are given in Table 7.

TABLE 7.

Date, new style.	Month.	Local mean time.		Maximum. θ_1	Temperature of air.	Vapor pressure. Absolute humidity.	Wind.		Sky and clouds.
							Dir.	Vel.	
		h.	*m.*		°C.	*mm.*		*m.p.s.*	
1898, January 29..	I	11	40	1.16	— 8.9	1.1	nw.	7	0
1899, February 28.	II	9	38	1.31	— 9.1	1.7	wsw.	2	2 A.-Cu.
1898, March 29....	III	10	9	1.42	— 4.6	2.0	sw.	4	†Ci.
1898, April 24.....	IV	10	53	1.45	9.6	2.7	sw.	2	1 Ci.
1901, May 1.......	V	11	37	1.45	10.2	3.0	ese.	3	0
1899, June 21.....	VI	*14	26	1.42	12.8	6.0	ne.	7	†Ci.
1889, July 12......	VII	10	16	1.33	21.3	10.6	se.	3	†Fr.-Cu., Cu.
1895, August 16...	VIII	11	14	1.34	13.2	6.4	ne.	10	0
1897, September 18	IX	10	54	1.35	12.4	2.3	nne.	2	†A.-Cu.
1898, October 18..	X	11	28	1.33	— 6.7	2.2	ene.	4	0
1894, November 9.	XI	11	1	1.14	— 9.4	1.5	ese.	2	0
1896, December 7.	XII	12	1	0.98	—16.9	0.8	ssw.	2	0

*2 p. m. † Less than one-tenth.

Thus we have three months (November to January) of low maxima, five months (February and July to October) of moderate, and four (March to June) of high maxima. The months of high absolute humidity, July and August, are unfavorable to great intensity of insolation. The maxima of intensity are higher not only in the spring months, but also in September, and the absolute maximum of October is equal to that of July, but how different are the conditions of the lower atmosphere! In October the temperature is —6.7° C. and absolute humidity 2.2 mm.; in July the temperature is 21.3° C. and absolute humidity 10.6 mm.

During ten months out of twelve the absolute maxima were observed in the forenoon, a fact observed also elsewhere, apparently due to the fact that in the morning there is less aqueous vapor and generally also less dust or haze than in the afternoon.

At the end of this memoir the author gives in detail, for both stations, all the corresponding observations of radiation, cloud, and wind. The maximum radiation of each month, shown in the author's tables in bold-face type, is given in the accompanying Table 7, in plain figures, in column under head of "Maximum."

THE STUDY OF EVAPORATION.

By Prof. A. VOEIKOV. Dated St. Petersburg, December, 1907.

I was much interested in Professor Bigelow's paper "on the Salton Sea and evaporation."[1] Such another occasion is not to be expected soon, and the study intrusted to a man of the knowledge and ability of Professor Bigelow will be of immense benefit to science.

My present remarks apply to the comparison of the different formulas for evaporation in which the velocity of the wind is introduced. Professor Bigelow, by introducing the same values of temperature, humidity, and wind, finds that the results vary more than in the relation of 2:1 (Stelling 0.3495, Abassia 0.1337). I think the principal cause of the discrepancy between these empirical formulas is that the wind velocity was not observed at the same place where the evaporating basin or dish is situated, the anemometer being placed much higher, on the top of a building or on a tower.

The better the anemometers are placed for the needs of general meteorology—that is to say, the freer is the access of air and the less the retardation by friction, by so much the less will these wind velocities agree with those at the surface of the evaporation basin or dish. Then, if the evaporation is measured from a large tank or basin in the open air, the access of the wind will be freer than to small evaporation dishes placed, as they often are, in screens whose walls impede the access of air; but, on the other hand, the humidity of the air will be greater over the surface of a larger body of water, owing to the diffusion of the greater quantity of evaporated water.

The examples in Table 1 show a great discrepancy in the rate of evaporation, while the wind velocity, temperature, and humidity of the air are nearly the same. The evaporometer and its exposure in the screen were the same. The wind velocity is given approximately by Wild's wind vane, with heavy inclined pendulum plane.

TABLE 1.

Month.	Pinsk, 52° N., 26° W.				Vasilivichi, 52.3° N., 29.6° W.			
	Evaporation.	Temperature.	Relative humidity.	Vapor tension.	Evaporation.	Temperature.	Relative humidity.	Vapor tension.
1897.	mm.	°C.	%	mm.	mm.	°C.	%	mm.
June	71.4	18.7	63	3.5	96.6	18.3	69	2.3
July	65.2	19.9	76	3.0	94.7	20.1	73	2.8
August	65.8	19.4	73	3.1	96.5	19.0	74	3.1
September	34.5	12.9	81	2.3	52.9	12.9	80	2.3

[1] Monthly Weather Review for July, 1907.

Both places are in nearly the same latitude and distant by about 100 kilometers. At Pinsk there is a great expanse of river and marsh to the south and west. So the winds have freer access than at Vasilivichi, where forests impede them more. But at the screen where the evaporators are placed there is a rather thick growth of trees at Pinsk, while at Vasilivichi there is no growth of trees in the vicinity of the screen.

If empirical formulas were deduced from the observations at these two places, their coefficients would be different, those from the Pinsk observations would be such as to give smaller values for the same wind velocity, and those from the Vasilivichi observations greater values.

THE EVAPORATING POWER OF THE AIR AT THE NEW YORK BOTANICAL GARDEN.

By C. STUART GAGER. From the Journal of New York Botanical Garden, December, 1907.

In May, 1900, three meteorological stations were established in the garden.[1] Station 1, located in the herbaceous garden, was equipped with a standard rain gage, a thermograph, and a set of maximum and minimum thermometers. Station 2 was on a low ridge in the center of the hemlock forest, and station 3 in the central portion of the elevated plain of the fruticetum. The last two stations were equipped with thermographs only.

Late in September, 1904, these three stations were abandoned.[2] The catchment basin of the rain gage was installed on the roof of the museum building over the physiological laboratory, and, by means of a lead pipe extending down thru one of the supporting pillars, it was connected with the gage at the base of the pillar, inside the laboratory. The amount of precipitation recorded at the new station was found to be approximately the same as at the old one. The thermometers and thermographs were all transferred to a shelter house located within the experiment garden, near the propagating houses, on the eastern border of the garden.

Until June, 1907, the meteorological records at the garden include only the dates and amounts of precipitation, and the temperature of the air and that of the soil at two depths. The amount of precipitation, however, is not an index of the amount of water available to vegetation. Part of the meteoric water drains away thru the soil before it is used, while a portion of it evaporates from the surface of the soil into the air. It is the ratio between annual precipitation and evaporation that chiefly determines how nearly a given region approaches to either a swamp or a desert. In a swamp evaporation is less than precipitation, while in a desert the reverse is true.

It is a well-known fact that the rate of evaporation from a given area depends upon the relative humidity of the surrounding air. Relative humidity, in turn, varies with the temperature of the air and with the environment. Thus, for a given air temperature, the rate of evaporation from a given water surface will vary with the area of the surface and with the depth of the water, and the rate of evaporation from moist substances will be modified by the nature of the substance, and with the amount of moisture it contains. Thus, for example, water will evaporate more rapidly from one square foot of water surface than from two square feet, and more rapidly from one square foot with a depth of, say, one quarter of an inch, than it will from the same area over a depth of one foot. Also the same amount of water will evaporate at different rates from clay soil and from sand soil. Shrubbery and foliage tend in several ways to increase the relative humidity of the surrounding air, thus retarding evaporation.

The experiments described in this paper form part of a more extended investigation, inaugurated by Dr. Burton E. Livingston, of the Desert Botanical Laboratory, of the Carnegie Institution, at Tucson, Arizona. Evaporimeters of uni-

[1] Journal N. Y. Botanical Garden, vol. 1, p. 76, 1900.
[2] Journal N. Y. Botanical Garden, vol. 5, p. 211, 1904.