

ART. XII.—ON THE TEMPERATURE OF THE SPRINGS AT QUEBEC.
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READ 1ST MARCH, 1834.

As the water of spring-wells is observed to be colder than the air in summer, and warmer than it in winter, their temperature, which, varies little comparatively with the change of seasons, was for a long time supposed to indicate the mean temperature of the countries in which they are situated. The opinion seemed confirmed by finding that such is actually, or very nearly, the case in the temperate countries of Europe, where exact enquiries into the subject were first instituted. But a more extensive experience in different climates has shewn, that it is only in temperate regions that this balance of heat between earth and air actually exists. In very cold climates the mean temperature of the earth is ascertained to be higher than that of the air, whilst within the tropics it is lower. There are some places in each continent where an equality exists, but on proceeding from these towards the equator or the pole, the mean heat of the air or earth is found to preponderate.—Philadelphia seems to be one of the points of equality, in this respect, in North America.

Baron Humboldt has shewn that the Isothermal lines often diverge widely from the parallels of latitude, and the Isogeothermal lines, which designate an equality of temperature in the superficial crust of the earth, vary again from the Isothermal. As the information necessary for

drawing correct Isogothermal lines is as yet very imperfect, any contribution to our knowledge on the subject will not be altogether useless. Hence, as no account of the mean temperature of the springs in any part of Lower Canada has yet appeared, I venture to submit the following to the Society, notwithstanding its imperfections, with the hope that some one who has better opportunities of observing, may be induced to turn his attention to the subject.

A difficulty occurs in this country in obtaining the temperature of wells throughout the year, as few perennial overflowing springs can be found.—The crust of the earth is soon frozen in the winter, and as no further infiltration takes place, the scanty drainage from deeper sources is frozen as it reaches the surface, if the well is shallow. In deep wells also, which retain a supply all the year round, the water at the surface is generally cooled to the freezing point. Hence it is only by examining the bottom of such wells, that the temperature of the earth, at this season, can be ascertained.

By means of a Six's register thermometer, I ascertained the temperature at the bottom of the deepest wells in the Upper Town of Quebec, in March, April, May, October, November and December of 1831. The same instrument also enabled me to ascertain it in February and March 1832. After this time it got out of order, and could no longer be used for the purpose. I had, however, in the mean time observed a well in the field next the citadel, where the water bubbled up with some force, and issued in a small stream. Its temperature in May, when the ground became bare, corresponded with that of the bottom of the wells in town, and it seemed likely to afford means of ascertaining the temperature of the earth, during the summer months, without any necessity for a register thermometer.

As my absence with the surveying party prevents me from attending to the subject during the summer, or autumn, I applied, in 1832, to my friend, Lt. Baddeley, for his co-operation. He readily promised it, but was prevented by an attack of the prevailing epidemic from obtaining more than two observations. In the spring of 1833, my friend, Dr. Skey, undertook to register the temperature of the well during my absence, and on my return in the fall, he gave me notes both on this well and another in the Artillery Barracks, taken several times each month, and recording every circumstance that could influence the state of the water at the time of the observation.

From the observations of these gentlemen, and those I have previously made, I have endeavored to ascertain the temperature of the wells for each month of the year. I am, however, without any observations in January, and from the want of a proper register thermometer, I cannot now supply the deficiency. But as the temperature of the earth at this season is gradually decreasing, we cannot err much in supposing it to be a mean between that observed in December and February. *

* The two following observations were made in January, 1835.—Their result corresponds very nearly with the mean between December and February of former years. They were made by means of a register thermometer, at the deepest of the wells formerly examined, which is situated behind the Court House.

January 10th, at 11, A. M.—Temperature of the water at the surface (the thermometer, which is sixteen inches long, being just immersed) 35° ; at the bottom 40° ; air 10° ; depth of water 15 feet; depth of well 25 feet.

January 20th, at noon.—Temperature of the water at the surface 35° ; at the bottom $40^{\circ}, 5$; air 25° ; depth of water the same as before. That part of the surface of the well where buckets are let down, was on both occasions covered with loose thin flakes of floating ice, and there was a crust of ice of considerable thickness adhering to the sides of the well, and projecting some distance over the surface of the water.

The following is the temperature of the Springs in each month deduced from the mean of all the observations. The wells are from 180 to 200 feet above the tide waters of the St. Lawrence.

January 40°,5,	May 37°,75,	September 48°,40,
February 39,	June 42,	October 48,
March 37, 75,	July 45, 75,	November 46, 5,
April 37, 75,	August 47, 25,	December 42.
Mean annual temperature 42°, 74.		

The variations of the temperature of the earth, at a very moderate depth, present a striking contrast to those of the air. Thus, the earth here is equally warm in June and December. It is coldest in April when the snow, which has lain on it all the winter, begins to disappear; and it acquires its greatest heat in September, from the accumulated effect of the sun's rays, and the infiltration of warm rains during the previous summer. As far as the present observations can be trusted, it at no season sinks materially below the mean annual temperature of the air, whilst its average is from five to six degrees above it.

The temperatures of the earth now stated can only be considered as approximations. The observations, besides being few, have not been continued through all the months of any particular year; nor have they all been made at the same well. In consequence of the first circumstance, we cannot be quite certain of the amount of change in each month, as the temperature would probably vary a little in different years; and the last makes the mean less certain than if it had been obtained by observations at one well only, since the seasons would then bring about a compensation, whether the water which fed the well filtered near the surface, or came from a depth below it. To ascertain correctly the mean temperature of the earth in any place, and its changes during the year, requires a series of observations continued regularly for several years.