Lake Okoboji As a Type of Aquatic Environment

F. A. Stromsten

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by

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HENRY FREDERICK WICKHAM, Editor

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Lake West Okoboji furnishes a particularly interesting field for limnological observation. Its topography distinguishes it from most lakes of glacial origin, which are usually more or less basin-shaped. Okoboji, on the other hand, has a volume development less than that of a cone of equal area and depth. Its shape might be compared to that of a funnel. The slope of the bottom for the first hundred feet in depth is gradual and about typical for lakes in this region. It then drops rather rapidly for the next thirty feet in depth so as to give a "deep hole" of comparatively small area. It is a rather difficult task to locate this deeper part under normal conditions on account of its narrow limits. During windy weather the boat will drift far enough before the anchor catches so that, ordinarily, when the thermometer touches the bottom it does not reach the greatest depth by ten or fifteen feet. There is no doubt but that this peculiar shape of bottom has an influence on the distribution of temperature, dissolved gases, and plankton. It appears that a number of springs must open into the lake near the surface and also at various points on the bottom. These may have some slight effect on the temperature and on the amount of carbon dioxide. They may also account for some of the cold spots found, especially in the shallow bays.

In spite of the fact that considerable study has been made of the geology and natural history of the regions around the lake, comparatively little work has been done on the lake itself. Tilton in 1915 and 1916 made some limnological observations on the lake, and in 1919 Birge and Juday spent several days at the Lakeside Laboratory in further investigations. The present series of papers, covering the period from 1922 to 1927, is an attempt to carry forward the work so well begun by these men.

Many of the data on area, volume and other physical measurements have been obtained from Birge and Juday's report, which, in turn, is based on a survey made by some engineering students from Ames during the year 1905 to 1912. I am also indebted to this same report and to other papers by Birge and Juday for several of the methods and plans for apparatus used. Dean Seashore, of the Graduate College of the University of Iowa, has very generously made available certain funds for equipment and assistants, and has been helpful in many ways. The university mechanician, Mr. Dempster has shown great interest in the making and designing of several valuable pieces of apparatus for the work. Several advanced students have aided in the determination of dissolved gases and of the hydrogen-ion concentration.

The results of these studies will be presented in three parts:

Part I will be devoted to the study of the physical characteristics of the lake such as:

a) A comparative study of the distribution and amount of heat absorbed during the several years studied.

b) The work of the wind and the effect of change in wind velocity in the distribution of heat and the thermal stratification of the lake.

Part II will be devoted to a comparative study of the dissolved gases and the hydrogen-ion concentration during the same period.

Part III will be a study of the distribution and abundance of animal plankton in the lake and the relations to the physical and chemical factors presented in parts I and II.

GENERAL FEATURES

West Okoboji is a long but rather narrow lake. It has a length of nearly six miles with a width of scarcely a mile for the most part. Its valley-like bed is widened in the south half by three bays, two on the west and one on the east. This makes the longest distance across the lake about three miles by following a somewhat diagonal line from the west shore of Miller's bay to the east shore of Smith's bay, near Arnold's Park. The main axis of the lake extends in a southeast-northwesterly direction, which is the direction of the prevailing winds of the summer season. The deepest portion of the lake follows the east shore-line rather closely, becoming deeper as it follows the main axis of the lake from the north shore to a point opposite Fort Dodge point where it is about 132 feet in depth. It then veers off towards the southwest, much in the same way that the deeper part of a river follows its outer curve. At the south end of the lake, near Terrace Park it grows shallow rather rapidly up to the shore-line, giving one the impression that an ancient river valley has been blocked. It is probable that, during the time of the Wisconsin ice sheet, according to Carman, "a lobe of ice (Okoboji lobe) occupied the site of the lakes" and that it built up a strong moraine which filled up the original outlet of the Okoboji system at this place. At the upper end of the lake the low shore-line shades off towards the northwest in a series of marshes and kettle holes. Likewise, from the south shore of Emerson's bay, Green Slough, with a series of kettle holes and marshes extend in a southwesterly direction towards the Little Sioux river. Elsewhere, with few exceptions, the shore-line is marked by rather high terraces and bluffs. A low point at Hayward's bay marks the outlet of Center Lake, while the low east end of Smith's bay is the present outlet of West Okoboji through East Okoboji and the Gar lakes. In a similar way the other low points on the shore-line probably mark the remains of early drainage valleys or arms of the lake. From the south shore of Miller's bay, at the outlet of the drainage canal, low land continues as a marshy valley to connect with Emerson's bay, so that if the lake level were to rise several feet the two bays would be connected, leaving a small island, Elm Crest, to the east. When these lakes were first seen by white men the water level must have been considerably higher than at present. Clark, of the Lewis and Clark Expedition describes this region as follows: "A large lake of nearly sixty miles in circumference, divided by rocks which approach very closely, * * * * it contains many islands and is known as Lac d'Esprit."[1]

MILLER'S BAY

Miller's is the smallest of the three principal bays. It is about three-quarters of a mile across the mouth and about seven-eighths of a mile in length. The west third is partly set off from the rest of the bay by two points of land. The one projecting from the north side is longer and narrower than the one from the south side. It is in the form of a long sickle-shaped sand bar which curves toward the southwest and west so as to partly enclose a shallow northwest baylet. This small baylet, comprising about twenty acres, is usually choked with weeds, of which the *Potamogetons*, *Chara*, *Ceratophyllum*, and *Myriophyllum* are the most numerous. During July and August these plants form huge platforms, sometimes blanketed by *Rhizoclonium*. On bright days these platforms are

[1] Journal of the Lewis and Clark Expedition, Aug. 8, 1804, quoted by Thos. H. Macbride, Iowa Geol. Survey, X, 190 (1899).

populated with hundreds of Bell's painted turtles. Among the weeds and in the smaller clear areas between the platforms may be found as many gar pike basking in the hot sun. Near the margins are the fishing grounds for black bass, and closer to the shore, perch and blue gills. The sand bar appears to be increasing in size from year to year, due to the ice push of the early spring crowding more sand and boulders up to the exposed margin. This continual extension and enlargement of the sand bar will eventually cut off the small baylet from the main bay and allow it to fill up with silt and decaying vegetation until it will be nothing more than a shallow pond or a marsh.

The land projection from the south shore is somewhat less extensive but higher and more bluff like.

Miller's bay as a whole is comparatively shallow, being on the average about twenty-five feet or less in depth except near its mouth where it is nearly fifty feet.

On account of its protected position Miller's bay has a surface temperature which ranges about 2°C warmer than that of the main lake. On account of extensive plant growth the surface also shows a higher percentage of dissolved oxygen. According to Jones ('25) about one-fifth of the bottom area of Miller's bay is covered with *Ceratophyllum*. On bright clear days it is often possible to see a continuous stream of oxygen bubbles coming to the surface from some of these submerged plants. The plankton fauna of Miller's bay seems to be more abundant and more diversified than in other parts of the lake. However, this may be due to the fact that Miller's bay has been more thoroughly and regularly explored than any other part.

SMITH'S BAY

Smith's bay is located on the east side of the lake. It is somewhat wider than Miller's bay but is also shallower. Its shore-line is precipitous for the most part and is closely crowded with summer cottages. The only good bathing beach is found at the southeast corner where the summer resort, Arnold's Park, is located. Similar to Miller's bay it is partly divided into a larger portion and a smaller baylet. The smaller part is located near the outlet of West Okoboji into East Okoboji. It is very shallow, being not over nine or ten feet when the lake is at normal level. It is usually pretty well choked up with weeds so that only a comparatively narrow channel is left for the passage of launches and lake steamers. The water is usually quite warm and somewhat stagnant. The main portion of Smith's bay is exposed to the strong northwest and southwest winds. Hence it is much freer from vegetation than either Miller's or Emerson's bay. Jones ('25) estimates that while almost 25 per cent of Emerson's and 20 per cent of Miller's bottom areas are covered with *Ceratophyllum*, only about 8 per cent of Smith's bay is thus infested. Such plankton tows as have been made in Smith's bay seem to show a less varied and less abundant plankton fauna than either of the other two bays. The fact that

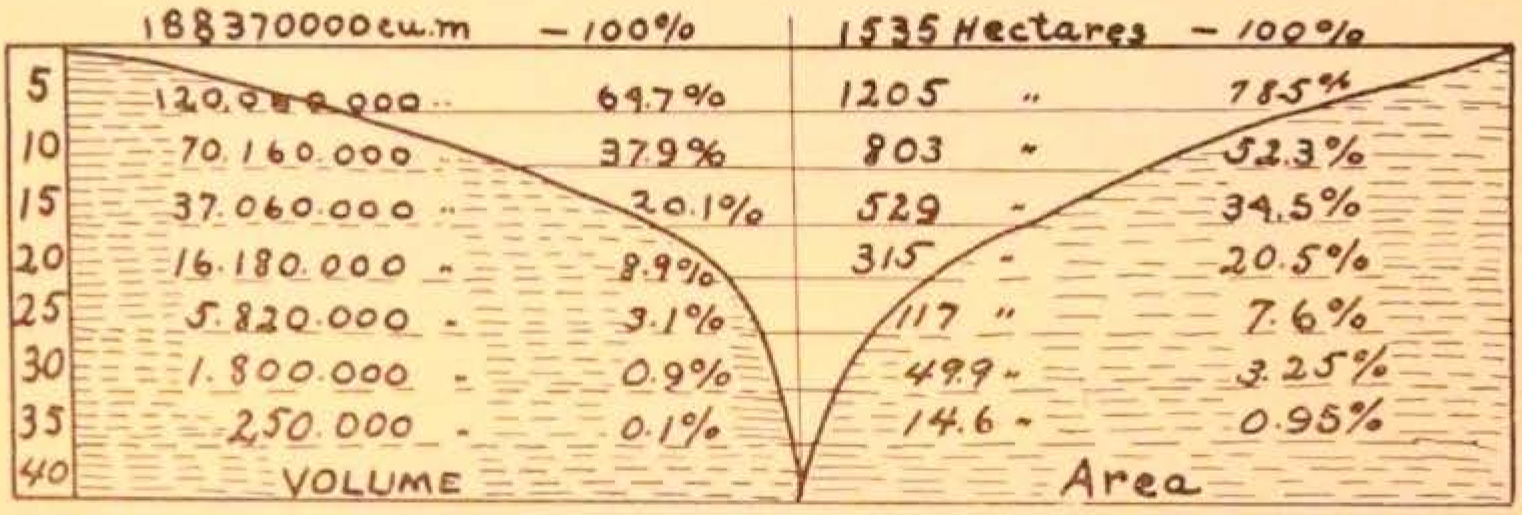

Figure 1. Curves showing percentages of area and volume of Lake Okoboji at different depths. Percentages measured from the central axis. Data from Birge and Juday '19.

the water is more frequently and severely disturbed by heavy winds and perhaps somewhat roiled by the continuous passage of steamers and speed boats may have had an effect on the plankton as well as upon the vegetation.

EMERSON'S BAY

Emerson's bay is more circular in outline than either Miller's or Smith's. It is partly cut off from the main lake by a sand bar, about 10 or 12 feet below the surface, extending from Bluff Point to Pocahontas Point. Like Miller's bay, it has a small baylet indenting its northwest shore. The bay for the most part is rather shallow and has a large portion of its floor covered with vegetation. Since *Ceratophyllum* comprises the greater part of this vegetation, the surface of the bay looks to be comparatively free from weeds. The fact that Emerson's is exposed to the full action of the strong southwest and southeast winds probably prevents those plants which are affected by strong wave action from getting a hold. At least there does not seem to be such large areas covered with "blanket algæ'' as are found in some other parts of the lake. Although Emerson's bay appears to support a fairly abundant plankton fauna, it seems to be limited to a comparatively few forms. *Daphnia retrocurva* and *Bosmina longirostris* are the most abundant cladoceran forms.

The following table of dimensions of Lake Okoboji is taken from Birge and Juday's report: ''A Limnological Reconnaissance of Lake Okoboji.'' (See fig. 1)

Length	5.46 mi.
Greatest breadth	2.84 mi.
Area	3788 acres
Greatest depth	132 feet
Mean depth (reduced thickness)	40.4 feet (1227 cm.)
Volume	246,340,000 cu. yards
	188,340,000 cu. meters
Length of shore-line	18.2 mi.
Shore development	2.13
Volume development	0.92
Mean slope of bottom	1°34″; 2.74%

GENERAL FEATURES

The entire shore-line of West Okoboji, including the bays, is approximately eighteen miles in length. The shores for the most part are precipitous and, except where they are completely unprotected from the dry southwest winds, are bordered with second growth burr oaks. Very few old trees are found since they were cut down by the early settlers. There are several stretches of sand and gravel leading out from the lower shores, but along the steeper parts, the shore is lined by large boulders which have been piled up and pushed back by the ice shove of many winters. The undersides of many of these boulders form excellent collecting places for various forms of aquatic life. Here may be collected leeches, with their cocoons, larvæ, fresh water sponges, snails and their egg clusters, hydra, planarians, aquatic earthworms, water mites, bryozoans, small crustaceans, such as *Gammarus* and *Hyalella*, caddis-fly and other insect larvæ and nymphs, protozoa and many other forms. During the bright summer days, the exposed boulders are populated with Bell's painted turtles enjoying the hot sunshine. In the clear spaces between the boulders in shallow water the sunfish build their nests and guard the eggs. The brilliantly colored appendages of the crayfish may be seen projecting from underneath those boulders lying close to the shore. Hundreds of gar pike line themselves next to the shore along the shallow beaches. Their heads are directed away from the shore, ready to scurry out into the deep water when frightened by the passer-by. In doing this they usually stir up the mud so that it affords an effectual screen to hide their retreat. About sundown, during the month of June, turtles crawl up on the low shores and for several hundred feet up a hillside to dig their nests and deposit their eggs. Bell's painted turtle will lay from nine to thirteen oblong eggs while the snapper's nest will contain a hundred or more round, white eggs about the size of a marble. When the nests have been carefully covered the eggs are left to be hatched by the heat from the sun. In about seven or eight weeks, provided the thirteen-striped spermophile does not find the nest and suck the eggs, the small turtles begin to hatch, dig their way out of the nests, and slowly wander down the long hill slope to disappear finally in the water. Scores of water birds, such as gulls, terns, sand pipers, and herons fly around the sand bars and rock covered points of land, like the sand bar of Miller's bay, Gull Point, and so forth.

APPARATUS AND METHODS

Air Temperatures. The maximum and minimum temperatures for each day were obtained from the Weather Bureau Monthly Bulletin. Those prior to 1926 were taken by Dr. Ferdinand J. Smith at his residence on the south shore of Miller's bay; those for 1927 are as reported by Mr. P. W. Lawrence at Lake Park, about 14 miles west of Okoboji on Silver Lake. No maximum and minimum temperatures have been reported for August 1925 or for the summer of 1926. All temperatures have been reduced to the centigrade scale to correspond with the readings made at the Lakeside Laboratory. Air temperatures were read on the laboratory grounds each day and on the lake each time water temperatures were taken. For this purpose a certified glass centigrade thermometer provided with a correction scale, was used until it was accidentally broken, after which a good grade stock thermometer was used. On the charts showing water temperatures the maximum and minimum air temperatures are shown in light broken lines, and the air temperature taken on the lake is shown by small circles connected by light lines.

Barometric Readings. Barometric readings were taken each day in the laboratory, and on the lake each time water and air temperatures were read. The instrument used was a Keuffel and Esser surveying barometer, compensated for temperature. The readings recorded in the tables are not corrected for altitude, so that it will be necessary to add about 1.44 to reduce to sea level.

Wind Velocity. Beginning with 1924 the wind velocity was recorded for various times during the day on the laboratory grounds and on the lake each time temperature readings were made. The instrument used for measuring the velocity was a portable Keuffel and Esser anemometer which had been carefully calibrated and furnished with a calibration curve. The force of the wind was estimated for 1922 and 1923 by comparing field notes and the Beaufort scale with those made after the anemometer was purchased.

Relative Humidity. The relative humidity was determined by means of a Lloyd Hygrodeik just before going out on the lake as well as for morning and evening.

Dissolved Gases. Winkler's method was used in determining the dissolved oxygen and Seyler's method, as described by Birge, for carbon dioxide determinations.

Hydrogen-ion Concentration. The colorimetric method was used for determining the pH. In 1923 the indicators and buffer solutions were made up by dissolving prepared tablets. In 1924 and 1925 solutions were made up at the University Drug Service Station and a modified Clark and Lubs method was used. A portable hydrogen electrode apparatus was also tried but without success.

Plankton Collections. Surface tows were made with coarse and fine bolting cloth nets. Deeper tows were made with a Birge bucket. Samples of water for plankton, dissolved gases, and hydrion concentration were obtained by means of a modified form of the Birge water bottle.

Water Temperatures. Water temperatures were read every day that weather conditions permitted. The first readings made each day were over the deepest part of the lake and at approximately 8:00 A.M. Other readings were made at different parts of the lake and at various hours during the days. On several occasions readings were made at two-hour intervals during the day and surface readings with oxygen determinations at two-hour intervals during the night.

The apparatus used for measuring water temperatures at various depths was made for the writer by the Charles Engelhard Company of New York. It consists essentially of three parts with the necessary set-up and operates on the principle of the Wheatstone bridge. The thermometer bulb consists of a chemically pure platinum wire fused in a quartz rod which in turn is fused in a quartz tube. The platinum wire is thus protected from the various corroding agents without interfering with its sensitivity. It is further protected by being encased in a double perforated brass tube attached to a water-tight head in which connections are made with the three copper lead wires. These are made waterproof by a pure rubber insulation and are connected with the Wheatstone bridge of the resistance box. The three resistance spools, I, II, and III, are wound of a wire of known value which does not change its resistance with varying temperature. These are grouped together with the thermometer resistance IV to form the four sides of the bridge, which is completed by an indicator. The three fixed resistances have values the same as the thermometer bulb when at a temperature corresponding to the starting point of the scale on the indicator. The scale is calibrated by hand for each tenth degree increase in temperature. In order to provide against inaccuracy on account of possible fluctuations in battery voltage, an adjustable resistance is inserted in the battery circuit. The instrument itself is used to measure the voltage. When the proof coil is connected with the bridge by means of a switch it takes the place of the thermometer spiral. The resistance of the proof coil is equivalent to the resistance which the thermometer spiral would have if heated to the highest temperature for which the instrument is calibrated. If the instrument does not read at the highest scale division when the proof coil is in circuit, proper adjustments are made by the rheostat.

The instrument is provided with two scales, each reading fifteen degrees centigrade. They are divided into tenths of a degree. One scale reads from 0° to 15° and the other from 12° to 27°; the overlap allowing for an additional check on the correctness of the instrument. In order to compensate for wave movements, the indicator is heavily weighted with a lead plate and allowed to swing freely in a double gimbal box. We believe that the instrument is more accurate than a reversing thermometer, and it is certain that much time and labor is saved in operation. Each reading made in lowering the thermometer bulb may be checked when it is being pulled up again, so that there are two readings for each time. The waterproofed cable is carefully calibrated for measuring the depth. The meter divisions are marked by bands of white adhesive tape on which the depth is printed with waterproof India ink.

The ice usually leaves Okoboji late in March or early in April. Since a large amount of heat is required to melt the ice, the average air temperature is considerably above freezing by the time the lake is cleared. The result is that the temperature of the surface water quickly rises to about 4°C., increases in density, and a vertical circulation is established. This will tend to equalize the temperature of all the water of the main body of the lake. This equalization of temperature is greatly aided by the strong winds of the early spring. Since at this time of the year there will be considerable fluctuation of temperature above and below freezing, the high winds and loss of heat through evaporation and radiation will tend to keep the water of the lake at a comparatively uniform temperature for some time. In certain years the lake will have a practically uniform temperature until after the middle of May, several weeks after the ice has melted. Where this condition exists every strong wind will put all of the water of the main lake in circulation, producing what is known as the *vernal overturn*. Similar conditions obtain in the late fall, just before the ice forms. This is the *autumnal overturn*. It is during these two periods that the deeper water of the lake replenishes its dissolved oxygen.

Several warm, calm days will tend to heat the superficial layers of water several degrees warmer than the water below. While much of this heat may be lost by evaporation, or by radiation during the cool nights enough will be stored up to produce a sufficient difference of density between the various layers to offer a considerable resistance to mixture. It will then require a much stronger wind to produce a circulation. The result is that a thermal stratification of the water will take place. In Lake Okoboji during normal years, the water becomes stratified by the middle of June so that only the upper nine to fifteen meters are ever put into circulation during the ordinary summer storms. The water below twenty meters may not be affected by the winds at any time during the summer. Between the layer normally put in circulation, known as the epilimnion, and the deeper layer, the hypolimnion, there is an intermediate layer, called by Birge, the thermocline. The thermocline is narrow as compared with the other two zones, varying from two to five meters. In this zone there is a rapid fall in temperature, averaging 1°C. or more per meter. It is disturbed only in the more severe storms.

The distribution of heat through the waters of a lake is a very interesting problem. Everyone knows that water is a very poor conductor of heat. Wegemann has estimated that with a sea five thousand meters in depth and having a temperature of 0°C. throughout, it would take more than a thousand years for a constant heat of 30°C. to raise the temperature at a depth of a hundred meters as much as 7.3°C. by conduction alone. Birge and Juday estimate that fully 95 per cent of the heat of Lake Okoboji is wind-distributed. It can easily be determined in a general way how much work must be done by the wind to raise the temperature of the lake to a certain amount.[2]

The friction of the wind pressing on the surface of the water will tend to set up a current in its direction thus heaping up the water on the leeward side. The water will then return, either along the shore or over the bottom. What is the ratio of the water current to the wind velocity producing it? How rapidly will the water heap up along the leeward shore? How deep will the water sink under certain temperature conditions before it is turned aside? What effect do the waves have on the general circulation? How far down will a current produced by a certain wind velocity be felt? What is the effect of the configuration of the shore-line and the topography of the lake bottom on the circulation and the distribution of heat and dissolved gases? These and many other questions are suggested when we begin to consider the rôle of the wind in the distribution of heat in the lake. If one knows the general meteorological conditions of the spring and early summer, can one predict the general temperature conditions of the lake, the approximate amount of distribution of oxygen, the lean and fat

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[2] Birge's formula for computing the amount of work done in heating any given stratum of water expressed in grams per square centimeter of surface is as follows:

$$W = RT.Z\ (1 - D)$$

in which RT is the reduced thickness of the stratum stated in centimeters and is therefore equal to the weight in grams of a column whose base is one square centimeter.

Z is the distance in centimeters from the surface to the middle of the stratum.

(1 — D) is the loss of weight.

Birge and Juday, University of Iowa Studies in Natural History, Vol. IX, No. 1, p. 19.

years for plankton, and eventually the favorable and unfavorable years for game fish?

A few tests have been made in an attempt to ascertain the rate of water current produced by a given wind velocity. The results can only be approximate, since the current meter used was not delicate enough to measure ordinary lake currents. When currents strong enough to be measured were present it was not possible to keep the boat from drifting long enough to render the readings even fairly reliable. The current meter did not register the direction of flow, which was another disadvantage. On certain occasions, readings were made off the end of the laboratory dock. It was found that with a wind velocity of 800 feet per minute a water current of about twenty-five feet per minute was produced, or a rate of about one-thirty-second of the wind velocity. Page ('02) states that "a comparison of 658 wind and current observations in the equatorial regions gave as the set imparted by a wind force four on the Beaufort scale (twenty miles an hour) a current velocity of fifteen miles per day. This is also a ratio of one to thirty-two. Ekmann ('05) has worked out a formula for finding the ratio between wind velocity and ocean currents in which he takes into account the effect of the rotation of the earth on its axis[3]. From his formula he finds that at the latitude of 45°N., the velocity of the surface water is approximately one-fifty-fifth that of the wind causing it.

It was not possible with our apparatus to determine how far down the effect of the wind was felt.[4] During the later part of the summer when the lake is full of floating *Rivularia*, it is possible to make some study of the water currents by watching the movements of these algæ. Even when a fairly stiff breeze is blowing it is remarkable how thin a film of water actually moves with the

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[3] Ekmann's formula $V_0 = \frac{0.0127}{\sqrt{\sin \Phi}} V'_w$

V_0 = velocity of surface water.
V'_w = wind velocity.
Φ = latitude of the place.

[4] Ekmann's formula for "depth of wind current" beyond which the motion "is assumed negligible" is as follows:

$$D = \pi \sqrt{\frac{u}{q\ \omega \sin \Phi}} \text{ or } D = \frac{7.6}{\sqrt{\sin \Phi}} (V'_w)$$

q = density
w = coefficient of viscosity
ω = angular velocity of earth

wind as indicated by these plants. Most of them are moving up or down. Only the most superficial are moving with the wind. According to Zöppritz ('78) "A perfectly steady wind acting continuously on the surface will through friction give rise to a movement of the surface waters in the same direction as the wind, itself. If the latter continues for a sufficient length of time, the impulse first felt only at the surface, will gradually communicate itself downward, owing to the viscosity (internal friction) of the water, and the lower strata to successively greater and greater depth will thus partake of the movement until it is finally shared by the whole mass, the velocity diminishing as the depth increases. The rate, however, at which the motion is communicated is exceedingly slow." He estimates that with a body of water having a depth of 4000 meters, a surface current of a given velocity would require a period of about 100,000 years to transmit a velocity of one-half this amount to a point half way to the bottom. He assumes in this a body of water of infinite extent, that is without a shore-line to modify the effect. Further, it would require 240 years for the layer at a depth of a hundred meters to attain half the surface velocity. A period of twenty-four hours is required before the change of direction of the wind affects the water at a depth of five meters. Zöppritz' figures are obviously too large since he does not take into account the turbulent nature of water movement. Under natural conditions one must also take into account the very important factors of the nature of the shore-line, and the slope and configuration of the bottom near the shore. Even under the best conditions after thermal stratification has been established it is only the very heaviest winds that disturb the waters of Okoboji below the depth of twenty meters. On account of the small size of the lake and the nearness of the shores together with the gradual slope of the bottom for the most part, it does not take long for the full effect of the wind to be felt the full depth of the disturbance. This has an important effect on the rapidity and completeness with which heat is distributed through the lake. The importance of the bottom and shore topography has been well discussed by Birge and Juday ('14) in their report on the Finger Lakes of New York. They say: "What may be called the mixing areas are more efficient because of the gradual slope of the bottom. Consider the condition of a lake with direct thermal stratification, whose form is that of an oblong tank with vertical sides. A wind blowing the surface water to one end would depress the isotherms there. The cold water would swing back and oscillate, but there would be very little friction between the strata and little mixture and correspondingly little warming of the lower water. In an actual lake with sloping bottom, the narrower ends concentrate and give force to the movements of the water caused by the wind and increase the amount of mixture due both to the direct and indirect effects of the wind. As the warm water is forced downward at the ends, it squeezes out the cooler water in a relatively thin layer between the descending surface of the epilimnion and the gradually sloping bottom of the lake. As the cool water swings back, its edge pushes in like a wedge between the bottom and the epilimnion. Both movements are attended with relatively great friction and corresponding mixture of warmer and cooler water. Thus the ends of the lake constitute its chief mixing areas, and they are the region where the gradual warming of the thermocline and hypolimnion goes on most rapidly. Relatively little warming is effected in the open water of the lake or its steep sides where movement is attended with little resistance and consequent mixture." (P. 575) In Okoboji, the bays, especially Miller's and Emerson's add to the mixing areas.

When Okoboji has a uniform or nearly uniform temperature, that is, when the difference in temperature between the surface and bottom is not much more than two or three degrees, a moderate wind will soon place all of the water in the main lake in rotation. This condition prevails in the early spring and late fall and to some extent through the entire summer of seasons like 1926 and 1927. If, however, the difference of temperature is as much as six or seven degrees centigrade, the warmer superficial waters having lost in weight cannot sink to the bottom but must spread out laterally over the cooler waters whose density is too great to allow them to sink farther. There will thus be a superficial circulation established. It is only when a very strong wind is blowing that water will heap up so rapidly that it will be able to sink much below the circulation first established. As a matter of fact as the summer season advances and the water becomes warmer there is a tendency for the difference of temperature between the superficial and deeper waters to become greater, increasing the resistance to mixture. The zone of circulation, the epilimnion, tends to become constantly shallower. The upper surface of the thermocline marks the lower limits of the average circulation. The lower surface of the thermocline in-

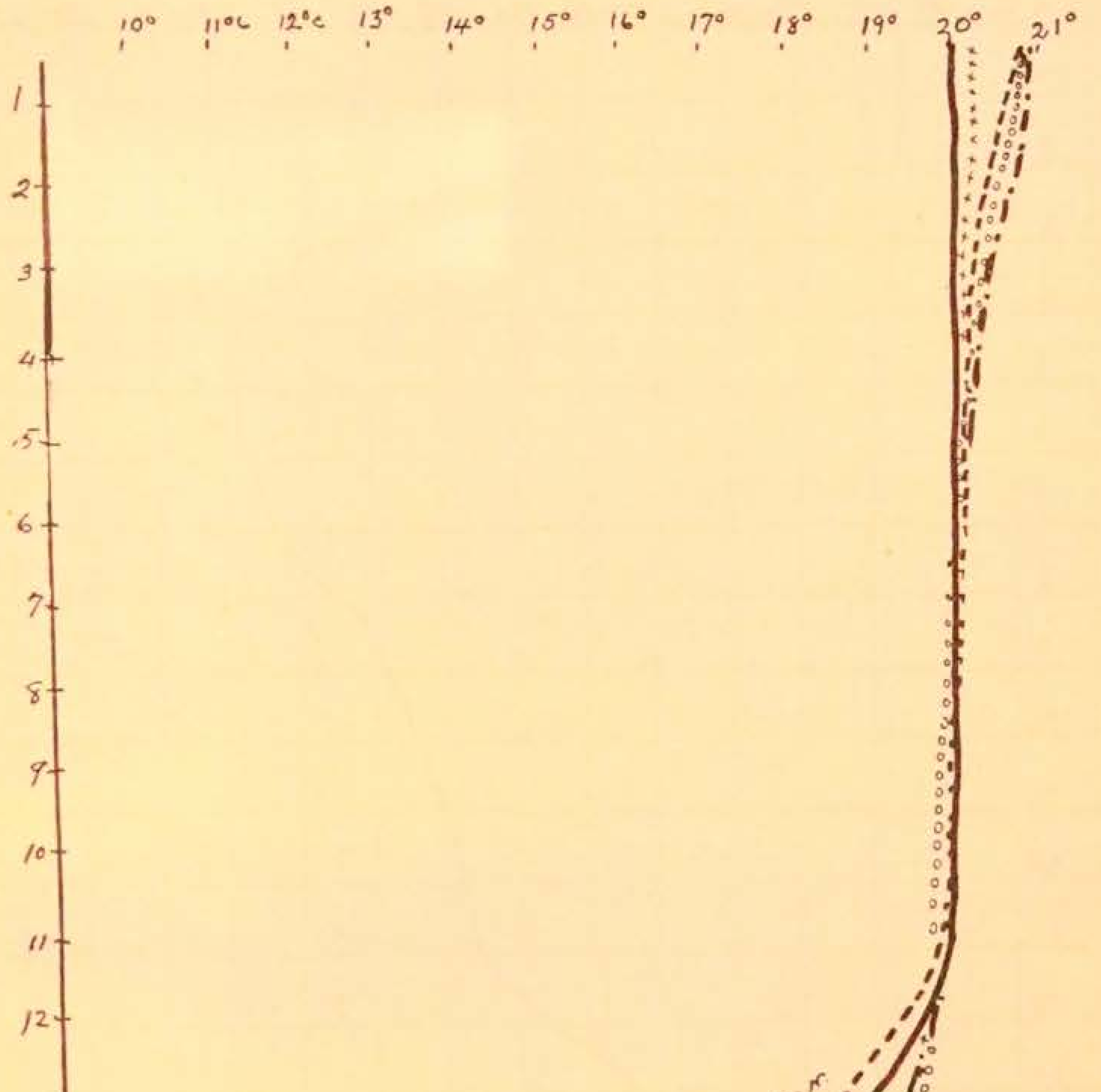

Figure 2. Effect of wind, deep hole, August 11, 1924.

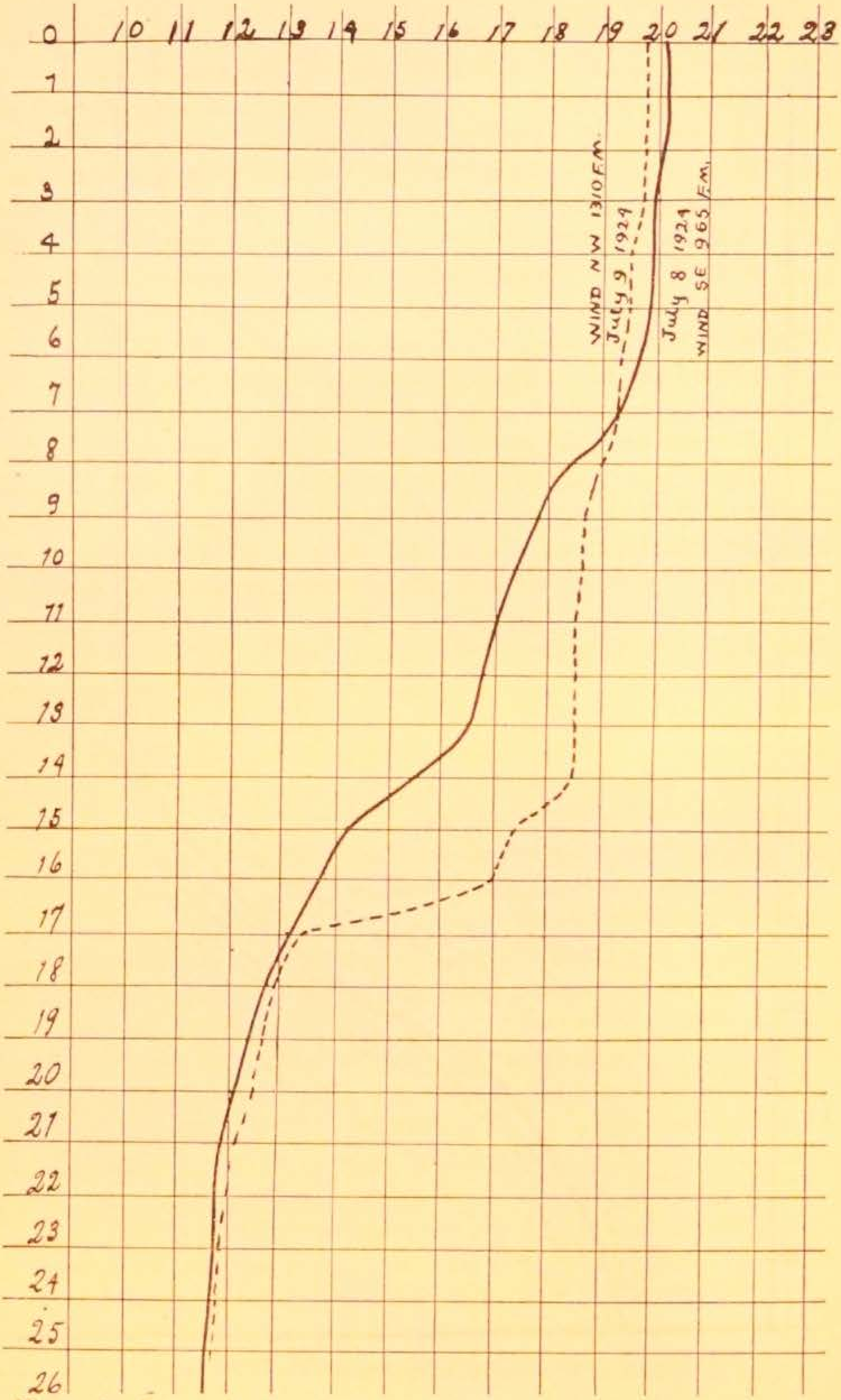

Figure 3. Curves showing the depth of disturbance due to change in wind velocity.

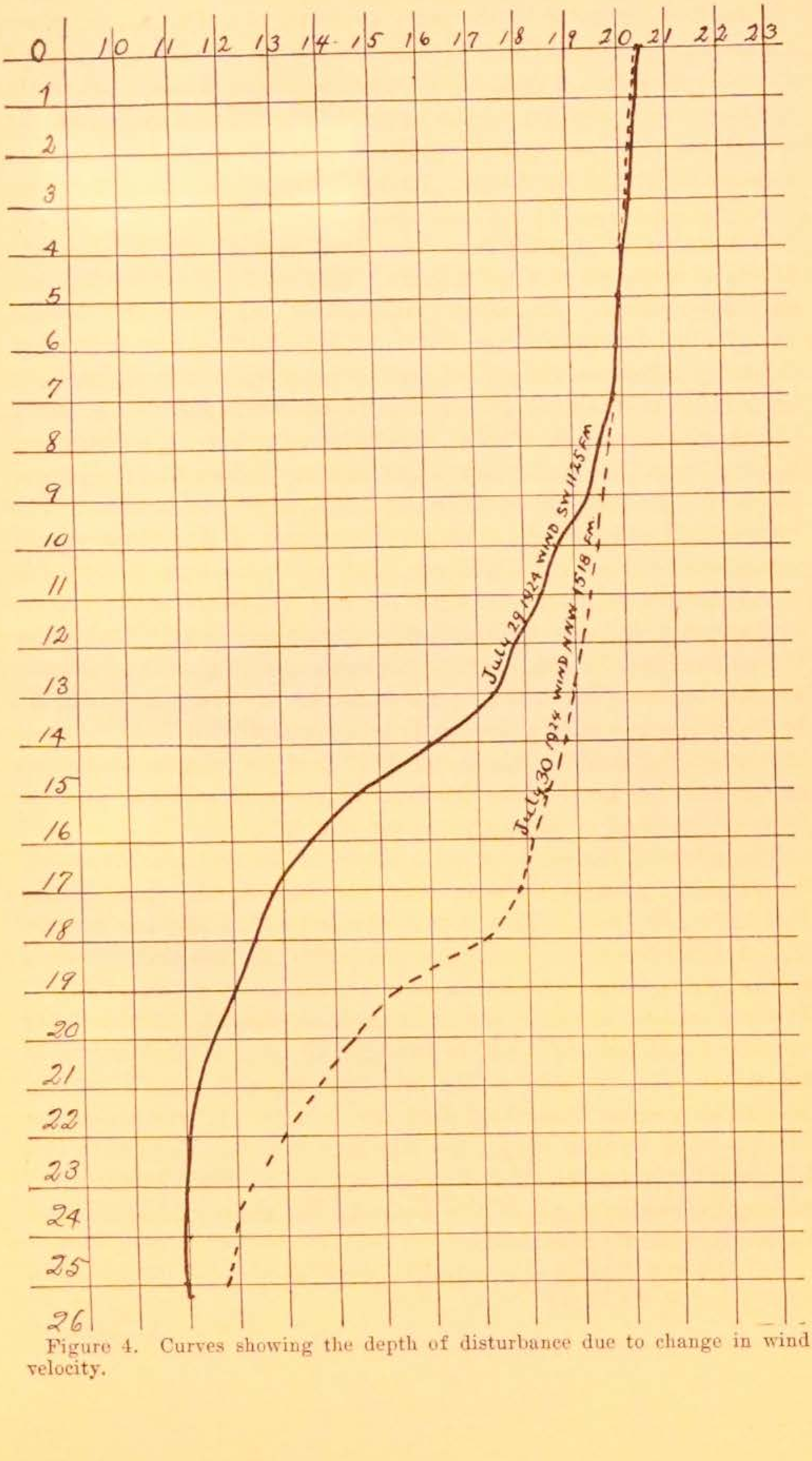

Figure 4. Curves showing the depth of disturbance due to change in wind velocity.

dicates depth affected by the more severe storms. On rare occasions the water of the hypolimnion may be directly affected by the wind storms even when a definite thermocline is established. There is, however, an oscillation of the hypolimnion which may persist for some time after very severe storms and which is probably present to some extent at all times. Its behavior has not been carefully studied.

A number of experiments have been carried out to show the effects of a change in wind velocity. Figures 2-4 show temperature curves for Okoboji on July 8 and 9, 1924. At this time the wind velocity had increased from 965 feet per minute at the time when the temperature was recorded on the morning of the eighth, to a velocity of over 1300 feet per minute when the record was taken on the morning of the ninth. It will be seen that the temperature is not affected below the level of 17 meters. Above this level there has been a tendency to equalize the temperature of the water. The upper third which contains about 40 per cent of the volume of the water affected, has lost slightly in heat which has been given up to warm the lower two-thirds. The air temperature of the afternoon of the eighth was very high so that it contributed enough heat above the amount lost by evaporation and radiation at night to raise the average temperature of the seventeen meters involved from 18.27°C. to 18.79°C. It appears that in 1924 the stability of Lake Okoboji was such that a wind velocity of 1300 feet per minute would put all of the water of 17 meters in depth in circulation but would have little or no effect on the water below this depth.

The effect of a stronger wind is shown in the temperature curves for July 29 and 30 of the same year. In this case the wind velocity had increased from 1125 feet per minute to 1518 feet per minute. The thermal resistance to mixture has increased somewhat, but even so the effect of the wind has been increased by its greater velocity. It must be said, however, that it is probable that the wind velocity indicated was not sufficient to produce all of the effect shown in the curve. The velocity of the late morning and early afternoon was much greater than 1500 feet per minute. It was altogether too windy to venture out on the lake in a launch. Even with this high wind velocity the effect was not as great as might be expected, although practically all of the water of the main lake must have been disturbed to some extent.

As with the difference in wind velocity, so also the difference in temperature from stratum to stratum, which means a difference in resistance to mixture, determines the depth to which circulation may be established. Birge has given us the formula for determining the thermal resistance of the work done in mixing a column of water with its unit base and height, and a uniform temperature gradient.[5] The charts and curves showing thermal resistance to vertical mixture are based on the formula $\frac{D_m - D_n}{8}$

When the difference in temperature between the surface and the bottom is not great the resistance to mixture is not so great but that a comparatively slight wind will tend to equalize the temperature. When there is a considerable difference in temperature, the resistance to mixture is increased and there will be a tendency to establish a zone varying in depth from the surface according to conditions, below which the temperature changes but little during the summer. It is interesting to compare the distribution of temperature from year to year. Not only is there a difference in the distribution of temperature throughout the lake but there is also a vast difference in the total amount of heat actually absorbed by the lake during different years.

When the summer heat income for a number of years is plotted it may seem to follow some sort of a cycle. It is, no doubt, profoundly affected by local climatic conditions which appear in a general way to be cyclic in nature. It is true that the amount and distribution of heat in the lake regulate to some extent at least the amount and distribution of dissolved oxygen and this in turn has an influence on the amount and distribution of plankton, which are important factors in the welfare of the fish communities. There is no question but that the fat and lean years of plankton life and

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[5] $W \text{ (ergs)} = \frac{12}{AC^2} D_2 - D_1)$

A = area of column.
C = height of column.
D_1 = density of upper surface.
D_2 = density of lower surface.

"If A and C are assumed as constants, for instance 1 sq. cm. and 100 cm., then the thermal resistance will vary according to the value of $D_2 - D_1$, or to state it in terms of $1 - D$, according to the value of $(1 - D_1) - (1 - D_2)$. In our work the thermal resistance unit $D_5 - D_4$ = .000008 is used. Then any column of water one square centimeter in area and 100 centimeters high with a uniform temperature gradient, the number of units of thermal resistance is equal to $\frac{D_m - D_n}{8}$, m and n being the temperature of the water at the ends of the columns."

to some extent the good and poor years for fish are tied up in some way with the temperature situation.

When the summer heat income for the years 1915-1927 is plotted it gives a rather interesting curve.[6] While the data for the years 1915-1921 are incomplete it probably indicates the tendency. The summer incomes for 1915 and 1916 were computed from Tilton's records for August 5, 1915 and July 26, 1916, while that for 1919 is Birge and Juday's results for July 30, 1919. It is not certain that these give the greatest amount of heat absorbed by the lake during the summers in question. There are no data for 1917-18 or 1920-21. In 1922, temperature data are available for the first two weeks in August only. For 1923-1927 temperature readings were made frequently, daily when it was possible to go out on the lake, and from these readings those giving the highest heat-income for the summer were chosen for the curve. It will be noted that there was a very low heat-income for 1915. A temperature curve for this year shows a poorly developed thermocline and the difference in temperature between the surface and the bottom was probably not more than five or six degrees. The next year the heat-income seems to have increased very much. In 1919 and 1922 the total amount of heat absorbed and retained up to the time the readings were made amounted to about 2100 gram-calories per square centimeter of surface. During these years there is a sharply defined thermocline established and the difference in temperature between surface and bottom was about fourteen or fifteen degrees centigrade. For 1923 there is a decided drop in the number of calories and for the next three summers the decline is very rapid. The thermocline becomes less sharply marked until it apparently vanishes in 1925, 1926 and 1927. The difference in surface and bottom temperatures also diminishes as can be seen by examining the temperature charts for these years. In 1927 the curve begins an upward trend. It will be interesting to see whether this upward trend continues during the next few years to fill out the curve.

A detailed study of the distribution of the heat through the several strata of the lake will now be made by use of several charts.

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[6] Birge and Juday compute the summer heat-income as follows: Summer heat-income = (T-4) .RT, in which T is the mean temperature of any stratum and RT the reduced thickness stated in centimeters. The result will be the number of gram calories per square centimeter of surface. The reduced thickness of the entire lake "is equal to the depth of a vertical sided tank necessary to hold all the water of the lake, if its area is equal to that of the lake's surface." ('19, p. 8).

In order to use data obtained on days when it was not possible, for one reason or another, to obtain readings for the full forty meters, only the temperature for the first twenty meters are plotted. The temperature below twenty meters varies but little for the summer and changes very gradually from this point down.

The temperature readings for 1922 were begun about the first

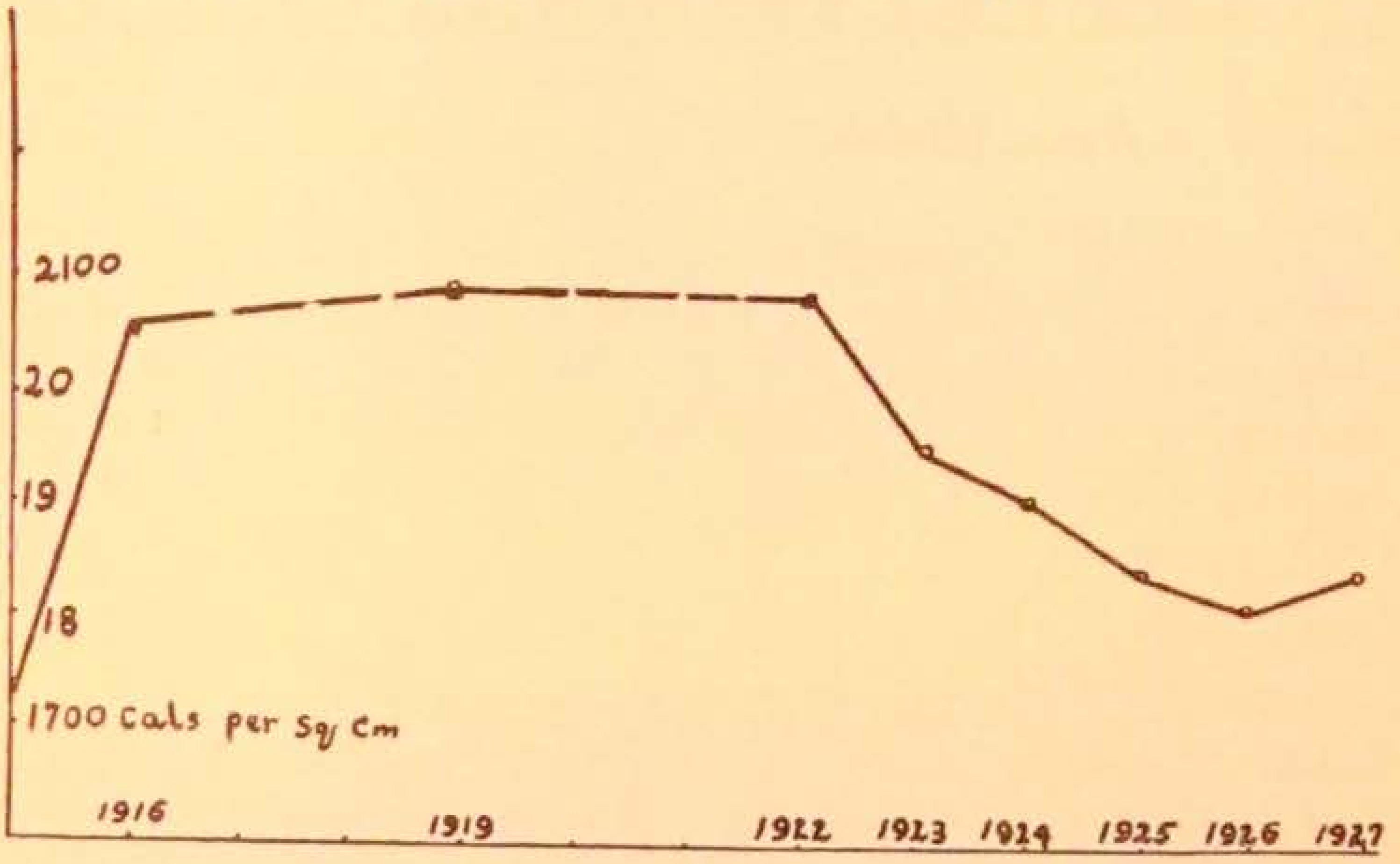


Figure 5. Curve of income of heat for the summers of 1915, 1916, 1919, and 1922 to 1927.

of August and continued through the nineteenth. The chart shows a rather wide difference in temperature between the surface and the twenty meter level—a difference of about 12°C., of which about one-half the difference is in the last five meters. The thermocline is located at about the fifteen meter level and it shows as great a fall in temperature in five meters as does the entire fifteen meters of the epilimnion. There is not much change in the depth of the thermocline during the time of observation except during a very heavy wind storm. The daily maximum and minimum temperatures were recorded by Dr. Ferdinand J. Smith at his residence on the south shore of Miller's bay and were obtained from the monthly Weather Bureau report. The wind velocity, where indicated, was estimated by comparing field notes with observations made after an anemometer was obtained.

In 1923 we find a difference of temperature between the surface and twenty meters as much as 11°C., even as early as the middle of June. The amount of difference increases gradually up until July 23 when the maximum of 15.5° difference is reached. The temperature at the twenty meter level has not changed much, but the surface temperature has increased from about twenty degrees on June 27 to nearly twenty-seven degrees on July 23. The greatest

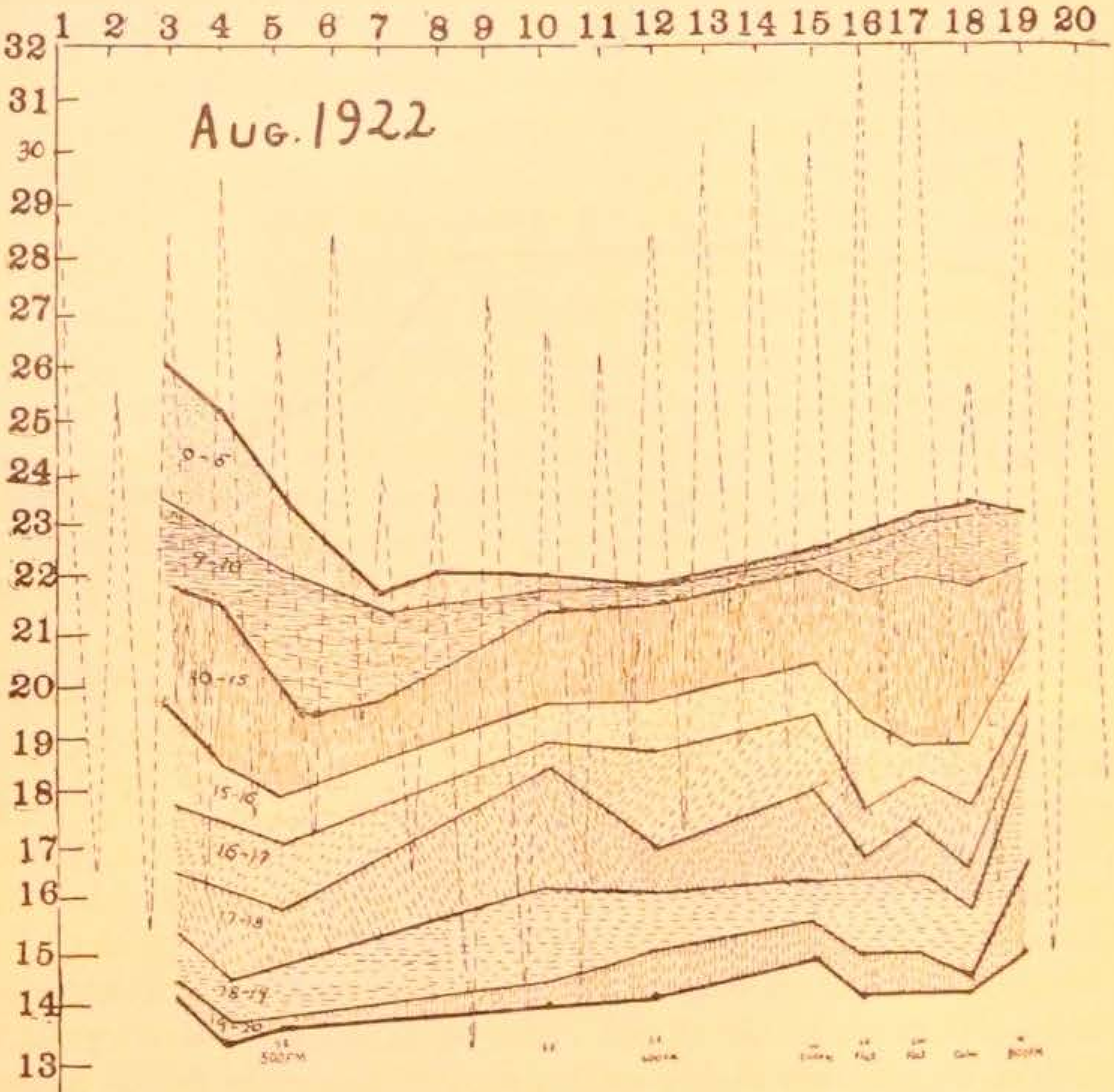
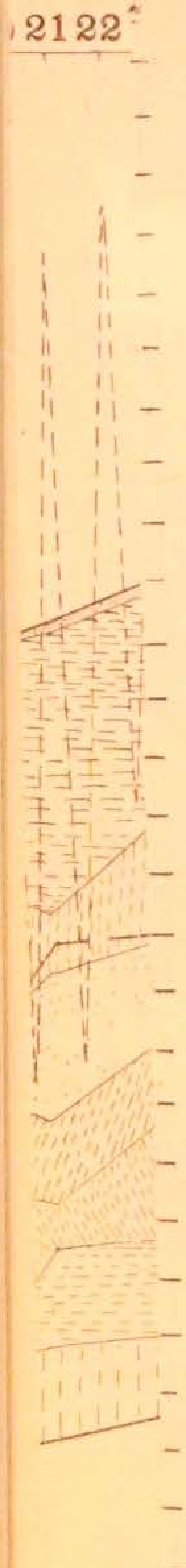
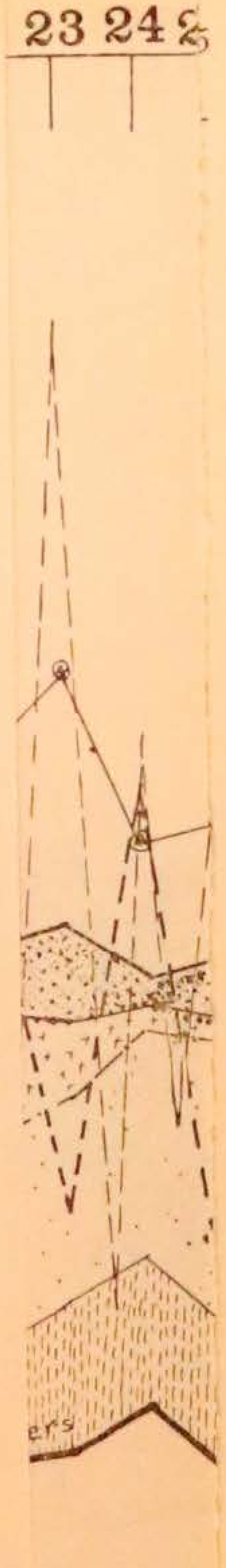


Figure 6. Temperature of each five meter zone down to the thermocline, and for each meter through the thermocline down to 20 meters from August 3 to August 19, 1922. The maximum and minimum air temperatures are shown by the dotted lines. The wind velocity is estimated, below.

fall in temperature is in the zone between ten and fifteen meters, or five meters nearer the surface than in 1922. The thermocline for 1923, then, began at about the depth of ten meters and was about five meters in thickness. The chart for 1923 also shows the effect of high wind velocity on the various strata of water. In the case of the sharper peaks of temperature, especially where the deeper strata are involved, the effect of the wind is exaggerated





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because the boat would drag anchor and drift so that the thermometer line would hang at an angle. These readings are included and plotted, however, because every test shows that they must indicate the approximate effect of the wind. Also the fact that the

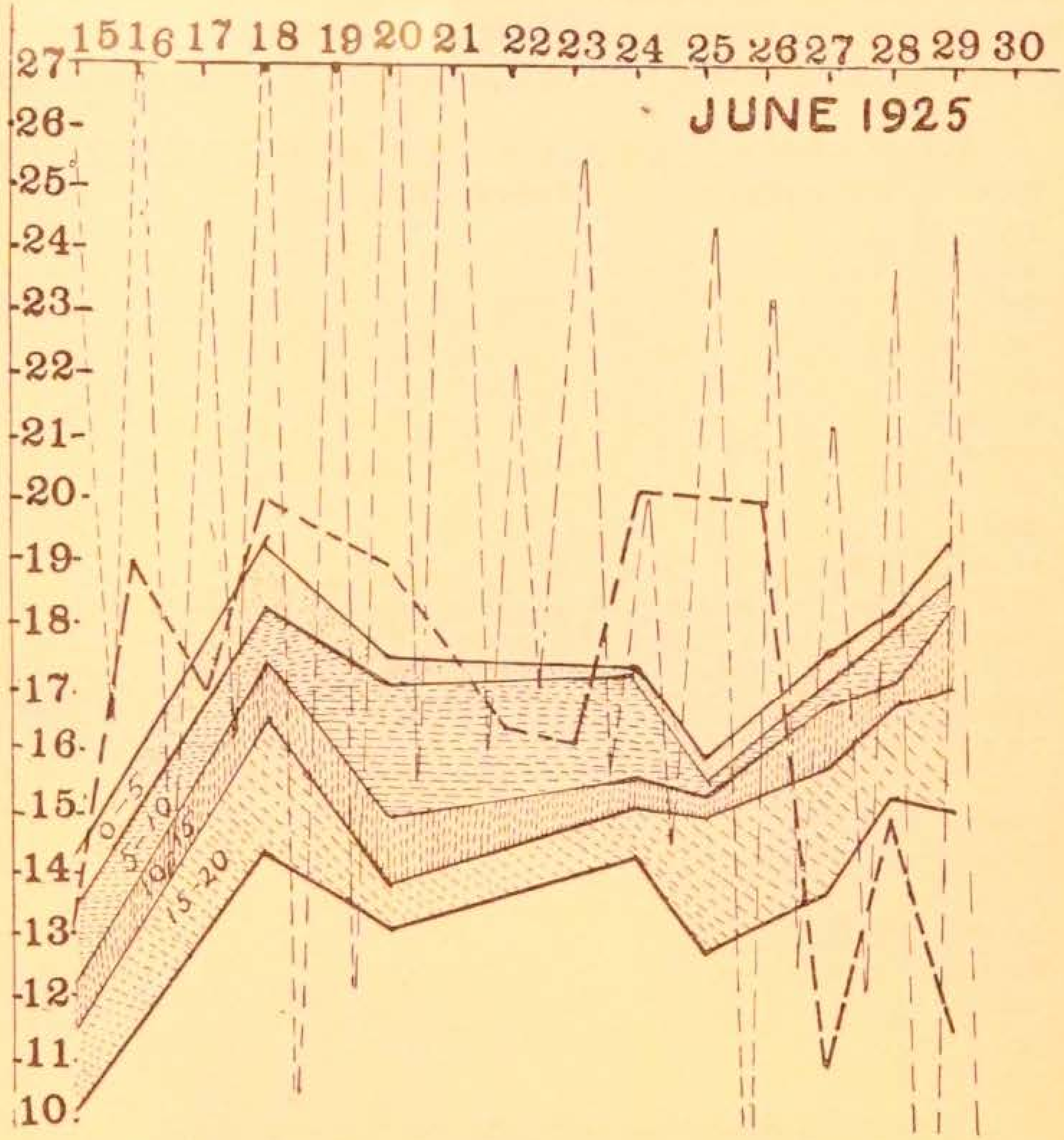


Figure 9. Heat distribution in Okoboji for June, 1925.

temperature at the twenty meter level remains practically the same indicates that the readings cannot be very far off.

The temperature chart for 1924 shows considerably less temperature difference in the upper twenty meters than prevailed in 1922 and 1923, although even here the amount of difference is as much as ten degrees at times. My data seem to indicate that where there is a difference of as much as 7°C. between the surface temperature and that of twenty meters one is likely to find a definite thermocline established in Lake Okoboji. When the difference of temperature is less than five degrees in the first twenty meters, there is not likely to be a definite thermocline and if it should be faintly indicated it is very evanescent. Also, where the temperature difference is as small as 7°C., the resistance to mixture is so slight that at many times during the summer, especially if there are many periods of rather high wind velocity, the deeper water will be frequently dis-

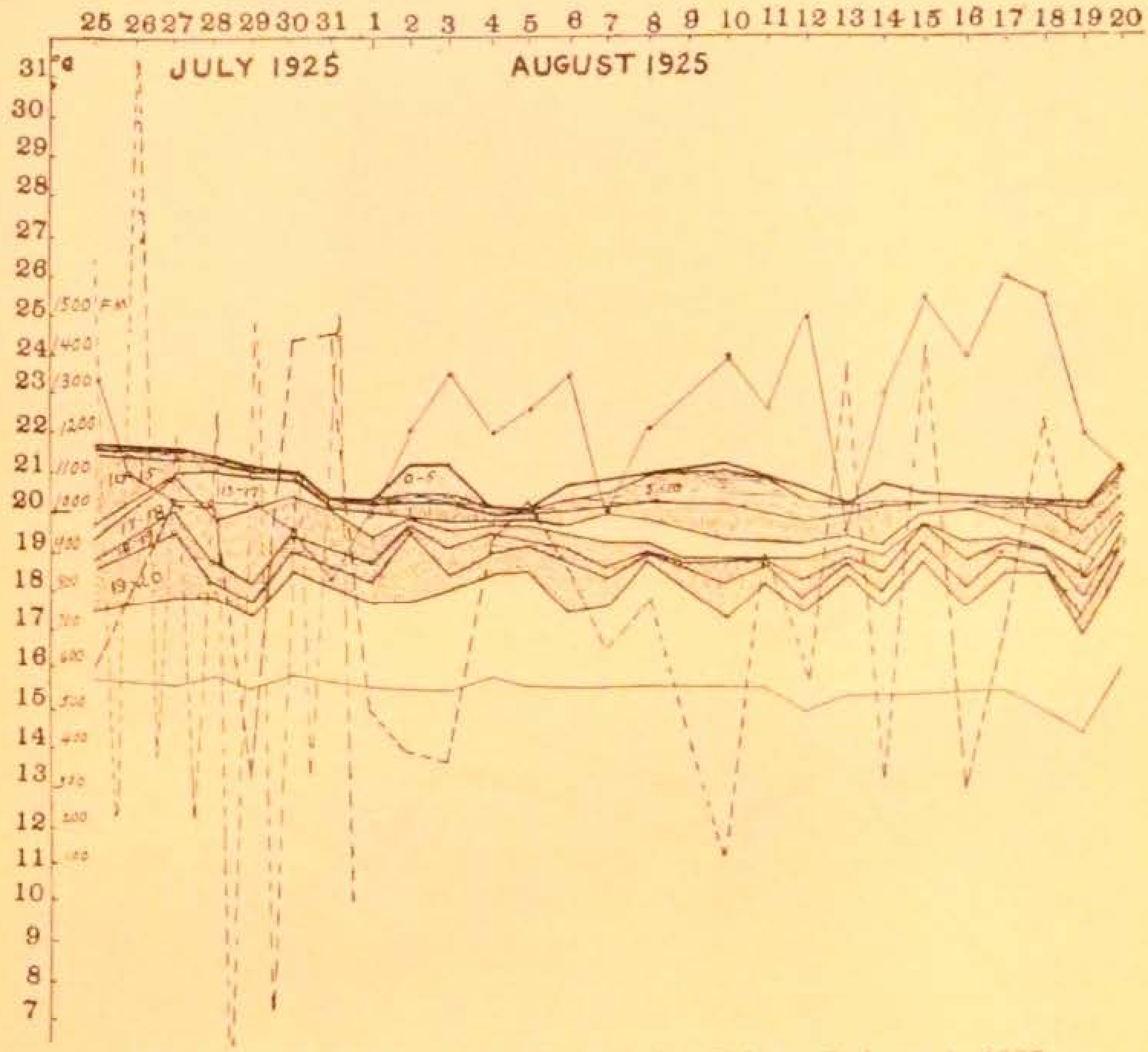
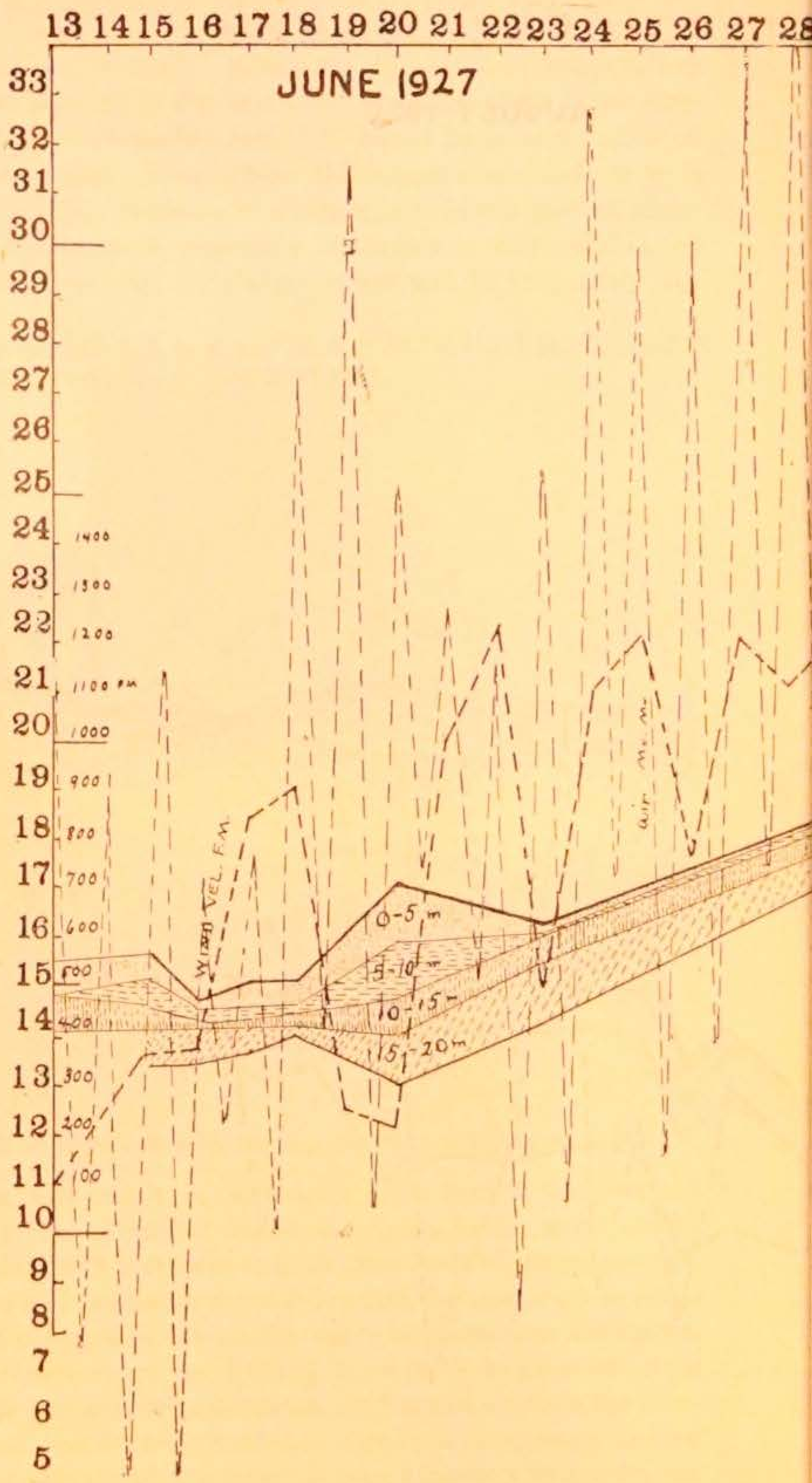


Figure 10. Heat distribution in Okoboji for July and August, 1925.

turbed. This will result in unusually high bottom temperature and unusually rich supply of dissolved oxygen in the lower strata. In the chart for 1923 there are two air temperature curves plotted. The maximum and minimum for the day and the temperature taken on the lake at the time of taking the water temperatures are shown.

The temperature chart for 1925 is incomplete on account of an accident to the temperature apparatus. At the end of June the thermometer spiral was broken, probably due to hitting some hidden rock below the surface of the lake. It was necessary to return the



JUNE 1927
13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28
33
32
31
30
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26
25
24 1400
23 1300
22 1200
21 1100 F.M.
20 1000
19 900
18 800
17 700
16 600
15 500
14 400
13 300
12 200
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WIND VEL. F.M.
0-5 m
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15-20 m

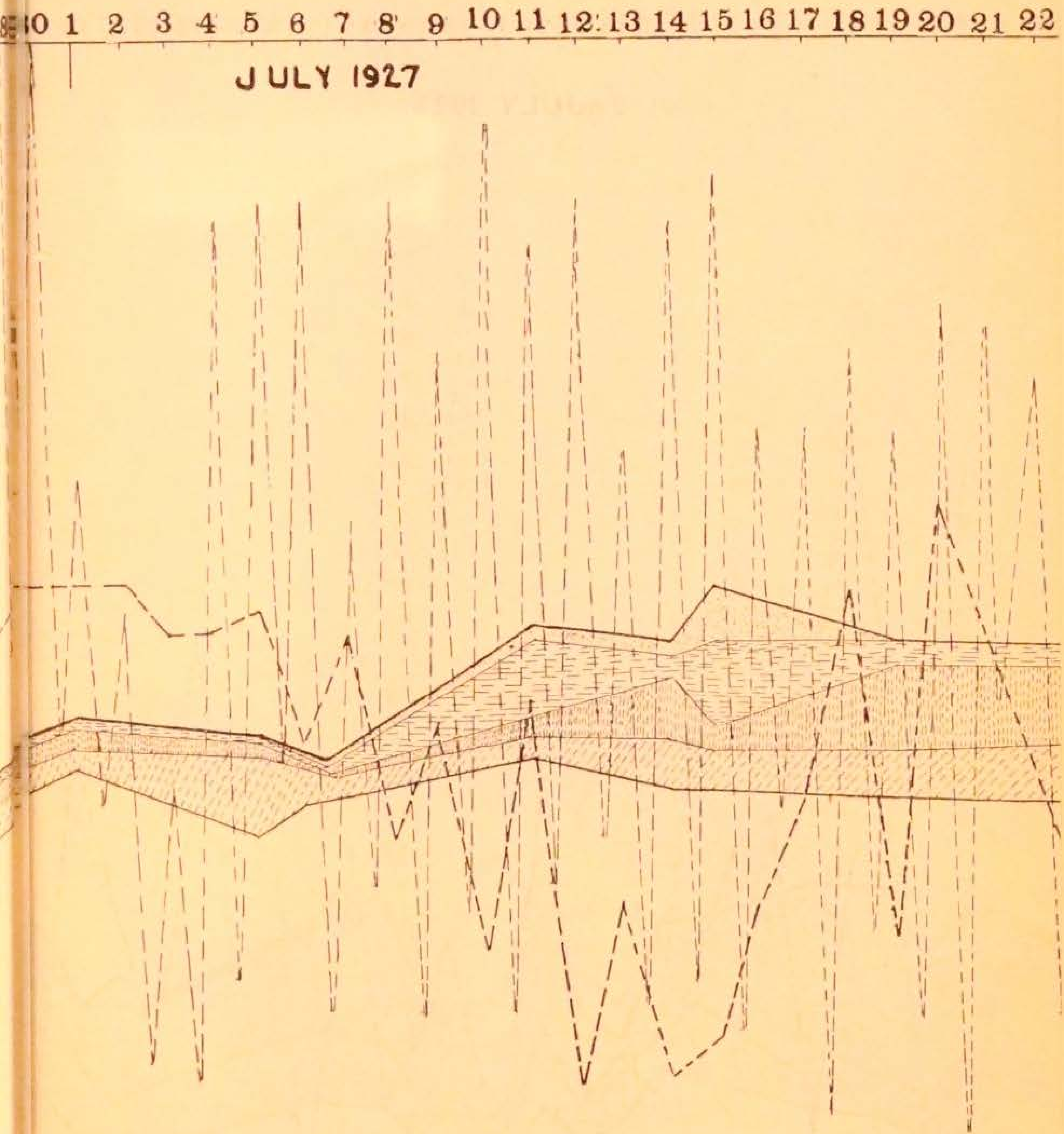
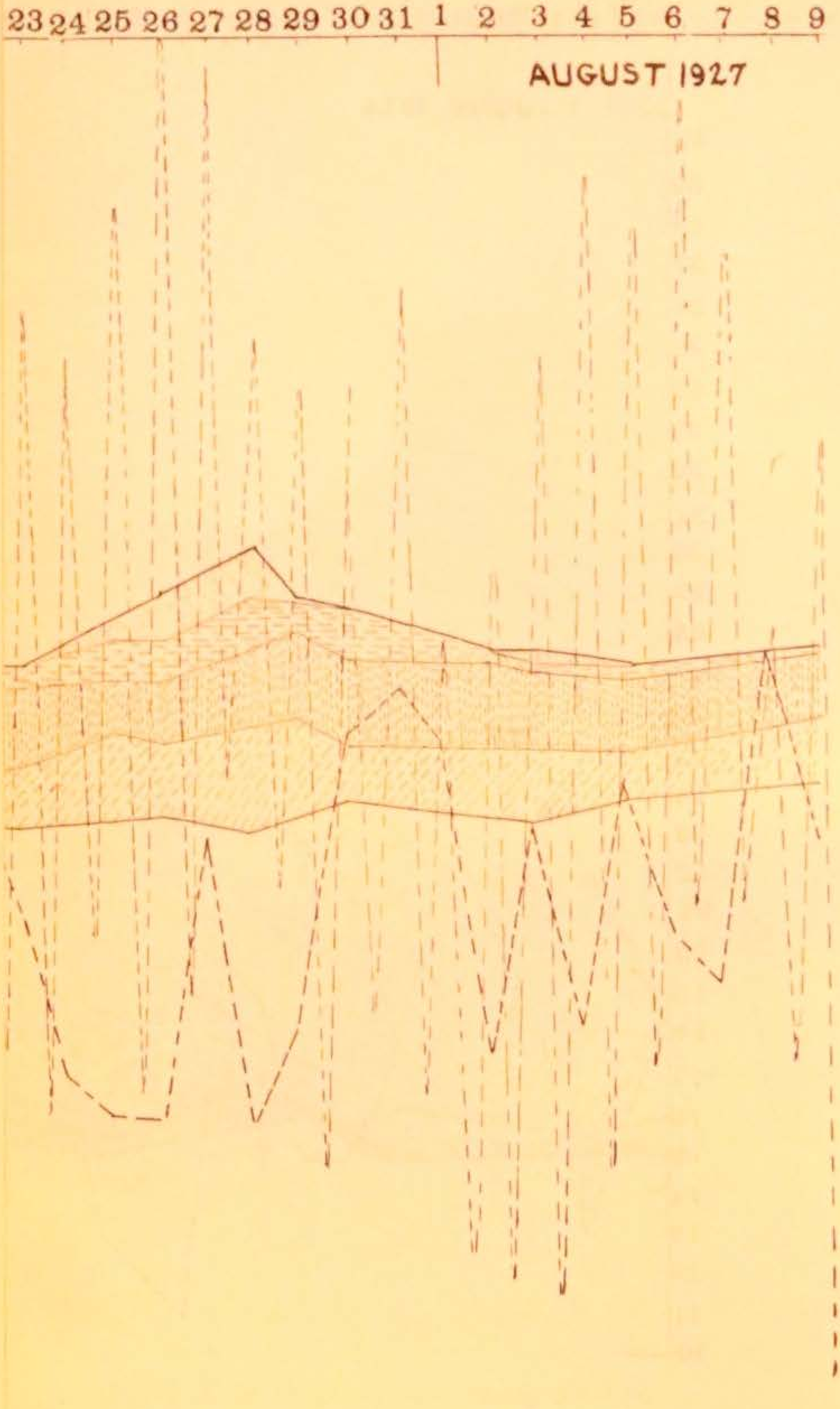


Figure 12. Heat distribution in Okoboji for 1927.


23 24 25 26 27 28 29 30 31 1 2 3 4 5 6 7 8 9
AUGUST 1927

entire apparatus to the factory in order to recalibrate it to the new bulb. The new spiral was then further protected against breakage by having, in addition to the double brass tube, a wire cage, such as is used to protect electric light bulbs, surrounding the entire thermometer mounting, thus lessening jars.

The remarkable thing about the temperature curves for this year is the high bottom temperature together with the low surface temperature. This is due, I think, to the weather conditions of the early spring. The high winds of June with the moderate temperature allowed a continual mixture of the water in the upper twenty meters so that not a sufficient difference in temperature obtained to establish a thermocline. The cold disagreeable summer was not conducive to the storing up of a great quantity of heat.

With the summer of 1926 we seem to have reached the climax of minimal temperature difference between surface and bottom. It would seem difficult to imagine a summer where there could be less difference. There does not appear to have been a distinct thermocline formed at any time during the season. Unfortunately the daily maximum and minimum temperature does not seem to have been recorded for this region during this year. Therefore the temperatures plotted on the chart are only those taken on the lake at the time water temperatures were taken. The general report shows that there was an excess of temperature for May, July and August, but that June was "persistently and disagreeably cold," with the only warm spell from June 6 to 12 and the last three days. May, June, and July were marked by wind velocities considerably above normal. The wind curve plotted on the chart indicates an unusually windy summer. The results were an abnormally high bottom temperature and a low surface temperature due to the continual stirring of the water and to cooling by evaporation. A comparison of the amount of dissolved gases and hydrion concentration for the several years which will be given in another study also shows the effects of this condition to a marked degree.

In 1927 there is a slight tendency to swing back to normal conditions. The early part of the summer from about June 20 until July 7, with high winds prevailing most of the time, there is a continual stirring of the waters and with the rather high air temperatures there is a rise in temperature of the entire twenty meters with very little spread. With the period of comparatively calm weather immediately following, there is gradual spread of temperature due mostly to the warming of the upper half. The high winds of July 18 to 20 reduce the difference in temperatures somewhat,

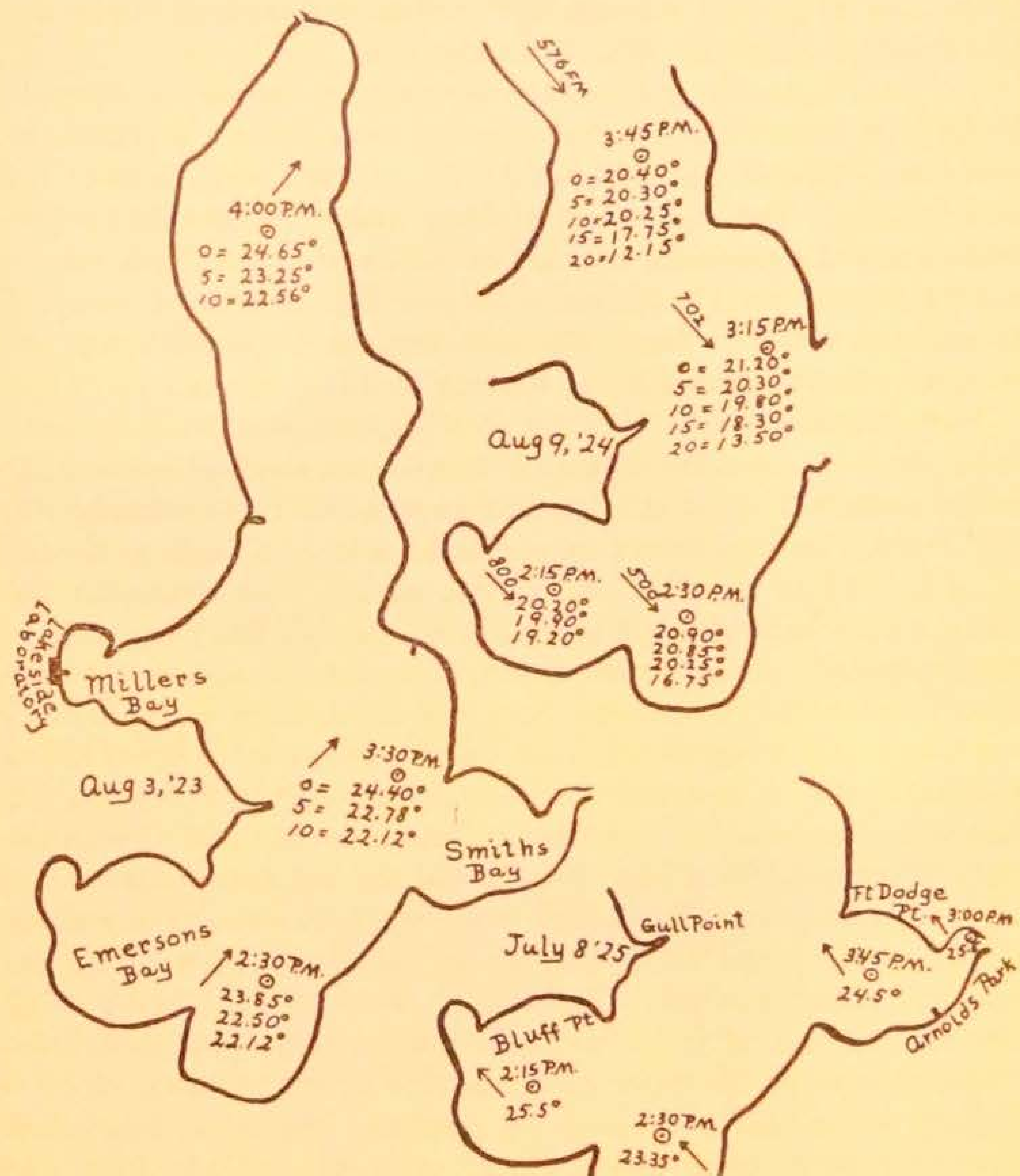


Figure 13. Showing the effect of the direction of the wind on the temperature of various parts of the lake. August 3, 1923; August 9, 1924; July 8, 1925.

but during the calm, hot week following the spreading effect is again apparent. With the beginning of August, the lower temperatures, especially at night, accompanied with higher wind velocities again pinch the temperature lines together.

The study of these temperature relations over a period of five years seems to bring out certain facts which are of considerable interest. Whether these results are due to the peculiar shape or volume development of Okoboji or are applicable to lakes in general must be brought out by comparative studies. No doubt the shape of the lake has a profound influence on the distribution of temperature as well as on the distribution and amount of dissolved oxygen and of plankton.

Several experiments have been tried in order to ascertain what effect, if any, the direction of the wind has on the surface temperature of various parts of the lake, and whether there is any evidence of a heaping up of water on the leeward side. Typical examples of these observations are shown in Figure 13, A, B and C. In A, we have the conditions for August 3, 1923, when with a very slight southwest to south breeze, we find a difference of 0.8°C. between the south end of the lake and near the north end. The most rapid increase in temperature is between the south end and the deep hole, opposite Fort Dodge Point, which is directly in line with the direction of the wind. It will be noticed that above the thermocline, ten meters, there is also an increase in temperature.

Depth	Terrace Park	Deep Hole	North End
0	23.85°	24.40°	24.65°
1	23.80°	24.25°	24.60°
2	23.55°	23.25°	24.40°
3	22.00°	23.00°	23.65°
4	22.56°	22.89°	23.35°
5	22.50°	22.78°	23.25°
6	22.40°	22.74°	23.18°
7	22.34°	22.67°	23.18°
8	22.34°	22.56°	23.18°
9	22.30°	22.40°	23.00°
10	22.12°	22.12°	22.56°
11	21.00°	21.24°	21.24°

In B, we have a similar condition. The wind is stronger and is indicated in feet per minute above the direction arrow. In C, we have a strong southwest wind but only the surface temperature was taken.

Probably a more interesting example is shown in the curve (Figure 14) where comparisons are made at regular intervals during a day and a night. The object of this study was especially to see whether there is any appreciable difference in the amount of dis-

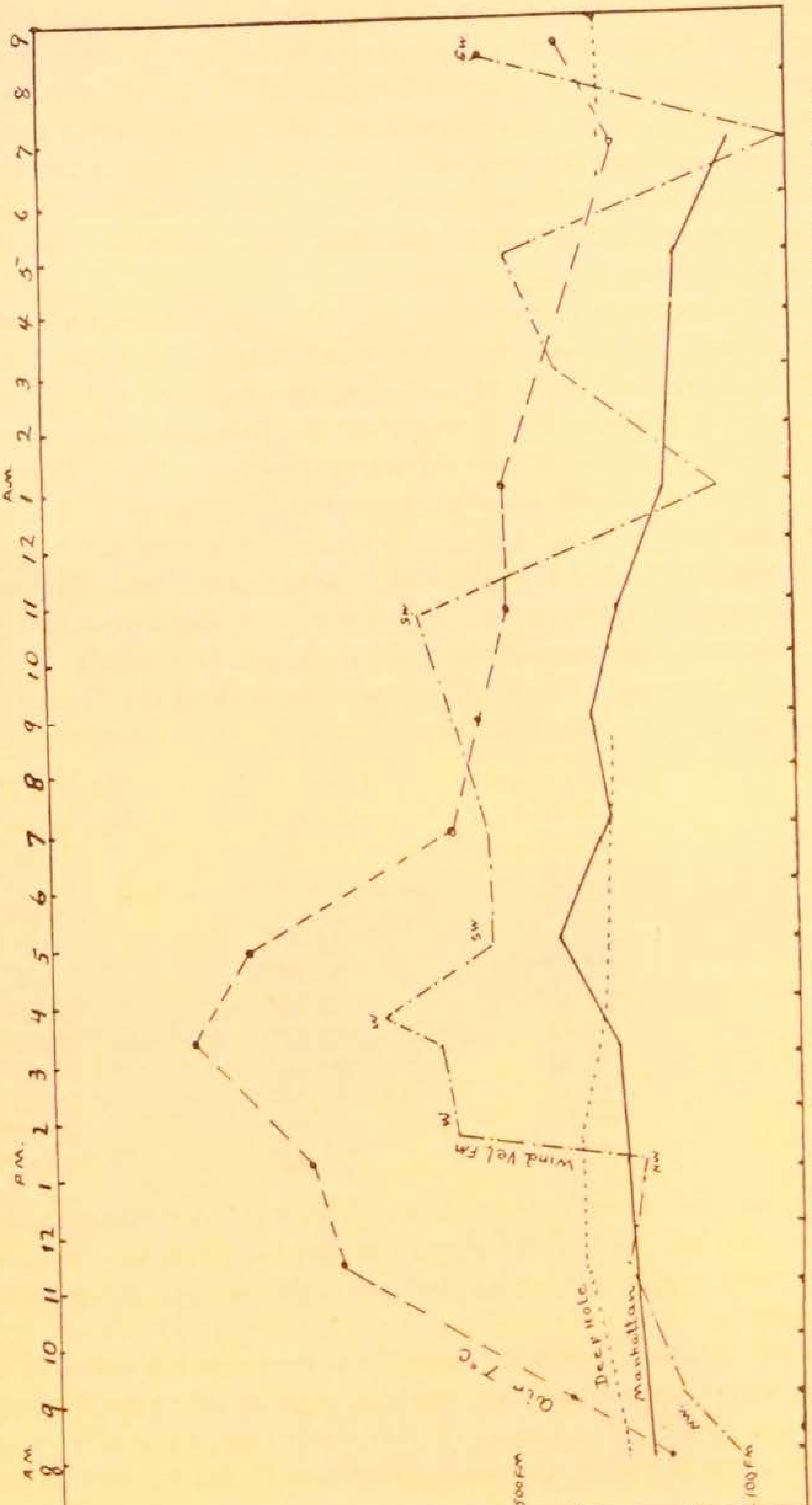


Figure 14. Surface temperature at the deep hole and near Manhattan during 24 hours at intervals of about two hours.

solved oxygen during various periods of the day and night and if there was any variation in the hydrogen-ion concentration. There were three stations established, one in the little baylet off from Miller's bay, sometimes called "Little Miller's" or Knupp's Garden, a second out from the Manhattan Hotel, and the third over the "deep hole." Little Miller's is very shallow, not over eight or ten feet in depth, and filled with growing vegetation. The other two stations are over the axis of the lake and free from vegetation. The station over the deep hole was so far away that it was not visited after 9:00 P.M. The table with its accompanying curve shows that the surface temperature over the deep hole tends to follow the air temperature but very much less pronounced, and begins to decline at about 1:30 P.M. Both the increase and decrease in temperature is probably influenced by the direction and velocity of the wind. At about 1:30 P.M. there is a short period of calm at which time the wind shifts from the northwest to west and later to the southwest. The effect of this wind shift is more evident in the temperature curve from the Manhattan station. During the earlier part of the day, the wind is blowing the warmer surface water away from this station, which being near the windward shore is being cooled by the return circulation. When the wind changes to the west and later to the southwest, it brings the warm surface water from Miller's bay, which, on account of being more protected and shallower is warmer than the main lake. The result is that the surface water of the Manhattan station increases rapidly in temperature and reaches the peak at about 5:00 P.M.

The surface water of a lake does not have a uniform temperature. The temperature of the surface increases somewhat from the windward shore toward the leeward side, as well as in depth. Certain spots on the surface may not be in the line of current, or may be situated with respect to certain topographical conditions of the bottom where there may be an upwelling of cool water from below, so as to be sensibly colder than the surrounding areas. In shallow waters this may also be due to bottom springs. These cold spots have often been noticed by long distance swimmers and, as well, by slowly trailing the thermometer behind a row boat.

The question as to whether a thermocline will be established or not depends upon the character of the early summer and spring months. If the weather is mild or cool and very windy the water will be stirred continually so that there will not be enough difference in temperature and consequently in density between the upper and lower strata to allow a thermocline to be established.

The fact that Lake Okoboji may show an unusually high bottom

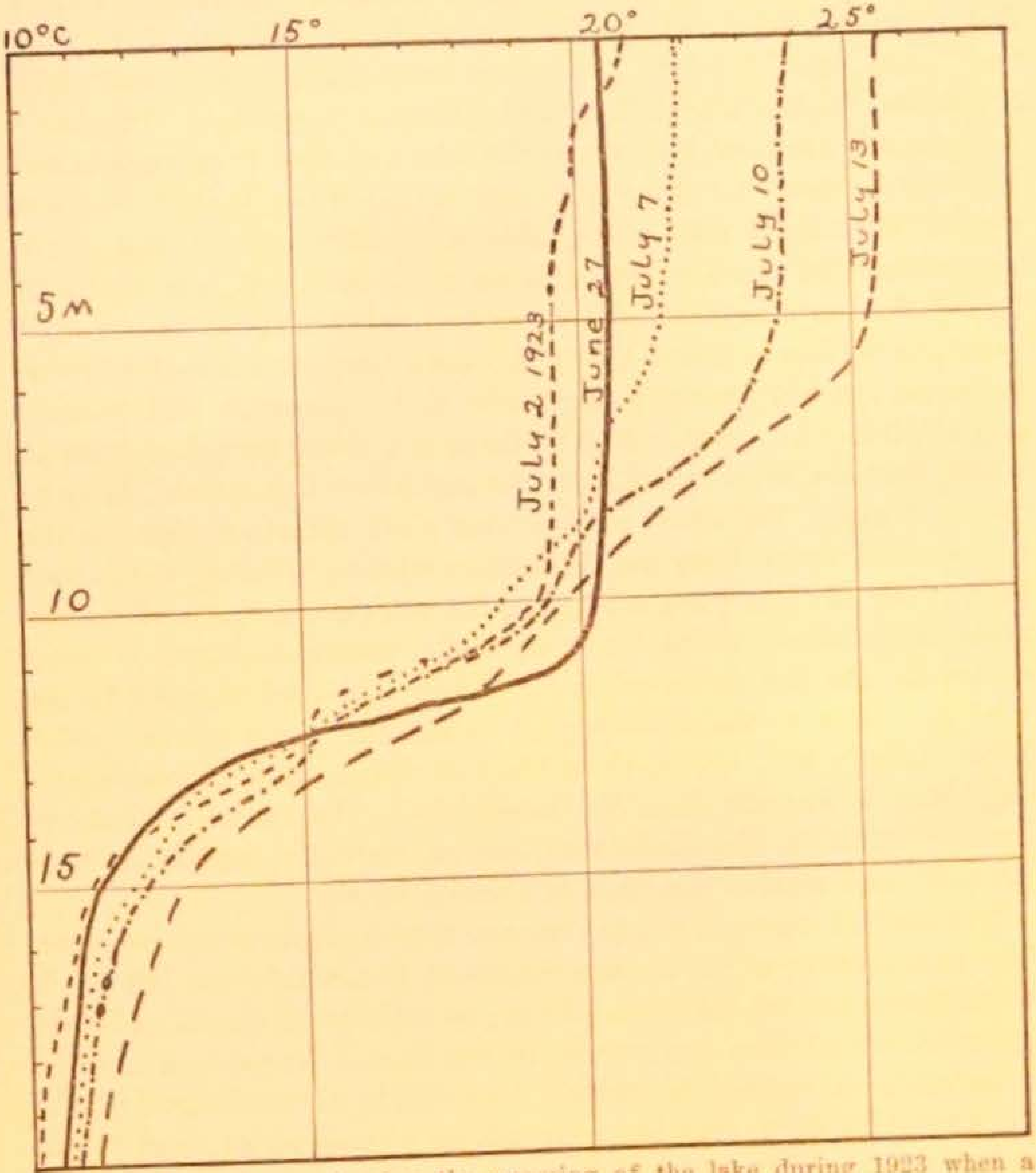


Figure 15. Curves showing the warming of the lake during 1923 when a distinct thermocline was present.

temperature in some years does not necessarily mean that it is warmer, or has absorbed more calories of heat, than in years that it shows a much lower bottom temperature. It may mean only that the high winds have kept the temperature more equalized. A cool, cloudy summer with excessive winds and an unusual amount of evaporation may make the mean temperature of the lake much lower. Much more heat would be lost by evaporation than would be lost by radiation during cold nights or cloudy weather. On

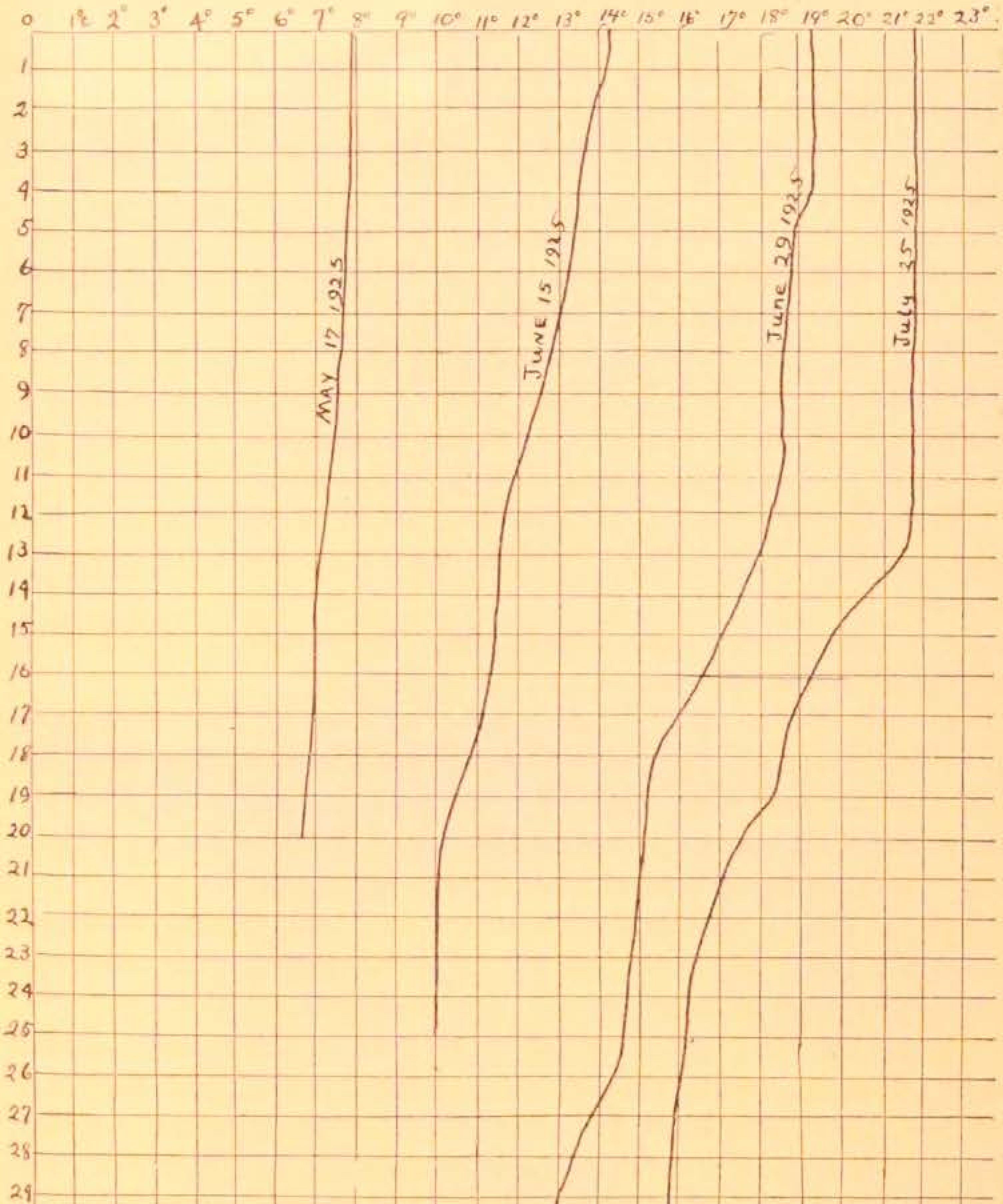


Figure 16. Temperature curves showing the warming of the lake during 1925 when no distinct thermocline was present.

the other hand it is not always true that the hottest summer will produce the warmest lake.

The heat absorption by the lake depends upon the air temperature, the wind velocity, evaporation, the shape and configuration of the lake, and the direction of the wind with reference to the long axis and bottom slope of the lake.

SUMMARY

The use of an especially designed platinum wire resistance thermometer has made possible a greater number of depth temperature readings for Lake Okoboji than is usually obtained in limnological observations.

A comparison of daily readings for the summers of 1922 to 1927 shows a considerable variation in the distribution and amount of heat absorbed during each season.

When the difference in temperature between the surface and twenty meters depth is less than four or five degrees centigrade a comparatively light wind will produce a complete circulation of the water to that depth, and probably to the bottom of the lake.

When the difference is greater than six or seven degrees it will take a much stronger wind to stir the water even below ten or twelve meters.

In a long, narrow lake, like Okoboji, the direction of the wind has an effect on its force.

The effect of the wind depends upon its velocity, the distribution of heat in the lake, and under certain conditions, its direction.

There has been a gradual diminution of the amount of heat absorbed by Lake Okoboji during the period 1922 to 1927. During 1927 the amount of heat absorbed increased slightly.

Tables, giving meteorological data and temperature readings, calories of heat absorbed, amount of work done by the wind, resistance to vertical mixture, etc., are presented.

Curves, showing the distribution of heat in the various depths of the lake, the wind velocity in feet per minute, and the daily maximum and minimum temperatures; the warming of the lake during years when a thermocline is established, and in years without a thermocline; the amount of heat absorbed by the lake for the several years under observation; the effect of changes in wind velocity on the distribution of heat at various depths; and the changes in temperature of the surface at two hour intervals during twenty-four hours and its relation to air temperature, velocity and direction of wind, are given.

Two figures are also presented, one showing the area and volume of the lake at different levels, the other showing the effect of the direction of the wind on the temperature at different parts of the lake.

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TABLES

Tables 1-13: Meteorological data and temperature readings for the years 1922 to 1927.

Table 14: Temperature, calories of heat absorbed, the work in transporting the heat to the several layers, the loss in density of the water in the various layers, and the resistance to mixture for July 25, 1923. The other columns show the resistance to mixture for typical days in 1924, 1925, 1926 and 1927.

Table 15: Shows the difference in temperature for the first twenty meters, for the epilimnion, thermocline, and hypolimnion; the thickness of each zone; the mean temperature of the lake, and the number of calories of heat in the lake at intervals of about one week for the summers of 1922 to 1927.

TABLE 1. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1922 Date	Aug. 3	4	5	5	10	12	15	16	17	18	19
Time	5:30p	3:45p	7:45a	8:30a	9:20a	7:45a	8:00a	8:00a	7:45a	9:00a	8:00a
Air° C.	38.80	30.50			18.30	19.60	32.00	25.40	28.00		
Wind			S.E.		S.E.	S.E.	W.	S.E.	S.W.		N.
Veloc.			500			600	200	Flat	Flat	Calm	800
Sky	Hazy	Hazy	Hazy		Foggy	Cloudy	Clear	Clear	Clear	Cloudy	Clear
Bar.											
Surf.	26.00	25.10	23.70	23.80	21.75	21.80	22.55	22.80	23.10	23.40	23.20
1. m.	24.50	24.20	23.80	23.80	21.75	21.80	22.55	22.75	23.00	23.25	23.20
2.	24.10	23.70	23.80	23.80	21.75	21.80	22.50	22.70	23.00	23.15	23.20
3.	23.80	23.20	23.70	23.80	21.75	21.80	22.45	22.70	23.00	23.09	23.20
4.	23.65	23.10	22.70	23.20	21.75	21.80	22.40	22.70	23.00	23.08	23.20
5.	23.20	22.80	22.20	22.60	21.75	21.80	22.40	22.70	23.00	23.06	23.20
6.	23.00	22.45	21.90	22.20	21.75	21.80	22.40	22.50	23.00	23.00	23.15
7.	22.60	22.00	21.50	21.90	21.75	21.70	22.40	22.40	23.00	22.70	23.10
8.	22.25	21.60	21.10	21.80	21.75	21.70	22.40	22.30	22.35	22.22	22.70
9.	21.90	21.60	20.80	21.60	21.75	21.70	22.40	22.00	22.00	22.02	22.20
10.	21.80	21.50	20.20	21.45	21.70	21.70	22.40	21.80	21.90	21.82	22.20
11.	21.70	21.30	Bottom	21.00	21.50	21.50	22.10	21.65	21.75	21.70	22.10
12.	21.35	20.90	Emerson's	20.70	20.80	21.25	21.85	21.50	21.60	21.60	21.90
13.	21.20	20.40	Bay	20.30	20.60	20.80	21.60	21.40	21.00	20.90	21.20
14.	20.50	19.80		19.50	20.20	20.20	21.00	20.80	20.30	20.23	21.20
15.	19.50	18.50		18.60	20.00	19.70	20.75	19.50	18.90	18.90	21.00
16.	17.80	17.50		17.40	18.30	18.80	20.30	17.70	18.20	17.75	20.70
17.	16.50	16.10		16.30	16.50	17.00	19.50	16.80	17.40	16.60	20.50
18.	15.40	14.60		15.30	15.90	16.05	18.00	16.10	16.20	15.75	19.70
19.	14.50	13.90		14.30	14.60	15.20	16.10	15.00	15.00	14.65	16.80
20.	14.10	13.40		13.60	14.19	14.20	15.70	14.10	14.10	14.10	15.50
21.	14.00			13.10	13.90	13.30	14.95	13.70	13.70	13.70	14.70
22.	13.20			13.00	13.60	13.45	14.50	13.55	13.40	13.40	14.25
23.	13.20			12.90	13.30	13.10	13.40	13.30	13.25	13.20	14.00
24.	13.20			12.80	13.25	13.00	13.20	13.10	13.10	13.10	13.75
25.	13.10	12.70		12.70	13.10	12.98	13.15	12.80		13.05	13.50
26.				12.50	13.05	12.98	13.10	12.80			13.40
27.				Bottom	13.00	12.90	12.95	12.40			13.30
28.				Terrace	13.00	12.85	12.80	12.40			13.15
29.				Park	12.90	12.80	12.75				13.00
30.						12.80	12.75				13.00
31.						12.70				End of	
32.						12.70				1922 readings	
33.						12.70					
34.						12.65					
35.											

TEMP. FRACTIONAL METERS
Through Thermocline

Depth	Aug. 12	16	16
13 m.	22.00	21.40	21.30
13.25	21.95	21.30	21.00
13.50	21.79	21.09	20.60
13.75	20.80	20.70	20.15
14.00	20.07	20.50	19.95
14.25	19.48	20.20	19.75
14.50	19.30	19.83	19.40
14.75	19.15	19.60	19.10
15.00	19.11	19.20	18.90
15⅛	18.98	19.05	18.80
15¼	18.67	18.90	18.60
15⅜	18.22	18.82	18.50
15½	18.16	18.60	18.35
15⅝	18.12	18.30	18.30
15¾	18.10	18.10	18.20
15⅞	18.08	18.00	18.10
16	18.08	17.95	17.90
			South end of Lake

TABLE 2. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1923	June				July															
Date	16	21	27	28	2	3	5	6	7	9	10	11	12	13	16	17	17	18	20	21
Time		9:45a	7:25p	1:30p	1:30p	7:30p	2:40p	2:30p	10:30a	8:00a	8:00a	10:30a		8:30a	8:30a	8.00a	1:30p		10:00a	8:00a
Air° C.	23.00	26.1	20.00	17.40	29.00	25.00	32.00	33.00	28.00	30.00	26.10	26.00		26.00	25.00	27.00	27.90	29.60	30.00	32.00
Wind	S.E.		N.E.	N.W.	S.E.	E.	S.E.	S.W.	S.W.	S.W.	N.E.	N.E.	N.	N.W.	E.	E.S.E.	E.	S.	S.W.	S.W.
Veloc.	800	950	840	Calm	Calm	Calm	700	325	400	1000	950	650	400	340	500	1000	900		840	950
Sky	P.C.	Cloudy	Rain	Clear	P.C.	P.C.	P.C.	P.C.	P.C.	Clear	Cloudy	Rain	Clear	Clear	Clear	Hazy	P.C.	Clear	Hazy	P.C.
Bar.																				
Surf.	23.20	22.70	21.50	20.60	20.90	20.40	20.93	21.50	21.80	23.00	23.80	23.80	24.40	25.48	25.38	23.80	25.02	24.20	24.98	25.12
1. m.	23.00	22.20	21.00	20.50	20.38	20.50	20.95	21.00	21.80	22.90	23.80	23.80	24.40	25.38	25.28	23.80	25.02	24.20	24.98	25.12
2.	22.00	22.15	20.85	20.15	20.00	20.40	20.85	20.85	21.80	22.90	23.70	23.80	24.40	25.38	25.02	23.80	24.92	24.20	24.98	25.07
3.	21.80	22.00	20.80	20.00	19.95	20.30	20.85	20.85	21.80	22.85	23.70	23.80	24.40	25.38	25.02	23.80	24.92	24.20	24.98	25.07
4.	21.70	21.90	20.80	20.00	19.60	20.15	20.35	20.80	21.70	22.70	23.70	23.80	24.40	25.35	25.02	23.80	24.92	24.20	24.98	25.02
5.	21.20	21.90	20.80	19.90	19.60	20.10	20.05	20.80	21.50	22.34	23.65	23.80	24.40	25.20	25.02	23.80	24.92	24.20	24.98	25.00
6.	20.30	21.90	20.79	19.90	19.59	19.80	20.00	20.75	21.46	21.90	23.35	23.80	24.30	25.00	23.35	23.00	24.92	24.20	24.42	24.97
7.	19.30	21.90	20.69	19.90	19.50	19.30	20.00	20.65	20.60	20.70	22.67	21.70	22.00	23.60	21.90	21.13	21.95	23.80	24.40	24.77
8.	18.60	21.60	20.55	19.90	19.50	19.10	20.00	20.55	20.35	20.30	21.46	21.35	21.46	22.12	21.17	20.80	21.38	21.90	23.80	22.95
9.		19.60	19.55	19.90	19.45	18.90	19.30	19.50	20.00	19.55	19.80	20.65	20.50	20.90	20.55	19.10	19.10	21.24	21.50	22.23
10.		17.70	18.60	18.60	19.45	18.70	18.78	18.60	18.60	18.70	19.35	18.60	20.70	19.90	20.15	18.39	18.50	20.80	20.60	20.25
11.		17.00	15.34	17.40	17.95	17.63	18.75	15.30	17.87	18.39	18.70	17.97	18.39	18.80	18.00	16.67	18.10	18.80	18.39	19.10
12.		16.50	13.10	16.00	16.00	15.60	18.50	13.10	15.89	16.45	15.35	16.56	16.78	17.87	16.67	16.23	16.67	17.12	16.98	16.56
13.		15.30	12.15	13.70	14.35	13.60	18.40	12.20	13.30	14.55	14.66	14.78	15.23	15.56	15.11	15.00	13.70	13.50	15.45	15.11
14.		13.90	11.90	11.50	12.75	12.10	16.90	11.90	12.55	12.10	13.40	13.70	13.00	14.10	13.90	14.00	12.70	12.90	13.00	14.44
15.		12.60	11.70	11.40	11.20	11.30	14.10	11.70	11.80	11.60	12.00	12.20	12.40	12.80	12.60	12.80	12.30	11.90	12.60	12.80
16.		12.60	11.10		10.90	10.90	12.60	11.10	11.30	11.30	11.70	11.68	11.80	12.40	11.60	11.60	11.80	11.50	12.30	12.25
17.		12.60	11.00			10.75	11.60	10.80	11.00	10.70	11.00	11.50	11.60	12.00	11.20	11.10	11.60	11.25	11.80	11.75
18.		12.15	10.80			10.55	11.05	10.30	10.80	10.30	10.60	11.25	11.30	11.60	11.00	10.80	11.30	11.10	11.40	11.40
19.		12.15	10.30			10.45			10.50		10.35	11.10	11.10	11.40	10.80	10.70	10.90	10.90	11.10	11.20
20.		12.10	10.20	11.10		10.35			10.45		10.30	10.80	10.80	11.10	10.40	10.50	10.70	10.60	11.00	11.00
21.		12.00									10.25	10.60		11.00			10.55	10.55	10.90	10.90
22.		11.90									10.25	10.50		10.90			10.35	10.35	10.70	10.85
23.		11.60									10.20	10.48		10.90			10.25	10.25	10.60	10.70
24.		11.58									10.10			10.80			10.15	10.22	10.60	10.60
25.		11.55									10.00			10.75			10.00	10.20	10.45	10.60
26.														10.70				10.15	10.35	10.60
27.														10.70				10.10	10.30	10.58
28.														10.60				10.00	10.30	10.50
29.														10.60				9.95	10.25	10.45
30.														10.60				9.81	10.20	10.40
31.																				
32.																				
33.																				
34.																				
35.																				

TABLE 3. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1923	July											July		Aug.						
Date	23	23	24	24	25	25	26	27	28	28	30	30	31	1	2	2	3	6	6	7
Time	8:00a	7:30p	6:30a	7:30p	8:00a	2:00p	8:00a	7:30p	10:00a	3:00p	8:30a	3:30p	10:30a	3:00p	8:30a	3:00p	8:30a	8:00a	2:00p	8:30a
Air °C.	32.00	26.6	23.50	25.00	25.00	27.20	25.00	20.00	21.00	29.00	25.00	27.90	24.00	25.00	20.00	24.50	23.00	22.00	25.00	23.00
Wind	W.	N.	N.W.	N.W.	E.	E.	S.W.	N.W.	S.W.	S.W.	S.W.	S.W.	S.W.	N.E.	S.E.	S.E.	S.E.	N.W.	N.W.	S.E.
Veloc.	950	1100	1050	600	Calm	Calm	800	1150	850	600	500	Calm	950	1250	890	500	300	Calm	700	840
Sky	Clear	Cloudy	Cloudy		Clear	Hazy	Cloudy	Cloudy	P.C.	P.C.	P.C.	P.C.	Sprnkle	P.C.	P.C.	P.C.	P.C.	Foggy	P.C.	P.C.
Bar.																				
Surf.	26.00	26.80	25.68	26.18	25.48	26.23	24.95	24.30	24.70	25.28	23.80	25.68	23.60	22.67	22.12	22.89	23.00	22.34	23.60	21.80
1. m.	26.00	26.80	25.70	26.18	25.38	26.18	24.95	24.30	24.70	25.28	23.80	25.18	23.60	22.67	22.12	22.80	22.89	22.23	23.25	21.80
2.	26.00	26.80	25.70	26.18	25.28	26.08	24.95	24.30	24.60	24.87	23.65	24.58	23.60	22.67	22.12	22.67	22.78	22.12	22.78	21.68
3.	26.00	26.80	25.70	26.13	25.28	25.73	24.90	24.30	24.55	24.67	23.65	24.20	23.60	22.67	22.12	22.67	22.78	22.12	22.34	21.60
4.	25.95	26.80	25.70	26.13	25.18	25.58	24.90	24.30	24.50	24.40	23.60	24.10	23.60	22.67	22.12	22.56	22.78	22.00	22.23	21.57
5.	25.95	26.80	25.70	25.98	25.18	25.48	25.00	24.20	24.50	24.40	23.55	24.00	23.60	22.67	22.12	22.34	22.78	22.00	22.12	21.57
6.	25.95	26.70	25.70	25.98	25.18	25.48	25.00	24.20	24.50	24.30	23.35	23.90	23.60	22.50	22.12	22.23	22.78	22.00	22.06	21.57
7.	25.95	26.70	25.70	25.88	25.18	25.48	25.00	24.15	24.45	24.25	23.35	23.60	23.60	22.50	22.12	22.23	22.78	22.00	22.00	21.57
8.	24.20	26.38	25.70	25.88	25.18	24.40	25.00	24.15	24.40	24.15	23.35	23.35	23.60	22.50	22.12	22.23	22.67	22.00	21.95	21.57
9.	22.67		22.12	24.92	23.25	21.50	23.35	24.15	24.40	23.90	22.45	22.78	23.60	22.50	22.12	22.12	22.34	22.00	21.90	21.57
10.	21.90	21.50	20.50	20.20	19.45	19.55	19.55	24.15	24.35	23.90	21.00	22.34	21.46	22.50	22.00	21.05	21.75	22.00	20.83	21.57
11.	19.70	19.90	19.45	19.00	17.87	19.10	19.10	24.15	20.00	17.24	19.15	20.20	18.39	22.50	21.00	20.00	18.70	21.79	21.46	21.23
12.	18.02	17.46	17.67	17.46	16.45	16.89	17.77	19.36	15.56	16.95	17.57	17.67	16.45	22.50	19.45	17.87	16.78	18.90	19.90	20.00
13.	16.78	14.66	17.00	15.89	14.44	15.11	16.45	15.78	14.44	15.78	16.56	15.89	14.78	22.50	16.78	14.78	15.23	16.78	17.12	16.12
14.	14.55	13.30	14.00	13.60	14.10	13.30	15.11	14.89	13.30	14.00	13.50	14.44	13.30	21.78	14.66	13.50	14.50	14.20	16.12	15.11
15.	12.90	12.70	13.10	13.20	12.40	12.40	12.80	13.10	12.65	13.00	12.70	12.75	12.40	16.00	12.80	12.85	13.50	13.10	13.50	13.00
16.	12.60	12.30	12.40	12.40	11.80	11.60	12.40	12.70	12.40	12.35	12.00	12.30	11.80	15.67	12.30	12.60	12.60	12.20	12.70	12.50
17.	12.40	12.10	11.80	12.20	11.50	11.35	12.10	12.00	12.40	12.10	11.50	11.90	11.50	12.80	12.00	12.10	12.10	11.80	12.20	12.10
18.	12.30	11.80	11.60	12.10	11.40	11.10	11.70	11.70	12.10	11.90	11.10	11.50	11.25	12.70	11.60	11.60	11.85	11.50	11.75	11.70
19.	12.00	11.60	11.30	11.60	11.10	10.90	11.50	11.50	11.70	11.60	10.90	11.40	10.60	12.10	11.20	11.30	11.60	11.20	11.30	11.35
20.	11.80	11.30	11.10	11.30	10.80	10.80	11.30	11.35	11.40	11.30	10.60	11.10	10.40	11.10	11.10	11.00	11.20	10.90	11.25	11.00
21.	11.70	11.20	11.00	11.10	10.60	10.60	11.10	11.20	11.30	10.90	10.50	10.90	10.40	10.80	10.75	10.60	11.10	10.80	11.00	10.85
22.	11.50	11.00	10.85	11.00	10.50	10.60	10.85	10.80	11.10	10.80	10.20	10.75	10.30	10.70	10.70	10.60	10.90	10.60	10.85	10.65
23.	11.30	10.80	10.75	10.80	10.40	10.50	10.70	10.70	11.00	10.70	10.10	10.70	10.20	10.50	10.60	10.50	10.70	10.60	10.70	10.55
24.	11.20		10.60	10.75	10.40	10.40	10.60	10.70	10.80	10.65	10.10	10.55	10.20	10.40	10.50	10.50	10.65	10.60	10.60	10.45
25.	11.20			10.75	10.30	10.35	10.40	10.60	10.70	10.60	10.10	10.40	10.10	10.30	10.45	10.40	10.60	10.60	10.55	10.40
26.	11.10			10.70	10.10	10.30	10.35	10.50		10.50		10.30	10.00	10.20		10.40	10.60	10.50	10.40	10.30
27.	11.10			10.60	10.10	10.20	10.35	10.50		10.40		10.30	10.00	10.15		10.35	10.60	10.50	10.40	10.35
28.	11.00			10.50	9.90	10.20	10.30	10.50		10.40		10.30	10.00	10.10		10.30	10.50	10.40	10.30	10.30
29.	10.90			10.45	9.90	10.10		10.40		10.30		10.20	9.90	10.10		10.20	10.50	10.30	10.30	10.20
30.	10.90			10.40	9.80	10.10		10.35		10.30			9.90	9.90		10.15	10.50	10.30	10.25	10.10
31.					9.80	10.00		10.20		10.30									10.25	10.10
32.					9.70	10.00		10.20		10.30									10.20	10.10
33.					9.70	9.80		10.15		10.10									10.15	10.05
34.					9.60	9.60				10.10									10.00	9.90
35.										10.05									9.95	9.85

TABLE 4. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1923	Aug.									
Date	8	9	9	10	11	11	13	14	14	15
Time	8:00a	8:30a	8:00p	9:00a	8:00a	2:10p	8:00a	9:00a	2:00p	8:00a
Air°C.	21.00	19.00	22.00	21.00	23.00	25.60	21.00	22.00	29.00	24.00
Wind	N.E.	S.E.	S.W.	S.W.		N.	S.W.	N.W.	N.W.	E.
Veloc.	800	1150	Calm		Flat	680	1200	Calm	325	600
Sky	Cloudy	Foggy	P.C.	Rain	Hazy	P.C.	Clear	Clear	Clear	Rain
Bar.										
Surf.	22.23	22.12	21.13	20.90	23.18	24.40	23.25	23.55	25.48	23.65
1. m.	22.23	22.12	21.13	20.90	22.78	24.40	23.25	23.50	25.28	23.70
2.	22.12	22.06	21.13	20.80	22.67	23.85	23.25	23.40	24.30	23.70
3.	22.08	22.00	21.00	20.75	22.67	23.40	23.25	23.35	24.00	23.70
4.	22.00	22.00	20.75	20.70	22.56	22.58	23.25	23.30	23.80	23.70
5.	21.95	22.00	20.70	20.50	22.45	22.25	23.25	23.28	23.75	23.70
6.	21.79	22.00	20.55	20.40	22.34	22.23	23.25	23.25	23.70	23.70
7.	21.70	21.95	20.55	20.40	22.30	22.23	23.30	23.09	23.65	23.60
8.	21.70	21.90	20.50	20.35	22.12	22.09	23.18	22.78	23.55	23.50
9.	21.70	21.90	20.50	20.30	21.90	21.95	23.18	22.67	23.35	23.35
10.	21.67	21.90	20.46	20.25	21.46	21.95	23.18	22.56	23.25	23.25
11.	21.57	21.79	19.75	20.20	20.92	21.35	23.18	21.00	22.89	22.80
12.	20.80	19.90	18.18	18.60	20.60	18.90	21.78	21.00	22.28	20.90
13.	16.23	18.39	16.89	16.45	17.67	16.56	17.46	19.80	20.20	20.00
14.	15.67	16.56	15.67	14.10	15.78	14.66	15.67	18.18	17.00	17.67
15.	13.20	13.70	13.00	13.20	13.40	12.90	14.44	15.50	15.89	15.56
16.	12.70	12.70	12.30	11.95	12.70	12.30	12.90	14.00	13.80	14.66
17.	12.20	12.50	11.70	11.95	12.30	12.00	12.60	12.50	12.60	13.50
18.	11.60	11.80	11.25	11.90	11.85	11.53	12.40	12.30	12.50	12.60
19.	11.35	11.60	11.00	11.30	11.55	11.50	12.20	12.05	12.30	12.30
20.	11.10	11.40	10.80	11.90	11.29	11.35	11.60	11.45	12.10	11.90
21.	10.90	11.10	10.55	11.85	11.10	11.22	11.40	11.20	11.70	11.85
22.	10.90	10.80	10.35	11.80	11.00	11.10	11.10	10.90	11.58	11.60
23.	10.90	10.60	10.25	11.75	10.90	11.00	11.00	10.85	11.45	11.40
24.	10.90	10.60	10.15	11.65	10.79	10.93	11.00	10.80	11.30	11.30
25.	10.70	10.50	10.00	11.60	10.70	10.83	10.95	10.75	11.10	11.30
26.	10.70	10.45	9.95		10.65	10.80		10.70	11.00	11.20
27.	10.50	10.35	9.95		10.63	10.78		10.70	11.00	11.10
28.	10.50	10.30			10.60	10.75		10.65		11.00
29.	10.50	10.30			10.60	10.73		10.65		11.00
30.	10.40	10.30				10.70		10.60		10.90
31.	10.40	10.30				10.70		10.60		
32.	10.35	10.30				10.65		10.59		
33.	10.35	10.20				10.60		10.55		
34.	10.30	10.05						10.48		
35.	10.30	10.00						10.39		

1923										
Date	16	16	17	17	18	18	20	20	22	22
Time	1:20p	8:00p	8:30a	2:00p	8:00a	2:00p	8:00a	2:30p	8:30a	2:00p
Air°C.	24.50	22.00	24.00	28.00	20.00	25.00	22.00	25.00	22.00	
Wind	E.	E.	N.W.		W.	N.W.	E.	S.E.	N.E.	N.
Veloc.	325	Calm	Flat	Calm	800	900	1000	890	Calm	Calm
Sky	Cloudy	Cloudy	Clear	Clear	Clear	Clear	Cloudy	Rain	Clear	
Bar.										
Surf.	23.60	23.50	23.35	24.48	23.35	23.80	23.25	22.15	21.57	22.12
1. m.	23.50	23.70	23.35	24.25	23.40	23.70	23.10	22.34	21.57	22.25
2.	23.40	23.70	23.25	23.80	23.60	23.65	23.00	22.45	21.57	22.00
3.	23.35	23.70	23.18	23.70	23.45	23.60	23.00	22.50	21.57	21.70
4.	23.25	23.65	23.10	23.50	23.40	22.89	23.00	22.34	21.57	21.68
5.	23.18	23.35	23.10	23.30	23.27	22.78	23.00	22.45	21.58	21.60
6.	23.10	23.25	23.10	23.26	23.25	22.56	23.00	22.67	21.60	21.58
7.	23.00	23.25	23.08	23.25	23.25	22.23	23.00	22.56	21.78	21.57
8.	23.00	23.18	23.08	23.23	22.80	22.12	23.00	22.50	21.78	21.56
9.	23.00	23.10	22.90	23.18	22.67	22.00	23.00	22.20	21.78	21.54
10.	22.45	23.00	22.68	23.00	22.40	21.90	22.34	22.20	21.78	21.52
11.	22.23	22.67	22.30	22.67	21.68	21.24	22.12	21.90	21.78	21.52
12.	22.00	22.00	21.79	21.90	20.80	20.50	21.57	20.50	21.78	21.50
13.	20.70	20.50	19.90	20.50	19.45	18.70	21.35	19.60	21.57	21.20
14.	18.08	16.78	17.23	17.67	17.46	16.56	17.87	16.65	17.00	19.00
15.	15.67	15.23	15.32	16.17	15.40	15.45	15.11	14.80	15.67	14.89
16.	14.10	13.60	14.32	14.89	14.00	13.50	14.00	13.60	14.89	14.55
17.	13.45	12.75	13.90	13.80	13.25	12.50	13.50	12.60	14.10	13.85
18.	13.00	12.70	12.80	13.35	12.80	12.00	12.60	12.10	12.30	13.15
19.	12.70	12.50	12.40	12.75	12.50	11.50	11.90	11.80	12.00	12.85
20.	12.30	11.50	11.80	12.30	12.00	11.20	11.60	11.50	11.60	12.25
21.	12.20	11.35	11.65	11.80	11.50	10.80	11.30	11.20	11.25	11.65
22.	12.05	11.15	11.53	11.50	11.30	10.70	11.20	11.10	11.10	11.60
23.	11.80	11.00	11.30	11.30	11.10	10.40	11.00	11.00	11.02	11.45
24.	11.65	10.90	11.20	11.20	11.00	10.40	10.90	10.85	10.90	11.30
25.	11.55	10.80	11.15	11.10	10.90	10.20	10.90	10.70	10.85	11.20
26.	11.55	10.75	11.00	11.02	10.80	10.10	10.85	10.70	10.75	11.15
27.	11.53	10.70	10.99	11.00	10.70	10.10	10.75	10.65	10.65	11.05
28.	11.50	10.60	10.90	10.92	10.65	10.00	10.65	10.60	10.65	11.05
29.	11.00			10.88			10.65	10.60	10.63	11.00
30.	10.95			10.75					10.62	10.90
31.	10.90			10.75					10.60	
32.	10.89			10.70					10.60	
33.	10.85			10.65					10.53	
34.	10.65			10.65					10.25	
35.				10.58					10.15	

TABLE 5. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1924	May	June																		
Date	28	4	6	9	10	11	12	13	14	16	16	17	19	19	20	20	21	23	24	25
Time	4:45p	4:45p	8:00a	12:12p	9:30a	8:00a	4:30p	8:00a	8:30a	8:00a	3:30p	1:30p	8:00a	4:00p	8:00a	4:00p	8:00a	3:00p	7:00p	8:30a
Air°C.		24.90	12.10	19.00	18.60	16.00	30.00	19.00	22.40	18.00	29.00	24.00	21.00	25.00	18.00	26.00	23.00	22.00	19.90	20.00
Wind	N.E.	S.E.	N.W.	N.W.	N.W.	E.	N.W.	N.W.		S.E.	S.S.E	S.S.E.	N.N.W.	N.	S.W.	S.	S.W.	S.E.	N.E.	N.W.
Veloc.	Fair	600	900	280	750	800	640	300	100	500	300	600	948	800	Slight	400	700	800	1100	340
Sky	P.C.	Clear	Cloudy	P.C.	P.C.	Cloudy	P.C.	Hazy	Cloudy	Cloudy	P.C.	Rain	Rain	P.C.	Sprnkle	Clear	Clear	Rain	Rain	P.C.
Bar.		28.43	28.53	28.62	28.69	28.56	28.44	28.62	28.58	28.58	28.42	28.31	28.12	28.24	28.60	28.55	28.63	28.50	28.54	28.69
Surf.	13.70	13.70	14.00	12.10	13.00	13.70	14.90	15.20	16.87	15.75	17.10	17.50	16.60	17.05	17.30	18.90	18.20	18.90	18.15	18.40
1. m.	11.30	13.70	13.90	11.90	13.00	13.80	14.80	15.10	16.60	15.75	16.90	17.20	16.60	16.90	17.20	18.10	18.20	18.80	18.15	18.18
2.	10.50	13.60	13.80	11.75	13.00	13.60	14.80	15.00	15.40	15.85	16.65	17.00	16.50	16.80	16.90	17.14	17.90	18.50	18.00	18.10
3.	10.20	13.50	13.70	11.65	12.70	13.50	14.50	14.90	14.70	15.90	16.25	16.60	16.50	16.70	16.85	17.10	17.85	18.30	17.97	17.70
4.	10.10	13.40	13.60	11.50	12.60	13.40	14.30	14.70	14.60	15.90	16.20	16.20	16.20	16.70	16.80	17.05	17.80	17.90	18.00	17.60
5.	9.80	13.35	13.55	11.35	12.50	13.30	14.10	14.10	14.20	15.80	16.10	15.10	16.20	16.70	16.65	16.90	17.80	17.70	17.80	17.60
6.	9.70	13.30	13.50	11.30	12.50	13.25	13.10	13.70	13.90	15.50	16.10	14.10	16.10	16.60	16.55	16.90	17.20	17.45	17.80	17.50
7.	9.65	11.80	13.35	11.25	12.30	12.90	12.90	13.50	13.70	14.90	16.00	13.90	16.00	16.60	16.55	16.85	16.95	17.35	17.80	17.48
8.	9.20	10.65	13.10	11.20	12.30	12.80	12.30	13.20	12.70	14.85	13.50	13.60	15.80	16.40	16.50	16.80	16.90	17.10	17.70	17.48
9.	9.20	10.35	12.70	11.10	11.50	12.75	11.80	12.60	12.35	14.50	13.50	13.20	15.60	16.15	16.10	16.60	16.10	17.00	17.70	17.48
10.	9.20	10.10	12.50	11.10	11.50	12.40	11.70	12.20	12.20	13.40	12.70	13.10	15.00	16.15	15.70	16.50	15.50	16.50	17.65	17.40
11.		10.00	12.45	11.10	11.50	12.25	11.70	12.10	12.00	13.15	12.65	12.90	14.60	16.10	14.25	14.50	14.90	15.80	17.50	15.70
12.		10.00	12.40	11.10	11.50	12.25	11.60	12.00	11.85	12.80	12.15	12.60	14.60	16.10	13.70	13.50	13.65	15.00	17.40	14.50
13.		9.85	12.35	11.10	11.50	12.20	11.50	11.90	11.60	12.65	11.40	12.50	14.00	15.90	13.40	13.10	13.10	13.95	16.10	13.95
14.		9.60	12.25	11.05	11.40	12.10	11.40	11.80	11.40	12.30	11.20	12.40	13.90	15.40	12.45	12.50	12.85	13.85	15.00	13.90
15.		9.60	12.20	11.05	11.40	12.00	11.40	11.80	11.40	11.50	11.10	12.20	13.60	14.80	12.10	12.20	12.70	13.80	14.50	13.50
16.		9.50	12.15	11.00	11.40	11.90	11.40	11.70	11.40	11.40	11.05	12.00	13.50	14.50	11.90	11.90	12.50	13.00	14.30	13.00
17.		9.45	11.90	10.05	11.40		11.40	11.60	11.35	11.40	10.95	11.90	13.40	14.40	11.75	11.75	12.45	12.60	14.10	12.50
18.		9.40	11.80	10.05	11.35		11.40	11.40	11.20	11.40	10.80	11.70	13.30	14.20	11.70	11.70	12.30	12.30	14.10	12.38
19.			11.60	9.85	11.20		11.40	11.20	11.10	11.35	10.70	11.60	13.25	14.10	11.60	11.50	12.00	12.30	13.40	12.20
20.			11.40		10.85		11.30	11.10	10.95	11.25	10.60	11.20	13.25	12.20	11.50	11.40	11.70	11.90	13.10	11.73
21.			11.10		10.40		10.80	10.90	10.70	11.20	10.55	11.20	13.15	12.10	11.30	11.30	11.55	11.80	13.00	11.70
22.			11.00		10.10		10.60	10.70	10.55	11.05	10.50	11.00	12.95	11.50	11.20	11.10	11.35	11.70	12.70	11.68
23.			11.00		10.10		10.40	10.50	10.40	10.80	10.45	10.70	12.70	11.40	11.05	10.97	11.20	11.70	12.50	11.60
24.			10.70		9.90		10.20	10.45	10.35	10.70	10.40	10.55	12.60	11.35	11.05	10.90	11.20	11.50	12.25	11.60
25.			10.55		9.85		10.10	10.40	10.20	10.65	10.35	10.45	12.40	11.30	11.00	10.80	11.10	11.45	12.15	11.58
26.			10.40		9.70		10.10	10.30	10.05	10.65	10.30	10.40	12.10	11.15	10.80	10.70	11.00	11.45	11.90	11.55
27.			10.30		9.70			10.20	9.93	10.60	10.20	10.40	12.00	11.10	10.65	10.63	10.95	11.40	11.80	11.50
28.					9.65			10.15	9.85	10.47	10.10	10.35	11.70	11.05	10.60	10.57	10.90	11.30	11.70	11.45
29.					9.65			10.10	9.80	10.48	10.05	10.15	11.60	11.00	10.50	10.55	10.85	11.30	11.65	11.45
30.								10.10	9.75	10.40	10.00	10.15	11.40	10.95	10.50	10.47	10.70	11.20	11.60	11.40
31.								10.00	9.73	10.35	10.00	10.10	11.15	10.90	10.30	10.40	10.70	11.20	11.60	11.35
32.								9.90	9.70	10.30	9.90	10.00	11.10	10.85	10.30	10.40	10.65	11.15	11.55	11.35
33.								9.40	9.70	10.30	9.45	9.50	10.90	10.70	10.05	10.40	10.60	10.90	11.50	11.25
34.									9.20	9.60		9.50	10.60	10.50	10.05	10.10	10.30	10.85	11.25	10.85
35.																				

TABLE 6. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1924	June					July														
Date	25	26	27	28	30	1	2	3	4	5	7	8	9	10	12	12	14	15	16	17
Time	5:10p	9:00a	8:30a	8:00a	8:30a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	10:00a	8:00a	8:00a	8:00a	1:00p	8:00a	8:00a	8:00a	8:00a
Air °C.	24.00		19.50	21.10	13.40							21.5	19.00	20.00	22.00	29.00	16.10	24.00	20.00	20.0
Wind	Flat	S.E.	S.E.	N.W.	N.N.W.		N.E.	N.E.	N.N.W.	S.	S.S.W.	S.S.E.	N.W.	S.W.	N.E.		N.W.	S.W.	N.N.W.	E.
Veloc.		773	390	1463	1100	465	313	90	265	190	827	965	1310	925	614	Flat	381	1135	260	1000
Sky	Sprkl	Cloudy	Cloudy	Cloudy	P.C.	Cloudy	P.C.	Clear	Clear	Clear	Clear	Hazy	P.C.	Clear	Rain	Cloudy	Clear	P.C.	Clear	P.C.
Bar.	28.57	28.59	28.50	28.21	28.86	28.82	28.71	28.86	28.81	28.78	28.65	28.42	28.52	28.70	28.42	28.39	28.76	28.56	28.40	28.67
Surf.	21.30	18.65	19.65	19.00	18.30	18.00	18.50	19.00	19.45	20.19	19.80	20.00	19.70	19.55	19.90	21.20	19.90	20.40	20.20	19.90
1. m.	19.40	18.60	20.10	19.00	18.30	18.00	18.50	19.00	19.40	20.19	19.79	20.00	19.70	19.45	19.35	20.85	19.90	20.30	20.20	19.85
2.	18.70	18.30	20.10	18.80	18.10	18.00	18.40	18.70	19.40	20.20	19.40	20.00	19.70	19.40	19.10	19.75	19.80	20.20	20.20	19.85
3.	18.25	18.20	20.10	18.80	18.10	18.00	18.20	18.60	19.35	20.13	19.39	19.90	19.70	19.20	19.10	19.40	19.75	20.20	20.20	19.60
4.	18.00	18.20	20.10	18.70	18.00	17.80	18.10	18.30	18.85	18.30	19.29	19.90	19.50	19.25		19.30	19.70	19.90	19.90	19.55
5.	17.65	18.20	20.00	18.70	17.90	17.50	17.90	18.10	18.60	18.19	19.30	19.80	19.50	19.25	19.10	19.15	19.60	19.90	19.85	19.40
6.	17.65	17.90	19.50	18.70	17.90	17.50	17.85	18.00	18.25	17.99	18.30	19.50	19.40	19.20	19.10	19.15	19.60	19.90	19.70	19.40
7.	17.60	17.90	19.50	18.50	17.90	17.50	17.85	17.90	18.15	17.80	17.85	19.40	19.20	19.20	18.99	19.05	19.60	19.90	19.65	19.40
8.	17.55	17.80	18.40	18.40	17.90	17.50	17.85	17.80	18.05	17.65	17.70	18.35	19.00	19.20	18.64	19.05	19.60	19.80	19.50	19.40
9.	17.50	17.75	17.60	18.30	17.50	17.50	17.85	17.70	17.88	17.30	17.55	17.85	18.60	19.20	18.20	19.05	19.60	19.80	18.85	19.40
10.	16.20	17.20	17.50	18.00	17.50	17.50	17.60	17.40	17.10	16.75	17.40	17.45	18.60	19.20	18.00	18.90	19.60	19.75	18.25	19.40
11.	14.80	15.65	17.00	17.70	17.50	17.20	17.20	16.70	16.73	16.45	17.30	17.00	18.50	18.60	17.75	18.65	19.30	19.75	18.00	19.40
12.	14.10	14.80	17.00	17.50	17.50	15.50	15.50	15.80	16.48	16.19	16.90	16.75	18.50	17.85	17.75	18.20	17.80	19.70	17.70	18.80
13.	14.00	14.55	16.40	16.70	17.50	14.60	14.60	15.40	15.40	15.70	15.65	16.50	18.50	17.00	17.74	17.50	16.70	19.50	17.20	17.20
14.	14.00	14.48	15.60	16.50	15.20	14.20	14.20	14.50	14.90	14.75	14.40	15.50	18.50	14.60	17.40	15.40	16.00	18.30	16.50	16.10
15.	14.00	14.38	15.00	15.50	14.90	14.00	14.00	14.00	13.75	13.90	13.80	14.20	17.40	14.30	16.50	14.85	15.12	17.00	15.50	15.00
16.		14.30	14.90	15.50	13.80	13.20	13.20	13.45	13.14	13.20	13.40	13.70	17.00	13.70	16.10	14.60	14.40	15.90	14.90	14.80
17.		13.58	14.50	14.50	13.20	13.00	13.00	13.05	12.88	12.80	12.90	13.10	13.40	13.15	13.85	13.85	13.80	15.50	14.20	14.00
18.		13.08	14.25	14.00	13.10	12.80	12.80	12.50	12.63	12.65	12.70	12.70	12.90	12.50	12.80	13.40	13.15	15.30	13.10	13.80
19.		12.70	13.90	13.60	12.70	12.70	12.70	12.20	12.49	12.35	12.35	12.30	12.80	12.30	12.40	12.30	12.65	14.70	12.80	13.70
20.		12.35	12.40	13.40	12.50	12.70	12.70	12.05	12.13	12.10	12.20	12.00	12.60	12.15	12.30	11.85	12.10	14.30	12.30	13.50
21.		12.25	12.10	13.00	12.50	12.40	12.40	11.93	11.85	11.74	12.00	11.70	12.20	11.95	12.10	11.70	11.90	13.90	12.05	12.80
22.		12.20	12.10	12.90	12.40	12.10	12.10	11.75	11.69	11.60	11.90	11.67	12.00	11.75	11.75	11.65	11.75	13.50	11.90	12.80
23.		12.15		12.80	11.60	11.90	11.90	11.70	11.60	11.49	11.70	11.60	11.90	11.63	11.60	11.60	11.65	12.60	11.60	12.10
24.		12.13		12.50	11.50	11.55	11.70	11.63	11.50	11.40	11.60	11.55	11.90	11.55	11.55	11.50	11.55	12.60	11.50	11.80
25.		12.10		12.30	11.50	11.50	11.60	11.50	11.43	11.30	11.60	11.50	11.80	11.50	11.55	11.40	11.50	12.40	11.40	11.80
26.		11.98		12.00	11.40	11.50	11.50	11.40	11.42		11.50	11.48	11.75	11.45			11.50	11.80	11.30	
27.		11.98		Rain	11.30		11.50	11.35	11.40			11.45	11.60	11.40			11.43	11.60		
28.		11.98			11.20			11.25	11.30			11.30	11.50	11.30			11.40	11.50		
29.		11.90			11.20			11.20	11.29			11.15	11.40	11.20			11.30	11.35		
30.		11.88			11.10			11.20	11.25			11.12	11.40	11.20			11.20	10.90		
31.												11.10		11.15			11.20	10.80		
32.												11.00		11.05			11.20	10.80		
33.												11.00		11.00			11.20			
34.												10.65		10.90			11.10			
35.														10.85			11.00			

TABLE 7. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1924	July												Aug.	
Date	19	20	21	22	23	24	25	26	28	28	30	31	1	3
Time	8:00a	9:00a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	7:30p	8:00a	8:00a	8:00a	8:00a
Air°C.	17.00	15.80	22.00	22.00	24.00	19.00	20.50	21.00	29.00	30.00	24.50	16.70	18.00	30.00
Wind	S.E.	S.E.	S.W.	N.W.	S.S.W.	N.W.	N.W.	N.E.	S.E.	S.E.	N.W.	N.E.	S.E.	S.
Veloc.	1057	935	600	580	1300	1290	800	375	1150	850	1518	779	252	520
Sky	P.C.	Foggy	Rain	Clear	Clear	Cloudy	P.C.	Clear	P.C.	P.C.	Cloudy	Cloudy	Cloudy	P.C.
Bar.	28.60	28.44	28.29	28.59	28.53	28.60	28.62	28.65	28.49	28.33	28.50	28.66	28.64	28.24
Surf.	20.10	19,50	19.75	20.20	19.80	20.40	20.15	19.85	21.70	20.55	20.40	20.90	19.30	19.65
1. m.	19.90	19.65	19.85	19.80	19.70	20.30	20.20	19.75	21 50	20.50	20.30	20.70	18.90	19.40
2.	19.65	19.65	19.85	19.80	19.70	20.10	20.05	19.70	21.45	20.45	20.20	20.60	18.85	19.00
3.	19.60	19.70	19.85	19.55	19.80	20.05	19.80	19.70	21.38	20.35	20.00	20.55	18.80	18.80
4.	19.53	19.60	19.70	19.50	19.70	20.00	19.70	19.70	21.38	20.10	19.90	20.50	18.75	18.80
5.	19.52	19.45	19.70	19.50	19.40	19.95	19.65	19.10	19.70	18.50	19.90	20.45	18.70	18.75
6.	19.50	19.40	19.65	19.50	19.40	19.90	19.60	19.30	19.50	18.30	19.80	20.40	18.70	18.65
7.	19.50	19.30	19.60	19.50	19.40	19.88	19.57	19.30	19.25	18.20	19.80	20.40	18.70	18.65
8.	19.50	19.25	19.50	19.50	19.40	19.88	19.55	19.30	19.14	18.05	19.70	20.35	18.70	18.45
9.	19.15	19.25	19.30	19.50	19.40	19.80	19.50	19.25	19.00	17.90	19.55	19.95	18.60	18.45
10.	18.35	18.40	19.24	19.48	19.35	19.78	19.40	19.25	18.95	17.90	19.45	19.50	18.60	18.30
11.	17.82	18.10	19.20	19.30	19.30	19.85	19.40	19.00	18.89	17.85	19.30	19.45	18.20	18.20
12.	17.00	18.00	18.40	18.90	19.10	19.80	19.40	18.40	18.15	17.30	19.15	18.50	17.15	18.20
13.	17.00	17.40	16.00	18.35	18.80	19.80	17.30	17.35	17.90	16.10	18.90	18.05	16.40	17.10
14.	15.40	16.60	14.80	16.40	18.20	19.80	16.20	16.00	16.60	14.70	18.80	16.60	15.90	15.45
15.	15.00	15.50	14.50	15.55	17.70	18.80	15.60	15.10	15.40	13.90	18.30	14.40	15.75	15.10
16.	14.90	15.10	14.10	14.60	15.60	15.80	14.60	14.05	13.89	13.10	18.10	13.50	14.75	14.50
17.	13.90	14.25	13.90	13.40	15.10	15.10	13.40	13.50	13.30	12.60	17.90	12.75	13.55	12.70
18.	13.35	14.05	13.80	12.65	14.00	14.00	12.80	12.80	12.90	12.00	17.20	12.15	12.40	12.00
19.	13.10	13.50	13.50	12.50	13.80	13.50	12.30	11.95	11.95	11.60	Too rough for careful readings	11.40	11.70	11.15
20.	12.60	12.70	13.00	12.35	13.80	13.30	11.85	11.38	11.50	11.15		11.00	11.30	10.90
21.	12.40	12.50		12.20	13.70	12.90	11.70	11.20	11.20	10.70		10.60	10.70	10.55
22.	12.20	12.45		12.10	13.10	12.85	11.55	11.05	11.00	10.55		10.40	10.50	10.05
23.	12.10	12.45		11.85	12.10	12.60	11.30	10.95	10.80	10.45		10.30	10.40	
24.	12.05	12.35		11.80	11.70	12.50	11.20	10.90	10.70	10.20		10.00	10.25	
25.	12.00	12.10		11.80	11.55	12.30	11.05	10.85	10.50	10.15			10.20	
26.	11.85	11.90		11.55	11.30	12.00	11.00	10.80	10.40				10.10	
27.	11.70	11.85		11.45	11.30	11.80	10.90	10.65	10.39				10.10	
28.	11.60					11.40	10.80	10.60	10.30					
29.	11.50					11.30	10.80	10.55	10.30					
30.	11.45					11.25	10.65	10.55	10.30					
31.							10.55	10.50	10.30					
32.							10.55	10.50	10.25					
33.							10.40	10.45	10.09					
34.							10.20	10.05						
35.							10.05	10.05						

TABLE 8. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1924							Aug.								
Date	4	5	5	6	7	8	9	11	11	11	11	12	13	16	19
Time	8:00a	8:00a	10:45a	7:00p	8:00a	8:00a	8:00a	8:00a	1:40p	3:45p	7:15p	8:30a	8:30a	8:00a	8:00a
Air°C.	22.06	23.00	28.00	20.30	18.30	19.50	15.00	19.25	26.00	27.50	23.00	21.00	17.30	16.00	20.00
Wind	N.E.	N.W.		N.N.W.	N.E.	S.W.	N.W.	N.W.	W.	W.	S.W.	S.W.	S.E.	N.E.	S.E.
Veloc.	1111	720	None	403	830	402	980	120	597	712	535	526	625	649	340
Sky	P.C.	Rain	P.C.	Clear	Clear	Rain	Cloudy	Clear	Clear	Clear	Clear	P.C.	Clear		Cloudy
Bar.	28.44	28.40	28.40	28.44	28.46	28.31	28.65	28.66	28.66	28.63	28.59	28.58	28.75	28.64	28.28
Surf.	20.00	20.80	21.10	22.00	22.40	21.50	21.20	20.00	20.80	20.85	20.20	20.35	19.70	18.70	18.10
1. m.	19.60	19.80	20.50	21.90	22.20	21.50	21.15	19.98	20.80	20.65	20.20	20.30	19.65	18.80	18.22
2.	19.55	19.70	19.70	21.90	22.20	21.30	20.95	19.98	20.60	20.40	20.10	20.20	19.48	18.78	18.20
3.	19.35	19.70	19.40	21.90	22.10	21.30	20.85	19.80	20.25	20.20	20.05	20.10	19.35	18.68	18.20
4.	19.25	19.58	19.25	21.85	22.05	21.20	20.80	19.80	20.10	19.95	20.05	20.10	19.30	18.60	18.10
5.	19.25	19.25	19.00	21.60	21.90	21.05	20.70	19.80	20.00	19.80	20.05	20.00	19.20	18.60	17.99
6.	19.15	18.75	18.65	21.40	21.75	21.00	20.58	19.80	19.92	19.75	20.02	20.00	19.15	18.52	17.98
7.	19.10	18.55	18.35	21.40	21.65	20.90	20.50	19.78	19.89	19.65	20.02	19.90	19.05	18.52	17.95
8.	18.90	18.50	18.30	21.15	21.60	20.80	20.40	19.78	19.88	19.55	20.00	19.80	18.95	18.50	17.92
9.	18.80	18.35	18.20	20.95	21.45	20.55	20.20	19.75	19.80	19.50	19.85	19.70	18.95	18.50	17.90
10.	18.70	18.25	18.05	20.85	21.35	20.50	20.00	19.73	19.80	19.50	19.80	19.70	18.95	18.42	17.85
11.	18.40	17.70	17.90	20.75	21.35	19.90	19.95	19.70	19.75	19.50	19.70	19.70	18.80	18.40	17.80
12.	18.15	17.30	17.85	20.40	21.30	19.00	19.55	19.25	19.75	19.45	19.65	19.20	18.70	18.40	17.75
13.	18.05	16.60	17.78	18.30	21.20	17.90	17.65	18.45	19.05	19.30	19.35	18.60	18.30	18.32	17.50
14.	17.90	15.50	16.55	17.50	20.80	17.25	15.90	17.80	18.50	18.60	18.55	17.70	16.80	18.25	17.20
15.	15.90	15.05	15.65	16.50	18.20	16.10	15.55	16.10	16.75	18.20	17.75	16.70	14.80	16.20	17.00
16.	14.05	14.30	14.28	14.85	16.80	14.90	14.30	14.90	15.05	17.90	16.25	15.00	13.40	15.30	16.85
17.	13.50	13.85	12.80	14.05	16.10	13.90	14.10	13.55	14.10	17.10	14.30	14.00	12.40	13.80	15.85
18.	11.90	13.20	11.65	13.75	15.65	13.00	13.05	12.85	13.00	14.90	13.20	13.00	11.80	13.00	13.30
19.	11.50	11.55	11.05	12.60	15.10	12.20	12.25	12.18	12.45	14.70	12.80	12.50	11.20	12.00	11.85
20.	11.00	10.70	10.80	12.20	14.10	11.65	11.40	11.70	12.10	13.05	12.50	12.00	10.99	11.30	10.90
21.	10.40	10.65	10.48	11.70	13.75	11.35	11.10	11.52	11.80		12.10	11.50	10.50	10.85	10.55
22.	10.15	10.50	10.30	11.50	13.25	11.05	10.85	11.29	11.60		11.90	11.30	10.23	10.85	10.45
23.	10.00	10.35	10.10	11.35	12.80	10.85	10.60	11.21			11.75	11.20	10.10	10.75	10.35
24.		10.05	10.05	11.20	12.60	10.70	10.45	11.11			11.58	11.00	9.92	10.60	10.22
25.		10.00	10.00	11.15	12.45	10.65	10.35	11.00			11.40	10.80	9.85	10.50	10.15
25.				11.15	12.25	10.55	10.30	10.90			11.35	10.70	9.80	10.30	10.15
27.				11.10	12.00	10.45	10.10	10.80			11.25	10.60	9.65	10.20	10.12
28.				11.05	11.85	10.38	10.00	10.78			11.12	10.50		10.10	10.10
29.				11.00	11.80	10.35	9.95	10.75			11.10	10.50		10.05	10.00
30.				11.00	11.70	10.25	9.80	10.70			11.00	10.40		9.90	9.99
31.				10.95		10.20	9.80	10.69				10.25		After two very	9.95
32.				Very windy		9.95	9.60	10.62				10.10		windy days	End of
33.				in forenoon		9.75	9.55	10.30				10.00			season
34.						9.65	9.25	9.85				9.65			
35.						9.60	9.05	9.60				9.40			

TABLE 9. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1925 Date	July 27	28	29	30	31	Aug. 1	2	3	4	5	6	7	8	10	11	12	13	14	15
Time	10:30a	10:00a	9:00a	9:00a	9:00a	8:00a	1:30p	8:30a	9:00a	9:00a	9:00a	9:00a	8:30a	8:30a	8:30a	2:30p	8:30a	8:00a	10:00a
Air° C.	20.00	20.00	20.00	19.00	18.00	20.00	23.5	23.5	22.00	22.00	23.5	20.00	22.00	24.00	22.8	25.00	19.5	23.00	22.5
Wind	N.E.	N.N.E.	N.	N.W.	N.E.	N.W.	N.W.	S.	S.	S.	S.W.	S.E.	S.	W.	S.E.	N.W.	N.E.		S.S.W.
Veloc.	1000	1000	315	1440	1450	500	393	360	970	1020	863	660	789	145	920	584	1380	310	1420
	61%	49%	80%	60%	87%	76%		80%	90%	80%	90%	94%	88%	75%	70%			90%	96%
Sky	Clear	Clear	Clear	Clear	Cloudy	Clear	Clear	Hazy	Clear	Cloudy	Cloudy	Cloudy	Cloudy	Clear					Sprinkle
*Bar.	30.08	30.09	29.97	30.00	30.07	30.13	30.07	30.01	30.05	30.01	29.90	29.88	29.88	29.98	29.95	29.78	30.01	30.15	29.87
Surf.	21.60	21.40	21.10	21.00	20.40	20.30	21.30	21.30	20.20	20.10	20.70	20.80	21.00	21.30	21.00	20.60	20.40	20.75	20.50
1. m.	21.60	21.40	21.10	21.00	20.50	20.30	21.25	21.30	20.20	20.10	20.70	20.80	21.00	21.25	21.00	20.60	20.30	20.75	20.30
2.	21.60	21.40	21.10	21.00	20.50	20.30	20.70	21.20	20.20	20.10	20.60	20.80	21.00	21.20	21.00	20.60	20.30	20.70	20.30
3.	21.60	21.40	21.10	21.00	20.50	20.20	20.50	21.00	20.20	20.00	20.60	20.70	21.00	21.20	21.00	20.50	20.30	20.60	20.30
4.	21.60	21.40	21.10	21.00	20.50	20.20	20.30	20.80	20.20	20.00	20.60	20.65	21.00	21.20	21.00	20.50	20.30	20.55	20.30
5.	21.60	21.40	21.10	21.00	20.50	20.20	20.30	20.50	20.20	20.00	20.50	20.65	21.00	21.15	21.00	20.50	20.30	20.50	20.30
6.	21.50	21.40	21.10	21.00	20.50	20.20	20.20	20.30	20.20	20.00	20.40	20.60	20.90	21.15	20.90	20.40	20.30	20.50	20.30
7.	21.50	21.40	21.00	21.00	20.50	20.20	20.20	20.30	20.00	20.00	20.40	20.60	20.60	21.15	20.90	20.40	20.30	20.50	20.30
8.	21.50	21.30	21.00	21.00	20.50	20.20	20.20	20.20	20.00	20.00	20.30	20.40	20.50	21.00	20.80	20.20	20.30	20.50	20.30
9.	21.50	21.30	21.00	21.00	20.50	20.20	20.20	20.20	20.00	20.00	20.30	20.30	20.30	21.00	20.20	20.10	20.30	20.48	20.30
10.	21.40	21.30	21.00	21.00	20.50	20.20	20.20	20.20	20.00	20.00	20.00	20.30	20.30	20.30	20.00	19.90	20.20	20.48	20.30
11.	21.30	21.30	20.98	21.00	20.50	20.20	20.10	20.20	20.00	20.00	20.00	20.30	20.00	20.00	19.90	19.80	20.20	20.45	20.30
12.	21.30	21.30	20.95	21.00	20.40	20.20	20.10	20.20	20.00	20.00	20.00	20.30	20.00	19.90	19.70	19.65	20.20	20.42	20.30
13.	21.30	21.30	20.93	21.00	20.40	20.20	20.10	20.00	20.00	20.00	19.80	20.10	20.00	19.70	19.60	19.55	19.75	20.10	20.20
14.	21.20	21.20	20.90	20.95	20.40	20.20	20.00	19.90	19.90	19.90	19.70	20.00	19.90	19.50	19.50	19.40	19.60	19.50	20.00
15.	21.00	21.00	20.63	20.90	20.40	20.00	19.85	19.70	19.90	19.90	19.60	20.00	19.80	19.30	19.40	19.30	19.50	19.25	20.00
16.	21.00	20.80	19.35	20.80	20.20	20.00	19.60	19.50	19.80	19.80	19.60	19.75	19.60	19.10	19.10	19.10	19.30	19.00	19.90
17.	21.00	19.80	18.98	20.50	20.00	19.40	19.60	19.40	19.80	19.70	19.40	19.20	29.20	18.70	18.90	18.90	19.10	18.98	19.80
18.	20.00	18.60	18.18	19.40	18.60	18.70	19.50	19.10	19.60	19.30	19.10	18.50	18.90	18.60	18.70	18.45	18.80	18.50	19.80
19.	19.50	18.20	17.65	18.90	18.50	18.30	19.40	18.40	19.00	19.20	18.80	18.30	18.90	18.20	18.50	17.90	18.75	18.00	19.70
20.	17.60	17.90	17.30	18.50	18.20	17.80	17.80	18.00	18.50	18.60	17.50	17.60	18.80	17.40	18.10	17.50	18.50	17.60	18.80
21.	17.40	17.80	17.10	18.40	18.00	17.20	17.20	17.20	18.00	17.60	16.90	17.20	17.60	17.20	17.65	17.10	18.10	16.85	18.40
22.	17.10	17.40	16.85	17.90	17.90	16.80	16.85	16.80	17.70	16.80	16.70	16.70	17.20	16.80	17.20	16.50	17.70	16.65	18.00
23.	16.90	16.90	16.30	17.30	16.80	16.50	16.40	16.60	17.00	16.40	16.50	16.60	16.60	16.50	16.60	16.15	17.60	16.50	17.80
24.	16.40	16.80	16.30	17.30	16.80	16.30	16.10	16.50	16.80	16.30	16.40	16.60	16.50	16.25	16.20	16.00	16.20	16.00	17.60
25.	16.10	16.50	16.22	16.90	16.80	16.25	15.95	16.30	16.60	16.20	16.20	16.10	16.40	16.10	16.10	15.60	16.10	15.90	17.10
26.	16.00	16.20	16.00	16.80		16.00	15.80	16.00	16.50	16.10	15.90	16.00	16.20	15.80	16.00	15.45	15.90	15.70	16.80
27.	15.90	16.10	15.75	16.60		15.60	15.80	15.90	16.30	16.00	15.90	15.90	16.10	15.70	15.90	15.30	15.50	15.50	16.70
28.	15.90	16.10	15.70	16.30		15.60	15.70	15.80	16.10	15.90	15.80	15.80	16.00	15.70	15.80	15.15	15.40	15.38	16.60
29.	15.80	16.00	15.60	16.00		15.50	15.60	15.60	16.00	15.90	15.70	15.70	15.90	15.50	15.60	15.00	15.40	15.35	16.40
30.	15.80	15.90	15.60	15.90		15.50	15.50	15.50	15.80	15.60									

* Readings corrected for altitude.

TABLE 10. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1926	June							July												
Date	16	18	23	25	28	29	30	5	6	7	9	12	13	14	15	16	17	19	20	22
Time	3:30p	3:15p	3:30p	9:45a	7:30p	7:15p	7:00p	8:00a	8:00a	8:50a	8:30a	3:30p	8:00a		8:00a	3:00p	7:30a	8:00a	2:15p	8:00a
Air °C.	18.00	22.00	27.00	20.00	23.00	25.00	28.00	32.00	23.50	26.00	25.50	26.00	17.00	25.00	23.00	32.00	24.00	27.00	32.00	21.00
Wind					S.E.		S.W.	N.E.	E.	S.	N.W.	N.W.	N.E.	S.E.	S.E.	S.E.	N.E.	S.W.	S.W.	N.W.
Veloc.	Strng	Calm	Fair	Calm	Strng	Calm	Slight	468	428	1273	435	913	591	680	533	1340	412	732	548	364
Sky	Rain	Cloudy		P.C.	P.C.	P.C.	Hazy	Cloudy	Clear	Cloudy	Cloudy	Clear	Clear	Clear	Hazy	Clear	Cloudy	Hazy	Clear	Hazy
Bar.	28.28	28.60	28.48		28.33	28.47	28.35	28.50	28.53	28.35	27.92	28.44	28.60	28.54	28.42	28.30	28.54	28.38	28.24	28.66
Surf.	16.00	15.60	16.40	17.30	19.20	18.50	18.60	20.60	19.50	21.00	21.10	20.30	19.90	17.20	17.90	21.50	17.60	18.10	22.20	19.00
1. m.	15.80	15.50	16.00	17.30	18.60	18.00	18.40	20.60	19.55	20.80	21.10	20.30	20.10	17.60	18.00	21.50	17.50	18.10	21.80	20.20
2.	15.70	15.35	16.00	17.15	18.30	18.00	18.30	20.50	19.55	20.60	21.10	20.20	20.10	18.00	18.10	21.00	17.00	18.20	21.60	20.40
3.	15.70	15.30	15.80	17.10	18.20	17.80	18.20	20.40	19.50	20.60	21.10	20.00	20.15	18.20	18.10	20.80	16.95	18.15	21.30	20.50
4.	15.60	15.30	15.60	17.10	18.00	17.70	18.15	20.30	19.40	20.50	21.10	19.80	20.20	18.40	18.00	20.60	16.90	18.10	21.10	20.50
5.	15.60	15.30	15.50	16.90	17.90	17.20	18.10	19.60	19.00	18.70	20.80	19.80	20.20	18.40	18.00	20.50	16.70	18.10	21.00	20.60
6.	15.50	15.30	15.40	16.90	17.70		17.40	18.40	18.30	18.40	20.80	19.70	20.20	18.40	18.00	20.20	16.40	18.10	20.90	20.60
7.	15.50	15.30	15.30	16.80	17.40		16.80	18.30	17.30	18.10	19.60	19.60	20.20	18.50	18.00	20.10	16.30	18.10	20.80	20.60
8.	15.48	15.30	15.30	16.80	17.20		16.50	17.70	16.15	17.10	19.00	19.50	20.15	18.50	18.00	20.00	16.20	18.10	20.70	20.60
9.	15.45	15.30	15.20	16.80	17.00		16.30	17.20	15.75	16.40	17.70	19.40	20.10	18.50	18.00	19.90	15.80	18.10	20.60	20.60
10.	15.40	15.25	15.20	16.70	16.90	16.10	16.10	16.90	15.40	16.10	17.00	19.20	19.80	18.40	17.70	19.80	15.50	18.10	20.20	20.60
11.	15.40	15.25	15.20	16.60	16.80	16.00	16.00	16.70	15.20	15.70	16.70	18.90	19.50	18.40	16.90	18.80	15.40	17.10	20.10	20.60
12.	15.40	15.20	15.20	16.60	16.60		15.95	16.60	15.10	15.60	16.50	18.80	18.90	17.60	16.50	18.20	15.20	16.45	18.30	20.30
13.	15.30	15.19	15.20	16.55	16.40		15.90	16.50	15.00	15.50	16.30	18.20	18.35	16.60	16.00	18.00	15.10	16.00	17.70	18.60
14.	15.30		15.20	16.50	16.30		15.80	16.35	14.90	15.30	16.20	18.10	17.80	16.20	15.60	17.70	14.75	15.60	17.40	18.00
15.	15.30		15.10	16.50	16.30	15.60	15.70	16.30	14.80	15.30	16.00	18.10	17.40	16.00	15.50	17.40	14.60	15.40	17.10	17.50
16.	15.30		15.10	16.40	16.20		15.50	16.20	14.75	15.30	15.70	17.60	17.10	15.60	15.00	16.75	14.50	15.20	16.70	17.20
17.	15.20		15.10	16.35	15.50		15.45	16.10	14.65	15.20	15.50	17.30	16.70	15.40	14.80	16.40	13.80	15.10	16.20	16.50
19.	15.20		15.10	16.20			15.40	16.00	14.60	15.20	15.50	16.80	16.50	15.20	14.70	16.20	13.50	14.70	16.00	16.20
19.	15.19		15.10	16.15			15.30	15.90	14.55	15.20	15.50	16.50	16.40	15.10	14.60	16.10	13.40	14.40	15.90	15.90
20.				16.10		15.40	15.20	15.85	14.50	15.10	15.40	16.10	16.30	15.00	14.50	15.50	13.30	14.20	15.70	15.70
21.				16.05			15.20	15.70	14.45	15.00	15.40	15.90	16.20	14.80	14.20		13.10	14.10	15.60	15.60
22.				15.90			15.15	15.70	14.40	15.00	15.20	15.80	16.15	14.80	14.20		12.85	14.00	15.40	15.50
23.								15.70	14.30	14.90	15.20	15.80	16.15	14.70	14.20		12.70	13.90	15.10	15.50
24.								15.60	14.30	14.90	15.20	15.50	15.85	14.50	14.10	15.20		13.80	14.80	15.40
25.								15.50	14.25	14.90	15.20	15.40	15.75	14.50	14.06			13.50	14.70	15.30
26.								15.30	14.10			15.00	15.70	14.40	13.70			13.40		14.80
27.								14.70	13.75			14.90	15.25	14.20	13.50			13.10		14.60
28.								14.00	13.20			14.80	14.95	13.90	13.20			13.00		14.50
29.								13.20	13.00				14.80	13.80	13.00			12.90		14.30
30.								13.20	12.95				14.70	13.50	12.90			12.90		14.20
31.														12.80	12.10					14.00
32.														12.50	11.95					
32.															11.80					
34.															11.65					
35.															11.60					

TABLE 11. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1926	July						Aug.													
Date	26	27	28	29	30	31	2	3	4	5	6	7	9	10	11	12	13	14	16	18
Time	7:30a	8:00a	8:00a	7:00p	8:00a	7:30a	8:00a	8:00a	8:00a		8:00a		3:00p	8:00a	1:30p	8:00a	8:00a	8:00a	8:00a	8:00a
Air°C.	20.50	20.50	23.00	25.50	24.50	22.50	23.00	24.50	24.50	21.00	21.50	19.00	29.00	19.00	22.00	19.50	19.50	18.50	20.00	22.50
Wind	S.E.	S.E.	S.E.	S.S.W.	N.W.	N.W.	S.W.	N.W.	S.	S.E.	N.N.W.	E.		N.N.E.	S.S.E.	N.W.	S.E.	N.N.E.	N.N.E.	E.S.E.
Veloc.	756	924	1496	518	258	633	790	286	650	340	1707	565	Flat	1010	810	837	475	908	870	686
Sky	Hazy	Hazy	Hazy	P.C.	Cloudy	Foggy	Clear	Clear	Cloudy	Clear	Clear	Clear	Clear	Misty	Cloudy	Cloudy	Cloudy	P.C.	Misty	Clear
Bar.	28.64	28.31	28.40	28.46	28.43	28.52	28.32	28.62	28.48	28.45	28.53	28.74	28.43	28.58	28.59	28.56	28.57	28.71	28.40	28.35
Surf.	18.30	18.90	18.20	20.10	20.50	17.50	19.50	18.90	21.80	21.40	21.10	20.60	22.55	19.40	21.20	20.70	19.60	20.80	20.90	20.70
1. m.	18.30	18.20	18.20	20.00	20.50	17.70	19.50	19.00	21.80	22.00	21.50	21.00	21.65	19.50	21.40	20.80	20.40	20.80	21.00	20.70
2.	18.30	18.20	18.30	19.90	20.00	17.70	19.80	19.00	21.70	22.10	21.60	21.10	21.40	19.60	21.40	20.80	20.70	20.90	21.00	20.70
3.	18.30	18.20	18.30	19.85	19.99	17.80	19.80	19.00	21.65	22.20	21.60	21.10	21.35	19.60	21.40	20.80	20.90	20.90	21.00	20.70
4.	18.30	18.20	18.40	19.80	19.95	17.80	19.70	19.00	21.60	22.30	21.60	21.10	21.15	19.60	21.40	20.80	21.00	20.90	21.00	20.70
5.	18.30	18.20	18.50	19.75	19.90	17.90	19.70	18.70	21.50	22.30	21.70	21.15	21.05	19.70	21.40	20.80	21.00	20.90	21.00	20.70
6.	18.30	18.20	18.50	19.70	19.90	18.00	19.60	18.50	21.50	22.40	21.70	21.20	21.02	19.70	21.40	20.80	21.00	20.90	21.00	20.70
7.	18.30	18.20	18.50	19.70	19.80	18.00	19.50	18.40	21.50	22.40	21.80	21.20	21.00	19.70	21.40	20.80	21.00	20.90	21.00	20.70
8.	18.30	18.20	18.50	19.65	19.70	18.00	19.40	18.20	20.90	22.40	21.80	21.20	20.95	19.70	21.40	20.80	21.00	20.90	21.00	20.60
9.	18.20	18.20	18.50	19.55	19.68	18.00	19.40	18.00	20.70	22.00	21.80	21.20	20.90	19.70	21.40	20.80	21.00	20.90	21.00	20.50
10.	18.10	18.20	18.50	19.50	19.65	18.00	18.80	17.80	20.60	21.70	21.50	21.20	2.090	19.70	21.40	20.80	21.00	20.90	20.90	20.50
11.	18.10	18.20	18.40	19.48	19.55	17.90	18.50	17.60	20.00	21.00	21.20	21.10	20.85	19.70	21.40	20.80	21.00	20.90	20.90	20.50
12.	18.00	18.20	18.40	19.35	19.40	17.70	18.40	17.30	19.80	20.70	21.00	20.90	20.65	19.70	21.40	20.80	21.00	20.90	20.70	20.00
13.	17.70	18.20	18.40	19.35	19.30	17.40	18.30	17.10	19.70	20.40	20.40	19.80	20.40	19.70	21.00	20.80	21.00	20.80	20.70	19.50
14.	17.50	18.10	18.40	19.00	18.90	17.10	18.00	17.00	19.40	20.00	20.00	19.50	20.15	19.30	20.80	20.50	20.60	20.80	20.50	19.50
15.	16.50	18.00	18.30	18.85	18.25	16.50	17.60	16.80	19.20	19.80	19.60	19.40	19.95	19.00	20.30	20.10	20.00	20.00	20.30	19.50
16.	16.10	17.80	18.20	18.35	17.50	15.60	16.80	16.00	18.70	18.50	19.60	18.90	18.90	18.50	19.50	19.80	19.30	19.60	20.00	19.50
17.	14.90	16.70	17.20	16.90	16.65	14.90	16.20	14.90	18.30	17.70	19.50	18.20	18.20	17.60	18.90	19.70	18.70	19.40	19.89	19.50
18.	14.70	16.40	16.80	16.55	16.20	14.60	15.60	14.60	17.40	17.40	19.40	17.40	17.55	16.70	18.30	19.00	18.30	18.60	19.50	19.10
19.	14.50	16.20	16.50	16.10	15.85	14.40	15.00	14.30	17.00	17.20	18.60	17.30	16.95	16.20	18.00	18.40	17.70	18.00	18.90	19.00
20.	14.30	15.70	16.00	15.90	15.50	14.10	14.80	13.90	16.40	16.90	18.10	16.70	16.50	15.80	17.60	17.70	17.20	17.80	18.10	17.70
21.	14.20	15.50	15.50	15.75	15.30	13.90	14.60	13.70	16.20	16.70	16.50	16.20	16.10	15.40	16.90	17.00	16.90	17.20	17.60	16.30
22.	14.10	15.30	15.20	15.45	15.15	13.70	14.40	13.50	16.00	16.40	16.00	16.10	15.90	15.15	16.60	16.60	16.50	16.60	16.60	16.00
23.	14.00	15.00	15.00	15.10	15.10	13.50	14.30	13.30	15.90	16.30	15.70	15.70	15.70	14.90	16.50	16.20	16.20	16.30	16.20	16.00
24.	13.90	14.80	14.70	14.90	14.80	13.40	14.10	13.00	15.50	16.10	15.70	15.50	15.60	14.70	16.20	16.00	16.00	16.10	15.90	15.90
25.	13.70	14.60	14.50	14.70	14.65	13.20	13.90	12.80	15.40	15.90	15.50	15.30	15.25	14.20	16.00	15.80	15.90	16.00	15.60	15.80
26.	13.50	14.50	14.30	14.60	14.50	13.10	13.70	12.60	15.30	15.80	15.20	15.10	15.05	14.10	15.70	15.50	15.50	15.80	15.40	15.50
27.	13.20	14.20	14.20	14.50	14.40	13.10	13.40	12.50	15.10	15.60	15.00	14.90	14.85	13.90	15.50	15.30	15.30	15.70	15.20	15.10
28.	13.00	14.20	14.10	14.25	14.25	12.80	13.30	12.40	14.90	15.50	15.00	14.70	14.80	13.90	15.30	15.20	15.20	15.00	15.20	14.90
29.	12.70	13.90	13.80	14.15	14.15	12.80	13.20	12.30	14.60	15.30	14.90	14.60	14.75			15.20	13.60		15.00	14.80
30.	12.70	13.60	13.80	14.10	14.08		13.10	12.20	14.50	15.10	14.60	14.60	14.70			15.10	13.10			14.80
31.		13.50	13.60		13.90		13.10		14.50	15.00	14.50	14.50	14.60			14.90				
32.		13.40	13.40		13.70				14.40	14.90			14.60			14.80				
33.		13.20	13.20		13.70					14.90			14.50							
34.		13.10	13.00		13.65					14.85										
35.		13.00	12.90		13.60															

TABLE 12. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1927	June							July						
Date	13	15	16	17	18	20	23	1	5	6	8	11	14	15
Time	10:30a	1:30p	8:30a	5:00p	10:00a	2:00p	8:30a	9:00a	7:30p	8:30a	8:30a	1:30p	8:30a	11:00a
Air °C.	21.00	22.00	15.50	19.00	21.00	22.00	20.00	23.80	26.00	28.00	18.00	30.00	23.00	20.00
Wind	N.E.	S.E.	N.E.	S.E.	S.W.	S.W.	S.W.	S.W.	N.W.	N.W.	S.W.	S.W.	S.W.	N.E.
Veloc.	Calm	350	350	Calm	900	720	400	1200	900	840	640	200	120	Calm
Sky	Clear	Clear	Cloudy	Rain	P.C.	Rain	Clear	Clear	P.C.	Clear	Cloudy	Clear	P.C.	Clear
Bar.	28.66	28.62	28.55	28.42	28.45	28.15	28.63	28.50	28.33	28.42	28.62	28.46	28.44	
Surf.	15.50	15.70	14.85	15.00	15.00	17.00	16.20	19.20	18.80	18.50	19.10	21.20	20.90	22.00
1. m.	15.10	15.70	14.85	14.90	14.90	16.90	16.20	19.20	18.80	18.50	19.10	20.30	20.80	21.50
2.	14.90	15.60	14.85	14.85	14.80	16.50	16.20	19.20	18.80	18.50	19.00	20.00	20.80	21.20
3.	14.90	15.40	14.85	14.85	14.80	16.10	16.10	19.20	18.80	18.40	19.00	20.00	20.70	21.10
4.	14.90	15.20	14.85	14.80	14.80	15.95	16.00	19.20	18.80	18.40	19.00	19.90	20.60	21.00
5.	14.80	15.10	14.80	14.80	14.70	15.90	16.00	19.20	18.80	18.40	19.00	19.90	20.60	20.90
6.	14.80	15.00	14.80	14.75	14.70	15.70	16.00	19.20	18.80	18.40	19.00	19.80	20.60	20.80
7.	14.80	14.90	14.75	14.70	14.70	15.30	16.00	19.20	18.80	18.40	19.00	19.60	20.60	20.50
8.	14.80	14.85	14.70	14.70	14.70	14.80	16.00	19.20	18.80	18.30	19.00	19.50	20.60	20.30
9.	14.80	14.70	14.65	14.65	14.70	14.80	16.00	19.20	18.80	18.30	19.00	19.30	20.30	19.30
10.	14.80	14.65	14.60	14.60	14.70	14.75	16.00	19.00	18.70	18.30	19.00	19.10	20.00	19.00
11.	14.60	14.60	14.50	14.60	14.70	14.60	15.90	19.00	18.70	18.30	19.00	19.00	19.70	18.90
12.	14.40	14.40	14.50	14.40	14.60	14.50	15.80	19.00	18.60	18.30	19.00	19.00	19.15	18.80
13.	14.30	14.30	14.40	14.30	14.50	14.30	15.80	18.80	18.50	18.30	18.90	18.80	19.00	18.60
14.	14.20	14.20	14.35	14.25	14.40	14.10	15.50	18.70	18.40	18.30	18.90	18.70	18.90	18.50
15.	14.10	14.15	14.30	14.25	14.20	14.00	15.40	18.50	18.40	18.20	18.90	18.70	18.70	18.40
16.		14.05	14.10	14.10	14.10	13.80	15.30	18.50	18.30	18.10	18.70	18.60	18.60	18.30
17.		13.90	13.80	14.09	14.10	13.70	14.90	18.40	18.00	18.10	18.60	18.50	18.50	18.00
18.		13.90	13.70	14.05	14.10	13.50	14.60	18.30	17.50	17.95	18.50	18.40	18.30	17.80
19.		13.70	13.60	13.82	14.00	13.30	14.50	18.20	17.40	17.80	18.00	18.30	18.10	17.60
20.		13.50	13.50	13.70	14.00	13.00	14.20	18.00	16.60	17.30	17.50	18.20	17.60	17.40
21.			13.30	13.50	13.80	13.00	14.10	17.80	16.00	17.00	17.00	17.70	17.30	17.00
22.			13.20	13.45	13.60	12.90	14.00	17.50	15.60	15.50	16.00	16.00	16.80	16.80
23.		13.10	13.10	13.30	13.50	12.80	13.80	17.40	15.50	15.20	15.30	15.50	16.30	15.90
24.			13.00	13.25	13.40		13.50	17.20	15.00	15.00	15.20	15.30	15.80	15.50
25.			12.90	13.00	13.20	hot all day	13.35	June 24-30	14.80	14.80	15.00	15.00	15.30	15.00
26.			12.85	12.85	13.10	June 19	13.20	very windy	14.70	14.30	14.70	14.90	15.10	14.60
27.			12.80	12.80	13.05		13.20		14.50	14.10	14.50	14.60	15.00	14.40
28.			12.70	12.75	13.00		13.10		14.20	14.10	14.20	14.30	14.90	14.30
29.			12.70	12.75	12.90		13.00		July 2-4	After cool	14.20	14.25	14.75	14.20
30.			12.60	12.70	12.80		12.90		windy	night	July 7	14.20	14.70	
31.			12.60				June 21-22				windy	July 9	July 12-13	
32.			12.60				very windy					windy	windy	
33.			12.60											
34.			12.60											
35.			12.50											

TABLE 13. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

1927	July							Aug.							
Date	19	23	25	26	28	29	30	2	3	5	9	12	15	17	23
Time	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	8:00a	2:00p
Air °C.	26.00	18.00	28.00	26.00	28.00	26.00	17.50	20.00	20.00	28.00	22.50	24.00	22.00	20.00	18.30
Wind	E.	S.W.	N.W.	W.	N.	E.	S.E.	S.E.	W.	S.	S.E.		S.	S.W.	N.E.
Veloc.	434	548	110	420	200	Calm	905	Calm	762	820	Calm	Flat	1004	262	770
Sky	Clear	Clear	Clear	Clear	P.C.	P.C.	Cloudy	P.C.	P.C.	P.C.	Clear	Clear	P.C.	P.C.	Clear
Bar.	28.67	28.72	28.52	28.50	28.50	28.60	28.48	28.72	28.60	28.52	28.73	28.39	28.65	28.43	28.80
Surf.	20.90	20.80	21.80	22.20	23.30	22.30	22.00	21.10	21.10	20.90	21.10	21.90	21.20	20.80	18.55
1. m.	20.90	20 80	21.80	22.10	23.10	22.20	22.00	21.10	21.10	20.90	21.10	21.80	21.20	20.80	18.55
2.	20.90	20.80	21.70	22.00	23.00	22.20	22.00	21.10	21.10	20.90	21.10	21.60	21.20	20.80	18.55
3.	20.90	20.80	21.70	21.70	22.80	22.20	22.00	21.10	21.00	20.90	21.10	21.60	21.20	20.80	18.50
4.	20.90	20.80	21.60	21.50	22.50	22.20	22.00	21.10	21.00	20.90	21.10	21.60	21.20	20.80	18.50
5.	20.90	20.80	21.40	21.30	22.20	22.10	22.00	21.00	20.90	20.90	21.10	21.50	21.00	20.80	18.40
6.	20.80	20.80	21.20	21.20	22.00	22.10	21.80	21.00	20.90	20.90	21.10	21.50	20.90	20.80	18.35
7.	20.80	20.70	21.00	21.00	21.70	22.00	21.80	21.00	20.80	20.80	21.10	21.50	20.90	20.80	18.35
8.	20.80	20.60	20.90	20.70	21.50	21.80	21.80	21.00	20.80	20.70	21.00	21.40	20.80	20.80	18.35
9.	20.60	20.50	20.90	20.60	21.40	21.60	21.50	20.90	20.70	20.60	21.00	21.40	20.80	20.70	18.40
10.	20.50	20.40	20.60	20.50	21.00	21.60	20.90	20.90	20.70	20.50	21.00	21.30	20.60	20.70	18.40
11.	19.80	20.30	20.50	20.30	20.50	20.90	20.30	20.70	20.50	20.30	21.00	21.20	20.50	20.70	18.40
12.	19.10	20.20	20.30	20.00	20.10	20.30	19.80	20.40	19.80	20.20	21.00	21.10	20.50	20.70	18.40
13.	18.90	19.30	20.10	19.60	20.00	20.00	19.30	20.00	19.50	20.00	20.80	20.80	20.40	20.60	18.40
14.	18.50	19.10	19.70	19.30	19.80	19.50	19.10	19.20	19.30	19.50	20.60	20.70	20.20	20.50	18.35
15.	18.40	18.70	19.30	19.00	19.30	19.20	19.00	19.00	19.00	19.00	19.70	20.50	20.20	20.40	18.30
16.	18.30	18.30	19.00	18.65	19.00	18.80	18.60	18.60	18.50	18.90	19.50	20.10	19.70	20.30	18.25
17.	18.10	18.10	18.50	18.30	18.80	18.20	18.40	18.30	18.40	18.50	19.30	19.80	19.50	19.50	18.15
18.	17.80	17.90	18.10	18.10	18.40	18.10	18.00	18.00	18.10	18.30	18.60	19.50	19.30	18.90	18.05
19.	17.55	17.60	17.90	17.90	18.30	17.90	17.90	17.70	17.70	18.00	18.40	19.00	18.70	18.40	17.90
20.	17.30	17.40	17.60	17.60	17.10	17.60	17.90	17.50	17.40	17.90	18.10	18.60	18.50	18.10	17.50
21.	17.20	17.10	17.40	17.20	17.00	17.30	17.20	17.20	17.30	17.30	18.00	18.20	18.00	17.70	17.35
22.	16.60	16.80	17.00	16.90	16.90	17.00	17.00	16.90	17.10	17.10	17.90	18.00	17.70	17.20	17.20
23.	16.40	16.50	16.65	16.50	16.80	16.70	16.40	16.50	17.00	16.80	17.50	17.60	17.30	17.00	17.10
24.	16.10	16.10	16.30	16.20	16.60	16.30	16.10	16.10	16.00	16.60	17.20	17.30	17.00	16.60	16.15
25.	15.90	15.60	15.80	15.70	16.40	16.00	15.60	15.50	15.50	16.20	17.00	16.90	16.60	16.40	15.70
26.	15.00	15.30	15.40	15.20	16.00	15.50	15.40	15.00	15.10	15.60	16.50	16.50	16.20	15.60	15.20
27.	14.80	14.70	15.10	14.80	15.50	15.20	15.10	14.70	14.80	15.40	16.10	16.30	15.80	15.50	14.85
28.	14.50	14.60	14.90	14.70	15.30	15.08	15.00	14.60	14.60	14.90	15.40	16.10	15.40	15.40	14.40
29.	14.35	14.50	14.80	14.70	15.30	15.00	14.90	14.60	14.50	14.80	15.10	16.00	15.20	15.30	14.15
30.	14.30	July 20-22		14.60	15.00	15.00	14.80	14.50	14.50	14.70	15.00	16.00	15.00	15.20	14.10
31.	July 16	Windy			July 27										
32.	Rain				Windy										
33.	July 18														
34.	Windy														
35.								14.40		14.40	14.90				13.90

TABLE 14. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

Depth	Temp. C.	(T-4) RT Calories July 25, 1923	RTZ (1-D) Work July 25, 1923	1-D	July 25 Dm-Dn 8 1923	Aug. 7 Dm-Dn 8 1924	July 25 Dm-Dn 8 1925	Aug. 9 Dm-Dn 8 1926	Dm-Dn 8 1927	RT	RTZ
0	26.23	2178.54	15.89	.003244	0.75	5.80		28.80	3.00	98	49
0-1											
1	2618	2087.	45.65	.003238	3.75		1.25	7.10	5.62	94	141
1-2											
2	26.06	1963.	71.22	.003208	11.00	3.00		1.25		89	222
2-3											
3	25.73	1825.	92.73	.003120	5.12	1.25	0.75	3.00		84	294
3-4											
4	25.58	1726.	110.84	.003079	3.25	4.38		3.00	2.98	80	360
4-5											
5	25.48	1611.0	125.78	.003053		4.00		1.25		75	412
5-6											
6	25.48	1504.	138.91	.003053		3.00		2.40		70	455
6-7											
7	25.48	1396.	148.99	.003053	2.62	1.68		1.13	3.00	65	488
7-8											
8	24.40	1224.	154.53	.003032	117.50	4.00		1.12		60	510
8-9											
9	21.50	962.	109.15	.002091	51.75	3.00	0.50	1.25	2.98	55	522
9-10											
10	19.55	793.	89.71	.001678	11.25				2.98	51	535
10-11											
11	19.10	695.	84.00	.001588	59.80	1.68	0.75	5.00	2.98	46	529
11-12											
12	16.49	537.	59.60	.001110	27.50	3.00		4.40	8.18	43	537
12-13											
13	15.11	444.	48.06	.000890	32.00	10.88	0.88	1.75	2.65	40	540
13-14											
14	13.30	344.	33.98	.000634	14.00	65.40	2.30	8.38	5.38	37	536
14-15											
15	12.40	277.	26.68	.000522	11.28	22.50		8.00	10.50	33	511
16	11.60	228.	21.33	.000431	3.40	14.38	8.00	18.75	7.63	30	495
17	11.35	208.	19.07	.000404	3.13	9.10	40.50	14.50	7.63	27	472
18	11.10	170.	16.67	.000378	2.50	10.68	2.40	12.35	12.50	24	444

Table 14. Temperature, calories of heat absorbed, the work in transporting the heat to the several layers, the loss in density of the water in the various layers, and the resistance to mixture for July 25, 1923. The other columns show the resistance to mixture for typical days in 1924, 1925, 1926 and 1927.

TABLE 15. TEMPERATURE READINGS AND METEOROLOGICAL DATA.

A					B Epilimnion			C Thermocline				D Hypolimnion					E	
Date	Depth meters	Surf. T.°C.	Bottom T.°C.	Fall of	Thickness meters	Fall of T.°C.	Fall per meter	Thickness meters	Fall of T.°C.	Fall per meter	Temp. at bottom	Thickness meters	Fall of Temp.	Fall per meter	Total depth	Δ T.°C.	Mean T.°C.	Calories meters
8-3-22	20	26.00	14.10	11.90	14	5.60	0.32	6	6.00	1.00	14.50	5	1.00	0.20	25	12.90	21.46	21475.8
8-10-22	20	21.75	14.00	6.25	14	1.72	0.12	8	7.08	0.88	13.15	5	0.48	0.09	27	8.98	20.49	20382.7
8-19-22	20	23.20	15.50	7.70	17	2.70	0.16	8	7.00	0.87	13.50	10	0.70	0.07	35	10.40	21.55	21586.5
6-16-23	8	23.20	18.60	4.60														
6-27-23	20	20.50	10.10	10.40	11	0.15	0.01	4	9.05	2.26	11.30	4	1.20	0.30	20	10.40	18.45	17125.0
7-6-23	20	21.50	10.20	11.30	8	0.95	0.12	8	9.45	1.19		4	0.90	0.22	....	....	17.92	15437.
7-13-23	20	25.48	11.10	14.38	6	0.48	0.08	9	12.20	1.35	12.80	14	2.20	0.15	28	14.88	20.88	20762.
7-20-23	20	24.98	11.00	13.98	8	1.18	0.17	6	10.80	1.80	13.00	17	1.80	0.10	30	14.78	20.21	19938.
7-27-23	20	24.30	11.35	12.95	11	0.15	0.01	6	12.15	2.02	12.00	13	2.20	0.08	40	14.50	20.30	20149.
8-3-23	20	23.00	11.20	11.80	10	1.25	0.12	6	6.10	1.01	12.60	18	1.50	0.08	35	12.90	19.55	191.26
8-9-23	20	21.13	10.80	10.33	10	0.67	0.07	7	8.05	1.12	11.70	20	2.40	0.12	37	11.83	19.49	19052.
8-14-23	20	25.48	12.10	13.38	11	2.59	0.23	6	10.29	1.71	12.60	18	1.80	0.10	35	14.68	20.52	20369.
8-22-23	20	21.57	11.60	9.97	13			5	9.27	1.85	12.30	19	1.30	0.07	37	11.57	19.60	19188.
6-4-24	18	13.70	9.40	4.30	6	0.50	0.08	2	2.75	1.32	10.65	9	1.25	0.14	....	....	10.68	6667.
6-12-24	20	14.90	11.30	3.60	7	2.00	0.29	2	1.10	0.55	11.80	15	1.60	0.10	25	3.80	13.19	11304.
6-19-24	20	16.60	13.25	3.35	9	1.00	0.11	2	1.00	0.50	14.60	28	5.00	0.18	40	5.00	14.44	12841.
6-26-24	20	18.65	12.35	6.30	10	1.45	0.14	2	2.40	1.20	14.80	27	3.20	0.12	39	7.05	17.05	16051.
7-3-24	20	18.70	12.05	6.65	10	0.70	0.07	2	1.60	0.80	15.20	18	4.60	0.26	30	7.50	16.53	15412.
7-10-24	20	19.55	12.15	7.40	11	0.95	0.09	4	4.60	1.15	14.60	24	3.95	3.25	38	8.90	17.53	16642.
7-17-24	20	19.90	13.50	6.40	12	1.10	0.09	5	4.80	0.96	14.00	7	2.20	0.31	25	8.80	18.01	17252.
7-24-24	20	20.40	13.30	7.10	14	1.60	0.11	5	6.30	1.26	13.50	11	2.25	0.20	30	9.15	18.69	18069.
7-31-24	20	20.90	11.00	9.90	11	1.45	0.14	6	6.70	1.11	12.75	18	3.25	0.26	35	12.10	18.38	17687.
8-7-24	20	22.40	14.10	8.30	14	1.60	0.11	6	6.70	1.11	14.10	20	4.00	0.16	40	11.55	20.27	20012.
8-13-24	20	19.70	10.99	8.71	13	1.40	0.10	6	7.10	1.18	11.20	16	3.00	0.19	35	11.50	17.57	16691.
8-19-24	20	18.10	10.90	7.20	16	1.25	0.09	4	5.95	1.49	10.90	12	0.95	0.08	32	8.15	16.65	15559.
6-15-25	20	14.30	10.20	4.10	25	4.30	0.19	....	....	....	....	....	....	....	25	4.30	12.62	10603.
6-20-25	20	17.60	13.20	4.40	6	0.60	0.10	3	1.90	0.63	15.10	15	2.20	0.15	25	4.70	15.49	14133.
6-27-25	20	17.60	13.70	3.90	15	1.80	0.12	3	2.00	0.66	14.50	13	2.40	0.19	30	5.60	16.46	15326.
7-25-25	20	21.70	17.50	4.20	13	0.17	0.01	2	1.80	0.90	19.40	24	3.70	0.15	30	6.00	20.72	20566.
7-31-25	20	20.60	18.20	2.40	17	0.20	0.01	1	1.80	1.80	18.60	10	3.00	0.30	30	5.10	19.95	19618.
8-7-25	20	20.80	18.30	2.50	18	1.60	0.09	1	0.70	0.70	18.50	10	3.00	0.30	35	5.30	19.97	19643.
8-14-25	20	20.75	18.00	2.75	18	1.75		....	....	....	....	....	....	....	30	5.34	19.91	19569.
8-20-25	20	21.20	18.80	2.40	....	....	....	....	....	....	....	....	....	....	30	5.40	20.31	20071.
6-16-26	20	16.00	15.19	0.81	....	....	....	....	....	....	....	....	....	....	....	....	15.30	13899.
6-23-26	20	16.40	15.10	1.40	....	....	....	....	....	....	....	....	....	....	....	....	15.34	13948.
6-30-26	20	18.60	15.20	3.30	....	....	....	....	....	....	....	....	....	....	....	....	16.00	14760.
7-6-26	20	19.50	14.55	4.95	6	0.50	0.08	4	4.25	1.06	15.75	20	2.80	0.14	29	6.55	15.77	14477.
7-13-26	20	20.10	16.30	3.80	30	5.50	0.18	....	....	....	....	....	....	....	30	5.50	17.90	17097.
7-20-26	20	22.20	15.70	6.50	11	1.10	0.10	1	1.80	1.80	18.30	14	3.60	0.26	25	7.50	17.90	17097.
7-27-26	20	18.90	15.70	3.20	16	1.10	0.07	1	1.10	1.10	16.70	18	2.90	0.16	35	6.50	16.20	15006.
8-3-26	20	18.90	13.90	5.00	15	2.10	0.14	2	2.90	1.45	14.90	13	2.70	0.20	30	6.70	16.27	15526.
8-9-26	20	22.55	16.50	6.05	15	2.80	0.18	4	2.95	0.74	16.95	14	2.45	0.17	33	8.05	20.24	19976.

8-16-26	20	20.90	18.10	2.80	20	2.90	0.14	1	0.80	0.80	18.10	10	3.10	0.31	30	5.90	....	....
6-13-27	20	15.50	13.15	2.35	30			..	.. ....	.. ....	....	....	.. ....	.. ....	30	2.35	....	....
6-18-27	20	15.00	14.00	1.00	30	2.20	0.07	..	.. ....	.. ....	....	....	.. ....	.. ....	30	2.20	....	....
6-23-27	20	16.20	14.20	2.00	30	3.30	0.11	..	.. ....	.. ....	....	....	.. ....	.. ....	30	3.30	....	....
7-5-27	20	18.80	17.40	1.40	30	4.60	0.15	..	.. ....	.. ....	....	....	.. ....	.. ....	30	4.60	....	....
7-11-27	20	21.20	18.20	3.00	21	3.50	0.17	1	1.70	1.70	16.00	7	1.80	0.26	30	7.00	....	....
7-19-27	20	20.90	17.30	3.60	25	5.00	0.20	1	0.90	0.90	15.00	3	1.60	0.53	30	6.60	....	....
7-26-27	20	22.20	17.60	4.60	30	7.60	0.25	..	.. ....	.. ....	....	....	.. ....	.. ....	30	7.60	....	....
8-2-27	20	21.10	17.50	3.60	30	6.60	0.22	..	.. ....	.. ....	....	....	.. ....	.. ....	30	6.60	....	....
8-9-27	20	21.10	18.10	2.00	30	6.10	0.20	..	.. ....	.. ....	....	....	.. ....	.. ....	30	6.10	....	....
8-15-27	20	21.20	18.50	2.70	30	6.20	0.20	..	.. ....	.. ....	....	....	.. ....	.. ....	30	6.20	....	....
8-23-27	20	18.55	17.50	1.05	23	1.45	0.07	1	0.95	0.95	16.15	5	2.05	0.41	30	4.45	....	....

Table 15. Showing difference in temperature of various layers. Section A. Temperature of the first twenty meters, showing date, surface temperature, bottom temperature of the zone; fall of temperature.

Section B. Temperature of the epilimnion, showing its thickness, fall of temperature, fall per meter and temperature at bottom of epilimnion.

Section C. Temperature of thermocline, when present, showing total fall of temperature in thermocline, fall of temperature per meter, and temperature at bottom of thermocline.

Section D. Temperature of hypolimnion, when present, showing thickness, total fall of temperature, and fall per meter.

Section E. Shows total depth of water measured; difference in temperature between surface and total depth measured; mean temperature of lake, and calories of heat absorbed.