

SOME SOIL AND WATER REACTIONS IN THE DUNES REGION OF PORTER COUNTY.

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During a two weeks' stay, October 21 to November 4, 1923, at the dunes of Porter County, devoted mainly to collecting small mammals, I made a number of hydrogen ion concentration determinations of the soil and water in the regions opposite Tremont and Mineral Springs, stations of the Chicago, Lake Shore and South Bend Railway. My interest in making the determinations came through knowledge of the value of proper hydrogen ion concentration in bacteriologic work and its still greater importance in our own body fluids, such as blood where the normal range is within the narrow limits, P_H 7.6 to P_H 7.8, specific alkalinities of 3.98 to 6.31. (At P_H 7.5 to P_H 7.2, specific alkalinities of 3.16 to 1.58, the pathologic condition of acidosis ensues and if the lower figure is maintained for any length of time death results.) The existence of two botanically different wooded swamps or swamp-like areas, one opposite each of the railway stations mentioned suggested further interest in the question as a possible explanation of their differences.

The method of making the determinations was that devised by Wherry¹, and use was made of the simple apparatus placed on the market as a "soil indicator set" by the La Motte Chemical Company of Baltimore. I found it desirable to use more test-tubes than accompany the set. The results of each determination were reached by observing the color changes of at least three indicators rather than by basing them on the specific color changes of one.

The chief aim was to determine whether there were any average differences in the soil and water acidities of the two wooded swamps referred to rather than to determine the acidity of the soil of specific plants. The differences in acidity of these two swamps were so slight and almost inconsequential that I determined the acidity of other places in the dunes.

Each of the two wooded swamps seems about equally wet and shaded. The swamp opposite Tremont is slowly traversed by Dune Creek. The conspicuous plants found in it and not found in the Mineral Springs swamp, or at most but sparingly are: *Platanus occidentalis*, *Carpinus caroliniana*, *Asimina trifolia*, *Trillium grandiflorum*, *Trillium sessile*, *Arisaema triphyllum*, *Arisaema dracontium*.

The tamarack swamp opposite Mineral Springs station has practically no drainage although the water in it seems to seep eastward toward the west branch of Dune Creek. The conspicuous plants found in it and apparently not found in the Tremont swamp or at most but sparingly are *Larix laricina*, *Thuja occidentalis*, *Betula papyrifera*,

¹ Wherry, Edgar T., Determining soil acidity and alkalinity by indicators in the field; Journ. Wash. Acad. Sci., Vol. 10, pp. 217-223. 1920.

———, Soil acidity—its nature, measurement and relation to plant distribution; Ann. Rept. Smithsonian Inst., 1920, pp. 247-268, 1922.

Betula lutea, *Toxicodendron vernix*, *Sambucus racemosa*, *Cornus canadensis*, *Coptis trifolia*, *Cypripedium candidum* and *Cypripedium hirsutum*².

These two wooded swamps are about two and a half miles apart. Between them is an unwooded swamp or marsh, in places quite wet where the conspicuous plants are sedges growing in tussocks, *Spiraea tomentosa* *Rosa carolina*, and a few examples of *Habenaria ciliaris* and *Gentiana saponaria*.

Just north of the Mineral Springs swamp is an interdunal pond and meadow called Little Lake³. The striking plants of this wet meadow are *Rhynchospora macrostachya*, *Eriocaulon septangulare*, *Drosera intermedia*, *Rhexia virginica*, *Polygala cruciata* and *Utricularia vulgaris*.

Just south of the Mineral Springs tamarack swamp and continuous with it is a very wet quaking bog. The conspicuous plants in it are various rushes, *Parnassia caroliniana*, *Sarracenia purpurea*, *Oxycoccus macrocarpus*, *Gentiana detonsa*, *Gerardia purpurea*, *Lobelia kalmii* and *Decodon verticillata*.

It was impossible to determine soil and water acidities throughout the entire extent of all these areas, but a few characteristic portions of each were selected and acidities determined in them. In addition to these some determinations were made of the soil of the wooded dunes, of the fore-dune area, of the water of Lake Michigan, of an artesian well and of a pump well.

Acidities of these places are given in the following table expressed in terms of what Wherry calls specific acidity or alkalinity rather than in terms of the P_{H} values. A minus sign is used to indicate alkalinity in the table (Table I). The specific acidity figure gives a better idea of the relative acidities and has the merit of yielding figures of appreciable size. Thus the difference between $P_{H}7$ (neutral) and $P_{H}6$ or $P_{H}8$ appears to the eye as one unit, yet the latter are respectively 10 times more acid or more alkaline than the former.

TABLE I. AVERAGE SPECIFIC ACIDITIES OF SOIL AND WATER IN DUNES REGION OF PORTER COUNTY.

Lake Michigan	—10
Artesian well, opposite Tremont, near Prairie Club Trail.....	—10
Pump well at Drive-Inn Cottage, Waverly Beach.....	10
The same water after boiling.....	—10

² As *Betula papyrifera*, *Thuja occidentalis* and *Cornus canadensis* in this swamp are close to their southern limits in this general region and are essentially northern plants a number of temperature readings of the soil were made on July 22, 1923, to see whether there were any local differences in temperature between the Tremont and the Mineral Springs swamps. The readings were made with a centigrade chemical thermometer about a foot long and inserted into the soil its entire length. The results of these readings showed a soil temperature in each swamp of about 18° C. Possibly the readings should have been taken at greater depth and have been made on a series of days. Those obtained were all made on one day, in the Tremont swamp earlier in day than in the Mineral Springs swamp which botanically should have been the cooler. The air temperature in the shade at 11 A. M. was 29° C. and at 3 P. M. 26° C.

³ Rand McNally's Map of Indiana Dunes by P. S. Goodman.

Dune Creek, near Waverly Beach.....	1
Opposite Tremont	1
At an intermedite point.....	1
A small south tributary opposite Tremont.....	—10
Fore-dune region (<i>Calamovilfa longifolia</i> , <i>Prunus pumila</i>)....	—7.7
Wooded dune, exposed sand.....	1
Average of several places covered with vegetation....	6
<i>Arctostaphylos uvaursi</i> patches, usually.....	3.16
Wooded swamp of Dune Creek, opposite Tremont.....	1
Wooded tamarack swamp, opposite Mineral Springs.....	4
East end of same amid <i>Salix amygdaloides</i>	7.7
Open swamp between the two preceding wooded swamps.....	30
Quaking bog, south edge of tamarack swamp.....	1.4
Boggy meadow, south end of Little Lake (<i>Drosera inter-</i> <i>media</i> , etc.)	83
Water in a "pitcher" from each of four different specimens of	—10 — 3.16 1 3.16 }
<i>Sarracenia purpurea</i>	

Essentially the same phenomenon illustrated by the difference of plus 10 to minus 10 in the case of the raw and boiled water of the pump well was noticed in preparing the distilled water used in mixing with the soils for making P_H determinations. The water distilled was from the city water supply of South Bend and issuing from the still is P_H6 . Boiling this distilled water renders it P_H7 . In the distilled water and in the water of the pump well the acidity is evidently due to presence of CO_2 .

The extreme variations seen in the water of "pitchers" of pitcher plants, $P_H6.5$ to P_H8 , may perhaps be accounted for, in part at least, by the activities of mosquito larvae living in them or by an ammonical decomposition of dead larvae. All four of the "pitchers" seemed to contain about the same number of living mosquito larvae.

The difference in specific acidity between the wooded swamp of Dune Creek opposite Tremont and the tamarack swamp opposite Mineral Springs is so small that it is probably an unimportant factor in the botanical differences between them. It is perhaps due to the better drainage of the former than of the latter.

Summary.—The water of Lake Michigan and of an artesian well near it have specific alkalinities of 10. This alkalinity appears to extend into the fore-dune area. Exposed sand of the higher dunes appears to be neutral. The wooded swamp flooded and drained by Dune Creek and Dune Creek itself is essentially neutral. The botanically different tamarack swamp about two and a half miles farther west with no very obvious drainage is slightly acid, specific acidity of about 4. A boggy interdunal meadow, without drainage and with several characteristic plants is distinctly acid, specific acidity of about 80. The soil of wooded dunes where covered with vegetation has a low but distinct specific acidity. There is a correlation between the kinds of plants growing in soils or waters of different P_H values but the differences

in such values do not appear to be as great as the differences between the plants might lead one to expect. The water in "pitchers" of pitcher plants varies from weakly alkaline to weakly acid.

NEW RECORDS OF INDIANA MAMMALS.

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The following new records within the state for Indiana mammals are only such as might be expected and as have been predicted, however the range of two species is extended to the northern boundary of the state and one species will probably be exterminated from the state within the next few years so that it seems worth while to make note of them. With the exception of the coyote the records are based on specimens which have been deposited in the United States National Museum and the National Zoological Park.

Masked Shrew, *Sorex personatus* Geoffroy St. Hilaire. Two specimens from Porter County caught in mouse traps baited with bacon placed in the quaking bog at the south end of the tamarack swamp opposite Mineral Springs Station of the Chicago, Lake Shore and South Bend Railway. They were taken in the last week of October, 1923. The vegetation where the traps were placed consisted of tall rushes, sphagnum, cranberries, pitcher plants, etc. The bog is very wet and when standing in it one's feet are always in an inch or more of water. Traps placed in the drier adjacent wooded swamp yielded only northern white-footed mice. Several specimens of this mouse were also taken in the line of traps which caught the shrews. The nearest previous record in the state appears to be Logansport¹.

Coyote or Prairie Wolf, *Canis latrans* Say. The South Bend Tribune of March 5, 1923, second section, page 1, contained a brief note regarding the St. Joseph County Commissioners having paid a bounty on a wolf. Following up the newspaper's information showed that Messrs. August Buysse and C. Sargent while hunting foxes in the southwestern part of St. Joseph County had followed an animal trailed by their dogs and shot it about ten miles west by south of the city limits of South Bend. It proved to be a female coyote. I had the opportunity of seeing the skin. It is probable that this wolf wandered into St. Joseph County from certain tamarack swamps in the Kankakee Valley, Laporte County where residents say wolves occur. Coyotes have been previously recorded from Laporte County and two specimens from Jasper County are in the United States National Museum¹ killed in 1906. Inquiry at the office of the county treasurer showed that no bounties on wolves had been paid in St. Joseph County, at least in recent years, aside from the present one. Some fox bounties were said to be paid nearly every year.

Jumping Mouse, *Zapus hudsonicus* (Zimmermann). One specimen from Porter County in the large subdunal meadow just south of the

¹ Hahn, Walter Louis, Mammals of Indiana, 33d Ann. Rept. Dept. Geol. Nat. Resources Indiana, 1908.