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The Distribution of Forest Trees in Iowa

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as judge. He rigidly excludes or at least minimizes every particle of evidence in favor of the accused.

In proof of this statement, witness his treatment of cats that do not come up, or rather down, to his expectations, and his naive brushing aside of the testimony of the animal trainers whose evidence is most damaging to his theories. For my own part, I still adhere to the belief that the argument submitted to this body in a former paper*, based on the multitude of homologies between man and the higher mammalia is a sound one, and that if this argument is to be overthrown it must be through careful observations of animals that are not psychologically disabled by starvation and imprisonment in boxes, however ingeniously contrived. And I further protest that the men who have gained their knowledge of animals by direct observation of animals in the field, have still their right to be heard on this question; that their observations demand consideration, and their opinions respect. In short, the old style field naturalist refuses to be ruled out of court by the experimental psychogolist of the new school. He emphatically denies jurisdiction, and appeals to the unbiased verdict of thoughtful men.

THE DISTRIBUTION OF FOREST TREES IN IOWA.

BY B. SHIMEK.

The discussion of the origin of our prairies, and of the distribution of our native forest trees, is as old as our knowledge of the central northwest. The earlier discussions were based on a knowledge of conditions as they existed when the white man first appeared in this section, and, though some of them are crude, and based upon insufficient observation, they fortunately give us at least a partial record of those conditions.

Later observers have the advantage of the results of a vast number of attempts at tree-planting, which have subjected existing conditions to a practical test, and which throw considerable light upon the causes which perpetuated the treeless prairies. From the very nature of the case, however, it is quite as difficult now to exactly distinguish in some cases

* "Do the Lower Animals Reason?" Proceedings Iowa Academy of Sciences, 1897

between cause and effect, or to avoid the substitution of a mere coincidence for a cause, as it was in the days of the earliest observers—in fact, while we now have knowledge of a greater number of possible causes, we are by that very fact exposed to the danger of a greater number of possible misinterpretations of effects. It is, therefore, well for the student of our forest and prairie problems to approach his subject with his mind in a position of receptive neutrality toward the various theories of the origin of prairies which have been advanced, but committed to none of them. For it seems that the chief weakness of the majority of the discussions which have been published thus far, is the fact that they are based, for the most part, upon single causes. It is well to bear in mind that the growth of trees may be prevented or influenced by a variety of causes, and that, therefore, there is at least a strong probability that a combination of these causes produced our prairies. For the prairies are not uniform in topography, nor in character of soil, nor in humidity. We have here in Iowa, prairies upon the flat, comparatively wet, north-central Wisconsin drift plain, and upon the adjacent dry, loess hills of the western part of the state. In fact, so far as their physical features are concerned, these areas agree only in being treeless. And even in more restricted areas differences may be observed. We find one side of a hill treeless, the other clothed with forest. One shore of a lake or stream is skirted with trees, while the other is unobstructed by tree or shrub. Sometimes it is the lowland, and sometimes the adjacent hill, which forms the promising nucleus or the last remnant of a forest. It is, therefore, not wise to assume that one cause alone is responsible for this condition, nor that in every restricted locality the predominating cause, or combination of causes, was the same. It is the purpose of this paper to present a discussion chiefly of a neglected agency which operates against the development of forest trees. In order, however, that it may not seem like another attempt to introduce a single cause explanation, a brief résumé of the causes which have been prominently discussed is here presented.

1. *Fire*.—This stands foremost in prominence among the discussions of the past.* It has no doubt been effective in reducing or checking forests, yet it alone could scarcely have been entirely responsible for our prairies. In the first place we have no proof that fires were sufficiently widespread before the advent of the white man to alone account for the extent of the prairies. Moreover fire-swept groves are by no means always reduced to prairie, but are often soon restored, if indeed they do not remain practically uninjured, the destruction of the underbrush often probably being of advantage to the trees. Nay, groves, even when exposed and of limited extent, have been able to persistently check the advances of prairie fires.† Higher, dry places have frequently suffered less from fires than comparatively wet lowlands, but this may be in part explained by the more scanty vegetation of the former.‡ There are no remains of charred wood, such as we might expect in case of widespread destruction of trees by this means.§

The unequal and interrupted distribution of trees along streams is scarcely consistent with the view that the streams exerted any considerable influence in checking vast conflagrations, and can in fact, be better explained in another manner. However, that fire exerted some influence in the formation of prairies, goes without question. It destroyed seedlings, and in some cases large trees. The location of many groves in the state suggests protection against fires. Such are Ocon grove, in Winnebago county, which is nearly surrounded by swamps; an ash grove on an island in Iowa lake, in Osceola county,|| where all else is prairie, and numerous groves in protected, damp places, especially along streams, in various parts of the state. True, the distribution of many of these groves may be

*See: Am. Jour. Sci. and Arts, Series I, Vol. I, pp. 332-3, 1818; Vol. II, p. 36, 1820; Vol. XXIII, pp. 40-45, 1833; Series II, Vol. XLI, pp. 154 et seq., 1866; C. A. White in Am. Nat., Vol. II, p. 152, 1868; Dr. G. M. Sternberg in Am. Nat., Vol. III, p. 162, 1869; J. A. Allen in Am. Nat., Vol. III, p. 577, 1869; C. A. White, Geol. of Iowa, Vol. I, pp. 131-3, 1870; C. A. White in Am. Nat., Vol. V, p. 63, 1871; T. H. Macbride in the following: Iowa Geol. Sur., Vol. IV, p. 115, 1894; Proc. Iowa Acad. Sci., Vol. III, pp. 96-101, 1896; Iowa Geol. Sur., Vol. IX, pp. 148-9, 1898; Iowa Geol. Sur., Vol. X, advance sheets, p. 4, 1899.

†See: A. Fendler in Am. Jour. of Sci. and Arts, Series II, Vol. XLI, pp. 154, et seq., 1866; T. H. Macbride in Proc. Iowa Acad. Sci., Vol. III, p. 97, 1896.

‡R. W. Wells in Am. Jour. of Sci. and Arts, Series I, Vol. I, p. 333; T. H. Macbride in Proc. Iowa Acad. Sci., l. c., and Iowa Geol. Sur., Vol. IX, pp. 148-9, 1898.

§T. H. Macbride, *ibid.*

|| Reported by T. H. Macbride.

accounted for in the manner suggested by a succeeding portion of this paper, but nevertheless it is not wholly wanting in value as testimony in support of the fire theory.

2. *Excess of Moisture.*—That excess of moisture is destructive to trees has long ago been established, and Lesquereaux, White and others, contended that such excess was primarily responsible for our prairies.*

They argued in substance, that the regions now occupied by prairies were formerly, after the recession of the glaciers, large lakes which gradually became swamps, and then dried, forming prairie which remained comparatively damp, the soil becoming "sour," because of poor drainage. Trees do not prosper in such soils, and this theory may be of value in explaining the absence of trees from portions of the drift plains of north-central Iowa, and from local low tracts, but it is not tenable for the loess hills of western Iowa, nor indeed for the rougher treeless parts of the drift area, such as those in western Lyon county. Excessively wet seasons may also be considered among the conditions unfavorable to the extension of forest areas, while in the same connection the effect of such seasons upon the fungus and insect enemies of trees, should receive consideration.

3. *Insufficient Moisture.*—That the amount of rainfall in Iowa diminishes as we go northwestward is a well-known fact. That the amount of forest varies in somewhat the same manner has also been pointed out,† and may be readily observed by reference to the appended map. The diminution in rainfall naturally produces conditions unfavorable to the growth of trees, and this variation in amount may account for some of the differences between the forest conditions of the northwestern and other portions of the state. It does not, however, account for the differences which we may observe in either of these sections. It does not explain why we have prairie tracts in the eastern part of the state, and groves in the western part, though the fact that the northern and eastern slopes in all parts of the state are more likely to produce groves, because they are more

*Oaleb Atwater, in *Am. Jour. Sci. and Arts*, 1st series, Vol. I, p. 120, 1818; A. Bourne, in same, Vol. II, p. 86, 1820; W. W. McGuire, in same, Vol. XXVI, pp. 93-8; reprint in same, Vol. XXXIII, p. 1839; Henry Engleman, in *Am. Jour. Sci. and Arts*, 2d series, Vol. XXXVI, p. 384, 1863; Alex. Winchell, in same, Vol. XXXVIII, p. 332, 1864; Leo Lesquereaux, in same, Vol. XXXIX, p. 317, and Vol. XL, p. 23, 1865; Jas. D. Dana, in same, Vol. XL, pp. 233 et seq., 1865; O. A. White, in *Am. Nat.*, Vol. II, pp. 143-155, 1868; J. D. Whitney, in *Am. Nat.*, Vol. X, pp. 656 et seq., 1876.

†First Annual Rep. of Iowa Weather Station, p. 50.

moist, the southern and western slopes being drier and hence more subject to fires, together with the fact that trees are more common along streams where evaporation and heavy dews are more abundant, have been urged with some reason in support of the claim that the prairies are due to insufficient moisture. During the growing season a lack of moisture means a lack of food, and should prolonged winters, and long hot summers alternate, the growing period becomes short, and during the dry season the vitality of the tree is further diminished by excessive transpiration. Deciduous trees have an advantage over evergreens in the latter case because their transpiring apparatus may be thrown off with the leaves during a dry season.

That dry, cold winters destroy trees has also been shown*, and was amply demonstrated in Iowa last year. But all this does not explain the alternation of prairie and forest in some parts of eastern Iowa where the differences in humidity are slight, or where greater local differences are not accompanied by a corresponding variation in tree-growth, nor does it explain why the bluffs on the Nebraska side of the Missouri river are clothed with forests, while those on the Iowa side are mostly treeless.†

4. *Temperature.*—Of course no general differences in this respect are noticeable in Iowa, but extremes of heat and cold during different seasons, and especially rapid changes during any one season, may do much injury to trees. For example, in sheltered localities which have a southerly exposure trees bud earlier and are often injured by frosts. This cause is sufficient to prevent the cultivation of trees in many such localities, and the same cause no doubt operated against the development of native groves.

That temperature alone is not sufficient to explain the peculiar distribution of forest and prairie is, however, evident.

*Thos. Meehan in *Am. Nat.*, Vol. VII, p. 234, 1873; Aven Nelson, *Bulletin* 15, *Wyo. Exp. Sta.*, 1893.

†This is true at least south of Omaha and Council Bluffs. The Nebraska side, north of Omaha, was not examined.

5. *Geological formations and soils.*—To the superficial geological formations and soils have been attributed various influences upon the development of forests and prairies.*

Some of the earlier observers reported that the loess was unfit for the growth of trees, but McGee showed, and now everyone recognizes, that in northeastern Iowa it is the tree-producing formation, while the drift is almost treeless. But the loess of the western part of the state is largely treeless, while groves are found on the drift in Worth, Winnebago, Dickinson, and other counties of the state. In the latter, however, there is always a thin veneer of fine loess-like soil.†

Moreover, alluvium everywhere may or may not produce native trees. It is, therefore, evident that while the fineness and quality of the soil no doubt influence the growth of trees, the particular geological formation or soil does not uniformly determine such growth. It may, however, produce some effect by developing upon different soils unequal quantities of fuel for destructive fires.‡

The foregoing are the most common causes and conditions which have been cited in explanation of the prairie phenomena. There remains one more which has thus far received rather scant notice,§ but which deserves a high rank, namely: wind. The effect of wind upon trees may be twofold—mechanical and physiological. The first is produced by breaking branches or even trunks of trees; by stripping or injuring foliage, by driving sand and dust against the more delicate tissues, into the stomata, etc., and by spreading fires. It was evidently this that Whitney had in mind when he wrote:¶ “If the force of the wind were essentially inimical to the growth of trees, we should find them thriving, if anywhere, in the sheltered nooks, and to the leeward of the northwesterners, that being the

*See: J. D. Whitney in Hall's Geology of Iowa, Vol. I, pt. I, p. 24, 1858; in *Am. Nat.*, Vol. X, pp. 577-656, 1876; W. J. McGee in *Proc. Am. A. Ad. Sci.*, Series I, Vol. XXVII, p. 198, 1878; in *Pop. Sci. Mo.*, Vol. XLIX, p. 115, 1883; Thos. J. Howell in *Pop. Sci. Mo.*, Vol. XXIII, pp. 521-2, 1883; W. J. McGee in *Eleventh Annual Rep. U. S. Geol. Sur.*, pp. 296-8, 1891; L. H. Pammel in *Iowa Geol. Sur.*, Vol. V, p. 233, 1895; Thos. H. Macbride in *Proc. Iowa Acad. Sci.*, Vol. III, p. 96, 1896.

†See author's discussion of surface deposits, in *Proc. Iowa Acad. Sci.*, Vol. IV, pp. 69 et. seq., 1897.

‡See: R. W. Wells in *Am. Jour. Sci. and Arts*, Series I, Vol. I, p. 333, 1818; and for more complete discussion, Thos. H. Macbride in *Iowa Geol. Sur.*, Vol. IX, pp. 148-9, 1898.

§ See Dr. Rush Nutt in *Am. Jour. Sci. and Arts*, series I, Vol. XXIII, pp. 40-45, 1833; paper read by Prof. H. H. McAfee, before the *Am. For. Ass'n* at Philadelphia, Sept., 1876; *Rep. of U. S. Dep't Agri. for 1889*, p. 276; *Rep. of Chief of Div. of For. for 1891*, p. 207; *Bull. Div. of For.*, 1893, p. 119.

¶ *Am. Nat.*, Vol. X, p. 582, 1876.

quarter from which the heaviest blasts come." However, there is little doubt that the physiological consequences far surpass any merely physical effect. Baranetzky* established the fact that shaking a plant increases the amount of transpiration for a short time, but that this soon falls below the normal, the diminution being due to the closing of the stomata. This means that the process of respiration and assimilation are checked, evidently by the temporary shock which the plant has received. If this shaking should be violent and long continued, as in a succession of strong winds, the plant would be weakened, and in the end probably destroyed. The most exposed trees would, of course, be in the greatest danger—hence those upon exposed hilltops, or upon the windward side of a hill, or upon open flat country.

The winds which would produce the greatest effect are naturally those which prevail during the spring and summer, when the leaves are in full vigor. Winter winds could have almost no effect of this kind, as the trees are then inactive. The prevailing summer winds in practically all of Iowa are south-westerly, and they increase in vigor and in frequency as we go westward in the state. It, therefore, follows that trees on flat areas or on southerly and westerly slopes are most exposed to these winds, and that danger to trees from them increases as we go westward. It is further true that these winds are frequent during the growing period in later spring when transpiration is greatest and most essential, and that in summer, especially westward, they are commonly hot blasts which weaken or destroy the guard cells, thus producing excessive evaporation and leaving the plant in a weakened condition with less energy for the initial growth of the following season. Moreover, such winds modify the humidity and temperature of the air and soil in a marked degree, and thus produce a direct

Viewed in the light of these facts the distribution of forests in Iowa becomes more intelligible. The accompanying map shows that the region south and east of the Wisconsin lobe is most heavily timbered, while the flat drift basin and the region west of it are almost treeless. Most of the streams in the eastern part of the state have a southeasterly course, and run for the most part in rather deep or at least distinct valleys. The effect on the physiological activity of the plant.

* Bot. Zeitung for 1872, p. 82.

southwesterly summer winds, therefore, sweep over this part of the state almost at right angles to the river valleys. Hence the valleys are protected, and this, coupled with a greater rainfall, gives to this part of the state a decided advantage as a tree producer.

In the Wisconsin drift area most of the streams also flow in a southeasterly direction, and where they have cut deeper valleys they are freely bordered with timber,* but where no valleys have been cut the shores and the adjacent plains are almost without exception entirely treeless.†

In the western part of the state the streams flow in a southwesterly direction, and the southwest summer winds, here more violent than eastward, sweep them with full force, and pass unhindered to the flat Wisconsin drift area beyond, which offers practically no obstacles to their progress. And in both these latter regions there are comparatively few trees, and these are mostly stunted, except where a bend in the valley, or a deep lateral ravine affords protection. In this western part of the state the groves are not on the hilltops, but nestle in ravines or on slopes which are on the leeward, north and east side. Even where there are larger tracts of timber, as for example above Hamburg, in Fremont county, and in and near Fairmount park, in Council Bluffs, they are not along the bluffs which face the Missouri river on the Iowa side, but are in the ravines and valleys or on the slopes which lie east of the ridges which form the river bluffs. The Missouri river flows nearly south, and its valley is so broad that the windward, or Iowa, bluffs are fully exposed to the southwest winds and are treeless, while the opposite protected leeward bluffs of the Nebraska side are for the most part quite heavily timbered. The bur oak which frequently forms the greater part of these western groves, also gives interesting testimony. As generally found in that part of the state it is small and stunted, not more than a foot or two in height, at or near the tops of the ridges, but commonly gradually increases in size down the leeward slopes, the better sheltered trees being much larger.‡ It is claimed by some that the small, stunted oaks near the tops of the ridges owe their small size to the fires which annually burned the

*As along the Des Moines river in Boone county and northward.

†As along the upper courses of the forks of the Des Moines river, and along most of the smaller streams in the Wisconsin drift area.

‡Examples are common in Crawford and Carroll counties, and in most of the Missouri river and Big Sioux river counties to the northwestern corner of the state.

stems, leaving only the bench-roots, but in many places, for example in Crawford and other counties, these little oaks have now been unmolested by fires for quite a number of years, yet they have not grown appreciably in exposed situations. The stunted condition of the plants is probably due chiefly to the action of winds. In their efforts to resist the strong, and often hot and dry winds, the plants fortify themselves by producing thicker walled cells, and stronger layers of cutin, thus turning some of their energy aside for this purpose, with the result that their general vigor is diminished, and if they survive they remain dwarfed.

All this suggests, too, that trees are found along our eastern streams largely because they are protected against summer winds, and not so much because there is more moisture in such situations.

The isolated groves of the state are almost invariably, at least in part, upon some knoll or ridge where they were able to gain a foothold and to maintain themselves because sheltered from the southwest winds,* wherever there are elevations which offer such protection, whether upon the otherwise flat drift areas, or in the regions covered by loess, there groves are likely to appear.

In further corroborative testimony it may be noted that the efforts at tree planting in the western part of the state are not always successful. Groves do not flourish except where protected. Walnut, ash, etc., do well in sheltered places or in thickets, but if grown in rows or singly in exposed places they soon die.†

That fruit trees and smaller plants are benefited by a protecting wind-break, has long been known to the farmers of the prairies. That our forest trees are equally benefited by such protection is undoubtedly true. It has been noted "that a tree will die, where a forest will live."‡

Numerous instances might be cited from the author's own observations in northwestern Iowa, in which trees planted in single rows have failed, while upon the same tract, with the same soil, the same species have flourished when grouped in

*Such are Ooon Grove in Winnebago county, small prairie groves in most of the northwestern counties, the vicinity of Pilot Mound in Winnebago county, the groves along the Des Moines river in Emmet county, etc.

† The cottonwood is an exception, as it grows better when not in groves, and is therefore, superior in some places for wind-breaks.

‡ Report of the U. S. Dep't of Agri., for 1889, p. 276.

larger groves in which the trees furnish mutual protection. In the latter cases the border trees, especially on the west, are frequently stunted and generally lacking in vigor; cottonwoods, however, usually being an exception. In many localities in that section of the state, rows or narrow bands of trees of some extent, which cross elevations and depressions, well illustrate the effect of winds. On the windward slopes, and the tops of the ridges, the lines and bands are interrupted, the trees being smaller or entirely extinct, while the most vigorous trees are found in the lee of the south-westerners. Yet a larger number of trees planted to form a grove will often thrive, even on the hilltops. It is also a well known fact that individual trees, or small parts of groves, which are mere remnants of larger groves upon higher or more exposed grounds, soon perish after isolation by the destruction of their companions.

To summarize briefly, wind must be regarded as one of the most of the important agencies which are concerned in Iowa in checking tree growth, for the following reasons:

1. Winds, especially when violent, or frequent, or hot and dry, affect trees unfavorably, both mechanically and physiologically.

2. During the season of the year when the physiological effect would be most keenly felt, the prevailing winds in Iowa are southwesterly, and being commonly both hot and dry, they are especially injurious to trees.

3. The distribution of our native forests is in harmony with the character and direction of the winds, taken in conjunction with the topography and direction of the river valleys.

4. The experiences of those who have planted trees, especially in the western part of the state, testify to the power of wind as a restraining factor of tree growth.

5. Wind is one of the most general of the agencies which are held to account for the development of prairies, both in frequency of occurrence and in the extent of the area over which it may operate, and hence, would produce substantially the same effect in kind, though not necessarily in degree, over large areas.

It must not be assumed, however, that individual localities may not furnish seeming contradictions, for the various agencies which have been discussed will affect the problem, more or less, locally. The differences between the eastern

and western parts of the state are, however, more general. The greater scarcity of timber in the west is in all probability due chiefly to the stronger, hotter and drier winds, to the southwest course of the river valleys, whose bluffs, therefore, offer but little shelter to trees, and to lesser rainfall. That wind, however, is primarily responsible is shown by the difference between the Iowa and Nebraska bluffs along the Missouri river. These bluffs have substantially the same amount of rainfall, etc., but differ in exposure to the southwest winds.

That artificial groves often survive, and even thrive, on the prairies is due to the care which they receive. Cultivation, replanting, general care, and massing in groves often improve the conditions to such a degree that the unfavorable influence of wind is counterbalanced. But neglected groves, when exposed, soon deteriorate, and finally perish.

* * * * *

Incidentally, an application of this view of wind action may be made to another question of interest. It has already been noted that in eastern Iowa the forests are chiefly on loess which here mantles the hills with nearly uniform thickness. It was, therefore, assumed, that trees found loess especially suitable to their growth. However, in western Iowa the loess hills, covered more irregularly with a much thicker deposit, are in large part devoid of trees, while on the other hand drift ridges often have more or less timber.*

It is noticeable, however, that in the drift area where groves have gained a foothold a thin veneer of loess-like material, varying from one to two feet in thickness, is found. This is true even of the scrub oak groves on the northeast slopes of the drift hills in western Lyon county,—a fine soil occurring in the groves, while on the south and west the ridges are gravelly at the surface and treeless.†

It would seem then that the mere presence of loess does not insure abundant native timber, and that trees may gain a foothold upon drift. In fact the drift-covered area is often capable of sustaining a remarkable growth of trees, the artificial groves near Sibley being a fine example. Some years ago the author suggested‡ that the loess instead of causing or favoring growth of timber, is rather a wind deposit collected

* As near Forest City, at Clear Lake, etc.

† See the author's discussion of surface deposits already noted.

‡ Proc. Iowa Acad. Sci., Vol. III, pp. 82-89, 1896.

in the protecting shelter of forests, the forest preceding the deposition of loess. Subsequent observations have only strengthened this belief, with some modifications.

It must be borne in mind that whatever work of this kind can be done by forests may also be done by smaller vegetation, but perhaps in different degree. If forests could collect and retain dust, prairie grasses and shrubs could do the same, and if the supply of material was greater, might even accomplish more. It is therefore not necessary to assume that all the region now covered by the loess was at one time a forest area, though evidences suggesting this for one locality at least, may be found in the vicinity of Council Bluffs.*

The thickets of *Symphoricarpos* and other shrubs, now common in many prairie sections, and, indeed grasses and other herbaceous plants, could to some extent operate in the same manner, though the deposit would probably be subject to greater variation in amount and distribution. The difference between the loess of eastern and western Iowa suggest something of the kind. It is a well-known fact that the loess of eastern Iowa is finer and more nearly uniform in thickness, which is less, than in the west. The eastern part of the state was (and is) farther removed from the source of dust supply, † its greater forest area insured a more uniform deposition of only the finest material, and its shorter dry seasons and less violent winds resulted in a deposit of lesser thickness. That the differences in conditions during the deposition of the loess as indicated by the fossils were essentially the same as those which exist between the two sections of the state to-day, has already been emphasized by the author. ‡

The greatest amount of the material carried by winds would be deposited where there are obstructions, such as ridges or hills, § and would generally be expected on the leeward side of the hills, || though the shifting of winds during different seasons,

*Discussed by the author in Proc. Iowa Acad. Sci., Vol. VI, pp. 98-113; also in the Jour. of Geol., Vol. VII, pp. 122-140.

†The western part of the state is drier, and moreover lies in the path of the stronger southwest winds which sweep over the dry prairies in summer while there is still a considerable amount of vegetation which may serve as an anchorage for the dust. Incidentally it may be noted that in summer the exposure of bare tracts by the partial or complete drying up of ponds and streams, the work of burrowing worms, insects and mammals and scratching birds, and the decay of vegetable matter all tend to increase the supply of material which may be transported or deposited.

‡Proc. Iowa Acad. Sci., Vol. III, p. 84; Vol. V, p. 15; Vol. VI, p. 110.

§Compare with drifting snow.

||On the drift hills of western Lyon county the fine soils do commonly appear only on the leeward sides, *f. e.*, north and east, as has been noted.

or because of local topography and changes in temperature, and the comparative abundance of vegetation, especially of trees, would locally very much modify any effect which might result from general causes.

The finer sub-soils in the groves of the drift area are indistinguishable from loess, though quite thin, and the amount of such deposits especially in the northern part of the most recent Wisconsin drift area will be greater as the region becomes drier, or as the number of groves increases,—though cultivation will no doubt affect the distribution and amount of the deposit.

It, therefor, appears that the facts herein presented are consistent with the theory of the æolian origin of the loess. However, the author desires that these facts and their relation to prairie formation stand upon their own merits, the application being a purely incidental after-thought.

ELEODES IN IOWA.

H. F. WICKHAM.

The genus *Eleodes* contains certain species of beetles belonging to the family Tenebrionidæ. They are terrestrial and cursorial, rarely being found on plants of any size, though a few are known to ascend the stems of shrubs. All are of large or medium size, and devoid of functional wings, the elytra being connate, forming a perfect shield which clasps the sides of the body. The integument is very thick, and forms, in connection with this elytral structure, an efficient protection from desiccation. Repugnatorial glands are present, secreting a powerful caustic fluid which is discharged through the anus when the insect is irritated. In order to protect themselves more efficiently they elevate the posterior portions of the body when alarmed, and run off in that position. Probably it is this habit which has suggested the name "circus bugs," often applied to them in the west.

From their abundance, both in species and individuals, they form a most characteristic feature of the arid regions of the west, their recognized range extending from the Missouri river to the Pacific ocean.

In view of their known habits and distribution, I was much interested in finding a number of specimens among the beetles