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MISCELLANEOUS PAPERS

by

Bohumil Shimek, Ph.D.

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COMMON NAMES OF PLANTS

B. Shimek

The discussion of the use of common names for plants has been less intense among professional botanists than that of rules of nomenclature for scientific names. The question, however, is of interest not only to the amateur lover of plants, but to the botanist as well.

The scientific name is, of course, more accurate, more widely used in fairly consistent fashion, and it should be employed in all scientific records, and in all other cases requiring accuracy, as, for example, in noxious-weed laws, tree-planting laws, etc.

Objections to scientific names on the score that they are too difficult, so often made by amateurs, lose much of their weight when we consider that many scientific names, such as Chrysanthemum, Gladiolus, Clematis, Asparagus, Trillium, Amaryllis, etc., are in common use as vernacular names; and that a number of scientific names, such as Nasturtium, Geranium, Smilax, Calla, etc., are improperly used as common names. Surely it would be as easy to use the latter names correctly as it is to use them incorrectly!

Despite the fact that scientific names are more consistent, more accurate, and often more expressive, common names are, and will continue to be, very widely used. Their greatest weakness is that they cannot be used internationally. Other weaknesses, such as lack of standardization, could be remedied in time by agreement and by education.

Those who are untrained in botanical lore find common names much more usable. With the increased attention to the outdoor world by organizations of various kinds, and with the back-to-nature tendency which is greatly stimulated by the increasing number of state and national parks toward which great numbers of visitors gravitate each year, there is greater demand for knowledge of the identity of our plants. Maniresponding diminution in the number of names exactly duplicated. Of the latter, however, Britton uses 30, of which only two, Wild Madder and Post Oak, are applied in each case to two species of the same genus. In all the other cases the same name is applied to species of different genera. In most cases two genera are thus represented, and in the main they are not closely related, the extreme, perhaps, being reached in the application of the name Hemlock (without adjectives) to species of *Tsuga* and *Oxypolis*. In two cases, those of the Rattle-box and Wire-grass, representatives of three genera are included under the same common name.

Because of their economic value and the popular interest which they have always aroused, trees have suffered from multiplicity of names more than any other group of plants.

In the very conservative "Our Native Trees," previously mentioned, only 10 common names are exactly duplicated, 8 being applied to members of the same genus, and 2 to members of different genera.

In Sargent's "Manual of the Trees of North America" the same common name is applied to two or more species of the same genus in 64 cases, 39 being applied to two species, 13 to three species, 9 to four species, and 1 each to five, seven and eight species. Thus, 4 species of *Malus* are called Crab-apple; 4 of *Salix*, Black Willow; 5 of *Populus*, Cottonwood; 4 of *Acer*, Sugar Maple; 8 of *Yucca*, Spanish Dagger; in *Pinus*, 4 as Nut Pine or Pinon, and 4 as Yellow Pine; in *Quercus*, 4 as Black Oak, 4 as Live Oak, 4 as Scrub Oak, and 7 as White Oak; while the name Red Fir is applied to one species of *Pseudotsuga* and three of *Abies;* the name Iron-wood to one species of *Cyrilla* and three of *Ostrya;* and the name Hemlock to one species of *Pseudotsuga* and four of *Tsuga*. In ten other cases species belonging to different genera are designated by the same common name.

One unfortunate feature of certain common names which have been coined in recent time is their inconvenient length resulting from an effort to make them descriptive. Such names as "Narrow-leaved White-topped Aster," and "Filiform White Water-crowfoot" are cumbersome and seem to carry us back in nomenclature to pre-Linnean times.

The attempt to express fancied resemblances in some cases,

and possibly carelessness in others, have resulted in the use of misleading names. Thus we have several species of true oaks, and in addition to that the Jerusalem Oak and Poison Oak are recognized, but neither is related to the oaks; Prickly Ash and Mountain Ash are not related to the true ashes; the Blue Beech is not a beech; the Ground Hemlock is not a hemlock; the Dog's-tooth Violet is not a violet; the Prairie Wake Robin (*Trillium recurvatum*) does not grow on the prairies; and the Rockrose is neither a rose nor does it grow on the rocks. So far as possible such names should be eliminated.

The use of some common names, with adjective modifiers, for species not closely related is also a source of confusion. For example, we have "snake-roots" of various kinds in *Aristolochia, Cimicifuga, Psoralea,* and *Sanicula,* and also rattlesnake-"root," -"grass," -"master," and -"weed"; we have various nettles belonging to the genus *Urtica,* but we also have wood, false, dead, hedge, spurge, and hemp nettles which belong to other genera and even families; and the same is true of various lilies.

It is also unfortunate that our manuals, etc., perpetuate scientific names where used erroneously as common names. Such common names as Syringa, Smilax, Geranium, and Nasturtium should be eliminated.

Greater consistency should be observed in the use of common names. Sometimes a common name is given to a genus and its species receive common names which are wholly unrelated to it; group names are sometimes given to more than one genus, instead of restricting them to a genus, or subdivision of a genus; and very local names are sometimes published while those of much wider use are disregarded.

One of the difficult questions calling for settlement is that of common names for obscure species, or species in which specific differences are not conspicuous. Such genera as *Asplenium, Potamogeton, Rumex,* and *Salix* suggest illustrations. Often it is only a part of the genus which contains obscure forms, as in *Prunus, Ranunculus, Aster,* etc. Perhaps it would be best to adopt a group name (in many cases it might be the scientific generic name), and then indicate the species by numbers or letters. It would, for example, be much simpler to write *Bidens a* instead of "Purple-stemmed Swamp Beggar-ticks."

Three methods of procedure suggest themselves in connection with the problem of the standardization of common names, and they are here briefly presented:

1. A check-list of common names should be prepared which will avoid, so far as possible, the weaknesses noted above. Vernacular nomenclature cannot follow ordinary rules of scientific nomenclature. No international considerations are involved; no law of priority can apply; no definite past date can be adopted as a starting point. The names in this check-list must be determined by agreement, particularly among all organizations interested in plant study, and when so determined they should be used in all subsequent publications.

2. Systematic botanists should participate freely in the work of the various clubs and organizations which are interested in outdoor life. Not only will they bring inspiration and information to places otherwise often inaccessible, but they will assist in broadening the field of influence of the standardized check-list.

3. More aggressive steps should be taken to restore systematic botany to its proper rank and place in the science curriculum. Certain phases of it should be presented in the secondary schools not only because of its value in developing systematic observation and thinking, but because the inevitable contact with the living world becomes a source of inspiration which will influence the entire lives of those who receive it early in their experience. If they do not go on with advanced botanical work they will have a source of wholesome physical, mental, and ethical influence throughout their lives, and if they do go on, their future work will be strongly influenced for the better by the inspiration and knowledge which they received. This work would offer perhaps the greatest opportunity for the establishment of the check-list as a standard for vernacular nomenclature.

This paper was read by request before the Systematic Section of the Botanical Society of America at the Cleveland meeting. The writer was not able to present it in person and hence could not press the adoption of the recommendation that a committee be appointed to coöperate with other similar

committees in the preparation of a check-list of common names. The recommendation is here repeated and urged upon all organizations interested in the vernacular nomenclature of our plants. Such work could be accomplished readily by correspondence and would entail little expense in connection with the preparation of the list.

THE RELATION BETWEEN THE MIGRANT AND NATIVE FLORA OF THE PRAIRIE REGION

B. Shimek

Even in a well established climax flora there is great fluctuation in the relative number of both individuals and species. The rapidity and character of these fluctuations is determined by various conditions.

We have, for example, the seasonal progression, repeated year after year, during which the flora displays very distinct and well-known phases.

Then there is the frequent fluctuation from year to year which is determined by the endless and extremely irregular variation in climatic and edaphic factors, each change favoring some forms, while others suffer.

And finally, there is the inevitable result of the accident of distribution in the uneven dispersal of seeds of the same species, due chiefly to changes in the direction and velocity of the wind, the volume and velocity of water currents, and the migrations and promiscuous wanderings of animals. In these cases the changes in the flora take place comparatively quickly in the case of annuals, and more slowly, though quite as effectively, in the case of perennials.

In this connection it is interesting to note that of the 265 species making up the bulk of the prairie flora of Iowa, 179 (67.5%) are ordinarily dispersed by wind; 65 (24.5%) by animals, chiefly birds; and 21 (8%) through hygroscopic properties.

The great majority of these species may also be dispersed more or less by surface water during heavy rainstorms, or by streams, especially when flooded. Violent tornadoes may also carry the heaviest of seeds and fruits.

The preponderance of wind-dispersed forms is significant, for during the summer months few days are quiet after the earlier morning hours. It also accounts for the fact that where a re-invasion of the prairie flora is taking place on areas which

had been disturbed, the wind-dispersed forms, particularly those which have capillary pappus, lead the invasion, and for a time usually take exclusive possession of the invaded area.

It is true, then, in a strict sense, that *all* the prairie flora is more or less migrant.

Ordinarily, however, we consider under that head the adventive flora which consists chiefly of what are usually designated as weeds.

This part of our flora is made up of two elements which are quite distinct in their source.

The great bulk consists of species which have been introduced from foreign lands, or from other parts of this country.

Cratty's recent list of the Immigrant Flora of Iowa contains 267 species. Of this number about 8 are widely distributed species which may have been introduced into some sections of our country, but appear to be native westward. The great majority of the others are found, some very locally, on cultivated grounds, or in the areas most completely dominated by man.

An interesting illustration of this fact is found in the distribution of this introduced flora in the vicinity of the towns of this state which are located on the older railways which were built before the prairie was broken. Along these railways belts of native prairie, usually varying from 10 to 20 feet in width, have been preserved, often for several miles, with only occasional interruptions by crossing highways, or where strips have been cultivated. Near the towns, however, there is invariably a strong weed element (often becoming dominant) which gradually fades out from the station, excepting on the roadbed proper, where it continues throughout. This distribution evidently results from the more frequent disturbances of the surface near the stations and along the roadbeds, and from the generous contributions brought in by railway trains, especially stock trains. These weeds do not enter the prairie strips on the sides of the railway right of way excepting where the surface has been disturbed.

In many cases these prairie strips have been preserved without appreciable deviation from the pure prairie type even where bordered on the one side by the roadbed with its ever present belt of weeds, and on the other by farm lands which have been under cultivation for from thirty to sixty years.

Of the invaders from outside the state probably 20 have come from other parts of our country, chiefly west and south, while the great majority, nearly 240, were received from the Old World.

The greater part of this foreign flora usually takes possession of cultivated and otherwise disturbed open areas where it is quite certain to come in competition with the native flora of the prairies, particularly if cultivation (or other disturbance) is stopped.

Indeed this foreign flora is itself reinforced by a group of migrant native prairie plants which also occupy disturbed areas and mingle freely with the invaders, in some cases even crowding them into a subordinate place. This group includes such species as *Hordeum jubatum, Oxybaphus nyctagineus, OEnothera biennis, Asclepias syriaca, Convolvulus sepium, Verbena stricta, Solidago rigida, Erigeron ramosus, E. canadensis, Ambrosia artemisiifolia,* and more than 20 other less aggressive forms.

Along the railways both the foreign and native migrants mingle freely, and take quick possession of disturbed areas; but on prairie areas remote from the main lines of travel the native species take possession, to the complete or nearly complete exclusion of the foreign forms. They were evidently "weeds" even in the earlier history of the native prairie.

So thoroughly have these foreign and native species mingled and so widely have they been distributed, that some confusion exists as to the source of some of them. Among these may be mentioned *Equisetum arvense, Poa compressa, Hordeum jubatum, Amaranthus blitoides, Lepidium apetalum, Trifolium repens, Erigeron canadensis* and *Achillea millefolium* (including *A. lanulosa*).

While all the last-named species occur abundantly in cultivated fields, waste places, and along railways, they also occur freely on disturbed or rather barren prairie areas quite remote from the main lines of travel. This would suggest that these species are native, or that they were introduced long ago through other than human agency.

The published records of these species are decidedly confusing. For example, one author states that *Hordeum jubatum* occurs on prairies from Texas to Minnesota and westward; another declares it came from west of the Missouri; while still another gives Europe as its source. *Lepidium apetalum* is given respectively as perhaps native in the western part of the United States; apparently naturalized from Asia; in the east introduced from Europe; and as occurring from Texas to Hudson Bay and westward. Other species of this group receive similar mistreatment.

As noted, this migrant flora usually takes quick advantage of any disturbance of the soil, for its members are the opportunists of the plant world. A gopher mound, an ant-hill, a newly eroded surface, an abandoned or neglected trail made by animals or man, and particularly the cultivation of large parts of the prairie, have furnished the conditions most favorable to invasion by this flora.

Man has contributed largely to the preparation of the surfaces for such invasion. His influence was no doubt felt long before the white man entered the prairies, for in the vicinity of their settlements and along the trails of their wandering bands, the aboriginal Indians not only constantly disturbed portions of the surface of the prairie but also aided in the transportation of migrant species.

Later, before the settlement of the prairie lands, wandering white hunters and trappers similarly aided in the distribution of the native migrant flora and occasionally introduced plant immigrants. This factor was by no means unimportant, for as late as the earlier eighties numerous hunters drove over the prairies of north-central Iowa in quest of game for the market as well as for sport.

This unstable element was soon followed by the actual settlers who not only disturbed the prairie by cultivation, but also introduced numerous foreign plant migrants with stock and crop seeds.

With the settlement of the country increased cultivation and improved methods of transportation still farther facilitated the introduction and diffusion of migrant forms. The railways especially contributed to this end. Not only did the construction and maintenance of the roadbed result in extensive and repeated disturbance of the prairie surface, but the trains brought in the seeds of many migrants.

An interesting comparative record is furnished by the Manitoba prairie. In 1883 and 1884 Christy found but three foreign weeds along the Canadian Pacific Railway between McGregor and Carberry. The railway was new, and the country was just being settled at the time. Thirty-six years later in the same territory the writer found forty species of Old World weeds, with a number of others that had probably been brought from the west.

In Iowa about 75 species of open-ground migrants have come to us from the Old World, and about one-half that number from other parts of the Western Hemisphere. About two-thirds of the foreign species have become more or less common.

Under certain conditions this introduced flora comes in direct conflict with the native prairie flora. As noted, areas which have been cultivated, or otherwise disturbed, are immediately invaded by a migrant flora, the major part of which is likely to consist of foreign forms, the remainder being made up almost wholly of the native "prairie weeds."

If cultivation is stopped, and the surface is not otherwise disturbed, there is gradual invasion of the area by species belonging to the more stable prairie flora, and the migrants are slowly crowded out, until finally the prairie flora is re-established. The rate at which the re-establishment takes place varies under different circumstances. Conditions under which plant growth is retarded usually rather favor the advance of the native prairie flora. During dry seasons, or on poor soils, for example, the native prairie flora has some advantage over the introduced migrants of the Old World, though the Russian Thistle forms an exception.

The availability of native seed for dispersal over the invaded area is also important. Where railways have been built through cultivated lands, for example, the restoration of the native flora on the undisturbed strips takes place very slowly and imperfectly, while in the cases in which strips of native prairie have been preserved along the railway right of way, or on uncultivated bits of prairie, the process is more rapid and more perfect. In a few cases which were followed rather closely by the writer the process required seven or eight years.

Contrary to a widespread belief the breaking up of the prairie turf does not permanently destroy the prairie flora,—it will come back if given an opportunity,—i.e., if left undisturbed for several years, especially if remnants of the native flora have been preserved nearby.

Neither is it true that the matted roots of grasses are essential to the perpetuation of this turf. Extensive root systems characterize the prairie flora as a whole, and there were areas of large extent on which prairie plants other than grasses predominated. Moreover, in some cases which the writer has followed for a number of years the reinvasion of formerly disturbed areas was not accomplished first by grasses, but chiefly by Compositae with capillary pappus, such as Solidago, Aster, Erigeron, etc., which maintained their supremacy for years, without yielding noticeably to grasses.

The advance of the native prairie plants in such cases is not uniform. As a rule the perennials, which constitute more than 80 per cent of the prairie flora, advance more slowly, but persist better. The annuals and the few biennials, which make up the remainder, are more erratic. They frequently mingle with the introduced migrants from the first, and many of them, particularly the Ambrosias, Erigerons, *Hordeum jubatum*, *OEnothera biennis*, and others, form a very conspicuous part of the native "prairie weeds."

There is also a great difference in the persistence of the migrant forms, *Poa pratensis* among our American migrants, and Melilotus among the foreigners, probably being most tenacious. Even these forms, however, may be crowded out, or at least reduced to a very secondary position, by the native flora, though this is accomplished more slowly.

It is obvious that this whole problem is of great economic importance. Its relation to the weed-problem already has been briefly considered. Our weed-laws need severe revision, and they must particularly distinguish between our harmless prairie flora and the harmful migrants. Under the present undiscriminating practice we pave the way for the introduction of the objectionable migrants by destroying the native prairie flora which alone seems to be able to keep invaders out.

Some of our prairie remnants should be saved, and they may readily be enlarged from these remnants as seeding centers.

These areas should be saved not only that coming generations may enjoy something of the charm of primitive Iowa, but because their study throws light upon the possibilities of plant-growing for economic purposes. The native flora represents the final outcome of the operation of all the ecological factors which have influenced plants through the centuries, and which are operating today not only on the remnants of the native flora, but on our crop plants as well.

For the purpose of preserving these records and these opportunities for study we should have well-selected prairie preserves in all parts of the prairie section of our country, each not less than a quarter-section in area.

Shall they be secured by private endowment? Shall they be sponsored by scientific societies? Shall the state and federal governments secure them? May railway companies be persuaded to preserve the prairie transects along their right of way? May our weed laws be so modified and interpreted that it will be possible to preserve strips of prairie flora along some of our highways rather than the noxious weeds which follow its destruction? These are questions for immediate consideration, before even these remnants of our prairie have disappeared.

Whatever may be the method, these areas should be secured, and there should be distinct limitations placed upon their uses. Landscape artists should be barred, and overzealous tree-planters should be restrained, in order that the *natural* prairie might be preserved; these preserves should not be made recreation grounds for picnickers and wandering tourists; their control should be placed in the hands of our educational institutions rather than our politicians; and portions of the tracts, particularly those which represent broken prairie, should be made experimental tracts under proper supervision by scientific workers representing every phase of the composite problem involved.

Our experience with the migrant flora teaches us that the prairie may be restored,—hence the prairie remnants may be enlarged to worthwhile dimensions. But this must be done before these remnants are totally destroyed. In Iowa such remnants are still found in all parts of the state, but each year they diminish in extent and number, and soon the prairie will be nothing but a vague tradition of a type even now forecast in some of our scientific literature.

THE BOTANICAL MANUALS AND THE IOWA FLORA

B. Shimek

The limited space in our ordinary botanical manuals does not permit a full discussion of variations in form, structure, habit, and geographic distribution. As a consequence imperfections and omissions appear which are often confusing and misleading to the user of the manual.

The two manuals, Gray's and Britton's, which are most frequently used for purposes of identification in Iowa, contain many inaccuracies of this character. Some of them are due to the limitations naturally placed on such works, but others are due to misunderstanding or error. The following notes on some of the more striking of these errors and omissions are offered, not in a spirit of criticism, but to help the students of our flora who are often misled by them.

No attempt is here made to discuss variations in taxonomic characters. Considering their necessarily brief descriptions the manuals cover these variations remarkably well, especially if both are consulted. These notes are limited to a discussion of habitat and geographic distribution.

The nomenclature of Gray's Manual, 7th ed., is employed in the main in this paper. Where the generic name differs in Britton's Manual it follows in parenthesis. As these notes are intended primarily for users of the manuals, common names and author's names are omitted, as they can be obtained from the manuals.

Where a note refers to but one of the manuals it is followed by the initial letter in parenthesis, (G.) for Gray and (B.) for Britton.

I Habitats

It is impossible to give a full and accurate statement of habitats within the narrow limits of the manuals. It is especially difficult to indicate the variations within the major habitats which we generally designate as swamps, forests, prairies, and sandy areas. The variations in the major habitats as displayed in Iowa are here indicated briefly under each head.

Swamp species. Comparatively few corrections need to be made for Iowa in this group.

Angelica atropurpurea is said to occur in alluvial soils (G.), but in Iowa it occurs in bogs.

Both manuals state that *Phlox maculata* is found in woods and along streams. In Iowa it occurs in boggy places, especially in the prairie sections.

Aster umbellatus is reported from moist thickets, but it occurs chiefly in prairie bogs, though sometimes entering the border thickets in swampy places.

Eleocharis Wolfii and *Solidago Riddellii* are said to occur on wet prairies, but the former usually grows in the shallow edges of ponds, and the latter in prairie bogs.

In a number of cases there are consistent differences between the floras of prairie and woodland bogs which are not brought out in the manuals. Thus both *Calla palustris* and *Symplocarpus foetidus* are referred to bogs, the latter also to wet soils (B.), but the former occurs (very rarely) in prairie bogs, while the latter grows in bogs (often of the "hanging" type), in wooded sections.

Several species which are normally swamp species, and are so listed, may appear on apparently dry prairie which was swampy earlier in the season, or on upland prairie after a series of moist seasons. In the former case it may be necessary to visit the locality earlier in the season to ascertain the origin of this flora. In the latter case but few individuals usually occur, and it behooves the observer to avoid hasty conclusions from the presence of individual specimens in any case. The swamp species which most frequently stray in this manner to the upland prairie are *Iris versicolor, Habenaria leucophaea, Cicuta maculata* and *Stachys palustris.* They might easily be mistaken for prairie plants under such circumstances by the inexperienced observer.

Forest species. The number of corrections for true forest plants is also small. A larger number of errors occurs where certain prairie species are ascribed to "woods."

As a rule the manuals make no distinction between alluvial, upland, and open woods, though their floras are more or less distinct.

Notes on the following true woodland species are of interest.

Cypripedium hirsutum is recorded as occurring in swamps and woods, but in Iowa it is found in deep woods, usually on upland slopes.

Alnus rhamnifolia is reported in both manuals as a swamp plant. Its only known locality in Iowa is well up on a bluff where there is no evidence of swampy conditions.

Osmunda Claytoniana is reported from low grounds (G.) and moist places (B.). In Iowa it occurs chiefly on well-wooded upland slopes, especially near the heads of ravines.

Both manuals give the habitat "rich soil" for *Quercus macrocarpa* and *Actinomeris alternifolia.* The former frequently grows in poor, dry upland soils, and then becomes stunted, and the latter is found on rich wooded bottomlands.

Mitella diphylla and *Asarum canadense var. reflexum* and *var. acuminatum* are similarly credited to "rich woods." The Mitella usually grows on woody rocky slopes or ledges. The Asarums grow in rich woods, but *var. acuminatum* is usually found on slopes (often rocky), while *var. reflexum* is common in lower alluvial woods, only occasionally ascending to upland woods.

Smilax ecirrhata, reported in dry soil (G.), or without habitat (B.), is found in deeper woods, especially on upland slopes.

Gaylussacia baccata, credited to "woodlands and swamps" (G.) and to "woods and thickets" (B.), has been found only in dry upland woods.

Hamamelis virginiana is reported from "damp woods" (G.) and "low woods" (B.). In Iowa (northeastern part) this species is always found on wooded (often rocky) slopes.

Aster Drummondii is said to grow in "open ground" (G.), and in "dry soil, borders of woods and prairies" (B.). In Iowa it is common in upland woods. It seems to blend with *A. sagittifolius* which is frequent in more open places, and this may have caused confusion.

Phegopteris hexagonoptera occurs in rather deep, mostly upland woods, but is credited to "rather open woods" (G.), and "dry woods" (B.).

Certain other species frequently occur in woods but are properly credited to other habitats in which they also occur. *Eupatorium purpureum* is reported from "moist soil" (B.), but occurs both in swamps and in deep woods. *Erigeron annuus,* credited to "fields" (B.), and "fields and waste places" (G.) also frequently occurs on wooded banks and slopes.

Prairie plants. A number of species credited to woods in the manuals belong properly to the prairies and open places. Their occurrence in woods is exceptional, and they then appear as a rule in very open woods on ridges, or in the thin prairie groves which consist largely of smaller and more or less scattered bur oaks, etc. In such places the undergrowth is made up of prairie plants, forest plants being absent or exceptional, yet they would be reported as found "in woods." In addition to the few properly recorded from "prairies and open or dry woods," the following species, normally of the prairies and only exceptionally in thin open woods, should be noted: *Ranunculus fascicularis, Heuchera hispida, Oxalis violacea,* and *Silene stellata* reported (B.) from "woods," the last also from "wooded banks" (G.); *Scrophularia leporella* from "rich open woods" (G.) and "woods and along roadsides" (B.); *Amphicarpa (Falcata) Pitcheri* from "rich woods and thickets" (G.) and "moist thickets" (B.); *Zizia aurea* from "river-banks, meadows, and rich woods" (G.); *Ceanothus americanus* from "woodlands and gravelly shores" (G.) and "dry open woods" (B.); *Anemone cylindrica* from "rocky woods and dry barrens" (G.) and "open places" (B.); *Polygala Senega* from "rocky woods" (B.) and "rocky soil" (G.); *Desmodium (Meibomia) canadense* from "open woods and banks of streams" (G.); *Lathyrus venosus* from "shady banks" (G.) and "river shores and banks" (B.); *Solidago serotina* from "thickets" (G.); *Pycnanthemum flexuosum* from "fields and thickets" (B.); *Fragaria virginiana* from "moist woodlands, fields, etc." (G.) and "dry soil" (B.); *Veronica (Leptandra) virginica* from "meadows, moist woods, thickets" (B.) and "rich soil" (G.); *Pedicularis canadensis* from "copses and woodlands" (B.) and "alluvial soil" (G.); *Hypoxis hirsuta* from "meadows and open woods" (G.) and "dry soil" (B.); and *Lilium philadelphicum* from "dry woods" (B.).

In addition to the foregoing prairie species reported from woods, a large number of other species, likewise of the prairies, have the habitat given indefinitely or erroneously. The most frequent indefinite designation of the habitat as "dry soil," "dry banks," "fields," "dry sand and gravel," etc., occurs with the following species which distinctly belong with the prairie flora in Iowa: *Andropogon scoparius, A. furcatus* (G.), *Sorghastrum nutans, Koeleria cristata, Bouteloua curtipendula, B. hirsuta, Hordeum jubatum* (B.), *Carex festucacea* (G.), *Carex straminea, C. pennsylvanica, Lilium philadelphicum* (G.), *Salix humilis, Comandra umbellata, Polygonum ramosissimum* (saline soil B.), *Chenopodium leptophyllum* (B.), *Oxybaphus nyctagineus* (B.), *O. floribundus* (B.), *O. hirsutus* (B.), *Lepidium apetalum, Potentilla arguta, P. canadensis, P. monspeliensis, Psoralea argophylla, P. esculenta, Astragalus canadensis* (G.), *Desmodium illinoense* (G.), *Lespedeza capitata, Vicia americana var. angustifolia* (B.), *Linum sulcatum, Polygala verticillata* (G.), *Euphorbia Preslii, E. corollata, Rhus glabra, Ceanothus ovatus* (G.), *Helianthemum canadense, OEnothera (Meriolix) serrulata, Gaura biennis, G. parviflorum* (B.), *Asclepias tuberosa, A. verticillata* (B.), *Acerates viridiflora* and varieties, *Phlox pilosa, Lithospermum canescens* (B.), *Ruellia ciliosa, Kuhnia eupatoroides* and *var. corymbulosa, Liatris (Lacinaria) cylindracea, L. punctata* (B.), *L. squarrosa, L. scariosa, Solidago speciosa var. angustata* (G.), *S. nemoralis, S. rigida, Aster laevis, A. multiflorus, A. ptarmicoides, Antennaria plantaginifolia, Parthenium integrifolium, Heliopsis scabra* (B.), *Rudbeckia hirta, Brauneria angustifolia* (G.), *B. pallida* (habitat omitted in Gray), *Lepachys (Ratibida) pinnata* (G.), *Helianthus grosseserratus* (often in rather moist places), *Achillea millefolium, Artemisia ludoviciana* (G.), *Cirsium (Carduus) discolor, C. Hillii, Lactuca ludoviciana* (B.), and *Lygodesmia juncea.*

The following prairie species are reported in the manuals as inhabiting rocky or sandy places: *Allium stellatum, Potentilla arguta, Acerates viridiflora* and its varieties, *Galium boreale,* and *Polygala Senega.* These species may occur on rocky hillsides, but they are commonly found on ordinary prairie.

The reported habitats of still other prairie plants are misleading. Thus, *Polygonum ramosissimum* is said to be found in saline soils (B.); *Astragalus canadensis* along streams (B.); *Lathyrus venosus* from river-banks (B.); *Convolvulus sepium* in alluvial soils or along streams (G.); and *Smilacina stellata* from moist banks (G.) and moist soil (B.); yet all these species occur freely upon the prairie.

Species of sandy areas. The majority of our prairie plants may be found also upon sandy areas. Certain species, however, are quite characteristic of sand and gravel habitats, but in some cases the record of their habitat is quite misleading.

Thus, *Cyperus filiculmis* is reported from dry soil (G.) and dry fields and hills (B.); *Polygonum tenue* from dry soil; *Froelichia floridana* from dry soil (B.); *Polanisia trachysperma* from prairies (B.); *Cristatella Jamesii* from dry soil (B.); *Potentilla paradoxa* from prairies and river-banks (G.) and shores and river-banks (B.); *Ptelea trifoliata* from rocky places (G.) and prairies (B.); *Rhus canadensis* from dry rocky banks; *Viola pedata* from dry fields and hillsides (B.); *Androsace occidentalis* from bare hills and barrens (G.) and dry soil (B.); *Lithospermum Gmelini* from dry woods (B.); *Synthyris Bullii* from oak barrens and prairies (G.) and dry prairies (B.); *Houstonia minima* from dry hills (G.) and dry soil (B.); *Aster linariifolius* from dry soil (G.) and dry or rocky soil (B.); *Ambrosia psilostachya* from prairies and plains (G.) and moist open soil (B.); *Helianthus petiolaris* from dry prairies (B.); and *Helianthus occidentalis* from dry barrens (G.) and dry soil (B.).

In Iowa all these species occur on sand, or on very sandy soil.

In quite a number of cases both manuals fail to record the habitat.

Contradictory references to habitat are made in a number of places. Thus the habitat of *Urtica gracilis* is given as moist ground (G.) and dry soil (B.); of *Apocynum cannabinum* as gravelly and sandy soil (G.) and fields and thickets (B.); of *Polygonum ramosissimum* as dry sandy soil (G.) and saline soil (B.); of *Ranunculus fascicularis* as dry or moist hills (G.) and woods (B.); of *Lilium philadelphicum* as dry or sandy ground (G.) and dry woods (B.); of *Physalis pruinosa* as sandy soil (G.) and cultivated soil (B.); of *Physalis virginiana* as dry hills, gravelly soils, etc. (G.) and rich soil (B.); of *Hypoxis hirsuta* as meadows and open woods (G.) and dry soil (B.); and of *Castilleja coccinea* as low sandy ground (G.) and meadows and thickets (B.). Most of these species belong in the main to the prairie flora, the first in rather low ground.

The chief causes of the inaccurate habitat references seem to lie in the failure of the manuals to recognize the prairie properly, and in a lack of differentiation of our forested areas. The mere reference to "woods" is very unsatisfactory, for we have alluvial woods, the woods of lower slopes, and upland woods, besides the prairie groves and thickets, and each presents floral peculiarities which are worthy of note.

II. Geographic Distribution

Geographic distribution is particularly difficult to indicate accurately in the limited space of the manuals. Most plants are irregularly distributed, and not a few are very local and the localities are often widely separated. Within the limits, as indicated, many species may be lacking entirely over areas of considerable extent, while they are common in other parts.

The manuals have scarcely done justice, however, to the Iowa flora, a fact difficult to explain since numerous papers, published by working botanists, have set out its composition quite fully. These papers are evidently either unknown to the eastern authors of the manuals, or have been ignored by them.

The distribution of a large number of species, as given in the manuals, is such that Iowa would scarcely be included. In quite a number of cases there is doubt because the limits of distribution are rather indefinite, but the following species would probably be considered by the less-experienced worker as excluded from our flora by both manuals, though all are found in Iowa:

Digitaria (Syntherisma) filiformis
Quercus palustris (less clearly in Britton)
Quercus lyrata
Ranunculus Purshii
Clematis verticillata (Atragene americana)
Cardamine Douglassii (purpurea)
Potentilla (Sibbaldiopsis) tridentata
Vaccinium vacillans (close in Britton)
Primula mistassinica
Gilia (Collomia) linearis (close in Gray)
Physostegia parviflora
Chelone obliqua
Houstonia angustifolia
Diervilla Lonicera (Diervilla)
Lonicera canadensis
Linnaea borealis v. americana
Viburnum dentatum

Prunus pumila
Acalypha gracilens
Lechea minor
Vaccinium pennsylvanicum
Solidago tenuifolia (Euthamia caroliniana)
Lygodesmia rostrata

Of these species *Clematis verticillata, Potentilla tridentata, Vaccinium pennsylvanicum, V. vacillans, Linnaea borealis var., Solidago tenuifolia* and *Diervilla Lonicera,* seem to be confined to northeastern Iowa, where they are local in distribution; *Prunus pumila* occurs rarely in the extreme northeastern and northwestern parts; *Chelone obliqua,* local north and east; *Ranunculus Purshii* and *Gilia linearis* in the northwestern part; *Houstonia angustifolia* and *Lygodesmia rostrata* in the western part; *Primula mistassinica* rarely in the central part; and *Quercus palustris* and *Q. lyrata* in the southeastern part, the latter being rare.

The following species are similarly excluded by Gray's Manual:

Woodsia ilvensis
Paspalum ciliatifolium
Panicum latifolium
Sphenopholis (Eatonia) obtusata
Hordeum pusillum
Calla palustris
Zygadenus chloranthus (near)
Habenaria Hookeri (near)
Astragalus plattensis
Viola lanceolata

Of these species *Woodsia ilvensis* and *Habenaria Hookeri* are rare in the northeastern part of the state; *Calla palustris* is rare in the north-central part; *Astragalus plattensis* is found in the far western part; *Viola lanceolata* in the Cedar River Valley at two widely separated points; and the remaining species are more widely distributed, especially in the northern and eastern parts of the state.

The following species in Britton's Manual do not have their range include Iowa:

Woodsia scopulina
Asplenium angustifolium
Cystopteris (Filix) bulbifera
Equisetum sylvaticum
Lycopodium complanatum
Lycopodium clavatum
Abies balsamea
Potamogeton praelongus
Melica Porteri (parviflora)
Betula lutea
Quercus bicolor (platanoides)
Coptis trifolia
Jeffersonia diphylla
Cristatella Jamesii
Physocarpus (Opulaster) opulifolius

Agrimonia striata
Rosa blanda
Amelanchier spicata
Oxytropis (Aragallus) Lamberti
Croton monanthogynus
Acer spicatum
Steironema quadrifolium
Phlox bifida
Lippia lanceolata
Lycopus rubellus
Tecoma radicans
Houstonia minima
Lonicera Sullivantii
Kuhnia eupatoroides
Rudbeckia subtomentosa
Brauneria purpurea
Coreopsis tripteris
Bidens aristosa
Artemisia frigida
Hieracium canadense

Of this series *Woodsia scopulina* and *Artemisia frigida* are found in the extreme northwestern part of the state, while *Oxytropis Lamberti* is more widely distributed in the west and northwest; *Amelanchier spicata, Steironema quadrifolium* and *Potamogeton praelongus* in the northern part; *Asplenium angustifolium, Abies balsamea, Coptis trifolia, Jeffersonia diphylla, Betula lutea* and *Acer spicatum* are local and limited to the northeastern part, the Betula also occurring in the north-central part; *Lycopodium clavatum, L. complanatum,* and *Phlox bifida* are local in the eastern part, while *Cystopteris bulbifera, Equisetum sylvaticum* and *Quercus bicolor* are more widely distributed in the same section; *Melica Porteri, Tecoma radicans, Croton monanthogynus, Houstonia minima,* and *Brauneria purpurea* are southeasterly in distribution; while the remaining species are more widely distributed, chiefly over the eastern half of the state.

In a few cases it is evident that species are erroneously credited to Iowa in the manuals, not always through any fault of their authors. Thus, one of the reports of *Isoetes melanopoda* is based on the phyllodial state of *Sagittaria heterophylla* according to Cratty, who examined the material at Ames on which the report was founded, and the writer was unable to find verification of earlier records.

The report of *Betula lenta* is based on *B. lutea* which was at first erroneously identified as *B. lenta.* A few trees in Clayton County, northeastern Iowa, are, however, probably *B. lenta.* A more critical study of this material is being made, and *B. lenta* may be restored to the Iowa list.

Robinia pseudoacacia (B.), *Diospyros virginiana,* and *Sassafras* *variifolium* (G.) are credited to Iowa, but the writer has been unable to verify the occurrence of native plants. The Robinia was introduced early for ornamental purposes, and has become widely distributed in eastern Iowa, but no authentic native specimens have been encountered. Diospyros and Sassafras are planted in southern Iowa, and both may occasionally escape from cultivation. Both species were probably introduced by southern people into that part of the state in its early history,—the one for its fruit and the other for its reputed medicinal properties.

The writer has been unable to find any authentic evidence which would show that *Polypodium polypodioides* (G.), *Cladium mariscoides* (G.), *Sarracenia purpurea* (G.), and *Silphium terebinthinaceum* (B.) are native to Iowa. The last species should be found in eastern Iowa as it is not rare in adjacent parts of Illinois, but no authentic case of its occurrence has been found by the writer. If present, it is exceedingly limited in distribution.

A small number of species native to the state is omitted entirely from the manuals. Thus, Gray omits *Cristatella Jamesii*, and Britton omits *Cirsium canescens* and *C. iowensis*. In several other cases certain named forms are omitted because of doubt as to the validity of the species. This is true, for example, in the genera Aster, Xanthium, Rudbeckia, and Helianthus, in which Britton recognizes a larger number of forms as distinct species. Some of the more striking cases of this kind are given in the comparative list of Gray and Britton names in the closing part of this paper.

In other cases it will be found that the use of synonyms results in apparent omission of species. These also are given in the above-mentioned list.

Quite frequently students of the Iowa flora have complained that they could not find certain species which are credited to the state. In a number of cases this is due to the assignment of the species in the manual to the wrong part of the state. All of these sectional references are in Gray's Manual, those in Britton's Manual being general references to "Iowa." It is interesting to note that Gray refers 225 species and varieties to Iowa, while Britton makes 166 such references.

The species which are referred to the wrong section of the state in Gray are the following:

Pinus Strobus, reported from eastern Iowa, but found also in the north-central part.

Abies balsamea, to central Iowa, but the species is limited to the northeast corner of the state.

Carex stenophylla, from northern Iowa, but found only in the northwestern part.

Erythronium mesochoreum, from western Iowa, but occurring across the two southern tiers of counties.

Betula alba var. papyrifera, from northern Iowa, but properly chiefly from the northeastern part, though a few occur in the north-central portion.

Alnus incana, from northern Iowa, but limited to the northeastern part.

Asimina triloba, from northeastern Iowa. This should read "southeastern."

Rubus triflorus, from northern Iowa, should be limited to northeastern Iowa.

Acer spicatum, from eastern Iowa, also limited to the northeastern part.

Mentzelia decapetala, from the western part, should be "northwestern."

Panax quinquefolia, from eastern Iowa. This species was formerly abundant at least as far west as Winnebago County in the north-central part.

Lonicera Sullivantii, from "central Iowa,' but it occurs throughout most of the eastern part of the state.

In quite a number of cases species which are more or less restricted in distribution are simply credited to "Iowa" in the manuals.

Both manuals refer the following species to "Iowa," but they are here grouped according to their more restricted distribution:

The northeastern quarter of the state:

Cryptogramma Stelleri
Phegopteris Robertiana
Taxus canadensis
Symplocarpus (Spathyema) foetidus

Lycopodium lucidulum
Northern Iowa:
Salix candida
Northwestern Iowa:
Beckmannia erucaeformis
Carex sychnocephala
Carex stenophylla
Southeastern Iowa:
Carya illinoensis (Hicoria Pecan)
Carya (Hicoria) laciniosa
Astragalus distortus
Synthyris Bullii (also local northward)

Gray's Manual similarly refers the following species to "Iowa," but they, too, are restricted as indicated:

Northeastern quarter of state:
Lycopodium complanatum var. flabelliforme (local and rare)
Salix rostrata (local)
Betula alba var. cordifolia
Chrysosplenium americanum
Sambucus racemosa (S. pubens)
Valeriana edulis
Northern Iowa:
Astragalus (Phaca) neglectus
Menyanthes trifoliata
Northwestern Iowa:
Marsilea vestita (very rare)
Opuntia fragilis (rare and local)
Senecio palustris (rare)
Western Iowa:
Aplopappus (Sideranthus) spinulosus
Central Iowa:
Stipa comata
Southern Iowa:
Quercus stellata
Southeastern Iowa:
Tecoma radicans
Brauneria purpurea
Phlox bifida (also local northward)
Eastern Iowa:

Phegopteris polypodioides (P. Phegopteris)
Aspidium (Dryopteris) Goldianum
Trillium nivale, chiefly eastward, but also westward to Sac and Cherokee Counties.
Schrankia uncinata is also reported from Iowa, but the writer has no authentic record of its occurrence in the state.

Britton's Manual likewise refers the following species to "Iowa," but they are found only in the sections indicated:

Northeastern Iowa:
Habenaria (Lysias) Hookeri
Adoxa Moschatellina (local)
Northern Iowa:
Calla palustris (very rare)
Salix pedicellaris
Northern and eastern Iowa:
Parnassia caroliniana (local)
Northwestern Iowa:
Amorpha microphylla (nana) (becoming rare)
Western half of Iowa:
Glycyrrhiza lepidota
Southern Iowa:
Erythronium mesochoreum (two southern tiers of counties)
Rhamnus lanceolata (southern half of state)
AEsculus octandra (south-central part)
Southeastern Iowa:
Carex laxiflora latifolia (albursina)
Commelina virginica
Eastern Iowa:
Betula nigra
Fraxinus quadrangulata
Viola pubescens is also more common eastward, though it extends across the state. Westward it is replaced largely by V. scabriuscula.

An additional reason for the difficulty with which some species are now found is their disappearance from large areas as a result of settlement and cultivation. This is true of many of our prairie, forest, and swamp species, which have been more and more restricted as their natural habitats were destroyed. Notable examples among prairie plants are *Liatris (Lacinaria) squarrosa*, *Anemone caroliniana*, and *Amorpha microphylla (nana)*; among forest plants the species of Phegopteris among ferns, the forest species of Cypripedium, and the brilliant *Lobelia cardinalis* of bottomland woods; and among swamp plants *Pontederia cordata, Calopogon pulchellus*, and *Gentiana crinita*.

Additional trouble is caused by the omission of the geographic distribution in several cases.

SYNONYMS

Most of the Iowa botanists have followed Gray's Manual, but several papers have appeared in which the nomenclature of Britton's Manual has been employed. To assist in clearing up the confusion caused by the use of the two systems, the following comparative list of the two sets of synonyms is presented as far as it applies to the Iowa flora.

Where the difference is in generic names and the specific names are not changed, only the former are given.

The common names and authors' names are again omitted, as they may be obtained from the manuals.

For convenience in reference the names from Britton's Manual are arranged alphabetically in the first column and the corresponding Gray synonyms are given in the second column, just opposite. This is necessary as Britton omits most of the Gray synonyms, while Gray's Manual gives the Britton synonyms quite fully.

List of Iowa Synonyms

Britton	Gray
Abutilon Abutilon	A. Theophrasti
Acerates viridiflora Ivesii	A. viridiflora lanceolata
Acroanthus	Microstylis
Acuan	Desmanthus
Adicea	Pilea
Adopogon	Krigia
Agastache anethiodora	A. Foeniculum
Agrimonia Brittoniana	A. striata
Agrimonia hirsuta	A. gryposepala
Agropyron spicatum	A. Smithii
Allionia	Oxybaphus

Allionia lanceolata	Oxybaphus albidus
Alsine	Stellaria
Amelanchier Botryapium	A. oblongifolia
Amorpha nana	A. microphylla
Ampelopsis cordata	Cissus Ampelopsis
Amygdalus persica	Prunus
Apios Apios	A. tuberosa
Arabis brachycarpa	A. Drummondii
Aragallus	Oxytropis
Aristida longiseta	A. purpurea
Aronia nigra	Pyrus melanocarpa
Asclepias exaltata	A. phytolaccoides
Astragalus carolinianus	A. canadensis
Astragalus crassicarpus	A. caryocarpus
Atheropogon curtipendula	Bouteloua
Atragene americana	Clematis verticillata
Batrachium divaricatum	Ranunculus circinatus
Batrachium trichophyllum	Ranunculus aquatilis capillaceus
Blephariglottis leucophaea	Habenaria
Boebera	Dyssodia
Bradleya	Wisteria
Brasenia purpurea	B. Schreberi
Bulbilis	Buchloe
Bursa	Capsella
Butneria	Calycanthus
Capnoides	Corydalis
Cardamine purpurea	C. Douglassii
Carduus	Cirsium
Carex albursina	C. laxiflora latifolia
Carex cristatella	C. cristata
Carex Haydeni	C. stricta decora
Carex interior	C. scirpoides
Carex pedicellata	C. communis
Carex setifolia	C. eburnea
Carex sterilis	C. stellulata
Carex teretiuscula	C. diandra
Carex teretiuscula prairie	C. diandra ramosa
Carex tribuloides moniliforme	C. tribuloides reducta
Carex xanthocarpa	C. setacea

Cassia marilandica	C. Metzgeri (in part)
Catalpa Catalpa	C. bignonioides
Cerastium longipedunculata	C. nutans
Chaetochloa	Setaria
Chamaenerion angustifolium	Epilobium
Chrysosplenium iowensis	C. tetrandrum
Citrullus Citrullus	C. vulgaris
Clematis missouriensis	C. virginiana (in part)
Clematis Simsii	C. Pitcheri
Collomia	Gilia
Comarum palustris	Potentilla
Corallorhiza multiflora	C. maculata
Cracca	Tephrosia
Crataegus Brownii	C. Margaretta
Crataegus campestris	C. pertomentosa
Crataegus Eggerti	C. coccinoides
Crataegus uniflora	C. tomentosa
Cuscuta paradoxa	C. glomerata
Cynoglossum virginicum	C. virginiana and C. boreale
Cyperus inflexus	C. aristatus
Cyperus speciosus	C. ferax
Cypripedium hirsutum	C. parviflorum
Cypripedium reginae	C. hirsutum
Dasyphora fruticosa	Potentilla
Dasystoma	Gerardia
Dasystoma Besseyana	Gerardia tenuifolia macrophylla
Dasystoma Gattingeri	Gerardia tenuifolia
Delphinium albescens	D. Penardi
Deringa	Cryptotaenia
Diervilla Diervilla	D. Lonicera
Diplachne	Leptochloa
Doellingeria umbellata	Aster
Drymocallis arguta	Potentilla
Eatonia	Sphenopholis
Eatonia pennsylvanica	Sphenopholis pallens
Eragrostis Eragrostis	E. minor
Eragrostis major	E. megastachya
Eriophorum polystachyon	E. angustifolium

Eryngium aquaticum	E. yuccifolium
Eupatorium ageratoides	E. urticaefolium
Euphorbia arkansana	E. dictyosperma (in part)
Euphorbia missouriensis	E. dictyosperma (in part)
Euphorbia nutans	E. Preslii
Euthamia caroliniana	Solidago tenuifolia
Euthamia graminifolia	Solidago
Falcata	Amphicarpa
Froelichia campestris	F. floridana
Galeorchis	Orchis
Gaylussacia resinosa	G. baccata
Glecoma	Nepeta
Gnaphalium obtusifolium	G. polycephalum
Gymnandeniopsis clavellata	Habenaria
Gyrostachys	Spiranthes
Hepatica acuta	H. acutiloba
Hepatica Hepatica	H. triloba
Hicoria minima	Carya cordiformis
Hicoria Pecan	Carya illinoensis
Homalocenchrus virginicus	Leersia
Hypericum maculatum	H. punctatum
Hypericum Sarothra	H. gentianoides
Hypericum sphaerocarpum	H. cistifolium
Hypopitys americana	Monotropa Hypopitys (in part)
Hypopitys lanuginosa	Monotropa Hypopitys (in part)
Hystrix Hystrix	H. patula
Impatiens aurea	I. pallida
Ionactis linariifolius	Aster
Juncoides pilosum	Luzula saltensis
Juncus acuminatus	J. debilis
Juniperus Sabina	J. horizontalis
Kneiffia fruticosa	OEnothera
Koellia	Pycnanthemum
Kuhnia glutinosa	K. eupatoroides corymbulosa
Kuhnistera	Petalostemum
Lacinaria	Liatris
Lactuca virosa	L. scariola integrata
Lappula Lappula	L. echinata
Lappula texana	L. Redowskii occidentalis

Lepargyrea	Shepherdia
Leptandra virginica	Veronica
Leptilon canadensis	Erigeron
Leptilon divaricatus	Erigeron
Leptorchis	Liparis
Lilium umbellatum	L. philadelphicum andinum
Limnorchis hyperborea	Habenaria
Limodorum tuberosum	Calopogon pulchellus
Linaria Linaria	L. vulgaris
Lithospermum linearifolium	L. angustifolium
Lolium italicum	L. multiflorum
Lotus	Hosackia
Lycium vulgare	L. halimifolium
Lycopersicum Lycopersicum	L. esculentum
Lysias Hookeriana	Habenaria Hookeri
Lysias orbiculata	Habenaria
Macrocalyx	Ellisia
Malus ioensis	Pyrus
Malus Malus	Pyrus
Malus Soulardi	Pyrus
Matteucia Struthiopteris	Onoclea
Meibomia	Desmodium
Melica diffusa	M. nitens
Melica parviflora	M. Porteri
Meriolix serrulata	OEnothera
Mesadenia reniformis	Cacalia
Micrampelis	Echinocystis
Moeringia lateriflora	Arenaria
Monarda mollis	M. mollis (in part)
Monarda scabra	M. mollis (in part)
Monniera	Bacopa
Morongia	Schrankia
Muhlenbergia diffusa	M. Schreberi
Nabalus	Prenanthes
Naumburgia	Lysimachia
Nothocalais	Agoseris
Onagra biennis	OEnothera
Onagra strigosa	OEnothera muricata
Onosmodium molle	O. occidentalis (in part)
Opulaster	Physocarpus

Opuntia humifusa	O. Rafinesquei
Oryzopsis melanocarpa	O. racemosa
Osmunda spectabilis	O. regalis
Oxalis Bushii	O. corniculata (in part)
Oxalis corniculata	O. corniculata (in part)
Oxalis cymosa	O. corniculata (in part)
Oxalis rufa	O. corniculata (in part)
Oxygraphis Cymbalaria	Ranunculus
Panicularia	Glyceria
Panicularia americana	Glyceria grandis
Panicularia brachyphylla	Glyceria fluitans
Panicum cognatum	Leptoloma
Panicum macrocarpon	P. latifolium
Panicum proliferum	P. dichotomiflorum
Parosela	Dalea
Parthenocissus	Psedera
Peramium	Epipactis
Phegopteris, Phegopteris	P. polypodioides
Philotria	Elodea
Phragmites Phragmites	P. communis
Poa flava	P. triflora
Polycodium stamineum	Vaccinium
Polygala virescens	P. sanguinea
Polygonum camporum	P. ramosissimum
Polygonum emersum	P. Muhlenbergii
Polygonum robustior	P. acre
Polygonum incarnatum	P. lapathifolium
Potamogeton lonchitis	P. americanus
Potamogeton Nuttallii	P. epihydrus
Pteridium	Pteris
Pulsatilla hirsutissima	Anemone patens Wolfgangiana
Pyrola rotundifolia	P. americana
Quamassia hyacinthina	Camassia esculenta
Quamoclit Quamoclit	Ipomoea
Quercus acuminata	Q. Muhlenbergii
Quercus minor	Q. stellata
Quercus platanoides	Q. bicolor
Quercus Schneckii	Q. texana
Ranunculus ovalis	R. rhomboideus

Ratibida	Lepachys
Rhus aromatica	R. canadensis
Rhus Cotinus	R. cotinoides
Rhus hirta	R. typhina
Ribes rubrum	R. vulgare
Roripa	Radicula
Rosa arkansana	R. pratincola
Rosa lucida	R. virginiana
Rubus procumbens	R. villosus
Rubus strigosus	R. idaeus aculeatissimus
Rumex salicifolius	R. pallidus (in part)
Rumex salicifolius	R. mexicanus (in part)
Sagittaria cristata	S. graminea
Sagittaria rigida	S. heterophylla
Salix Bebbiana	S. rostrata
Salix interior	S. longifolia
Salmonia	Polygonatum
Sambucus pubens	S. racemosus
Sassafras Sassafras	S. variifolium
Savastana	Hierochloe
Scutellaria cordifolia	S. versicolor
Scutellaria incana	S. canescens
Sibbaldiopsis tridentata	Potentilla
Sideranthus	Aplopappus
Sieversia ciliata	Geum triflorum
Silene alba	S. nivea
Sinapsis	Brassica
Solidago flexicaulis	S. latifolia
Solidago rigidiuscula	S. speciosa angustata
Sophia pinnata	Sisymbrium canescens
Sorbus Aucuparia	Pyrus
Sorghastrum avenaceum	S. nutans
Spartina cynosuroides	S. Michauxiana
Spathyema	Symplocarpus
Sporobolus cuspidatus	S. brevifolius
Sporobolus longifolius	S. asper
Stenophragma Thaliana	Sisymbrium
Symphoricarpos Symphoricarpos	S. orbiculatus

Syndesmon	Anemonella
Synosma suaveolens	Cacalia
Syntherisma	Digitaria
Taraxacum Taraxacum	T. officinale
Thalesia	Orobanche
Thalictrum purpurascens	T. dasycarpum
Thaspium trifoliatum	T. aureum atropurpureum
Tricuspis seslerioides	Tridens flavus
Trifolium aureum	T. agrarium
Triphora	Pogonia
Unifolium	Maianthemum
Uvularia sessilifolia	Oakesia
Vaccaria	Saponaria
Vagnera	Smilacina
Verbesina	Actinomeris
Vicia linearis	V. angustofolia
Washingtonia	Osmorrhiza
Zygadenus elegans	Z. chloranthus

ECOLOGICAL CONDITIONS DURING LOESS-DEPOSITION

B. SHIMEK

The climatic and other physical conditions under which the deposition of our American loess has taken place have invited both study and speculation ever since scientific observers entered the Mississippi Valley. The result has been a varied assortment of hypotheses and conclusions relative to the agencies which have been concerned in the work of deposition, duplicating in fact the diversity of views concerning the origin of the loess of Europe and China.

For more than half a century after the publication of Cornelius' paper in 1818 (22)[1] there was practical unanimity in the acceptance of the subaqueous mode of deposition as most plausible. Many modifications of the fundamental concept that the loess was formed in water were, however, presented by various writers.

Cornelius himself regarded the "clays" (now known as loess) of Natchez, Mississippi, as alluvial, and this view was widely accepted by a distinguished line of geologists until comparatively recent time, swollen streams being regarded as the agency of transportation and deposition by most writers (7, 16, 18, 21, 24, 42).

Some, however, have regarded the deposit as lacustrine, dammed rivers or thawed basins in glacial ice forming the necessary lakes (6, 19, 20, 23, 26, 34, 38, 41, 43, 65, 68, 69, 70, 71, 74); still others connected it with outwash from the retreating front of the glaciers (5, 12, 13, 35, 36, 44, 47, 72); and a few even regarded it as marine (30, 33).

When Richthofen in 1870 (45) presented his first suggestion of eolian origin for the great loess deposits of China, and followed it with a series of papers in which he set out his views

[1]The numbers in parentheses throughout this paper refer to the bibliography.

more fully (especially in 46), there was developed a general disposition not to accept this explanation for the American loess, however plausible it might appear in China where adjacent deserts could furnish enormous amounts of dust.

Richthofen based his conclusion that loess was of eolian and not aqueous origin chiefly on the varying altitudes at which it occurs, on the absence of stratification, on the fauna consisting of land shells, and on the presence of root-marks.

The most vigorous objection to this view was expressed by Todd in a paper (widely approved at the time by American geologists) published in 1879 (66), in which he attempted to show that the inequalities in altitude in our loess could be accounted for by assuming its deposition in the huge Lake Missouri, presumably covering all our loess area; that there is lamination if not stratification in the loess; that there are "semi-aquatic" and aquatic shells in the loess; that root-marks in the loess are formed by deep-rooted modern plants; and that the loess resembles the present deposits of the Missouri, while its deposition would require a great elevation on the seaward side to keep out moisture.

Curiously, every one of these arguments fails. If a great lake covered the loess region there were no immediate land-surfaces on which the land shells could develop; there is lamination in the loess, but it follows surface contours after the dune fashion; the shells called "semi-aquatic" by Todd are strictly terrestrial, and the one aquatic pulmonate, *Limnaea humilis,* which he mentions, is very local and not common in the loess; there *are* buried root-marks as is shown in many sections in the Upper Mississippi Valley (for examples see 60, pl. VII, fig. 1); only some of the present deposits of the Missouri resemble loess, and they have been washed down from the bordering loess bluffs; and there is no need of presuming that desert areas had to be created by great elevations to account for the source of loess dust.

The greatest obstacle to the aqueous concept of loess-deposition is presented by the wide prevalence within it of the shells of terrestrial mollusks. The force of this obstacle was weakened in the minds of many by misstatements with which references to these fossils fairly bristle, and which must have resulted from a lack of first-hand knowledge of the habits and character of this fauna.

Thus, Humphreys and Abbot (31) speak of "vast numbers of freshwater shells," Foster (26) states that the shells are all freshwater; Bannister (3, 4) and Green (28, 29) speak only of freshwater shells; while a large number of earlier (and some more recent) writers place the emphasis on the aquatic species by referring to "freshwater and land shells" (8, 37, 74), or, in one case (37), to "lacustrine, fluviatile, amphibious and land shells."

In some cases the habits of the fossil species have been given incorrectly. Thus *Helicina occulta* and *Pomatiopsis lapidaria* (9, 10, 11, also 52, 56, 57) have been repeatedly listed as aquatic (though both are truly terrestrial) simply because they have the operculum of our aquatic prosobranchs. The species of Succinea are frequently listed as "amphibious" or "semi-aquatic" (24, 38). This designation might apply only to one species, namely, *S. retusa*, and that is exceedingly rare in loess. The species which predominate in the loess, namely, *S. ovalis, S. avara,* and *S. grosvenori,* are strictly terrestrial, the last especially occurring in dry, often high places.

In many cases the references to the abundance of the few aquatic pulmonates which have been found in the loess have been careless or exaggerated. Thus, Todd (66) states that *Limnaea humilis* is "quite abundant" in the western loess. The experience of the writer, covering more than 50 years in the field, has shown that all the forms which have been included under that name are very local, quite rare, and not scattered through the loess, but restricted to belts or pockets which represent the bottoms or edges of buried shallow ponds (50, 51, 52). Baker (2) reports a related species, *Lymnaea (Fossaria) parva* as "common" in a loess exposure in the S.W. 1/4, S.W. 1/4, Sec. 14, T. 5 N., R. 4 E. As a matter of fact, the shells of Lymnaea in this exposure are practically, if not wholly, restricted to narrow belts or lenses of material which is not loess, and which probably represents successive edges of a pond, or the border of a sluggish stream. In 1880 Call (8), in a paper in which he states that the "lacustrine origin (of the loess) is now a quite generally conceded point," reports Physa, Limnophysa, Planorbis, and perhaps Ancylus, as "found throughout the loess mingled with land shells—." Physa and Planorbis are exceedingly rare in the loess, and Ancylus is scarcely known, while Limnophysa (Lymnaea, etc.) is very local and restricted as noted above. All these genera include freshwater pulmonates which usually live in shallow ponds, and if more than a rarely occasional shell is present, they are found in belts or pockets suggesting the bottom or edges of shallow ponds or sluggish streams (50, 51, 52). Other specific cases might be cited, but these will serve to illustrate the point.

Another misleading factor has been the frequent reporting of fossils from the loess when in reality they belonged to some other formation, geological or human.

Most if not all of the vertebrate "loess" fossils of the Mississippi Valley are of this type; Aftonian fossil shells have been so reported; alluvial and lacustral deposits have furnished their quota; human burial places have been drawn upon; and perhaps most influential of all has been the supposed evidence of loess mussels (Unionidae) which really came from Indian mounds! (25, 51, 62)

One reason for this historical reference to the prevailing views mostly of a half-century ago lies in the fact that there is still a tendency in some quarters to exaggerate the abundance, wide distribution, and significance of the freshwater shells which occur in the loess. In numbers they are insignificant when compared with the land forms; they are limited in distribution and practically restricted to what are manifestly pond or slack-water beds; and they are pulmonates which live in shallow waters or at their borders, and may be found in insignificant ponds often on uplands, such as might easily have been buried ultimately in loess dust.

The advocates of water-deposition have been hard put to it to explain the presence of the land shells in the deposit. Kingsmill (33), in his comments on Richthofen's first paper on the loess of China, suggested that "a shell or other animal relic has only to drop into a fissure or be carried down by a stream of water during a flood," and practically the same thought was expressed by Todd somewhat later (66). Unfortunately for this view the loess does not fissure sufficiently to admit shells to all parts of the fossiliferous beds, and the shells never appear in vertical seams, but are more likely to show a horizontal arrangement.

It should be noted that the few who have attempted to account for the present condition of the loess by a gradual downward decomposition, as Wood (71), or degradation, as Todd (67), would encounter the same difficulty in accounting for the shells in the loess.

The more common explanation has been that the land shells were washed into the loess-depositing water from adjacent lands, but this view encounters many obstacles.

1. The water-theory postulates either large, persisting lakes, or periodically swollen streams. If the former, then objects as heavy as some of the land shells would not be carried far into the lake, and should be deposited chiefly near its shore. No such shore lines are detectable, nor are the fossils distributed in a way that would suggest either washing into the border of the lake or floating over it as drift,—in the latter case without the accompaniment of silt.

If the latter alternative, the swollen streams, is contemplated then we must consider that to deposit loess in the highest places would require such enormous volumes of water that to expose land surfaces in time for plants and snails to develop powerful currents would be necessary, and these would not be restricted only to the carrying of the fine materials of the loess. The loess is too uniform in texture for this view.

2. Both the vertical and horizontal distribution of the shells in the loess is consistent with that of the modern shells on the surface, and not with that of drifted shells. This has been brought out by the writer in a number of papers (49, 52, 53, 54, 57, 61, 63, 64) and subsequent observations have only served to emphasize the conclusion.

3. If the loess was deposited in water and the land shells were washed into it from higher places, then the loess and the shells should be chiefly on the lower slopes or flats. As a matter of fact, both are most abundant on the highest parts of the ridges in most of the region of well-developed loess.

4. The absence of silt from the inner spire of perfect specimens of loess shells is noteworthy. Fuller and Clapp (27) have objected to this evidence on the ground that this would be included only after prolonged rolling. It is evident that these authors gave little attention to a comparison of land shells carried by running water and those which die and remain on higher ground. Many of the former, especially if submersed, are sure to contain silt, while the latter, like the shells of the loess, will be free from it.

5. *Helicina occulta* is one of the most common and most widely distributed fossils of the loess. Although living on upland wooded slopes, hence terrestrial, it is provided with an operculum. This operculum is drawn a short distance into the body-whorl when the "foot" of the snail is withdrawn into the shell. Not infrequently this operculum is found lying within the body-whorl of fossil specimens. This operculum is detached from the soft parts very soon after the death of the animal, and would not be left within the shell if the latter should be carried by a stream. It is, moreover, of interest to note that in many years' experience the writer has very rarely found drifted modern shells of this species along streams, even where it is locally quite common. The reason for this is probably found in the habits of this snail. It is always found on deeply wooded slopes where the erosional and carrying power of water is slight even during violent storms, and few shells are carried away, even when dead (52, 56, 57).

Fuller and Clapp (27) objected to this evidence and stated that the preservation of the operculum simply means that the shell was buried before the animal decayed. This objection will not stand for three reasons: This snail when living will not float, and a current strong enough to carry it along the bottom would carry coarser material (of which there is always an abundance in the loess region, though not in the loess) than that of the loess; living snails are very rarely washed from the uplands, the empty shells sometimes being carried into the alluvium; and this species particularly (the chief and almost only species to be considered in this connection) rarely finds its way into stream-drift even when dead, as noted above.

As the eolian concept gained ground the remaining advocates of the aqueous theory (for the most part without first-hand knowledge of the subject) avidly grasped at the misinformation and its consequent misinterpretation beclouded the question even to this day. (For a more detailed discussion of this feature of the subject see the writer's papers, 53, 62, etc.)

Though Richthofen's explanation of the origin of the loess was in disrepute with American geologists, at least so far as American loess was concerned, the writer ventured to present a paper (51) in 1896 in which the origin of the loess was ascribed to eolian agencies. The plausibility of the same explanation was suggested, but not urged, as early as 1890 (49). At that time the writer had not seen Richthofen's papers, and from others had gained the impression that his theory primarily postulated the proximity of large deserts from which the enormous quantities of dust could be derived,—a condition which did not exist in our own country.

This paper was followed by a number of others supplementing and enlarging upon the first (52, 53, 57, 58, 60, 61, 62).

In all the writer's earlier papers the emphasis was placed on the significance of the fauna, though various other, especially physical features were brought out.

Thus it was shown that the loess appears at various altitudes; that in horizontal distribution it is distinctly related to broad stream valleys with large bars at low water, or to sand-dune areas; that along broad valleys it is thicker in the main on the east side; that the particles of which loess is composed are coarser on the east side of the broad valleys; that where lamination is evident it resembles that of dunes rather than of water-deposits; that in practically treeless country the loess is thickest on tops of the ridges, thus resembling snow-drifts formed when the wind is not too strong, but in forested areas it forms a more uniform blanket; that lime-nodules and iron root-tubes may be formed around living roots and are not related to loess-deposition; that there are several interglacial loesses; and other features of minor importance, but related more or less to the genesis of the loess.

Some of these facts had been observed by others, notably those having to do with distribution and structure, but in each case personal observations at least added confirmation.

While the fauna was emphasized its relation to the flora was considered from the first on the basis of personal field-observations, with a growing conviction that the chief value of the mollusks of the loess was as indicators of ecological plant conditions, and this conclusion was presented in several papers, being especially emphasized in "The Genesis of Loess a Problem in Plant Ecology" (60) and in "Land Snails as Indicators of Ecological Conditions" (64).

The value of this molluscan fauna of the loess for purposes of determining climatic and habitat conditions lies in the fact that it consists of species still living[3] whose habits and dependence upon living plants are well known. It has been suggested by Kay (32) and others that the fauna was perhaps able to adapt itself to varying climatic conditions of considerable range. This might be true of individual species, but in the light of what is known concerning the habits and distribution of the species composing it, it is inconceivable that the entire fauna could adapt itself to the great changes in climate which would be involved.

The statement (*ibid.*) that "some fossils of the loess have been interpreted as demanding conditions as temperate as the conditions of the present time" should also be corrected, for it is not merely some species but the *entire fauna* which leads to the conclusion stated. It may furthermore be reiterated that there is no warrant for the use of such names as *gelida* (see Baker 2, etc.) for loess forms to express varietal deviation from a type, as there is absolutely no evidence to show that cold was responsible for such deviation.

In 1902 the writer (55) called attention to the three requirements for loess deposition, namely, a source of supply, a transporting agency, and an anchorage for the dust. The first is found in river-bar, sand-dunes, and in lesser degree in any area not closely covered with vegetation. The second is wind, in our territory prevailing from the southwest in summer and the northwest in winter. The third consists of plants

[3]The recent efforts of F. C. Baker (2, and other papers) to name variants as distinct species or varieties, which then would appear as though extinct, is far-fetched, for these forms are well included within the range of variations shown by the living forms.

which form an unequal covering for the reception of the dust.

Evidence that plants were abundant during loess-deposition is briefly set out in the following four sections:

1. The usually equal or greater thickness of the loess over tops of ridges indicates that during all the period of deposition an anchorage prevented the loose, soft materials of the loess from washing away. Plants alone could furnish such anchorage.

2. The uniform thickness of the loess in many places suggests its deposition in the shelter of taller vegetation,—the forest. The uniform blanket of snow in the forest illustrates the manner of deposition.

3. Abundant root-marks, chiefly in the form of iron-tubules, in many parts of the loess are proof of an abundant vegetation. They are not always in the upper parts of the loess, as Todd (66) tried to show, but they are often buried, under other strata of loess, or even under drift, indicating an earlier vegetation.

The statement of Fuller and Clapp (27) that the perfection of the laminae of the loess shows that they have never been penetrated by rootlets, and hence there were no plants and no food for snails, is without warrant. It is contradicted by the buried root-marks noted above, by the frequent maintenance of fine lamination (a character not always shown by loess) where there is distinct evidence of root penetration, and by the distribution of the shells of herbivorous snails through the deposit which is distinctly not that of drifted shells. The reason for the frequent absence of older root-marks from the upper portions of the loess is evidently due to the modern flora which absorbs the older roots as they decay.

4. The most convincing evidence of the presence of an abundant flora is furnished by the fossil land snails, and they show not only the presence of an abundant vegetation, necessary for food and shelter, but they also indicate floral type areas, as was shown by the writer in various papers (50, 51, 53, 54, 56, 58, 60, 61, 62, and especially 64).

Fuller and Clapp (27) report that in Indiana fossils are found in the loess only up to an altitude of about 500 feet, and they regard this as evidence that water deposited the

loess and shells at lower levels. The true explanation evidently lies in the absence of forests from the higher levels, and the consequent absence of the forest-loving snails. Throughout the Upper Mississippi Valley treeless prairies occupied the more elevated, and hence more exposed areas, and land snails did not thrive upon them.

The question is frequently asked, if vegetation, and especially forest vegetation, was so abundant why do we not find evidences of logs and other vegetable structures? In 1895 the writer (51) made observations near Solon, Iowa, on dust accumulation in the forest during a very dry season, one of several consecutive dry seasons, when an unusually large amount of dust was being transported. A layer of dust approximately 1 mm. in depth covered everything. Some of this was probably blown away again, and other added, but it would probably be a liberal estimate to assume that the net increment was 1 mm. for the season. If a log one foot in diameter lay upon the surface where this increment is being slowly accumulated it would take 300 years to just cover the log if the latter resisted decay. But the log would disappear long before this amount could be accumulated,—and so with all other vegetation. Vegetable structures are preserved only in very wet places, not in the dry situations in which loess is deposited. The same undoubtedly applies to animal remains other than shells of mollusks.

It should be added that the very large iron-tubules (root-marks) which are frequently found in buried loess indicate large roots, probably those of trees.

The foregoing discussion is largely historical, and it is not intended as a criticism of those who held the older views (some of them changed these views as was shown in later papers) but rather as a presentation of the successive steps in the development of this problem.

So long as the aqueous theory of loess-deposition was accepted there were insurmountable difficulties in the way of explaining the ecological conditions under which the land-snail fauna and its concomitant flora could be developed.

The general acceptance of the eolian agency has simplified this part of the problem, as the close connection between climatic conditions, flora and terrestrial molluscan fauna is obvious (64).

For some years, however, the aqueous and eolian agencies have had a rival, more or less insistent, in glacial action, and even where loess was not considered a direct product of the glaciers, efforts have been made to connect its formation with immediate post glacial conditions while the climate was still cold, or at least distinctly cooler than at present (1, 5, 12, 13, 14, 16, 17, 35, 36, 40, 44). Here again the land snails form a barrier which the advocates of glacial or sub-glacial conditions have found it difficult to pass.

In 1879 Todd (66) concluded that because the pond snails of the loess were smaller and few in number the waters were cold, but that, because of the numerous land snails of our present climate, the lands were moist, with their temperature not differing greatly from the present!

A more elaborate effort to show that loess was deposited under near-glacial conditions was made by McGee and Call (40) in 1882. They assumed that the loess was deposited in ice-bound basins or lakes, and supported this in part by the claim that the fauna was depauperate. A plate[2] is included to show this depauperation, but several significant errors were made. The probability is that the two fossil species of Limnophysa do not belong to the species named, and are therefore being compared with modern specimens of different species. Neither the modern nor fossil shells of *Patula striatella* and *Helicina occulta* are of average size, and the difference in the plate is exaggerated. Figures 25-29 are supposed to represent the same species, *Stenotrema monodon,* but figures 28, 29, the two modern shells, represent *S. fraterna,* a much larger species. The figures of *Patula strigosa* similarly exaggerate the difference between fossil and modern forms, for the fossils are much more nearly approached, indeed about equalled, by modern representatives of this extremely variable race. A similar exaggeration appears in the figures of *Succinea obliqua* (now *ovalis*). Figure 35 represents a very large specimen from New York,—much larger than any that the writer has seen in Iowa. There is, in fact, very little difference between the fossil and modern forms of this species in our territory, especially where the latter come from higher or drier grounds.

[2]This plate was drawn by the present writer while a student, though no credit is given for it in the paper. The shells were later destroyed in the mails.

This depauperation (so greatly exaggerated in the plate), has been accepted as evidence of a cold climate by a number of authors, and the error has found its way into at least one textbook (25). The writer has repeatedly shown that such depauperation as exists may be traced toward the dry regions of the west, being evidently due to seasonal drouth rather than cold (53, 57, 61).

Many compromises, or combination causes, have been offered, but many of these include deposits other than loess and it is difficult to consider them without taking them up individually. It is sufficient to note that quite a number of these compromises include the condition of a cold climate.

Suffice it to say that the fossils are fatal to every explanation which postulates a climate distinctly colder than the present. Unfortunately, some advocates of a cold climate do not attempt to explain the presence of the shells, but ignore them, or brush them aside as "little shells" of little importance.

The disposition to connect the formation of loess closely with glacial conditions is probably due in large part to the common linking of loess with the Iowan Drift. Calvin (13, 15) observed that there is quite an accumulation of loess just outside the Iowan border in Iowa, and the same observation has been made in Illinois since.

Unfortunately, the conclusions based on a rather limited area have been applied to the entire loess field. The two greatest areas of loess-deposition are found in western Iowa, along the Missouri, and in central Nebraska, along the Platte.

In the Iowa field the loess is thickest in the bluffs bordering the valley of the Missouri, and tapers down to a comparatively thin deposit near the border of the Wisconsin Drift in Carroll County. It here probably approaches close to the old buried border of the Iowan, but by its thin edge,—the great bulk lies quite a distance to the southwest and west. If there was any connection between this greatest of our loess deposits and the Iowan it might be expected that the bulk of it would be nearer the Iowan instead of the reverse. Its evident source is shown in Plate I, Fig. 1.

Even more convincing is the loess of central and southern Nebraska, which has received so little attention from students of the problem. It was mentioned by Todd (66), but Savage (48) in a paper which admirably sets out certain phases of the loess problem, errs in stating that loess extends only a few miles west of the Missouri. The writer has found typical fossiliferous loess not only at Lincoln, Platte River Junction, Abie, Hooper, Bremer, West Point, and Clarkson, all localities well back from the Missouri River, but also at North Platte in central Nebraska, along the Platte River, and at Oxford and Atlanta in the south-central part of the state, along the Republican River. The manifest source of the material is shown in Plate I, Figs. 2 and 3.

The deposit along the Platte is much bulkier than that along the border of the Iowan in Iowa, and that along the Republican quite equals it. Yet it would be very difficult to establish any connection between these deposits and the Iowan Drift, while the relation to the broad bars of the Platte and the Republican is obvious.

It is interesting to note that of the 2130 fossils which the writer collected in the North Platte and Republican areas, the great majority, or 1972, belong to the species *Vallonia gracilicosta, Gonyodiscus shimekii, Pupilla muscorum, Succinea grosvenorii,* and *Succinea avara,* these and the remaining species all occurring also in the loess of Iowa.

With the exception of the widely distributed *Succinea avara,* the remaining species named look westward for their modern prototypes, though the Vallonia and *Succinea grosvenorii* still live in Iowa, the latter only in the western part.

The southern loess also fails to connect definitely with the Iowan, and that is especially true of that which lies west of the lower Mississippi, as on Crowley's Ridge, Arkansas. It is possible that some of the material might have been washed down from the Iowan Drift in the north, but it is probable that the bulk of the northern contribution came from the massive deposit along the Missouri to which reference is made above.

There seems to be no adequate reason for the wholesale linking of the bulk of the loess with the Iowan, and there is certainly no warrant for the belief that loess was deposited in a cold climate (49, 56, 57, 59, 61).

On the contrary, it is more likely that loess deposition did not begin until the glacial ice retreated far to the north. After the recession of each glacial sheet the area from which it retreated was soon covered with a swamp and prairie vegetation such as covered the Wisconsin Drift lobe in Iowa before its settlement. The streams were sluggish, few bars were formed or exposed, there were many kettleholes (see Plate II, Figure 3), and the dust supply was limited. A long period of time would be required to cut and widen the river-channels so that extensive bars would be formed, the ice in the meantime retreating far beyond the loess territory. This period of time would be longest in the case of the Kansan (which even today has not finished this process in northwestern Iowa, see Plate II, Fig. 2, and in more limited areas in the southern part) because it covered the entire state, during which important changes occurred in the Kansan itself, and it would be correspondingly shorter for the drift sheets which only partly covered the state (see Plate II, Figs. 1 and 3), since the deeply eroded Kansan offered readier drainage-outlets.

The loess, instead of being closely connected with the ice sheets, was evidently widely separated from them in time.

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PLATE I

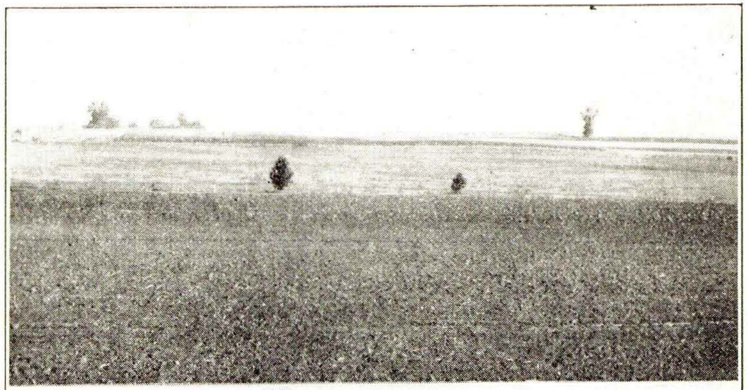

Figure 1

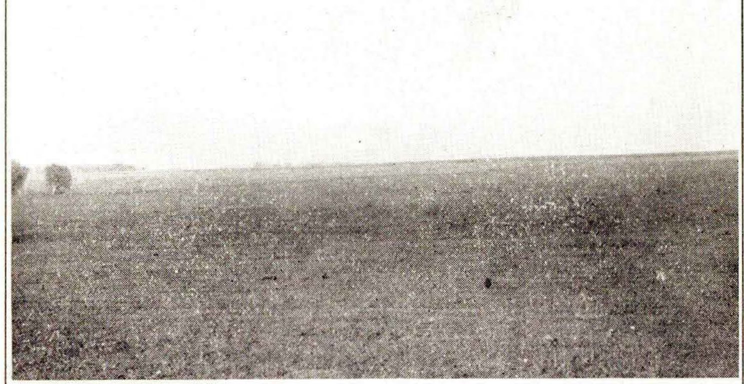

Figure 2

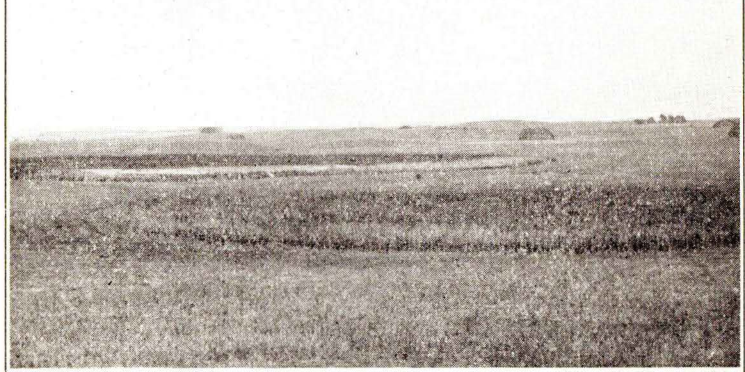

Figure 3

EXPLANATION OF PLATE I

Little Eroded Drift Surface From Which Little Dust Is Derived—Originally Prairie

Fig. 1—A bar consisting of sand and fine yellow silt, along the Missouri River, Harrison County, Iowa. The valley is bordered with loess bluffs.

Fig. 2—Bars in the Platte River at North Platte. Loess bluffs border the south side of the river.

Fig. 3—Bars in the Republican River near Oxford, Nebraska. Loess bluffs border the valley.

PLATE II

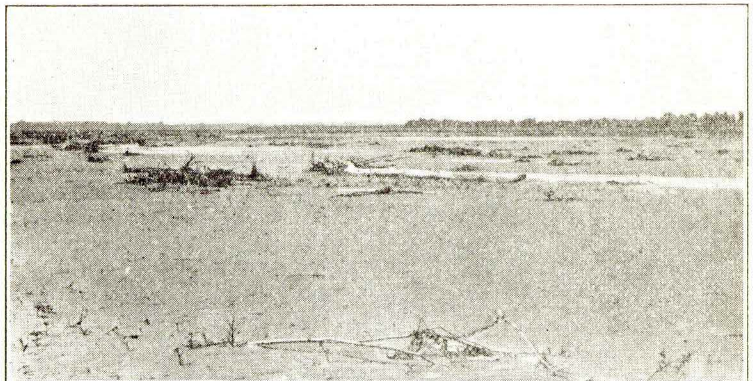

Figure 1

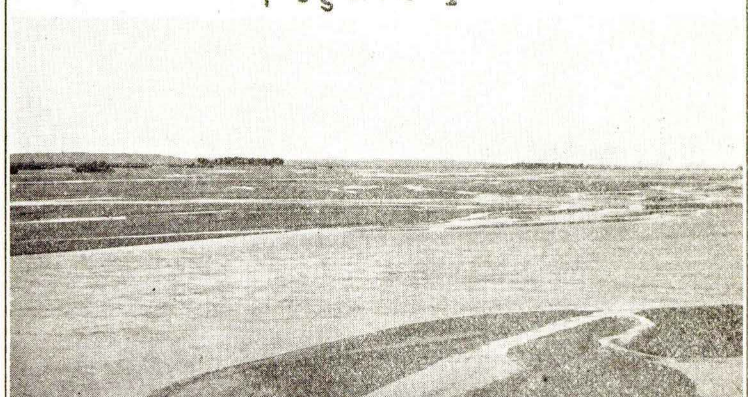

Figure 2

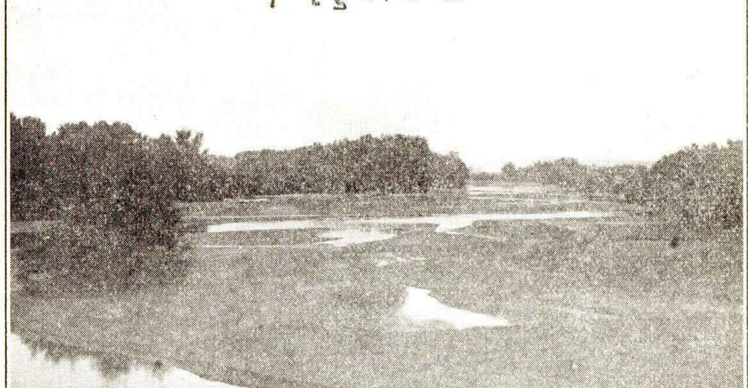

Figure 3

EXPLANATION OF PLATE II

River-bars, the Source of Loess Dust

Fig. 1—Iowan drift in Bremer County, Iowa.

Fig. 2—Kansan drift in O'Brien County, Iowa.

Fig. 3—Morainic Wisconsin drift surface, with two kettleholes.

SYNOPTICAL INDEX