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RECENT ADVANCES OF THE FOREST IN IOWA*

W. E. LOOMIS AND A. L. MCCOMB

At the time of settlement Iowa was definitely a prairie state with less than 20 per cent of its area covered by timber. Such a distribution of vegetation, coupled with short time observations, has led to the general assumption that prairie is the climax vegetation of the state. The writers have recently (7) assembled evidence that the present climate of Iowa is capable of supporting a forest climax. Prairie is therefore a subclimax associates maintained by its early establishment and by the marginal nature of the climate, but particularly by a combination of soil factors favoring prairie over woodland.

The establishment of our classification depends upon evidence that forest is not only able to survive in Iowa, but that it has been able to invade the prairie at an appreciable rate under undisturbed conditions. Additional evidence of the spread of forest in Iowa, both after and before settlement, is presented here.

FOREST INVASION IN WESTERN IOWA

A very striking invasion of former fields and pastures, originally covered by prairie, is occurring in western Iowa at the present time



Figure 1. Newly established woodland on former prairie in central western Iowa. Trees mostly burr and red oak under 50 years of age. Only scattering trees in prairie covered this area in 1853.

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(Fig. 1). *Quercus macrocarpa* and *Ulmus americana* with associated species are invading numerous areas of a few hundred to several thousand acres each in Harrison, Monona and Woodbury Counties. Invasion is most marked on the less intensively farmed lands of the Knox-Monona soil association. Very few trees, even in closed forests, are more than 50 years old, and invasion seems to have been increased rather than decreased by the recent dry cycle.

It is noteworthy also that little or no drought damage has occurred in undisturbed forest, although injury in woodland pastures has been severe to complete. It seems probable that trampling by stock has reduced soil aeration below the point necessary to maintain the root growth needed for forest survival in dry seasons. The importance of soil aeration, suggested here, can be observed throughout the prairie peninsula extending from Iowa across Northern Illinois and Indiana to northwestern Ohio. Poorly aerated soils are invaded slowly and by scrubby, xeric forest species.

Notes of the original land surveyors in the early 1850's show that forest in the Missouri River Counties of western Iowa was limited to scattered brushy groves. Some of these were in protected areas, but many were noted as on exposed ridges. In addition young burr oak trees were scattered throughout the grasslands, "evidently invading the prairie in spite of the fires which burn off the grass." These notes indicate that forest was invading western Iowa at the time of settlement, and these scattered seed trees have formed the basis of the present invasion. Invasion has undoubtedly been accelerated by cultivation and grazing of marginal lands which destroyed or disturbed their original prairie cover. The deep, well aerated but retentive loess soils of the region with their relatively low nitrogen content (10) are also favorable to forest.

The sharp, hog-back ridges of the loess hills are usually not forested, perhaps because of poor infiltration of rainfall, but the most exposed portions of smoother ridges have been covered with closed and stable forest. The evidence seems to warrant the conclusion that the present climate of western Iowa will support an oak-hickory forest climax providing soil factors are favorable. The marginal nature of the climate limits the forest potentialities to deep, permeable soils with good water storage capacities.

FOREST INVASION IN GUTHRIE COUNTY

Guthrie County in southwestern Iowa is partly covered by Mankato (late Wisconsin) drift soils, but primarily by a rather thin covering of Peorian loess which has been eroded away on the slopes to expose the underlying Kansan till. Under prairie vegetation the principle soil type formed on the loess has been Tama (2) while Clinton represents the effects of a considerable period of forest on the same parent material. Shelby has formed under grass on the Kansan till and Lindley under forest.

The soils developed from the same parent material under prairie and under forest are distinctly different. The decaying grass roots

distribute carbon through the surface layers to produce the deep, black prairie soils. The decaying leaves of the forest form a shallow layer of black soil, and their decomposition accelerates the leaching of various minerals from the layer just below, forming a gray, A_2 horizon (Fig. 2). When forest first invades the prairie it grows, of course, on a prairie soil. After a period, which is almost certainly more than 1000 and perhaps more than 3000 years, a forest-soil profile is formed. The presence of forest on prairie soil is, therefore, the best available indication of recent, presettlement spread of the forest.

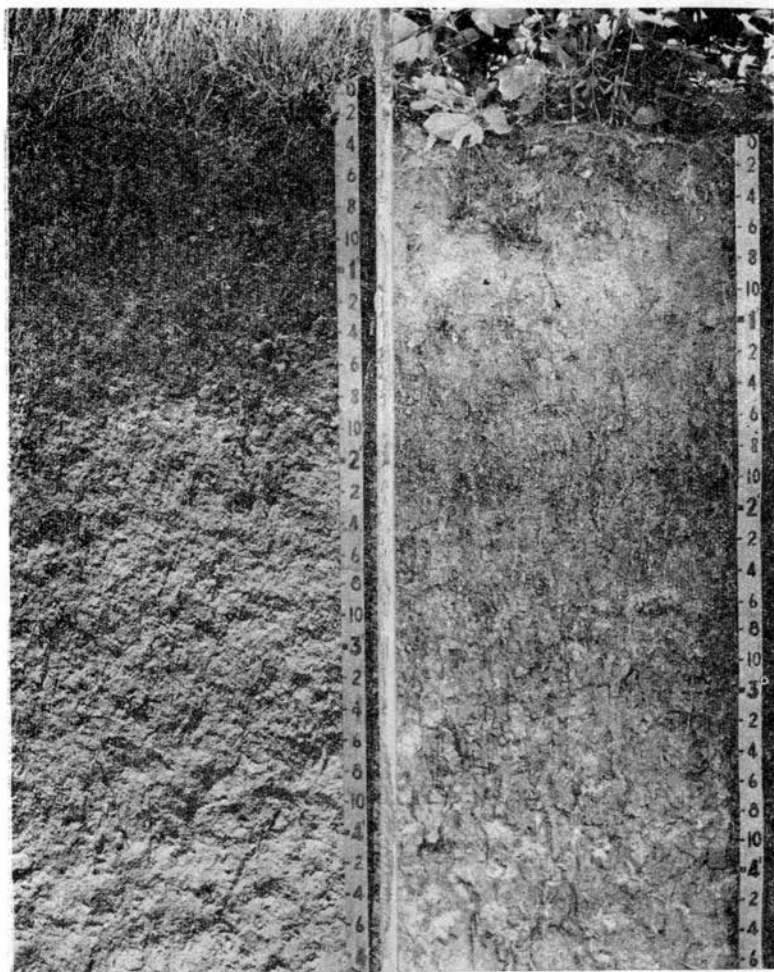


Figure 2. Soil profiles formed from Peorian loess. Left Tama
Published by UNIScholarWorks, 1944. Right Fayette formed under forest. (Photos
by R. W. Simonson).

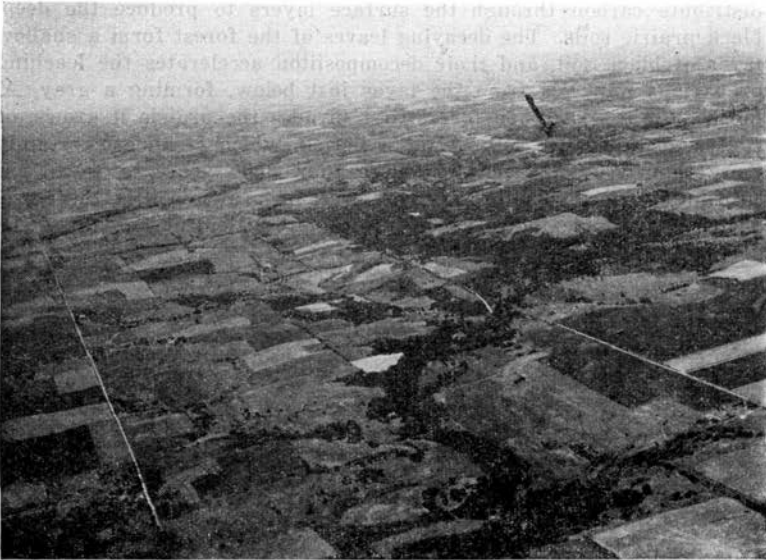


Figure 3. Recently established, presettlement forest in northwestern Guthrie County. Of nearly 5000 acres of original forest only 160 acres, shown at arrow, had been established long enough to form a forest soil profile (*cf.* figure 2).



Figure 4. Newly established forest in western Guthrie County. <https://scholarworks.uni.edu/iopias/vol51/iss1/18> center background in 1850; the remainder was prairie.

The soil survey of Guthrie County (3) shows that 1.2 per cent of the County is covered by Lindley and 0.7 by Clinton, a total of 1.9 per cent forest soil. The surveyor's notes of 1850, however, indicate that 8.1 per cent of the County was covered by forest at the time of settlement. These figures show that the forests of this prairie county had increased 325 per cent in a period so recent that the invaded soils showed no detectable changes.

An area of this presettlement forest is shown in Figure 3. In 1850 forest covered between 4000 and 5000 acres of this land along the Raccoon River. Of the total, 160 acres, or less than four per cent, had been in forest long enough to develop a forest (Clinton) profile. A still more recent advance of the type shown in Monona County is illustrated in Figure 4. Nearly 1000 acres of oak forest and brush pasture is now present in a Union Township area that consisted of 40 acres of brush and scattered seed trees in 1850. No forest soil is mapped in this township.

FOREST INVASION IN CLAYTON COUNTY

Clayton County in northeastern Iowa was covered by the Nebraskan, and the western half of the county by the Kansan ice sheet. Except for a small area in the southwestern corner, the county was unglaciated in late Pleistocene times. The soils are therefore formed of Peorian loess which is eroded on the slopes to expose the underlying Kansan or Nebraskan till, or the original rocks. The soil survey of the county (1) lists the prairie soil as Tama with a lighter phase, stated to represent recent forest invasion, which has more recently been classed as Downs. Forest has formed Lindley on the slopes and Clinton with the closely related Fayette where it has invaded the rolling loess plain.

The loess is relatively coarse and well leached, and therefore adapted to afforestation. The rainfall is 34 inches, and the rainfall-evaporation ratio is the highest in Iowa. Under these conditions we would expect maximum forest invasion, and we find that more than half (53 per cent) of the original loess covering has been in forest long enough to form Clinton or Fayette, forest profiles. The corresponding figure for Guthrie County is 1.6 per cent. Prairie still occupied 25 per cent of the County, however, in strips and isolated bodies on the wider, smoother, loess covered ridges of the Kansan till plain.

Evidence of recent forest advance in two stages is shown in some 32,000 acres of Downs, a partially podsolized prairie soil indicating moderately recent forestation, and a nearly equal area of original timber on soil still mapped as Tama. The surveyor's notes indicate that much of this most recent invasion was not fully closed, being interspersed with plum and hazel thickets. White oak, hickory and other trees were noted in the prairie areas also, either as individuals or in small groves. The impression of recent and continuing invasion of the prairies is clearly given.

Wagner Township lies on the Great Meadow ridge in northwestern Clayton County, and while well drained is not deeply dissected by

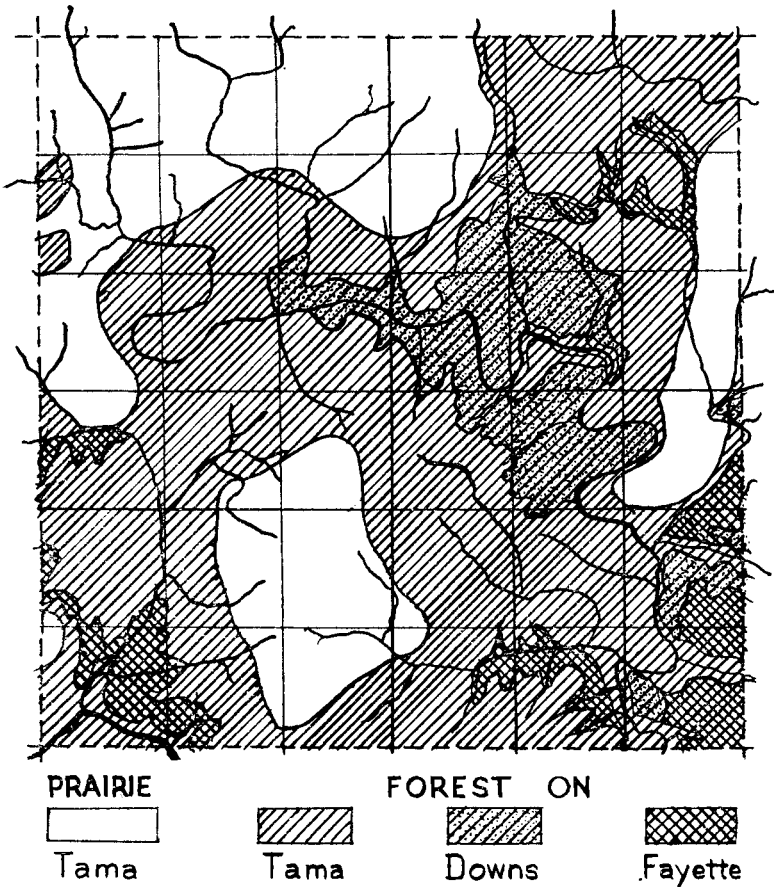


Figure 5. Soils and forests of Wagner Township, Clayton County. The original survey shows 70 per cent of the township in forest, of which 10 per cent was old and one-half so recent as to show no soil changes.

stream beds. Only 10 per cent of the Township shows a well developed forest profile (Fayette). Most of the remainder is Tama or partially degraded Tama (Downs). The forest and major soil type distributions of the township are shown in Figure 5. In 1849 forest covered 70 per cent of the area, and some 11,000 acres of forest had been so recently established as to have had no visible effect upon the soil profile.

SUMMARY AND DISCUSSION

The impression of a recent climatic change obtained from these forest areas, is clearly substantiated by the deliniation of the soil types involved. Both in the Clinton-Downs-Tama transitions and in

the Ames-Clarion distributions of the Mankato drift, the margins of the fully developed forest soils are clear-cut and sharp. Only arrested forest invasion during a considerable period of prairie-climax climate could account for such clear-cut soil type margins. Margins seem distinct also in the intermediate Downs and degraded Clarion which represent more recent forestation. Since the formations on Mankato till and Peorian loess are essentially identical, we may assume that the soil changes represent climatic changes during post glacial times. Other evidence for such changes is obtained from fossil peat deposits in Iowa (5), Ohio (8) and Ontario (11), and from various historical and archeological records from the northern hemisphere (4). The best available estimates of the time intervals involved indicate that the present period of forest invasion and forest-climax climate in Iowa and eastward began some 800 years ago. The preceding 5000 or 6000 years is assumed to have had a prairie-climax climate with the exception of an interval 2000 or 3000 years ago when the advances represented by the Downs soils were made. Still earlier we find a hardwood-forest climate preceded by a boreal climate at the end of the Wisconsin glacial epoch.

On the basis of climate alone we might assume that the prairies of Iowa are relics of a prehistoric xerothermic era. Buried soil (9) and peat (6) profiles, however, indicate that approximately the present distribution of prairie and forest has existed in the State since Kansan and probably since Nebraskan times. Studies of Illinoian till plains and of the Port Hudson-terrace prairies of Arkansas and Louisiana indicate that grass covered plains of fine textured soils resist forest invasion in spite of a forest climate, and that the resistance tends to increase with time and the development of an impervious, planosol profile under the grass. All of the forest invasion cited here has occurred on well drained silt loam or lighter soils. Poorly drained, heavier soils such as Webster and Clyde have rarely been invaded if at all, and the heavier soils of southern Iowa, developed from thin layers of fine textured loess, show little presettlement invasion.

We conclude then, that forest has advanced on favorable soils in Iowa, both before and since the State was settled, and a forest-climax climate is indicated for the present epoch. The loess and glacial till plains of the State, however, are so unfavorable for forest and produced such rank growth of grasses, that it is probable that most of the State would have persisted indefinitely in subclimax or edaphic climax prairie. Cultivation, which destroys the prairie and reduces the high nitrogen content of the soil, may be expected to increase the **spread of the forest in Iowa.**

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