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PAPERS OF THE MICHIGAN ACADEMY OF SCIENCE ARTS AND LETTERS

EDITORS

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VOLUME XXVIII (1942)

"Pusilla res mundus est nisi in illo
quod quaerat omnis mundus habeat."
—SENECA, *Naturales Quaestiones*

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THE FRONTIER OF NEW ENGLAND IN THE SEVENTEENTH AND EIGHTEENTH CENTURIES AND ITS SIGNIFICANCE IN AMERICAN HISTORY

STANLEY D. DODGE

IN DISCUSSIONS of the development of the frontier of settlement in the United States Miss Semple and others have tacitly assumed that the Appalachian Mountains were a serious barrier to the westward movement of the pioneers.[1] The facts upon which this assumption has been made are that from such centers of settlement as Philadelphia the pioneers spread to the base of the first high Appalachian ridges in the course of fifty years after the first arrival of Europeans, and that then, for from fifty to a hundred years, the outer edge of the area of European settlement lay in the Appalachian Mountains. Throughout this period the valleys of the Ohio and its tributaries came more and more under the control of the French operating from their bases at Montreal and Quebec.

The northeastern end of the frontier of settlement in the United States was in New England. An examination of the position of the frontier there will make a better interpretation of the importance of the Appalachians possible, in the first place, because the mountains of New England are not so difficult to traverse as are those farther south, and, in the second place, because the frontier of settlement never lay for any long period in either the Green Mountains or the White Mountains. Only the southern continuation of the Green Mountains in the Berkshire Hills of western Massachusetts acted in any way as a barrier to the progress of settlement.

Let us examine the facts of the settlement of New England. The accompanying map (Fig. 1) shows by its isochrons the dates of settlement of the various sections of the New England states. It is based on the recorded settlement dates of some five or six hundred towns.[2] The settlement of New England started in a minor way about 1610, when agents of English companies began spending the winter as well as the summer on the coast of Maine, but the first real settlements were not made till Plymouth was settled in 1620, Cape Ann in 1623, and Salem about 1627.

In the period from 1630 to 1660 the frontier of settlement advanced rapidly in the southern part of New England. The Connecticut Valley was occupied in 1636 at Wethersfield, Hartford, and Windsor in Connecticut, and at Springfield in Massachusetts. New Haven and Providence were settled in 1636 likewise, and within a few years most of the coast from Boston southwestward to New York was settled and from Boston northeastward as far as the Penobscot River.

After 1660 the settlement was less rapid, with some exceptions. The position of the isochrons for the years just after 1660 shows that no progress was made in Maine,[3] and that there was delay in the advance of the frontier into the eastern upland of southern New England from the vicinity of Boston, and into the western upland from the Connecticut Valley.

The circumstances of this slowing of the advance of the frontier need examination. Three separate nations were contending for the fur trade of the Connecticut Valley. The Dutch at Hartford were soon ejected by the English, who, however, continued the struggle for the possession of the beaver areas. The French were the only formidable foe. From their bases on the St. Lawrence they, with their Indian allies, followed the highways provided by the three principal rivers of New England, the Connecticut, the Merrimac, and the Kennebec. Along these they attacked the frontier settlements. The bloody massacre at Deerfield occurred in 1675, that at Hatfield in 1677, and, in general, from 1670 on the frontier was a dangerous place in which to live. Forts and blockhouses were of little avail; the English were driven back from the most exposed points.

In Maine the French had established themselves at Norridgewock, and for nearly a hundred years they were successful in protecting themselves from all encroachments on the part of the English along the Kennebec River, which was the principal highway to the interior of the province. East of the Penobscot the French controlled almost all the coast as well as all the interior.

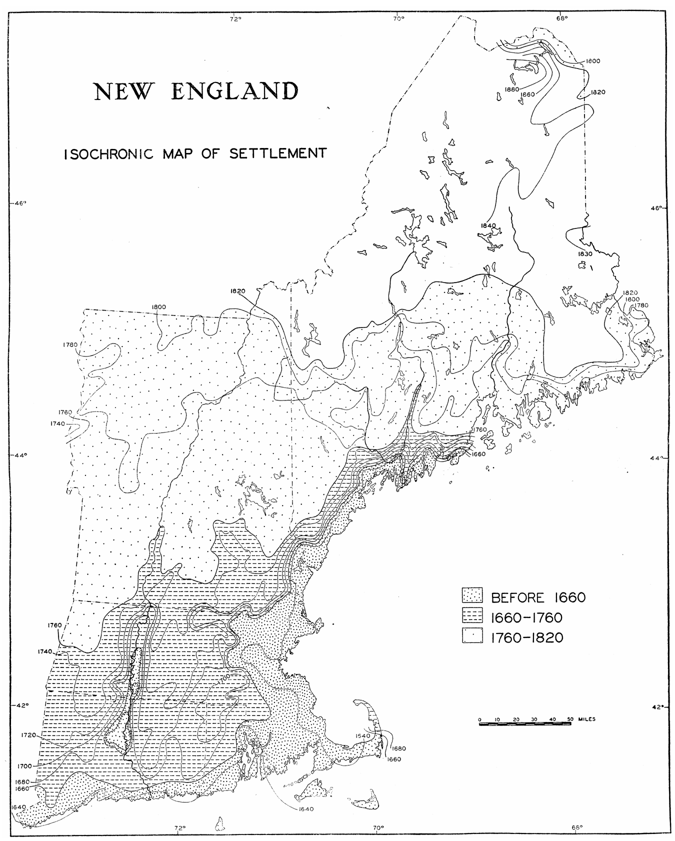

FIG. 1

It was in Maine alone, in the period from 1660 to 1760, that the frontier failed to be advanced at all. Elsewhere by the end of the period settlements had been made up the Connecticut as far as Charlestown, New Hampshire, and up the Merrimac beyond Concord. Toward the end of the period there was a fort up the Kennebec in Maine — Fort Western on the site of Augusta.

At other places settlement was only delayed, not halted entirely, as it was in Maine. It was delayed at the eastern edges of the eastern and western uplands in Massachusetts and Connecticut. In Maine, however, no significant topographic feature may be discerned in the zone in which the frontier rested in the period in which it was stationary.

The short period in which progress of settlement was delayed in southern New England may be explained sufficiently by the fact that the eastern upland was settled largely from the west, and by the consequent fact that the concentration of isochrons on the map in a position coinciding with that of the eastern edge of the eastern upland is merely incidental to the mechanical requirements of cartography. The delay thus indicated needs no explanation, therefore, since it was more apparent than real. In the western upland of Connecticut a similar illusion occurs largely because that area was settled from the south by people moving inland from New Haven along the course of the Housatonic River.

In Maine the explanation involves the consideration of a greater number of factors, for there the failure of the frontier to advance was real and not a cartographical illusion. A solution to the problem may be found among the following points:

1. It was in Maine that the first serious difficulties with the Indians developed, owing to the kidnaping and removal to England of several of them by one of the early exploratory voyagers in 1607.[4]

2. It was in Maine that the French secured greater control by the establishment of posts like that at Norridgewock and those at Castine and Machias, east of the English settlements.[5]

3. It was in Maine that the frontier lay nearer the French base at Quebec, and it was there that the frontier was connected to the French base by the easy natural highway provided by the Kennebec and Chaudière rivers.

4. It was in Maine that the fur trade was ultimately of greater concern than it was farther south, for beaver appear to have frequented the rivers of this state in greater numbers than they did those of the other New England states, at least in the portions of them that were then accessible.[6]

5. It was in Maine that the interest of English merchants in the fur trade persisted, and it was to their advantage to prevent as much as possible any movement into the interior that would interfere with the continuance of a supply of beaver.[7]

We may summarize these five points in the single general statement that the frontier remained stationary in Maine for nearly a hundred years because the French were successful in preventing any encroachment of the English in the area that they considered to be rightfully theirs, and because it was to the interest of the English merchants that the forest of Maine remain a wilderness and the haunt of the beaver.

Which of the five points was really significant in the history of the frontier in New England is explained by events after 1760. In 1755 a concerted attack on the French control of North America was begun. The ill-fated Braddock sought to capture Fort Duquesne at the head of the Ohio River in 1755, and Forbes succeeded in taking it in 1757 and in establishing Fort Pitt in its place. Crown Point on Lake Champlain fell to Amherst and Fort Niagara at the mouth of the Niagara River to Sir William Johnson. In 1759 Quebec was taken. When the treaty of peace was signed in 1763 the French government relinquished control of Canada, in which the principal strongholds had fallen to the English. Almost immediately the dam was broken that had held up the waters of English settlement. The English spread in the next forty years over as much territory in New England as they had been able to occupy in the preceding one hundred and forty. New Hampshire and Vermont, except for two small sections in the extreme north, were settled before 1800, and mostly before 1790. In Maine settlements were made up the Androscoggin, Kennebec, and Penobscot rivers almost to the latitude of the northern boundary of Vermont and New Hampshire.

To support the proposition that it was the French possession of the northern part of the northern states of New England that prevented any advance of the frontier in the period 1660 to 1760 we may adduce two facts. In the first place, once the French menace had been removed settlement advanced rapidly to the boundary of Canada. In the second place, there was no halting of the steady advance of the frontier in the areas less effectively controlled by the French in the southern parts of the uplands of Massachusetts and Connecticut, and for the United States as a whole there was no halting of the movement of people southward from Pennsylvania into the Piedmont of Virginia and North Carolina or into the valleys of the southern Appalachians in Virginia, North Carolina, and Tennessee.

In conclusion, it may be said, therefore, that probably throughout its length the Appalachian barrier was a barrier in appearance only, that it was incidental to a halting of the advance of the frontier of English settlements, and that, had the French not possessed the interior of the North American continent, the Appalachian barrier would not have held up the continuous advance of settlement across the United States.

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[1] Semple, E. C., *American History and Its Geographic Conditions* (Boston, 1903), p. 36.

[2] Local histories, John Hayward's *New England Gazetteer* (Boston, 1839), H. E. Mitchell, *The Madison Register, 1903* (Kents Hill, Maine, 1903), and other registers.

[3] Greene, Francis Byron, *History of Boothbay, Southport, and Boothbay Harbor, Maine, 1628-1905* . . . (Portland, 1906), pp. 85, 96.

[4] James Rosier's narrative in Charles Herbert Levermore, *Forerunners and Competitors of the Pilgrims and Puritans* (Brooklyn, New York, 1912).

[5] Mitchell, *op. cit*., pp. 11-13.

[6] Clayton, W. Woodford, *History of Cumberland County, Maine* (Philadelphia, 1880), p. 234.

[7] Hanson, John Wesley, *History of the Old Towns of Norridgewock and Canaan* . . . (Boston, 1849), p. 313. In colonial times the reservation of trees in the forest of Maine for the exclusive use of the Royal Navy probably also helped to keep the forest intact. See Joseph Williamson, "Brigadier-General Samuel Waldo," *Collections of the Maine Historical Society*, First Series, 9 (1887): 80; Francis Gould Butler, *A History of Farmington, Franklin County, Maine* . . . (Farmington, 1885), p. 19.

A NEW MAP ON THE SURFACE CONFIGURATION OF MEXICO

HARRY E. HOY

THE physiography of Middle America is complex. There is a surprising array of mountains, plateaus, and plains of various types occurring under diverse conditions of climate and natural vegetation.

The physiographic map of Mexico here presented (Fig. 1) is the first of two on the configuration of Middle America. It includes all of Mexico and the adjacent areas of the United States, Guatemala, Honduras, British Honduras, and Salvador. The second map, now being drawn, will include all of Central America, the West Indies, and the north-coast countries of South America.

The first step in the preparation of the map was the tracing of the National Geographic Society's map of Mexico, Central America, and the West Indies (scale 1: 5,500,000). The tracing was enlarged by the photostatic process to 1: 2,750,000. For the physiographic details the standard reference works on Middle America by Schuchert, Sorre, and Sanders were utilized. Even more valuable was the series of Mexican Air Navigation Maps, on a scale of 1: 500,000, consulted in the office of Professor Preston E. James, of the University of Michigan, and the "Millionth Maps" of the American Geographical Society. It should be noted, however, that the degree of reliability of these two series varies, for some are made from detailed topographic surveys on a scale of 1: 100,000 and others contain scant topographic data, compiled from various sources.

Ten physiographic regions are tentatively outlined in Figure 2:

1. Central Plateau, a vast tilted upland sloping from 8,600 feet south of Mexico, D.F., to 3,600 feet, where the plateau extends into Arizona and New Mexico. The region is characterized by block-faulted mountains and volcanoes and separated by basins of interior drainage. This physiographic division dominates the surface configuration of the country.

2. Sierra Madre Occidental and Associated Coastal Piedmont, forming the highest ranges in the country — moderately high when seen from the Central Plateau and very high and abrupt when viewed from the Pacific side. The Coastal Piedmont consists of alluvial fans and low block-faulted outliers of the main mountain system. There is no good counterpart in the United States.

3. Sierra Madre Oriental, a low system of ranges when viewed from the west, but a bold escarpment from the east. A series of upturned sedimentaries parallel the mountains on the east.

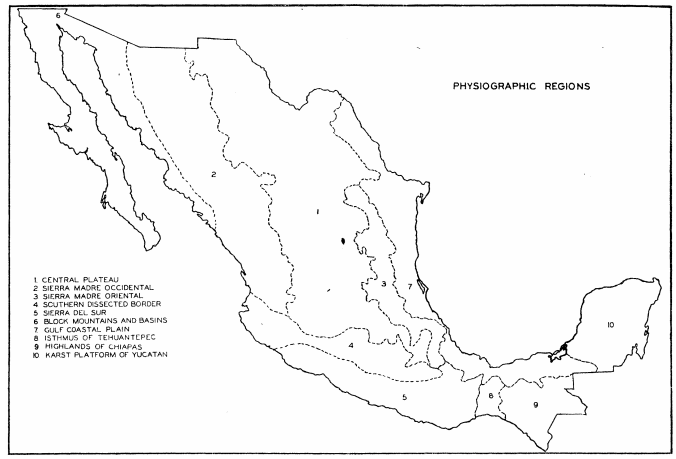

FIG. 2

4. Southern Dissected Border, so called for want of a better name, is the escarpment bordering the Central Plateau on the south. Structurally it is the northern flank of the Balsas Graben further emphasized by the series of giant volcanic cones along its crest. The more notable peaks are Pico de Colima, Nevado de Toluca, Popocatepetl, and Ixtaccihuatl.

5. Sierra Madre del Sur, a dissected plateau, south of the Balsas Graben. There is less dissection in the eastern part, where the more level uplands make up the Oaxaca Plateau.

6. Block Mountains and Basins of northwest Mexico, composed of (1) the Sonora Desert, a mountain and bolson region like the Mohave of California, and (2) Lower California, a peninsula of block ranges and tablelands much like southern California.

7. Gulf Coastal Plain, a gently rolling sedimentary rock plain sloping toward the Gulf of Mexico. The surface is interrupted by occasional volcanic cones or plugs of volcanoes. The region is widest in the north, nearly pinches out to the south of Tampico, and widens to the south of Veracruz.

8. Isthmus of Tehuantepec, a low divide (300 feet) marking the structural break between North and Central America. Region 5 to the west stands much higher, as does the Chiapas Highland to the east.

9. Highlands of Chiapas, formed by the dissection of a plateau area. The highland of Guatemala and Honduras is an extension of this region into Central America.

10. Karst Platform of Yucatan, a low level plain interrupted by a few hills generally under 500 feet elevation. This region is characterized by collapsed limestone caverns known as “cenotes,” and by the absence of surface streams.

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THE SURFACE CONFIGURATION OF THE ATLAS LANDS

HENRY MADISON KENDALL

THE usual description of the surface of northwest Africa includes the statement that this area is one of folded mountain ranges disposed along two southwest-northeast lines, with one transverse connecting chain flanked by complementary plateaus (Fig. 1). The Rif, the Tellean Atlas, the High Atlas, the Anti-Atlas, and the Saharan Atlas are classed as folded mountains differing mainly in height. The Middle Atlas has to its west the Moroccan Meseta and to its east the Plateau of the Shotts. There are fringing coastal plains along the Moroccan and Tunisian coasts. Beyond this, the character of the surface is left largely to the imagination. It cannot be questioned that the division suggested has many uses of convenience, that its basis in tradition is well founded, and that it may provide the imaginative with some notion of origin. That it describes satisfactorily the nature of the broader types of surface must be denied.

An attempt is here made to suggest the kinds of surface which are found in the Atlas Lands and to indicate the pattern in which they occur. The inquiry relates to surface, particularly as regards relief and slope, and the unit indicating the scale of inquiry is the Atlas Lands as a whole. Compilation was made on a base with the scale of 1: 2,000,000. Source materials included the sheets of the International Millionth Map of the World; the maps of the French Army geographical service on the scale of 1: 200,000 for most of the area and on larger scale for some parts; and works of French geographers, notably those of Bernard, Ficheur, Gautier, Gentil, and Solignac.[1] In the construction of the final map (Fig. 2) four main types of surface were distinguished: plain, hilly land, tableland, and mountain.[2]

When the distribution of the four types was plotted certain agreements with and certain variations from the usual concept of the surface of the Atlas Lands appeared (Fig. 2). The High Atlas remains as a zone of mountain land stretching from southwest to northeast across the southern portion of Morocco. Extending to the north are the transverse mountainous Middle Atlas and, to the south, the subparallel mountainous Anti-Atlas. The Middle Atlas is narrowly joined to the north flank by a series of high ridges. A huge deeply dissected volcanic mass blocks the gap between the High Atlas and the Anti-Atlas. To the north and west of the Middle Atlas and not joined to it lies the crescent-shaped Rif, a mountain zone with fringing hilly and tabular piedmont. These are the four main mountainous areas of the region.

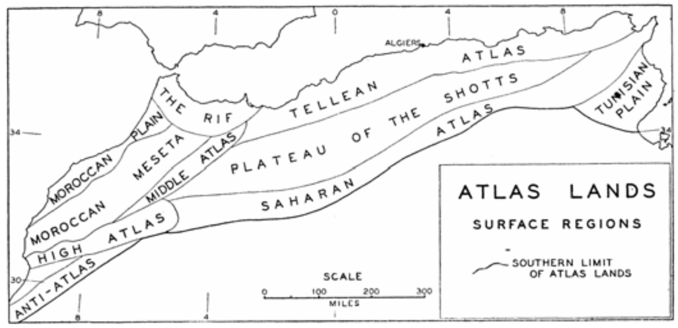

FIG. 1. Northwestern Africa: surface regions

The Tellean Atlas and the Saharan Atlas are not mountainous in the greater part of their extent. To be sure, the dominance of folded structure in the Tellean area is unquestioned, but variations in amplitude of folding and in magnitude of dissection produce a complex pattern of plains, hilly lands, and mountains. The pattern in the Saharan Atlas is considerably less complex, though the concept of a continuous mountain chain is there equally misleading. Structurally, a zone of folding extends eastward in rough continuation of the individual ridges of the High Atlas, but only the higher parts project through the horizontal sedimentaries, which lie both to the north and to the south. In the central section it is difficult to distinguish any evidence of relief great enough to suggest even a hilly land. In comparison with the High Atlas this is certainly not a mountain land, except for two relatively small areas.

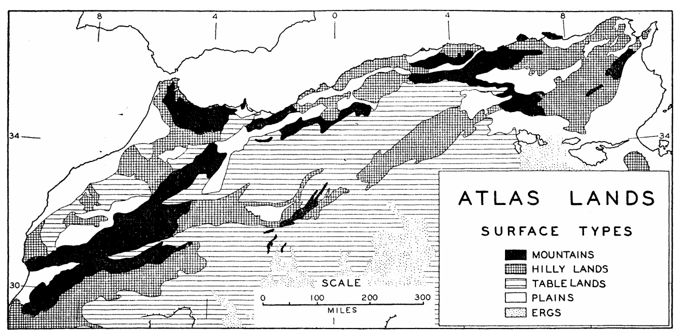

FIG. 2. Northwestern Africa: surface types

The surface of the Plateau of the Shotts is broken in a few places by hilly zones and by basins of interior drainage. Except for the easternmost basin none of the interruptions are on a sufficiently large scale to destroy the concept of tableland.

There is great variation from place to place over the surface of the Moroccan Meseta. An escarpment of between 300 and 500 feet elevation marks part of the contact with the plain on the west, but it is not continuous along the whole contact. Abrupt change to mountains is noted along the southern and part of the eastern margins. The materials upon which the present surface is developed include recent alluvium, massive crystallines, horizontal-lying sedimentaries, and sharply folded sedimentaries. The area is in part plain, in part hilly land, and in part tableland.

Along the west coast of Morocco and along the east coast of Tunis there are small areas of plains.

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[1] The following works are especially significant:

Bernard, A., *Afrique septentrionale et occidentale*. Volume 11, Part I, of Géographie universelle. Paris, 1937.

Bernard, A., et Ficheur, E., "Les Régions naturelles de l'Algérie," *Annales de Géographie*, 11: 221-246, 339-365, 419-437. 1902.

Bernard, A., et de Flotte de Roquevaire, R., *Atlas d'Algérie et de Tunisie*. Paris, 1924 —.

Bernard, A., *l'Algérie*. Paris, 1929.

Gautier, E. F., *Structure de l'Algérie*. Paris, 1922.

Gentil, L., *Le Maroc physique*. Paris, 1912.

Solignac, M., *Carte géologique de la Tunisie à 1: 500,000*. Paris, 1931.

[2] For a summary of definitions see V. C. Finch and G. T. Trewartha, *Elements of Geography* (New York, 1936), pp. 319, 416, 428, 443. See also P. E. James, "The Surface Configuration of South America," *Pap. Mich. Acad. Sci., Arts, and Letters*, 22 (1936): 369-372. 1937.

LIPSZKY'S MAP AND THE FIRST GENERAL LAND SURVEY OF HUNGARY (1786-1806)

GEORGE KISS

MAPS are among the best monuments of a culture, of the civilization and history of an age. Their technique reflects the degree of cartographical skill; their accuracy shows the attainments of surveyors and astronomers; the amount of information recorded is characteristic of the state of geographical knowledge; the type of execution indicates the artistic skill and taste of the period. The great map of Hungary published by John Lipszky in 1806 offers an excellent example of the craftsmanship, skill, good taste, and scholarly accomplishments of early modern cartographers in Europe.[1]

In 1806, when Lipszky published his map, Hungary, the eastern half of the Habsburg monarchy, was in many respects a medieval country. Certainly its social system lagged far behind those of the more advanced countries of western Europe. Hungarian nobility held under its power millions of serfs who, although assured of a livelihood on their tenant farms or on the great estates, were deprived of all political rights.

At the dawn of the nineteenth century Hungary was a country of great herds of cattle and sheep, of charming, sleepy little towns, surrounded by orchards and vineyards, a country of stagecoaches rattling along some of the most impassable roads of the continent. It was a land of rivers sluggishly rolling through hundreds of miles of marshes, a land of great primeval forests, where thousands of pigs were fattened on acorns and where the "gentlemen of the highway" plied their none-too-prosperous trade. It was a country where trade was restricted to the cities and carried on with great difficulty along the few highways and on the rivers, and where the great estates with their châteaux built in imitation of Versailles rubbed elbows with the thatch-roofed hut of the serf; it was a source of raw materials, wheat, meat, metals for the growing trade and industry of Austria.

This was the land we find so truthfully represented on Lipszky's great map, a land on the threshold of the modern era, perhaps the most backward part of Central Europe at the time. Lipszky certainly did pioneer work in many respects, yet he was not without predecessors. Let us consider briefly the developments that antedated the publication of his map.

It was in the first or second decade of the sixteenth century that Lazarus, secretary to Archbishop Bakócz, Primate of Hungary, published a map of Hungary in Vienna.[2] This was the first map of the country prepared by a Hungarian, and it served, with later corrections, as a base for the Hungarian sheets of the great atlases of Mercator, Münster, Ortelius, and others. During the sixteenth and seventeenth centuries, when the Turk occupied the greater part of Hungary, most maps of this country were published abroad, based on the rather scanty and often inaccurate information received by the map makers. Wit's map of Hungary, of 1688 (Fig. 1), gives a good idea of the distortion we find on maps of this period.

After 1700 detailed cartographic work was started by the Austrian government; it was carried out mostly by French, German, and Italian military surveyors. At the same time maps were published by civilian cartographers. The map of John Christopher Müller, of 1709, on a scale of 1:550,000, and the map of Ignaz Müller, of 1769, on a scale of 1:360,000, were the most notable ones among these.[3]

The eighteenth century witnessed the rise of new political and economic systems throughout Europe. Mercantilism was adopted by Austria-Hungary, with a resulting expansion of both manufacture and foreign trade, based on the resources of the realm. The need for accurate and detailed information about the state of the empire transformed map making from the inaccurate sketching of the preceding era into a highly important undertaking, initiated and carried out by the state. The ruler of Austria-Hungary, Maria Theresa, ordered the surveying of all her domains in 1763, and this survey was executed on a scale of 1: 28,800.[4] Completed by 1785, on some three thousand sheets, this first or "Josephine" survey of Austria-Hungary (named after Joseph II, son and successor of Maria Theresa) was executed by officers of the Austrian army. The sheets were withheld from publication, and individuals did not have access to them. It was only as a major in a cavalry regiment, and former army surveyor, that Lipszky obtained permission to make use of these maps in the compilation of his work.

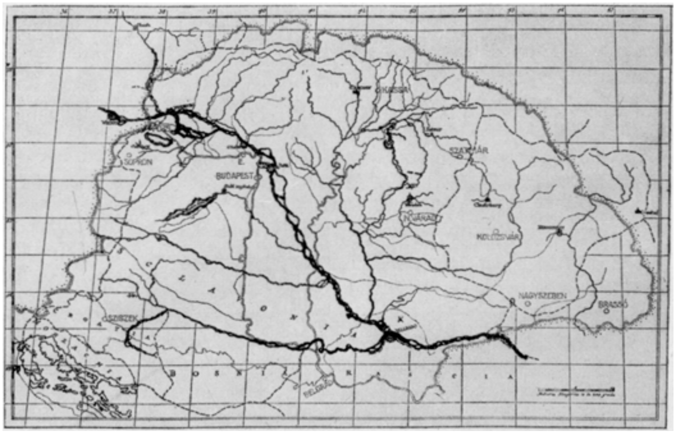

FIG. 1. Wit's map of Hungary, published in 1688. The dotted lines represent boundaries and the double lines rivers as they appear on a modern map; the heavy lines, the distortion given by the old map

The “Josephine” survey was followed by another military survey, executed by the Austrian Military Topographical Institute, on a geodetical basis, between 1807 and 1868.[5] This, in turn, was followed by the first modern survey of Austria-Hungary, on a scale of 1: 75,000.

Because of his privileged position and the permission he obtained to use the detailed maps of the military survey Lipszky was able to produce a map far more accurate than those of any of his predecessors. And, in addition to the information available on the 1,451 sheets of the “Josephine” survey on Hungary, he had recourse to some of the material collected throughout Hungary in 1784-85, by the General Land Survey, ordered by Joseph II.

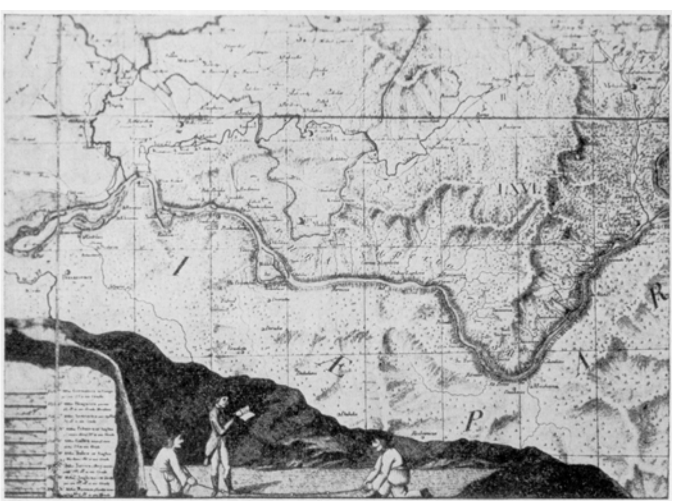

FIG. 2. A surveyor and his aides (from Lipszky's map). The peasant on the left is dressed in Rumanian costume of the early nineteenth century; the one on the right, in Hungarian costume of the same date

This General Land Survey has a unique position in Hungarian history. It was the first modern census of the country, yet most of the results obtained were destroyed by certain groups whose interests were endangered by the intentions of the Survey. Hungary had preserved the institution of serfdom until 1848, but the nobility was exempted from taxation. Both Charles III and Maria Theresa had attempted to induce the nobility to contribute its share to the finances of the state. Although each of these attempts was unsuccessful, Joseph II, a ruler deeply impressed by the ideas current at the time in Europe and anxious to achieve an ideal state of religious and personal liberty within his own realm, ordered a general land survey to be carried out in 1784-85. This survey, coupled with a census of the population, was to provide data on land use and on the income of nobility, bourgeoisie, and serfs alike. Although the survey was completed, in many places with the help of the army, most of the material collected — sketches, field notes, income returns — had been destroyed in 1787-88 by the wrath of the gentry, who were reluctant to give up their old privileges.[6]

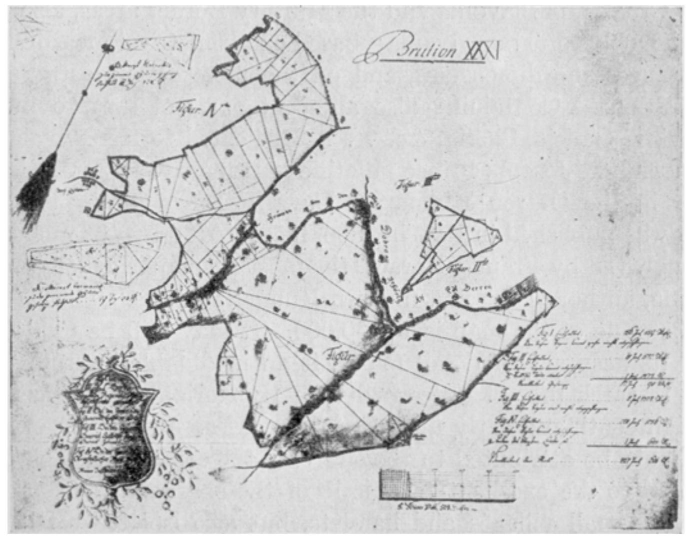

FIG. 3. Preliminary field sketch (*brouillon*) of a part of Zala County, western Hungary, executed by Joseph Badstieber, topographic engineer, for the General Survey of 1784-85

The instruments used in the two surveys, the “Josephine” survey and the General Land Survey, which served as bases for Lipszky's work, are depicted on the map itself (Fig. 2). They are the chain, the sextant, and the plane table. To determine rectangular lines the surveyors also used the “Egyptian triangle,” an application of a Pythagorean principle. The field sketches were quite accurate, and many were executed with great skill (Fig. 3).

Let us now turn our attention to Lipszky^s map (Pl. I, Fig. 1), entitled: “General Map of the Kingdom of Hungary, of its annexed parts, Croatia, of Slavonia and the Military Border areas, also of the Grand Duchy of Transylvania; based on geometrical measurements of distances and dimensions, and on the most recent astronomical observations. Containing also adjacent parts of the. provinces of Bukovina, Galicia, Silesia, &c. . . . Dedicated to His Royal Highness Archduke Joseph, Prince Palatine of Hungary, by John Lipszky, Major in the ‘Baron Kinmayer' Cavalry Regiment.” The map, which was published in Pest in 1806, measures 80 by 49.5 inches. It was engraved by Francis Karacs, the most accomplished engraver of his time, author of the first modern Hungarian atlas.[7]

The scale of the map is 1: 460,000. It may still be used in the field; its accuracy of detail makes it an invaluable instrument for every research project concerned with Hungarian conditions in the late eighteenth and early nineteenth centuries. Its wealth of material should be attributed to the efforts of the compiler and cartographer and to the excellent technique of the engraver. It represents not only small villages and hamlets, but also isolated settlements of but one or two houses, industrial establishments, roads, canals, ferries, bridges. It also shows the exact extent of marshy areas, forests, and swamps as they existed about 1800 (Pl. I, Fig. 2).

Among the many interesting characteristics of Lipszky's map its method of reproducing place names is of great interest. It usually gives the name of a village or town in the language of the majority of its inhabitants and in Latin, followed by the name of the village in other tongues spoken in that vicinity. Thus we may attempt a reconstruction of the distribution of national minorities in Hungary about 1800.

Of the many maps of Hungary published in the late eighteenth and early nineteenth centuries none can be compared with this great work. Its impartial way of representing disputed place names and conflicting administrative boundaries, its highly perfected cartographical technique, and the artistic skill of draftsman and engraver make it a truly important document of early modern Hungarian geography and a splendid monument to its author and publisher, John Lipszky.

UNIVERSITY OF MICHIGAN

[1] The copy of Lipszky's map on which this study is based is part of the library of Professor Robert B. Hall, of the University of Michigan, to whom the author is indebted for permission to use it.

[2] Prinz, Gyula, *Magyar Földrajz — Magyarország tájrajza* ("Hungarian Geography — Regional Geography of Hungary"), I: 74 ff. Budapest, 1936.

[3] Irmédi-Molnár, László, "Magyar térképekről" ("About Hungarian Maps"), *Földrajzi Zsebkönyv* ("Geographical Yearbook"), 1939, p. 178. Budapest, 1939.

[4] Prinz, *op. cit*., p. 78.

[5] *Ibid*., p. 79.

[6] See Irmédi-Molnár, László, "Az 1786. évi kataszteri felmérés Zalavármegyében" ("The Cadastral Survey of 1786 in Zala County"), *Földrajzi Közlemények* ("Geographical Review"), 67 (1939): 330-340. Budapest, 1939.

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Föglein, Antal, "A 'Conscriptio Josephina' sorsa" ("The Fate of the 'Conscriptio Josephina'"), *Levéltári Közlemények*, (Communications from the National Archives), 9: 112-119. Budapest, 1931.

[7] Irmédi-Molnár, *op. cit*., p. 180.

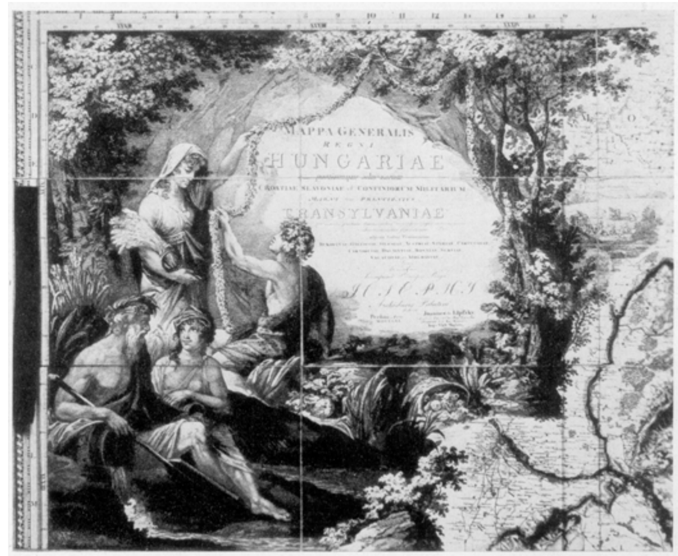

FIG. 1. Cartouche and title on Lipszky's map

FIG. 2. Detail from Lipszky's map, showing the vicinity of Pozsony, in northwestern Hungary

CHANGES IN DISTRIBUTION OF FARM BUILDINGS IN RELATION TO LAND TYPES, CHARLEVOIX COUNTY, MICHIGAN*

IVAN F. SCHNEIDER

CHARLEVOIX COUNTY is in the cutover section of northern Michigan on the northwest side of the Lower Peninsula adjacent to Lake Michigan. In this county land was first cleared for agricultural use in the early part of the eighteen fifties. Agricultural development continued as the virgin forests were removed until at the present time almost 50 per cent of its land area is included in farms.

Since the success or the failure of farming ventures depends to a large extent upon the character of the land, a study of the changes in the number and the distribution of farm buildings on the natural land divisions between 1922 and 1940 was made in an effort to determine: (1) whether the quality of the land is related to the changes in farm buildings; (2) whether agricultural expansion has reached its peak; and (3) whether any predictions can be made of the future trend of agriculture in Charlevoix County.

In this investigation it was assumed that an occupied farm dwelling was indicative of an active farm unit and that changes in the number and condition of rural buildings reflected the trend of land use.

Information on which the study was based was obtained from the data of two surveys: (1) the survey of the Land Economic Survey division of the Michigan Department of Conservation, made in 1922, which inventoried the natural resources of the county, and also located all the rural dwellings and indicated whether they were occupied or vacant; and (2) the land-type survey sponsored in 1940 by the Michigan Agricultural Experiment Station, in coöperation with other agencies, which not only gave the location of rural buildings and their state of occupancy, but also listed their condition. The following rating system for farms, which has been standardized on a state-wide basis, was used:

Excellent farm (A). — Very large house, barns, and other buildings; all in excellent condition. The largest and most prosperous farms in the state.

Good farm (B). — Well-kept buildings with modern improvements. Evidence of a large volume of farm business.

Average farm (C). — Buildings of adequate size and not in need of major repairs. The average Michigan farm.

Poor farm (D). — Buildings either small or in a poor state of repair. Little money or labor expended for maintenance in recent years.

Very poor farm (E). — Buildings small and in a condition that indicates they will probably become uninhabitable within a few years unless better maintained than in the past.

Vacant farm (F). — Buildings inhabitable but not occupied.

Buildings gone or in ruins (G). — Farmstead uninhabitable.

Rural residence (R). — Income of occupant derived wholly or largely from sources other than agriculture.

For the present study the land types mapped in Charlevoix County in 1940 were arranged in eleven broad land divisions based on topography, drainage, and the texture of the soil. A relative agricultural rating was given each of the natural land divisions. Brief descriptions of each follow:

Sand, plains and dunes. — Sand dunes; sand plains, dry to poorly drained; gravel ridges; and low lake benches. Fourth-class agricultural land. Soil types — Bridgman sand, Rubicon sand, Eastport sand, Alpena sandy loam, Saugatuck sand, and Newton sand.

Sand, valleys. — Level sandy valley floors surrounded by steep hills. Soils droughty and low in natural fertility. Third- and fourth-class agricultural land. Soil types — Kalkaska and Rubicon sand.

Sand, lake benches. — High level sandy lake benches. Soils droughty and low in natural fertility. Third- and fourth-class agricultural land. Soil types — Kalkaska and Rubicon sand.

Sand, hills. — Hilly sandy land, with some extremely rough areas. Substratum predominantly sand. Low natural fertility. Third- and fourth-class agricultural land. Soil type — Emmet sand.

Sandy loam, valleys. — Narrow, level sandy loam valley floors surrounded by steep hills. Surface soils varying from a sandy loam to a loam and underlain at one to three feet by gravel, cobbles, or clay. Second-class agricultural land. Soil type — Antrim sandy loam.

Sandy loam, undulating. — Level to undulating sandy loam uplands, generally underlain by sandy clay at two to three feet. First- and second-class agricultural land. Soil type — Emmet sandy loam.

Sandy loam, hilly. — Hilly sandy loam. Surface varying from a loamy sand to a sandy loam, underlain by sandy clay at two to three feet. Second- and third-class agricultural land. Soil type — Emmet sandy loam.

Loam, lake benches. — Loam. Higher lake benches locally wet and underlain by clay. Level to undulating topography. Second-class agricultural land, except in extremely stony areas or in places where drainage is required. Soil types — Kawkawlin loam, Bowers loam, Munuscong loam, and Bergland loam.

Loam, undulating. — Level to undulating loam uplands, usually underlain by clayey substratum at two to three feet. First-class agricultural land. Soil type — Onaway loam.

Loam, hilly. — Drumlins. Rolling to extremely hilly; loam over clayey substratum. Productive soil, but its value for agricultural use is limited by the large number of steep slopes. Soil type — Onaway loam.

Swamp, level. — Swamps, marshes, and bogs. Fourth-class agricultural land. Soil types — Carbondale muck, Rifle peat, and Greenwood peat.

FARM-BUILDING CHANGES BETWEEN 1922 AND 1940

The total number of farm buildings tabulated from the 1922 map of the Land Economic Survey was 1667. At that time 1320 were occupied and 347 were vacant. Eighteen years later the number had increased to 1712, of which 1155 were occupied and 557 were either vacant or simply indicated locations of former farm enterprises (Table I).

TABLE I

OCCUPIED AND VACANT FARM BUILDINGS IN 1922 AND 1940

Year	Occupied	Vacant	Total
1922	1320	347	1667
1940	1155	557	1712

A breakdown of the data reveals that three changes in the occupancy of farm buildings had taken place: (1) those occupied in 1922 and either occupied or vacant in 1940; (2) those vacant in 1922 and either occupied or vacant in 1940; and (3) those erected since 1922 and either occupied or vacant in 1940.

By means of Tables II-IV the changes in number, distribution, and condition of farm buildings can be studied in relation to the eleven natural land divisions. Reference to them will show, for instance, that 162 occupied buildings were located on the sandy valley land in 1922.

TABLE II

THE 1940 CLASSIFICATION OF THE RURAL BUILDINGS THAT WERE OCCUPIED IN 1922

(The abbreviations used in Tables II–IV are explained on page 456.)

Natural land divisions	A	B	C	D	E	R	F	G
Sand, plains and dunes	..	..	3	...	4	5	1	6
Sand, valleys	..	2	12	36	47	5	23	37
Sand, lake benches	..	1	8	16	3	6	4	7
Sand, hills	..	..	5	34	52	7	22	47
Sandy loam, valleys	..	3	27	22	8	7	11	3
Sandy loam, undulating	..	14	58	56	10	2	13	10
Sandy loam, hilly	..	1	30	107	32	8	18	13
Loam, lake benches	1	..	15	25	8	6	4	8
Loam, undulating	..	20	129	57	2	10	9	6
Loam, hilly	..	6	70	57	18	3	13	7
	Occupied 1058						Vacant 262	
Total	1320							

TABLE III

THE 1940 CLASSIFICATION OF THE RURAL BUILDINGS THAT WERE VACANT IN 1922

Natural land divisions	C	D	E	R	F	G
Sand, plains and dunes	..	..	..	..	..	3
Sand, valleys	..	4	7	1	9	33
Sand, lake benches	1	..	..	2	..	5
Sand, hills	1	2	8	1	7	57
Sandy loam, valleys	1	3	..	2	3	7
Sandy loam, undulating	3	1	1	..	6	10
Sandy loam, hilly	3	8	11	1	8	42
Loam, lake benches	2	1	3	2	..	10
Loam, undulating	10	7	..	2	2	12
Loam, hilly	5	4	5	3	10	18
	Occupied 105				Vacant 242	
Total	347					

TABLE IV

THE 1940 CLASSIFICATION OF THE RURAL BUILDINGS THAT HAVE BEEN CONSTRUCTED SINCE 1922

Natural land divisions	C	D	E	F	G
Sand, plains and dunes	..	..	..	..	..
Sand, valleys	..	3	14	7	4
Sand, lake benches	..	..	2	2	..
Sand, hills	1	3	10	5	9
Sandy loam, valleys	..	1	4	..	..
Sandy loam, undulating	2	..	4	1	4
Sandy loam, hilly	1	3	9	3	12
Loam, lake benches	1	..	1	..	1
Loam, undulating	3	1	..	..	..
Loam, hilly	2	..	..	..	5
	Occupied 65			Vacant 53	
Total	118				

What happened to them in the eighteen-year period? Only 102 were still occupied in 1940 (Table II). These were classified as follows: 2 good farms; 12 average farms; 36 poor farms; 47 very poor farms; and 5 rural residences. Sixty unoccupied farmsteads existed, of which 23 were inhabitable, and 37 were uninhabitable.

Fifty-four vacant houses were tabulated on the sandy valley land division in 1922 (Table III). Twelve of these farms were occupied in 1940, of which 4 were classified as poor farms, 7 as very poor farms, and 1 as the home of a rural resident. Forty-two were still unoccupied in 1940, with 9 in the inhabitable class and 33 in the uninhabitable class.

Twenty-eight new farm units have been erected on the sandy valley land division since the 1922 survey (Table IV). Of these farms 17 were occupied in 1940, with 3 in the poor class and 14 in the very poor class. Of the 11 farm buildings that had been abandoned 7 were classified as inhabitable and 4 as uninhabitable.

In summarizing these changes on a county-wide basis it was found that in 1922 there was a total of 1320 occupied houses in Charlevoix County, whereas in 1940 only 1058 were still occupied (Table II). On the other hand, 105 of the 347 farm buildings vacant in 1922 were occupied in 1940, whereas 242 had remained vacant or had become uninhabitable (Table III). One hundred and eighteen farm buildings had been erected since 1922, and the 1940 survey indicated that 53 of these dwellings had already been vacated. People still resided in 65 of them (Table IV).

Further examination of Tables II-IV reveals a number of interesting conditions. Almost 50 per cent of the 118 farmsteads established between 1922 and 1940 have already failed (Table IV). It seems significant that 80 per cent were situated on but three of the natural land divisions, namely, the level to undulating sandy valleys, the sandy hills, and the sandy loam hills. Seventy per cent of the farm buildings vacant in both 1922 and 1940 were also located on the same natural land divisions (Table III). Sixty per cent of the houses occupied in 1922, but vacated before 1940, were on the same land divisions (Table II).

OCCUPIED FARMS IN 1922 AND 1940

The number of occupied farm buildings on each of the natural land divisions in 1922 and 1940 was compared, and the percentage of decrease of the occupied farm buildings was calculated for each division (Table V). No buildings were tabulated on the swamp land division in either survey. The table reveals that, although the number of farm units decreased over the eighteen-year period on all the natural land divisions, the percentage of change on the heavier soils was relatively small. The 15 per cent decrease on the loam lake bench division, which is rather good farm land, can be accounted for because of the inclusions of poorly drained clay land and the extremely stony and bouldery soil in the natural land division. The 9 per cent decrease in the undulating sandy loam that is also good land is partially due to the abandonment of farm buildings in the Chandler Hill area in the eastern part of the county. Factors that caused the vacancy of these buildings were: (1) the existence of an island of productive land surrounded by sparsely settled sandy land from which the removal of the timber had eliminated all opportunity for securing supplemental income in the winter by working in the woods; (2) the difficulty of obtaining an adequate water supply; and (3) the consolidation of farm units. On the four sandy land divisions the decrease in occupied units ranged from 23 to 63 per cent.

TABLE V

LOCATIONS OF OCCUPIED FARM BUILDINGS IN 1922 AND 1940 ACCORDING TO NATURAL LAND DIVISIONS

Natural land divisions	1922	1940	Change	Percentage of change
Sand, plains and dunes	19	7	− 12	63
Sand, valleys	162	125	− 37	23
Sand, lake benches	45	31	− 14	31
Sand, hills	167	116	− 51	31
Sandy loam, valleys	81	69	− 12	15
Sandy loam, undulating	163	149	− 14	9
Sandy loam, hilly	209	205	− 4	2
Loam, lake benches	67	57	− 10	15
Loam, undulating	233	229	− 4	2
Loam, hilly	174	167	− 7	4
Totals	1320	1155	− 165	13

1940 FARM-BUILDING CLASSIFICATION

The 1940 farm-building classification has been summarized by the natural land divisions (Table VI). The second column of this table indicates the number of occupied farm buildings, vacant farm buildings, or farm-building ruins on each land division. The total number of occupied and vacant farms was computed from Tables II-IV and is recorded in the third and fourth columns. By dividing the number of occupied farm buildings by the total number of farm buildings an agricultural success index has been calculated for each natural land division. These data are recorded in the fifth column of Table VI. A study of the indexes discloses that the level to undulating loams and level to undulating sandy loams are most suitable for agricultural use, since 89 and 77 per cent respectively of the farm units located upon these types were relatively successful. Further study reveals that the level to undulating sandy valleys, the rolling to hilly sandy land, and the sand plains and dunes constitute the poorest types for farming, since their agricultural success indexes were only 52, 44, and 41 per cent respectively.

TABLE VI

1940 FARM-BUILDING CLASSIFICATION BY NATURAL LAND DIVISIONS

Natural land divisions	Number	Occupied	Vacant	Agricultural success index
Sand, plains and dunes	17	7	10	41
Sand, valleys	238	125	113	52
Sand, lake benches	49	31	18	62
Sand, hills	263	116	147	44
Sandy loam, valleys	93	69	24	74
Sandy loam, undulating	193	149	44	77
Sandy loam, hilly	301	205	96	68
Loam, lake benches	80	57	23	71
Loam, undulating	258	229	29	89
Loam, hilly	220	167	53	76
Totals	1712	1155	557	67

A further analysis of Table II shows that in the sandy valley land division 36 occupied farms were classified as poor and 47 as very poor, whereas in the sandy hill division 34 were classified as poor and 52 as very poor. The undulating loam land division, however, has 20 good farms, 129 average farms, 57 poor farms, and only 2 very poor farms. If the trend of the last eighteen years continues, between 30 and 40 per cent of the farm units on the sandy land divisions will become abandoned in the next twenty years. On the heavier-textured soils, however, only a slight decrease in the number of occupied farm buildings is in prospect.

RECREATIONAL DEVELOPMENT

The reversals indicated by the changes in occupancy that have taken place are offset in some degree for the county as a whole by the expansion of recreational dwelling units. The 1922 survey showed only 79 cottages, including summer homes and hunting cabins, in Charlevoix County. The 1940 survey, however, identified a total of 633 such developments, or eight times the number in 1922. The increase is due to the recreational attraction of Lake Charlevoix and its South Arm, Walloon Lake, and Lake Michigan, coupled with the improvement of Michigan's highway system and also automotive transportation, both of which have assisted in stimulating this rapid recreational expansion.

CONCLUSIONS

1. If one uses the number and condition of farm buildings as a criterion, it becomes apparent that the agricultural use of the land in the last eighteen years has remained relatively stable on the better soils and has decreased on the poorer soils.

2. The agricultural success index as determined by the number of occupied and vacant farm buildings on the various land divisions correlates closely with the soil productivity indexes of the natural land divisions.

3. Some agricultural expansion is still in progress, but it is evident that the recent pioneers are not settling on the more productive soils.

4. The relatively large number of farm failures on the sandy valley and the sandy hill land divisions and the tendency of recent pioneers to settle upon the less productive soils indicate the need of zoning controls to reduce the number of unsuccessful farm enterprises.

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* Authorized as Journal Article No. 587 (N. S.) from the Michigan Agricultural Experiment Station.

AN AREA ANALYSIS OF HUMPHREYS COUNTY, TENNESSEE

H. THOMPSON STRAW

THE area analysis of Humphreys County, Tennessee, is one of a limited number of experimental studies designed to test a simplified technique as it might be applied to the problems of unemployment. The National Resources Planning Board, in coöperation with the Bureau of the Budget, is charged with the programing and the evaluation of most construction and public works proposals. In order to provide a background of specific and regional information against which individual projects and programs could be reviewed a technique, commonly referred to as the "Colby technique," was devised. The present study is one of several completed under the direction of the Southern Studies Project.[1] These studies, together with the papers prepared by members of other departments of geography and by the National Resources Planning Board itself, will form the bases of judging the efficacy of the method of work. This particular paper is an attempt to condense a much longer original report, and yet give some idea of the results of the technique. The method outlined by the Board has been followed not only in the collection of material but also, so far as the limitation of the paper permits, in its presentation.

Humphreys County is located west of the central part of Tennessee and is one of about ten similar political units that comprise the upland hilly region which lies immediately west of the Nashville Basin and which is usually referred to locally as the Western Highland Rim (see Fig. 3). The county is predominantly rural and is in one of the less fertile sections of the Corn and Winter Wheat Belt.[2] Too far north for the successful production of cotton and too far from the established tobacco markets to make tobacco raising profitable, it is therefore without a dominant cash crop and has the greatest amount of its cultivated land in corn. The general picture that has already been painted for the entire Rim land[3] is one of self-sufficient farms of low income, widespread illiteracy, inadequate schools and roads, and substandard houses lacking even such conveniences as telephones and electric lights, and that general picture is fairly true of this county in particular. The relief loads in the past have been high, and so has the amount of state aid for services such as the schools.

Any attempt to make recommendations for the future development of the county must take into consideration the fact that the building of the Gilbertsville Dam by the Tennessee Valley Authority and the establishment of the Kentucky Reservoir will result in the inundation of the entire western strip of the county lying adjacent to the Tennessee River. The completion of the reservoir means the removal of some 21,000 acres from cultivation, and, significantly, the lands so removed have been accounted in the light of past agricultural practices to be among the best croplands of the area. The income of the county's inhabitants, which has been below the level of those of both the state and the nation, is thus threatened with further curtailment.

CHARACTERISTICS OF EMPLOYMENT

Population and the Employment Problem

As has been stated before, Humphreys County is predominantly rural and agricultural. There are, however, two small towns, Waverly, with a population of 1,318, and McEwen, with a population of 617, which together comprise 15.5 per cent of the population of the county. Since manufacturing, except for the processing of local raw materials such as timber and grain, scarcely exists, the towns are transportation, service, and county-seat centers.

Humphreys County is similar to many other Southern upland areas in its small proportion of Negroes and in the general pattern of its population growth. In 1930 the Negro population constituted but 6 per cent of the total population of the county, a steady decline from the 14.7 per cent of 1880 (Fig. 1). During the intervening fifty years the Negro population had decreased not only proportionately but numerically as well, with many of the Negroes migrating from the upland area to the near-by lowlands, especially to the cotton-growing section about Memphis to the west.[4] In population growth the county is very similar to those which share its upland position. A slow growth from the date of settlement in 1800 reached a climax in 1910 (Fig. 1). The next two decades saw an actual decline brought about by the migration of workers to other parts of the state or the nation that offered greater economic opportunities. Better transportation and improved education were important factors in making this migration possible. In the past decade a reversal of this trend has taken place, for the population has again increased. Fewer economic opportunities, especially in the urban centers that had probably attracted many of the earlier migrants, resulted in keeping at home many of the younger people who would normally have migrated, and have even caused the return of some who had formerly migrated from the county.

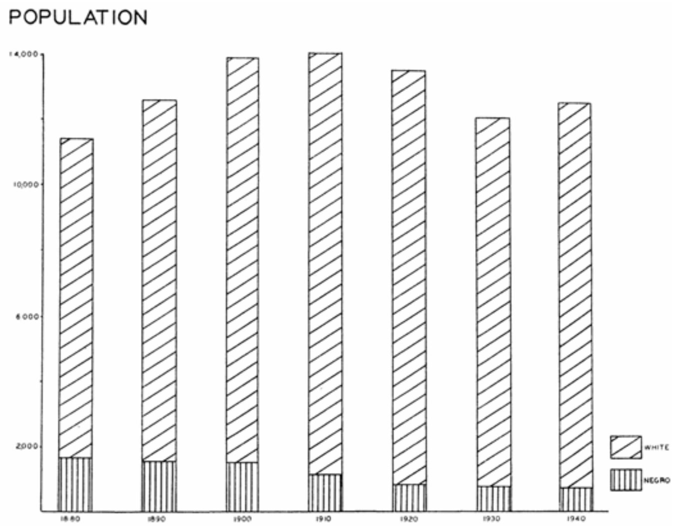

FIG. 1. Population growth of Humphreys County, Tennessee, 1880-1940

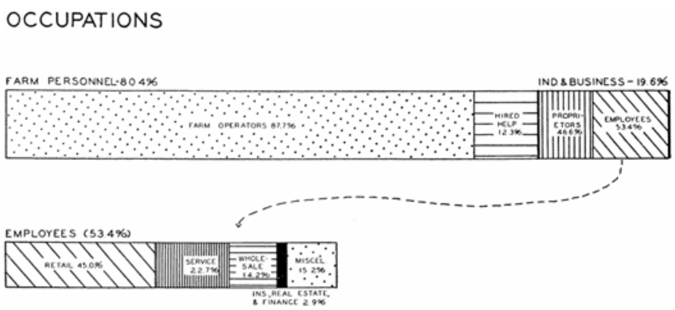

FIG. 2. Occupations in Humphreys County, Tennessee, 1935

In its early history lumbering was of great importance, but the distribution of occupations within the county today, as shown in Figure 2, gives preëminence to agriculture. Of the 2,278 persons employed 80.4 per cent are engaged in farming, of whom the large majority, 87.7 per cent, are farm operators. Of the business and industrial group, it is significant that the number of proprietors (46.6 per cent) nearly equals that of the employees (53.4 per cent), a definite indication that most of the business and industrial establishments of the county are small. Retail and service types predominate among the employees.

Description of Unemployment

The unemployment census of 1937[5] presents a clear picture of the types of additional work needed in the area. Among the males the largest groups of unemployed were laborers, skilled and semiskilled workers, and farmers. The majority registering were farm laborers, and of these the number of persons who were partly unemployed was nearly two and one-half times as large as the number of those who were totally unemployed. Thus the need of supplementary employment for those who work on the farm is very evident.

The largest group of unemployed females consisted of young workers, although servant classes, semiskilled workers, and clerks added to their number. In general, on the basis of the number of registrants, unemployment among the men appears to be more extensive than among the women. Any future plans for emergency work, however, should include a larger percentage of work suitable for the smaller group than that offered at present in order to effect an equitable distribution between the two sexes.

It is interesting to note that the largest group of those registering as in need of employment was between the ages of 15 and 25, many of whom had become of employment age since the beginning of the depression. This age distribution further attests the seriousness of the cessation of migration in augmenting the problem of unemployment.

FACTORS AFFECTING EMPLOYMENT AND INCOME STABILITY

Basic Natural Resources

The major basic natural resources of the county consist of the climate, surface, and soils as related to agriculture and the forests. The climate is a transition between the humid subtropical and the humid continental (poleward Cfa of the Köppen classification). The rainfall is heavy, about 50 inches a year,[6] and the growing seasons average fewer than 200 days a year. Since this period is shorter than the recognized minimum required by cotton in the United States, the acreage devoted to this crop has been very small in recent decades.

Nor does tobacco, which frequently replaces cotton as the cash crop in the upper South, occupy more than a small acreage within the county. Its limitations are not the natural ones of climate or soil but distance from the markets, such as Clarksville, Tennessee, and Hopkinsville, Kentucky, and the policy of the administrators of the Agricultural Adjustment Act of limiting tobacco acreage.

Since Humphreys County lies within the Interior Low Plateau Province[7] it takes its major characteristics of surface from the larger area. Most of the rocks that underlie it are limestones and, like the remainder of the province, it has suffered a series of uplifts that have governed the rates of river erosion and deposition. Today four distinct types of surface can be recognized, and inasmuch as each is associated with one or two individual rock strata the geologic map is a fairly good basis for arriving at an understanding of the surface features. Each of these surface types has a characteristic soil association, since the soils are generally immature and derive most of their qualities from the weathered rock of the river deposit on which they develop.

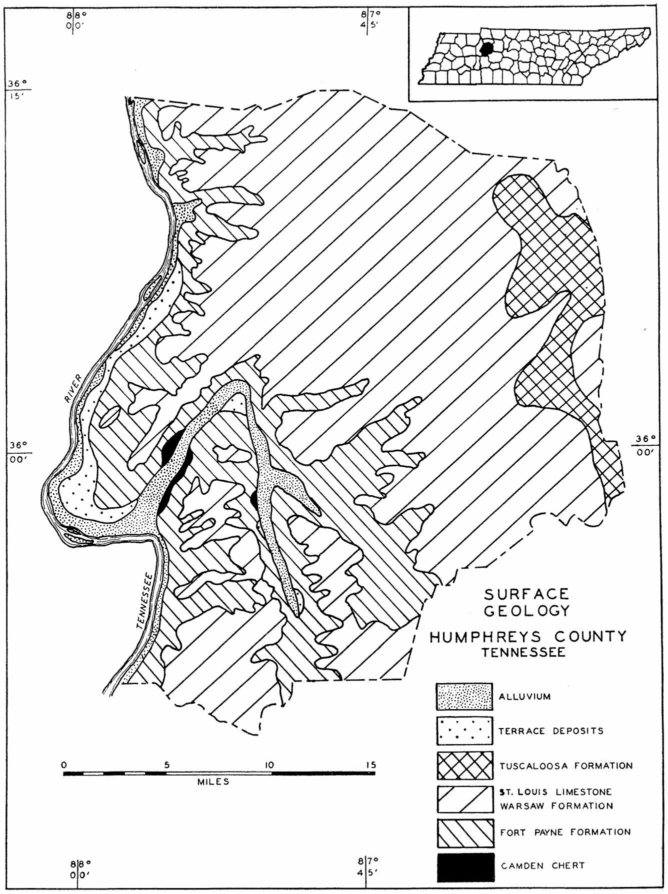

FIG. 3

(After Geologic Map of Tennessee, revised by W. F. Pond, Division of Geology, Nashville, Tennessee, 1933)

At the highest elevation within the county is the first type of surface, the McEwen Upland, developed on the Tuscaloosa formation (Fig. 3). It occupies the broad, flat, and but slightly eroded portions of the plateau. Associated with it are Dickson, Laurence, and Guthrie soils, all of the second and the third class[8] (Fig. 4). Although the soil is generally suitable for agriculture, the inferior drainage in some areas and the tendency to erode in others discourage the tilling of crops and foster the development of dairying.

The second type of surface, which covers the major part of the county and is a mixture of narrow valleys and steep hills, is associated with the St. Louis limestone and the Fort Payne formation (Fig. 3). In the valleys the Ennis and the Humphreys soils are found (Fig. 4). These are of the first, second, and third class and are cleared and planted to crops such as corn, peanuts, and hay. The steep hills are covered with Bodine, Baxter, and Dickson, fourth-and fifth-class soils useful for some pasture but mainly for forest. Almost none of the area is suitable for tilled agriculture. Nevertheless there is a scattering of small cleared areas on which poor subsistence agriculture is practiced. In almost every one it is necessary to supplement the farm income, sometimes by work off the farm, but all too frequently by public relief aid.

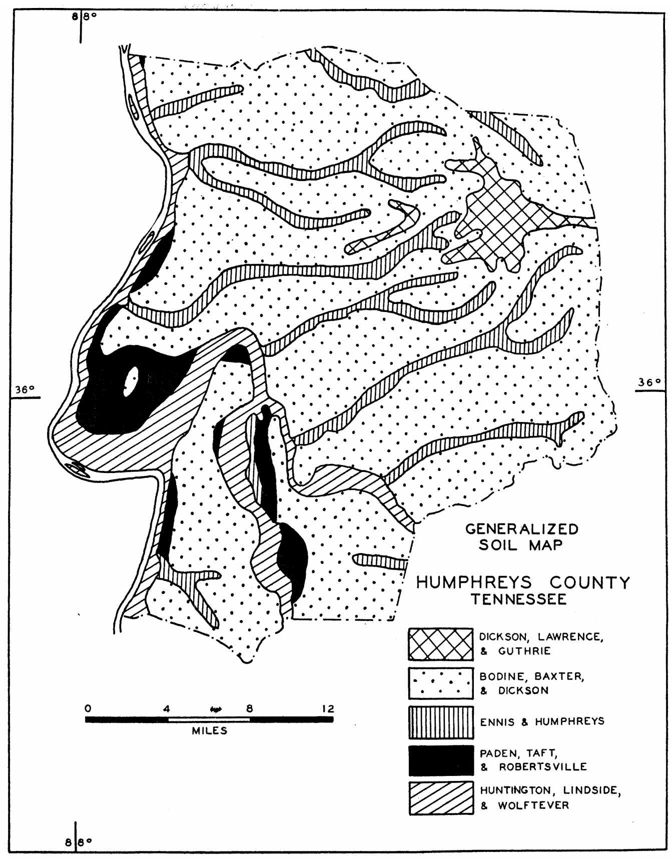

FIG. 4.

(After G. M. Wells and others, "Soil Survey of Humphreys County, Tennessee," manuscript prepared by the Division of Soils Survey, in coöperation with the Tennessee Experiment Station and the Tennessee Valley Authority. Reproduced with permission of W. K. Kellogg, principal soil scientist)

The third surface division comprises the terrace deposits created by the rivers in earlier cycles (Fig. 3). The soils here are Paden, Taft, and Robertsville, generally of the second and third class (Fig. 4). Since their use for cropland is restricted by a clay hardpan, by high acidity, and relatively low fertility, their importance is mainly for homestead sites, and the adjacent lower, seasonally flooded, but far richer, alluvium constitutes the cropland. Save for the clearings of the homesteads, much of the land of the terraces is in forest.

The last surface division, lying along the major streams, the Tennessee, Duck, and Buffalo rivers, is the recent river alluvium (Fig. 3). On its flat surface are the Huntington, Lindside, and Wolftever soils of the first- and second-class type (Fig. 4). Corn, peanuts, and lespedeza seed are the common summer crops, and many of the higher parts, less subject to flood, carry a winter crop such as wheat.

Essentials of Regional Economy

The population pattern of the county is distinctly a riverine one; most of the people live along the smaller creek bottoms or, if near one of the larger streams, on an adjacent river terrace where their homes are free from the danger of seasonal flooding (Fig. 5). A few have settled on the McEwen Upland in the northeastern part of the county, and a scattering is to be found on the ridges even where the slope is too steep for grazing. In 1930 the majority of farms on which these people lived were classified as self-sufficing (34.0 per cent) or general (23.6 per cent), figures which are approximately accurate today. Of the 2,691 houses, 41.9 per cent were judged substandard.[9] Only 109 of the farms have telephones, and only 80 are lighted with electricity. Corn, peanuts, lespedeza seed, and wheat are the basis of the lowland economy. The first two, corn and peanuts, are used to fatten hogs; the lespedeza seed and the wheat, in general, are sold as cash crops. The upland is devoted to subsistence farming and livestock, mainly dairy herds, since the cheese factory at McEwen furnishes a market for milk.

Seventy per cent of the county is still forested, largely by upland hardwoods. In 1937 there were twenty-four mills in the area, nine of them operating full time, each employing five men on the average and producing mainly crossties.[10] In addition, wood was shipped out of the county for chemical use and for chestnut extract. Tennessee Valley Authority studies[11] in the area indicate that only a small part of the timber is of saw-log size, and much is even below cordwood size. A too-rapid exploitation, failure to cull defective trees, and lack of forest-fire control have all been causes of the decline in productivity from earlier times when the area had a thriving forest industry.

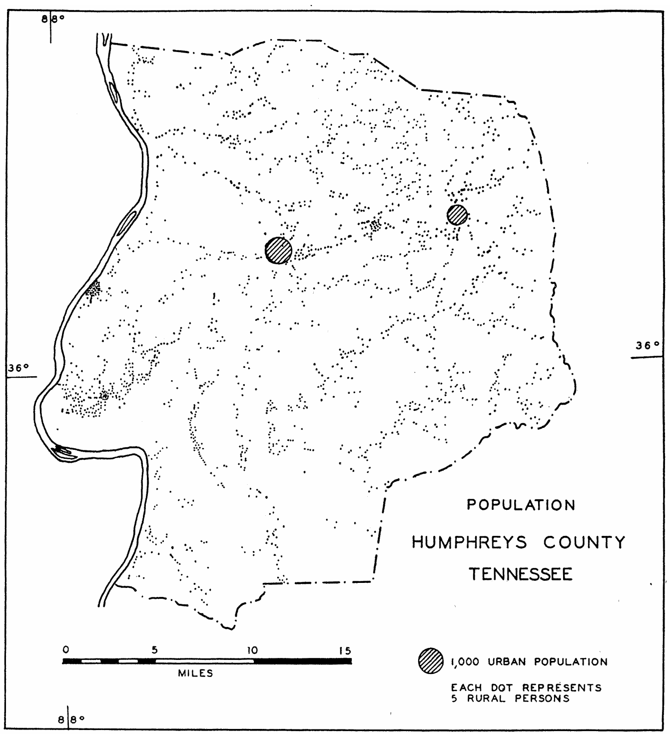

FIG. 5

(Source: United States Bureau of the Census, Population of Tennessee, 1940. Dots distributed according to planimetric maps of the Tennessee Valley Authority)

CURRENT PROBLEMS

The current problems of the county are: (1) increase of the average income of the farms with consequent reduction in the relief loads, (2) improvement of forest yields, (3) rendering of aid in the resettlement of farmers dispossessed of owned or rented lands by the creation of the reservoir, (4) provision of vocational training for the many young people who must continue to migrate from the county in the future, and (5) decrease of the cost of local government, which must be borne by fewer farms after the completion of the reservoir.

DIRECTION OF READJUSTMENTS

The major readjustments needed are the improvement of farming and forest practices and the inauguration of specific government services. In the detailed study of the Humphreys County Program Committee, in which the test-demonstration farm figures were used as a basis, it was estimated that 1,450 family-size farms "at an acceptable level of living" could be maintained in the county. In 1940 only 1,407 farms were reported, a figure that will be lowered by the emigration from the county of some farms from the bottoms that are to be flooded.

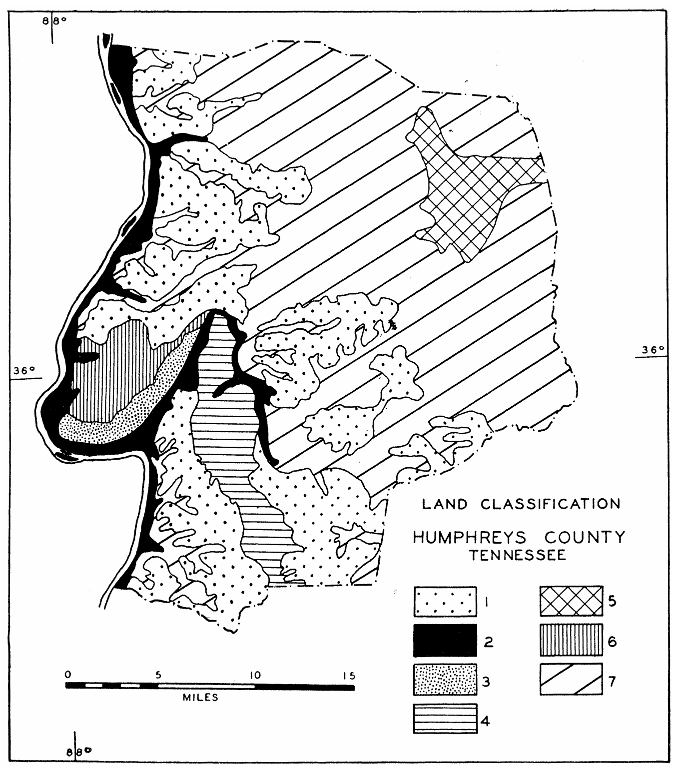

FIG. 6

KEY TO SYMBOLS

1. Land unsuited to agriculture
2. River-bottom lands to be flooded by Kentucky reservoir
3. River-bottom lands to be protected by proposed dikes
4. Buffalo River bottom lands
5. McEwen area
6. River-terrace area
7. Ridge-and-valley area

(Adapted from Humphreys County Program Planning Committee, "Land Use Classification of Humphreys County, Tennessee," manuscript, May, 1940)

Improvement in farming consists in a shift of emphasis from grain farming to livestock, contour plowing, the planting of winter cover crops, the damming of gullies, and the fertilization of not only cropland but also pasture. The improvement of forest land includes fire protection, culling, and selective cutting. The planting of game birds will augment forest-land income in the future.

Perhaps the two most-needed government services are rural planning, which will prohibit the influx of settlers during the next economic depression, and a system of vocational training to enable young people to migrate more easily in the future.

OVERALL RECOMMENDATIONS

For specific recommendations the map of land classification (Fig. 6) is helpful. The land classified as nonfarmland (area No. 1) should be devoted to forest. Fire prevention and proper care and cutting should be practiced so that yields may increase. Further study is needed to determine (1) whether national, state, or private control can best accomplish these ends, and (2), if accomplished by private control, whether a tax system such as the deferred timber tax recommended by the United States Forest Service might not be desirable. Reforestation by the Tennessee Valley Authority, especially near the reservoir, should continue. The landowners of the area that is to be flooded by the Tennessee Valley Authority reservoir (area No. 2) have been paid and are able to move and purchase new farms. The numerous tenants of this section constitute the chief problem, however. The proposed diked area (area No. 3), which will be leased by the Tennessee Valley Authority to former tenants, will provide a partial solution. Further recommendations are the continuance of Tennessee Valley Authority helped by maintaining an assistant in resettlement in the office of the county agency, and Farm Security Administration loans to encourage tenants to become farm owners elsewhere. The Buffalo River bottoms (area No. 4) will remain in cultivation and should have the continued aid of the Tennessee Valley Authority and the Tennessee Extension Service with test-demonstration farms. The major problem of this area seems to be the low farm incomes, largely resultant from improper farm practices. The McEwen Upland and the ridge-and-valley area (areas Nos. 5 and 7) should have greater emphasis placed upon forest land and pasture land to augment the income from the present cropland. State aid in forest-fire protection and in the test-demonstration farm program and from the Tennessee Valley Authority through its fertilizer distribution program is recommended. The possibility of establishing »more factories such as those at McEwen for canning tomatoes and making cheese, to increase the farm income and provide additional employment, should be studied. Every possible aid and coöperation should be given the community study projects that cover the western part of these areas.[12] Many of the people on the river terrace (area No. 6) have rented land on the bottoms for crops. The proposed diked area will not be sufficient for their future needs. Aid from the Tennessee Valley Authority and the Farm Security Administration is necessary in order to relocate some of them.

An additional recommendation to the state would be a constitutional amendment enabling a consolidation of counties to allow a decrease in local tax burdens and an increase of services, especially aid in vocational training, which will be sorely needed in the future.

The local government could well continue the studies of recommended land use to the end of passing a zoning law that would curtail an increase in the number of farms during periods of economic depression.

PUBLIC WORKS RECOMMENDATIONS

There should be inaugurated a study of the needs for new roads and schools to fit the changed pattern of population that will be brought about by resettlement. It will be desirable to adjust the program as nearly as possible to provide additional work during the slack season in agriculture. Another recommendation would be to bring above substandard levels the 1,127 houses now in need of repairs. It is also suggested that a study of the possibilities of developing recreation along the proposed reservoir be made.

ACKNOWLEDGMENTS

The author is greatly indebted to many persons in Tennessee for information and help given, particularly to Mr. J. W. Moon, senior soil scientist at Knoxville; to Mr. H. A. Powers, of the Agricultural Relations Department of the Tennessee Valley Authority; to Mr. G. B. Shivery, extension forester; and the Messrs. Frank Joyce and H. S. Duncan, of the University of Tennessee Agricultural Extension Service; to Mr. W. M. Tolley, Humphreys county agent; to Messrs. Clifton Goodlett and Nathan Lowe, assistant agents; and to Miss Mattie Lee Fort, Humphreys County office of the Department of Public Welfare. Appreciation should also be expressed to Dr. Charles E. Kellogg; principal soil scientist, for his permission to use the generalized soil map of Humphreys County on which Figure 4 of this paper is based.

WESTERN MICHIGAN COLLEGE OF EDUCATION
KALAMAZOO, MICHIGAN

[1] Sponsored by the Committee on Geographic Research, Division of Geology and Geography, National Research Council, with Dr. Preston E. James as chairman.

[2] Baker, O. E., "Agricultural Regions of North America. Pt. III. The Middle Country Where South and North Meet," *Econ. Geog.*, 3 (1927): 309-353.

[3] Lucas, Broder F., and Callahan, E. P., *Major Rural Land Use Problems in Tennessee*, p. 11. Nashville, Tenn.: Tenn. State Planning Comm., 1936.

[4] *Preliminary Population Report*, Sec. IIA, pp. 8-11. Nashville, Tenn.: Tenn. State Planning Comm., 1935.

[5] Bureau of the Census, *Census of Partial Employment, Unemployment and Occupations:* 1937, III: 185, 381, 395. Washington, D.C., 1938.

[6] United States Weather Bureau, "Western Tennessee," Sec. 76 of *Climatic Summary of the United States*, U. S. Government Print. Office, Washington, D.C., 1933, pp. 10, 17, 18.

[7] Fenneman, Nevin M., "Physiographic Divisions of the United States," *Ann. Assn. Am. Geog.*, 18 (1928): 307-309.

[8] The soils of the county have been generalized into five classes on the basis of productivity, workability, and the problem of conservation. The first three are those suitable for cropland, the fourth is suited to pasture, and the fifth to forest land. The results of the survey, still in manuscript form, were made available to the author at the office of J. W. Moon, senior soil scientist at Knoxville, Tennessee.

[9] Tennessee Emergency Relief Administration Rural Housing Survey. See *Preliminary Population Report*, Sec. IVE, Table 1.

[10] Welles, Geo. M., and Others, "Soil Survey of Humphreys County, Tennessee." Manuscript, p. 142h.

[11] Tennessee Valley Authority, Dept. of Forestry Relations, Map of Forest Condition Classes, Humphreys County, Tenn. Knoxville, 1940.

[12] A description of certain of these projects, in manuscript form, prepared by Mr. Clifton Goodlett, was made available to the author at the office of the county agent at Waverly, Tennessee.

NEW DRUMLIN AREAS IN CHEBOYGAN AND PRESQUE ISLE COUNTIES, MICHIGAN

STANARD G. BERGQUIST

IN A paper entitled "The Distribution of Drumlins in Michigan,"[1] presented before the Geology Section of the Michigan Academy in 1941, the author described in detail the various drumlin districts that were known in the state at that time. It was pointed out that new areas of distribution would undoubtedly be uncovered in other portions of Michigan when more thorough field work was carried on.

In the summer of 1941, through a coöperative project financed jointly by Michigan State College and the State Geological Survey, the writer, with the aid of two of his students, Dale Wallington and Robert C. Hannum, engaged in a rather extensive program of field investigation in Emmet, Cheboygan, and Presque Isle counties. Several new drumlin districts were located and carefully mapped (Fig. 1). Areas which previously had been only partially covered in reconnaissance were rechecked and brought up to date.

DRUMLINS EAST OF MULLET LAKE

Several small clusters of well-defined drumlins are centered near the rural towns of Aloha, Alverno, and Manning in Cheboygan County. They protrude through the sandy-clayey Algonquin lake plain in the region to the east of Mullet Lake and north of Black Lake. In this section they are undoubtedly cored in ground moraine that was deposited by the Huron ice lobe in its northeastwardly retreat across the area. The ice sheet that was responsible for the actual sculpturing of the drumlin forms moved into the district from the northwest, however, as is evidenced by the trends of the ridges.

The surface of the lacustrine plain in general ranges in elevation from 630 to 730 feet above sea level. The highest drumlins in the area attain an elevation of 735 feet, a height only five feet below the water plane of Lake Algonquin, whose shore is marked by features which stand at 740 feet. During the interval of occupation by the lake the drumlins were washed by its waters and subsequently smeared over with a thin coating of sediment deposited when the lake subsided.

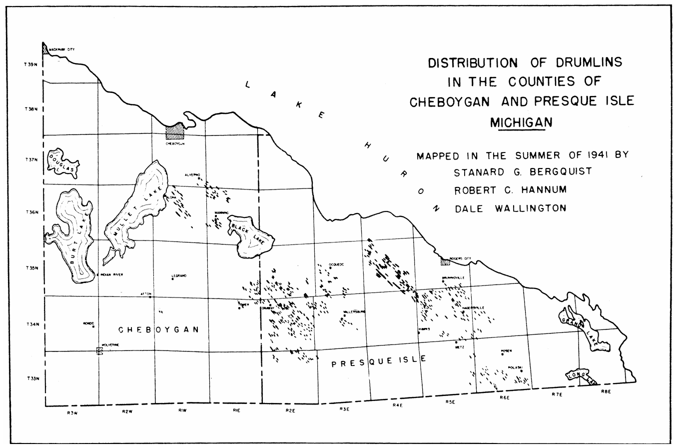

FIG. 1

A small pit, cut into a gravelly bar at an elevation of 685 feet, in the northeast quarter of Section 24, T. 36 N., R. 1 W., exposes five to seven feet of stratified material resting directly on unstratified boulder clay. Numerous erratics scattered promiscuously over the surface of the plain likewise seem to attest to a relatively thin coating of lacustrine wash over the till plain that supports the drumlin forms.

The drumlins of the district are relatively flat-topped and more or less symmetrical in outline. As a rule, both the nose ends and the tail ends of the ridges have slopes which are quite uniform. The absence of steepened stoss slopes may possibly be explained on the supposition that the forms were subdued by wave action during the occupancy of the area by Lake Algonquin.

The drumlins are arranged in parallel series, ranging in trend from S. 45° E. to S. 50° E. The ridges are somewhat low in relief, with crests seldom reaching more than forty feet above the level of the plain. The forms are relatively short, rarely exceeding half a mile in maximum length.

THE ONAWAY DRUMLIN DISTRICT

A comparative study of the map contained in this report with the one that accompanies the paper previously referred to will serve to reveal that the drumlin-till plain section has been greatly extended by field mapping during the field season of 1941. Altogether, several hundred individual drumlins were mapped out in the area included between the towns of Onaway, Ocqueoc, and

Millersburg. Most of these forms are concentrated in the district to the south and east of Onaway in Presque Isle County. A small cluster is centered in the southeast corner of T. 35 N., R. 1 E., in Cheboygan County.

The till plain upon which the drumlins in this area are situated ranges in elevation from 860 feet in the north to 770 feet in the south. The plain is somewhat undulating in districts where drumlins are scarce or absent and definitely ridged where the forms are abundant. The boulder clay of the ground moraine is composed of the same type of material that comprises the drumlin ridges.

The drumlins of the Onaway district range in size from small features not more than twenty feet high and about an eighth of a mile long to well-defined ridges fifty and more feet high and up to a half mile in length. The ridges are best developed in areas where the drift is thick and where ample material was available for reworking by the advancing ice sheet. In localities where the drift is limited the features occur in the form of small, poorly developed drumlinoids. In such areas the drainage is haphazard, and vast tracts of swampy and marshy lowlands, responsive to a water table held close to the surface by the limestone floor, separate the till-plain drumlin areas. Where the rock pavement is exposed to the surface and the glacial till is absent or practically so, drumlins are missing altogether. There is no visible evidence that any of the drumlins in the region have been cut out of bedrock.

Glacial striae bearing S. 25° E. are present on the limestone surface in the region of Tower dam on the west edge of the drumlin district. These conform rather closely with the striae bearing S. 27° E. at the Marvin quarry south of Afton, which is some twelve miles to the west of the nearest drumlins at Onaway. Glacial markings bearing S. 32° E. are preserved on the rock pavement two miles directly north of the town of Onaway.

The long axes of the drumlins of the Onaway district range in direction from S. 35° E. to S. 45° E. Their trends, in general, are not in absolute harmony with the directional movement of the ice that produced the scorings in the rock pavement.

DRUMLIN DISTRICT NEAR ROGERS CITY

An extensive drumlin-till plain sets in at the northwest corner of T. 35 N., R. 4 E., and runs in a southeastwardly direction through the rural centers of Bruningville, Hagensville, Metz, Posen, and Polaski in Presque Isle County. On Leverett's map[2] this region is represented in part as a series of disconnected morainic islands separated from one another by areas of ground moraine. Field investigations carried on during the summer of 1941 revealed the presence of several hundred drumlins and drumlinoids widely dispersed over the plain, which stands at an elevation ranging from 760 to 860 feet above sea level.

In the northwest portion of the till plain, directly to the west and slightly north of Rogers City, is a grouping of well-defined drumlins with the long axes aligned in the general direction S. 45° E. The ridges are more or less symmetrical in outline, although there is a tendency in some of the larger forms to have stoss ends slightly steeper than the slopes on the lee. The drumlins in this section range from one-quarter to one and three-quarter miles in length and from twenty-five to sixty and more feet in height. They are grouped in parallel arrangement and are separated from one another by sags, which are fairly well drained.

Directly south of Rogers City, in the region extending from Bruningville through Metz, Posen, and Polaski, the drumlins are more widely dispersed in clusters, which are separated by marshy lowlands and swampy drainways. In this section they have trends that vary from S. 25° E. to S. 35° E. The forms are comparatively low and short, seldom obtaining a relief exceeding 35 feet or a length greater than three quarters of a mile. Many of the features, especially near the south end of the county, are poorly defined and assume the shape of drumlinoids. Here again the drift is thin and the drainage haphazard in development.

From Polaski the till plain continues southward into Alpena County, which was mapped out by Ver Wiebe.[3] Although his map shows no indication of drumlins on the plain I am certain that a detailed field study will reveal their presence there. Certain other areas in Alpena and adjacent counties may well be critically examined for possibilities of new drumlin localities and an extension of those which have already been mapped out merely in reconnaissance.

MICHIGAN STATE COLLEGE
EAST LANSING, MICHIGAN

[1] Bergquist, S. G., "The Distribution of Drumlins in Michigan," *Pap. Mich. Acad. Sci., Arts, and Letters*, 27 (1941): 451-464. 1942.

[2] Leverett, Frank, *Map of the Surface Formations of the Southern Peninsula of Michigan*, 1924. Published by the Geological Survey Division, Department of Conservation of Michigan, in Coöperation with the United States Geological Survey and the State Department of Agriculture.

[3] Ver Wiebe, W. A., *Geological Map Showing Surface Formation of Alpena County*, 1924. Department of Conservation of Michigan, Land Economic Survey and Geological Survey Coöperating.

STRATIGRAPHIC WORK IN NORTHERN MICHIGAN, 1933-1941

FREDRIK T. THWAITES

INTRODUCTION

SINCE the publication in 1934 of "Well Logs in the Northern Peninsula of Michigan Showing the Cambrian Section"[1] attempts have been made by the writer to clarify some of the tentative conclusions set forth therein. Various circumstances prevented the realization of more than a small fraction of the contemplated studies. In view of the complete halt in field work enforced by the war it seems fitting both to record the progress made and to outline the unsolved problems for the benefit of future students of the geology of a district to which it is possible the present writer may never return. Work which was accomplished included study of cuttings from several deep wells and visits to outcrops at Limestone Mountain, Munising, Menominee River, Jacobsville, and Freda.

REVISION OF THE CAMBRIAN AND LOWER ORDOVICIAN SECTION

Detailed work in Wisconsin by Raasch, Twenhofel, Wanenmacher, and the writer has demonstrated beyond serious question that the formation names "Mazomanie" and "Devils Lake" should be abandoned.[2] It has been established that the strata formerly ascribed to these formations belong within formations previously named. Beds formerly attributed to the "Mazomanie" are now recognized as part of the Franconia, and those of the "Devils Lake" are divided between Franconia and Trempealeau. The beds in Dickinson County which Ulrich placed in his "Devils Lake"[3] are very likely Franconia.

In view of the facts stated above the nomenclature used on the Centennial geologic map[4] needs revision. Another point of confusion on this map is the use of the name "Hermansville" as restricted to the same beds that were termed "Beekmantown" in the 1934 paper by the present author. This formation is the Prairie du Chien group of the U. S. Geological Survey,[5] still commonly known in Wisconsin by the time-honored name "Lower Magnesian." The name "Hermansville" was given by Van Hise and Bayley in 1900[6] and appears from their text to embrace all the strata which Rominger termed "Calciferous" and "Chazy,"[7] that is, both the Trempealeau and the Lower Magnesian. Just what type locality these authors had in mind is not clear from their brief description. In view of this uncertainty of definition the name "Hermansville" could very well be dropped. There are at least two fairly persistent sandstone horizons within the Prairie du Chien group of northern Michigan. For this reason any attempt to apply the threefold division into Oneota, New Richmond, and Shakopee (Willow River) formations, as has been done in western Wisconsin and Minnesota, would be unwise. In passing it may also be noted that the geologic columns given by Newcombe[8] are not in accord with the 1934 paper by the writer. Question may also be raised as to the division of the Prairie du Chien group into two systems, "Ozarkian" and "Canadian." Strong as is the evidence for a break in sedimentation prior to the deposition of the St. Peter sandstone, the writer has never been able to find any facts whatsoever in Michigan, Wisconsin, Minnesota, or Illinois which justify a systemic division within the Prairie du Chien.

ERRORS IN CENTENNIAL MAP OF MICHIGAN

Attention should be directed to certain errors in the Centennial geological map of Michigan. The strata exposed in the bed of the Menominee River at Grand Rapids are incorrectly mapped as "Black River." This correlation is not in accord with that of Rominger,[9] who gave a detailed section of twenty-one feet of obvious Prairie du Chien dolomite, most of which is now concealed by the power dam. The earlier correlation is checked by the log of the well at Stephenson. The mistake is evidently due to an attempt to join the map of Wisconsin prepared in 1912 by Hotchkiss and the present writer.[10] This map followed a manuscript map of Marinette County by Samuel Weidman. Another error is the mapping of Silver Mountain in T. 49 N., Rs. 35 and 36 W. as Paleozoic. Irving describes the rock in this hill as diabase,[11] probably of Keweenawan although possibly of Huronian age. So far as could be seen from a lake steamer, the Huron islands are not sandstone, as mapped, but a light-colored crystalline rock, probably granite. They are round knobs entirely unlike the forms developed on the sandstone of the mainland to the south.

RECORDS OF DEEP WELLS

The following records are based upon examination of samples by the writer, and include wells both in Michigan and in Wisconsin close to the state line. Well records are especially important in the eastern part of northern Michigan, where the low relief makes outcrops scarce and unsatisfactory.

CHICAGO AND NORTH WESTERN RAILWAY CO. WELL, POWERS, MICHIGAN

(University of Wisconsin sample numbers 89676–89860)

Sec. 16, T. 38 N., R. 16 W.
Elevation 867.1

	Thickness in feet	Depth in feet
DRIFT, 52 feet		
Peat and muck	10	10
Sand, fine, gray, glacial	10	20
Till, gray, dolomitic	10	30
Clay, gray, dolomitic	10	40
Till, gray, stony	12	52
PRAIRIE DU CHIEN, 71 feet		
Dolomite, gray, some blue, residue sand, shale	23	75
Dolomite, light gray, sandy	5	80
Sandstone, very fine grained, light gray, dolomitic	5	85
Dolomite, light gray, sandy, some chert	15	100
Dolomite, light gray and pink, sandy, oölitic chert at bottom	23	123
TREMPEALEAU, 119 feet		
Sandstone, very fine to medium-grained, light gray, dolomitic	2	125
Dolomite, light gray, fine sand	5	130
Dolomite, light gray, residue quartz silt	25	155
Dolomite, light gray, residue fine sand	40	195
Dolomite, light gray, residue sand, silt, glauconite	10	205
Dolomite, light gray, much sand, silt, glauconite	15	220
Dolomite, light gray, fine sand, silt, glauconite	22	242
FRANCONIA, 143 feet		
Sandstone, medium- to fine-grained, light pink, dolomitic	23	265
Sandstone, fine-grained, light gray, dolomitic	40	305
Sandstone, medium- to fine-grained, light gray, dolomitic	20	325
Sandstone, medium to very fine grained, light gray, dolomitic	30	355
Sandstone, medium- to fine-grained, light gray, dolomitic	20	375
Sandstone, coarse- to fine-grained, light gray, dolomitic (Ironton member)	10	385
DRESBACH, 18 feet		
Sandstone, medium- to fine-grained, white	18	403
RANDVILLE, 591 feet (beds inclined)		
Dolomite, light gray, residue quartz sand and silt with sericite	37	440
Dolomite, pink gray, residue quartz silt	20	460
Dolomite, light gray, residue silt and sand	75	535
Marble, dolomitic, light gray and pink, residue quartz silt	40	575
Dolomite, light gray, residue quartz silt	30	605
Marble, dolomitic, white to light gray, residue quartz silt	40	645
Dolomite, light gray to white, residue quartz silt, talc	349	994

Insoluble residues proved invaluable in examining these samples; not only did their study establish the base of the Prairie du Chien by the lowest oölitic chert but it also determined the pre-Cambrian age of the Randville dolomite by discovery of metamorphic minerals.

SOUTHERN KRAFT PAPER MILL WELL, MARINETTE, WISCONSIN

(University of Wisconsin sample numbers 97284–97349)

	Thickness in feet	Depth in feet
BLACK RIVER (PLATTEVILLE), 125 feet		
Dolomite, blue gray, some gray	93	93
No sample	12	105
Dolomite, blue gray and gray	20	125
PRAIRIE DU CHIEN, 350 feet		
Dolomite, light gray; chert, white	40	165
Dolomite, light gray	40	205
Sandstone, medium- to fine-grained, gray, dolomitic	10	215
Dolomite, light gray and black	10	225
Dolomite, light gray; shale, green gray; chert, white	30	255
Dolomite, light gray, scattered sand grains	10	265
Dolomite, light gray, some sand	30	295
Sandstone, medium-grained, light gray, very dolomitic	10	305
Dolomite, light gray	20	325
Dolomite, light gray, some scattered sand grains	30	355
Dolomite, light gray, pink, red	20	375
Dolomite, light gray	100	475
TREMPEALEAU, 40 feet		
Sandstone, very fine grained, pink, dolomitic	10	485
Sandstone, fine-grained, gray, very dolomitic, hard	30	515
FRANCONIA, 172 feet		
Sandstone, medium- to fine-grained, light gray	30	545
Sandstone, fine-grained, gray	20	565
Sandstone, fine- to medium-grained, gray	60	625
Sandstone, medium- to fine-grained, gray	10	635
Sandstone, fine- to medium-grained, gray, dolomitic	20	655
Sandstone, medium- to fine-grained, light gray	32	687
PRE-CAMBRIAN, 7 feet		
Granite, red	7	694

This record appears to show a considerably greater thickness of Prairie du Chien than was present in other wells in the vicinity. This may be due either to a difference in determination of the top or to a lateral variation in thickness.

WHITE HOUSE MILK CO. WELL, STEPHENSON, MICHIGAN

(University of Wisconsin sample numbers 98828–98907)

	Thickness in feet	Depth in feet
DRIFT, 38 feet		
Silt, sandy, yellow brown, very dolomitic	10	10
Sand, fine- to medium-grained, gray	10	20
Silt, light gray, very dolomitic	10	30
Till, many pebbles of dolomite	8	38
PRAIRIE DU CHIEN, 12 feet		
Dolomite, light gray; chert, gray, oölitic; sandstone, medium-grained, light gray; shale, gray, white, pink	12	50
TREMPEALEAU, 120 feet		
Dolomite, silty, light gray	95	145
Dolomite, silty, light gray, glauconitic	5	150
Dolomite, silty, pink, glauconitic	5	155
Dolomite, silty, gray, glauconitic	5	160
Dolomite, sandy, gray, pyritic	10	170
FRANCONIA, 140 feet		
Sandstone, fine-grained, gray, dolomitic	15	185
Sandstone, medium- to fine-grained, light gray, dolomitic	5	190
Sandstone, very fine grained, light gray, dolomitic	5	195
Sandstone, fine- to medium-grained, gray, dolomitic, hard	10	205
Siltstone, sandy, gray, dolomitic	5	210
Sandstone, medium- to fine-grained, light gray, dolomitic	25	235
Sandstone, fine- to medium-grained, light gray	10	245
Sandstone, fine- to medium-grained, light gray, dolomitic	5	250
Sandstone, medium- to coarse-grained, light gray, dolomitic (Ironton member?)	30	280
Sandstone, medium- to fine-grained, light gray	20	300
Sandstone, medium- to coarse-grained, light gray (Ironton member)	10	310
DRESBACH, 75 feet		
Sandstone, medium- to fine-grained, pink, light gray	15	325
Sandstone, fine- to medium-grained, light gray	25	350
Sandstone, medium- to coarse-grained, light gray	7	357
Siltstone, gray	3	360
Sandstone, medium- to coarse-grained, light gray	15	375
Sandstone, fine- to medium-grained, light gray	10	385
PRE-CAMBRIAN, 10 feet		
Granite, pink	10	395

The foregoing record demonstrates, as does that at Powers, the westward thinning of the Dresbach against the pre-Cambrian basement.

BADGER PAPER MILLS CO. WELL, PESHTIGO, WISCONSIN

(University of Wisconsin sample numbers 111791–111928)

	Thickness in feet	Depth in feet
DRIFT, 28 feet		
Sand, medium-grained, reddish brown	28	28
GALENA-PLATTEVILLE, 72 feet		
Dolomite, dark gray, blue streaks	17	45
Dolomite, dark blue gray	15	60
Dolomite, dark blue gray and light gray	10	70
Dolomite, light gray	15	85
Dolomite, light gray and dark gray	10	95
Dolomite, dark gray, some light gray	15	110
PRAIRIE DU CHIEN, 270 feet		
Dolomite, gray to light gray	20	130
Dolomite, light gray, some pink; sandstone, medium- to fine-grained, light gray	10	140
Dolomite, light gray, some dark gray	30	170
Dolomite, light gray; sandstone, coarse- to medium-grained, light gray	10	180
Dolomite, light gray	15	195
Dolomite, light gray; sandstone, coarse- to fine-grained, light gray	5	200
Shale, gray	5	205
Dolomite, light gray, sandy	20	225
Dolomite, light gray	35	260
Dolomite, light gray, some purple, sandy	5	265
Dolomite, light gray, sandy; chert, white, pink	15	280
Dolomite, light gray, some green gray	10	290
Dolomite, light gray; some chert, white	45	335
Dolomite, light gray; chert, white	10	345
Dolomite, light gray, residue sand, chert, glauconite	35	380
TREMPEALEAU, 40 feet		
Dolomite, gray, pink, silty, glauconitic	10	390
Dolomite, gray with black specks, silty	5	395
Dolomite, light gray, sandy, glauconitic	2	397
Sandstone, fine-grained, light gray	3	400
Dolomite, light gray, sandy	20	420
FRANCONIA, 85 feet		
Sandstone, medium- to fine-grained, light gray, dolomitic	20	440
Sandstone, medium- to fine-grained, gray, dolomitic (no sample, 450–455)	25	465
Sandstone, fine- to medium-grained, light gray, dolomitic	10	475
Sandstone, medium- to coarse-grained, light gray, dolomitic (Ironton member?)	15	490
Sandstone, medium- to fine-grained, light gray	10	500

	Thickness in feet	Depth in feet
FRANCONIA, 85 feet (*Concluded*)		
Sandstone, coarse- to medium-grained, light gray (Ironton member)	5	505
DRESBACH, 200 feet		
Sandstone, medium- to fine-grained, light gray	50	555
Sandstone, fine-grained, light gray	10	565
Sandstone, medium- to fine-grained, light gray	65	630
Sandstone, fine-grained, light gray	10	640
Sandstone, medium- to fine-grained, light gray	25	665
Sandstone, fine-grained, light gray	10	675
Sandstone, medium- to fine-grained, light gray	30	705
PRE-CAMBRIAN, 3 feet		
Granite, red, decomposed	3	708

The close agreement of this record with that of a shallower well given in the paper of 1934 is noteworthy.

LIMESTONE MOUNTAIN AND VICINITY

The writer spent three days at Limestone Mountain in 1935 in company with Josiah Bridge of the United States Geological Survey, G. O. Raasch, then of the University of Wisconsin, and C. A. Bays, at that time a student at the same institution. Most of the exposures were visited and extensive fossil collections were made. A map, the basis of Figure 1, was prepared. The excellent account by Case and Robinson[12] was used as a guide. These authors say: "The dips in the uppermost of all the exposures show a remarkable diversity although there seems to be quite generally a dip toward the center of the outlier in each case. There is no suggestion of folding" (p. 176). They also state: "In our opinion these outliers have been broken both by major faults, which involve the sandstone below, and by minor faults or breaks, the result of erosional forces" (p. 181). Although dips were recorded on the map their cross section displays horizontal strata. Grading for a ski slide and close examination of the topography along the section shown in Figure 1 convinced the writer's party that disturbance of the strata is not confined to slumped blocks. There is a considerable area of vertical strata which have been eroded into a series of small hogbacks. This structure may be drag along a major fault on the east side of the hill, as indicated in the block diagram. On the south the strata of Little Limestone are much less disturbed and appear to be faulted against the vertical beds. On account of the drift cover the structure of the northern part of Big Limestone is not so clear. East and southeast of Big Limestone road cuts disclose dips up to 35 degrees, with both northeast and northwest strikes. Silver Mountain, several miles to the south, was not visited, but its form strongly suggests a tilted fault block with a dip slope on the northwest.

The sandstone which immediately underlies the Black River dolomite of Limestone Mountain was found to be in large part fine-grained and apparently dolomitic. It is probably the Glenwood member of the Platteville dolomite. Farther from the dolomite contact the sandstone is coarser and shows the irregular coloration, the confused bedding, and the pebble zones which are characteristic of the Bayfield group of sandstones of Wisconsin.[13] The relation of this sandstone to the strata at the type locality of the Jacobsville sandstone farther north is not clear. Similar rock is also exposed east of Limestone Mountain along the shores of Keweenaw Bay. At L'Anse the Jacobsville rests unconformably on the Huronian.[14] The red and light-gray sandstone at Jacobsville is somewhat more quartzose and even-bedded than is common in the Bayfield group and slightly suggests the Devils Island formation of Wisconsin. It is stated that geophysical measurements indicate that it is only about 1,100 feet in thickness and much less in the vicinity of Limestone Mountain.[15] However, a well at Lake Linden did not reach the bottom at 1,502 feet.[16]

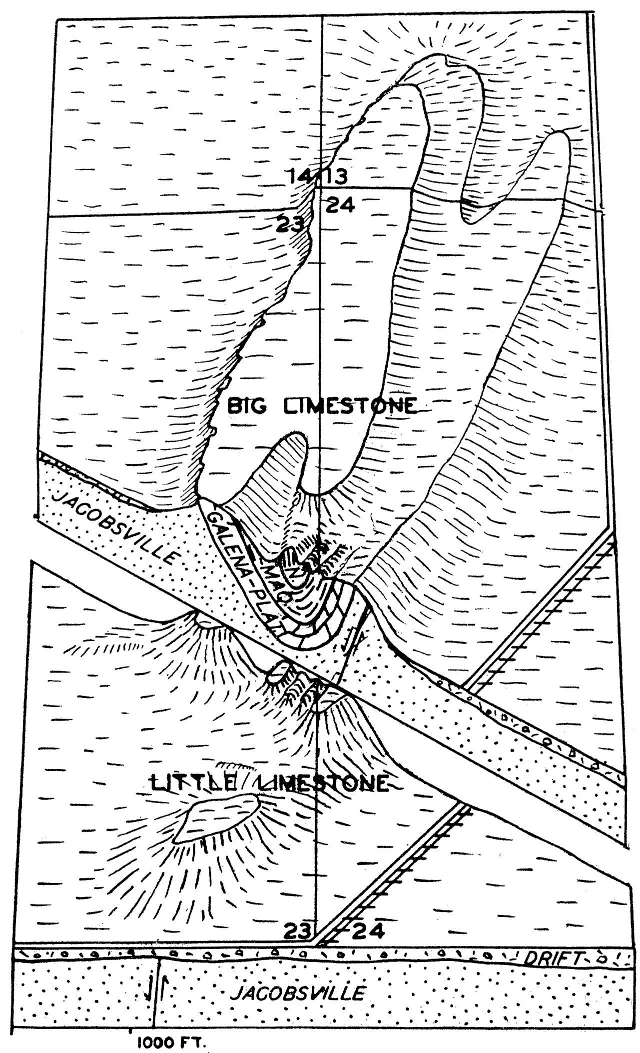

FIG. 1. Block diagram of Limestone Mountain, T. 51 N., R. 35 W., Michigan.
Drawn from sketch by C. A. Bays, 1935

RELATION OF JACOBSVILLE SANDSTONE TO MIDDLE KEWEENAWAN TRAP

For many years the outcrops of sandstone in the northeastern part of T. 46 N., R. 41 W., have been cited to demonstrate an unconformity between horizontal Lake Superior sandstone and tilted Middle Keweenawan traps.[17] However, Allen and Barrett report on - the authority of Seaman's field notes that sandstone in Sections 11 and 14, about a mile west of the locality in Section 13 described by Pumpelly and Irving, is intruded by diabase.[18] The dip of the Keweenawan flows in this locality is only a few degrees to the north, and a faint northerly dip is recorded in the sandstone of Section 13. These facts strongly suggest that the sandstone is all Lower Keweenawan and that it has no connection with the problem of the Jacobsville sandstone. Certainly the burden of proof is now upon anyone who correlates this sandstone as Jacobsville.

It has long been known that the contact of the Jacobsville sandstone with the traps on Keweenaw Point is a thrust fault. This structure was described in detail by Irving and Chamberlin, who concluded that there has only been a slight amount of movement since the deposition of the sandstone, which they ascribed to the Cambrian.[19] The fault is exactly similar to that of northwestern Wisconsin described by the present writer.[20] In both localities the thickness of sandstone beds upturned by the thrust is several thousand feet, which demonstrates a considerable post-sandstone movement. The fact that conglomerate is confined to the vicinity of the fault is probably explained by other faults within the sandstone. It is true that there is débris from the Middle Keweenawan in these conglomerates, but similar débris is also present in all the sedimentary layers within the Middle Keweenawan itself. The dips of the sandstone toward the fault, which caused certain early geologists to conclude that the sandstone is older than the traps, may be overturned layers, as the writer proved on Middle River, Wisconsin.[21]

CAUSE OF THE KEWEENAW FAULT

One of the most striking features of the Middle Keweenawan traps is their localization with practically no outliers. Does it not seem plausible to conclude that they originated in a sinking basin bounded in part by fault scarps? The original setting would then be quite similar to that of the basalts of the Columbia Plateau. It is noteworthy that much of the border of the traps is along faults, for instance, from Douglas County, Wisconsin southwest, as well as parts of the southeastern border in Wisconsin. Only locally do these faults pass within the area of flows. The writer suggests that the Keweenaw Point fault was initiated by an older fault scarp along which the flows were either bordered or at least much reduced in thickness. Much of the faulting may be the result of settling, with only a moderate amount of crustal shortening. It is clear that trap occurs under the sandstone as far east as Silver Mountain, but that the border of the flows is concealed farther to the north.[22]

AGE OF THE KEWEENAW FAULT

One of the objections of the early geologists to extensive post-sandstone movement on the Keweenaw fault was the vast amount of erosion since the major movement. If we correlate the Jacobsville with the Bayfield group of Wisconsin, however, this erosion is recognized as the “Great Denudation” which led to the pre-Cambrian peneplain. It does not follow that all movement is post-Jacobsville. The quartzose nature of the Bayfield sandstones proves that by the time of their deposition much of the traps had been overlapped and buried, so that débris came chiefly from the pre-Keweenawan rocks.[23] The age of deformation at Limestone Mountain casts little light on this problem. The complex down-dropped structure of the mountain is not parallel to the thrust fault and is more closely allied to the local disturbances recorded at several localities in the Mississippi Valley,[24] for instance, at Des Plaines, Illinois, and Glover Bluff, Wisconsin. Although many of these structures have been termed “cryptovolcanic,” there is no positive evidence of igneous intrusion in any of them. Limestone Mountain appears to be located close to or above the eastern border of the flows under the Jacobsville sandstone, and it is quite possible that this explains the faulting. It is also probable that there was movement on the Keweenaw fault at the same time.

VICINITY OF MUNISING

The geology of the vicinity of Munising was studied in considerable detail by Bergquist.[25] The writer visited Munising in 1938, and compared the exposures with both subsurface data and the Wisconsin column. Typical siltstone of the Lodi member of the Trempealeau was found in the road to Miners Castle high above the base of the “Hermansville.” It is clear that the glauconitic and pyritic dolomite of Au Train Falls is Trempealeau and not Prairie du Chien. The contact traced by Bergquist is the division between the Franconia and the Trempealeau and not the base of the “Ozarkian,” as he supposed. This correlation is followed in Figure 2.

No line of division into Franconia and Dresbach could be found in the sandstones which make up the Pictured Rocks. It is evident, therefore, that the type locality of the Munising sandstone embraces only the Franconia of Wisconsin and that the underlying formations have pinched out south of Munising, as shown in Figure 2. The base of the Franconia is about ten feet of conglomerate, with pebbles of quartz and quartzite, which lies on irregularly bedded arkosic sandstone.[26] This underlying sandstone is Jacobsville and closely resembles the Bayfield sandstone of Wisconsin. It is highly improbable that it is a lateral change in the Dresbach, which is evenly bedded, light-colored, and clearly marine.

Figure 2 correlates what is known of the relations of the Jacobsville to the overlying marine deposits. The northern section strongly suggests that these younger beds overlapped unconformably a tilted and base-leveled nonmarine sequence, the Jacobsville. In the southern section the Paleozoic strata are so much more disturbed that the unconformable relation is not clearly demonstrated. Near the eastern side of Michigan the succession is not the same as that at Munising. Instead, the Jacobsville is separated from the Black River by a light-colored sandstone of unknown age.[27] At Limestone Mountain sandstone occurs directly below the Black

River. These facts suggest progressive overlap of the Paleozoic strata on a pre-Cambrian basement which was not wholly crystallines but included the Jacobsville.

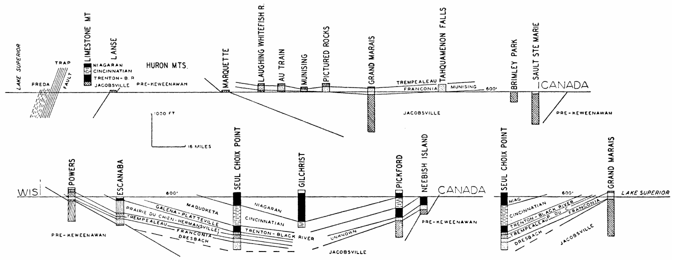

FIG. 2. Diagrammatic sections of northern Michigan from Limestone Mountain to Sault Ste Marie; from Powers to Neebish Island; and from Seul Choix Point to Grand Marais. Well records are connected to show correlation, not details of structure, between them

CONCLUSIONS AND UNSOLVED PROBLEMS

The conclusions reached by the author from information available to him at the date of writing this paper are summarized below:

1. The original Munising sandstone is the Franconia of Wisconsin.

2. The age of the Jacobsville sandstone is not yet established, but is quite likely Upper Keweenawan; it is probably a nonmarine deposit.

3. Faulting has been recurrent throughout the district; the Keweenaw and the Limestone Mountain faults may be related to pre-Keweenawan displacements which bounded the Middle Keweenawan flows.

4. Much movement has taken place on these faults since the deposition of the Jacobsville, and the denudation of the upthrust areas is apparently an event of pre-Cambrian time; the last movement, however, was post-Silurian.

5. The Jacobsville sandstone overlapped the traps because disturbance went on during its deposition.

6. The Paleozoic formations overlapped the Jacobsville from the south, progressively thinning out around the northern end of the Michigan basin.

7. The term "Hermansville" apparently included both Trempealeau and Prairie du Chien and is so poorly defined that it should be abandoned.

8. The sandstone which the older geologists thought unconformable on the Middle Keweenawan flows of the South Range may be Lower Keweenawan.

Although the writer hopes that he may return to this long-neglected district, this is uncertain and should not stand in the way of anyone else who wishes to finish the work he began; if the suggestions here given prove of value in guiding such research they will have fulfilled their purpose.

It must be recognized that the foregoing summary presents more unsolved problems than definitely established facts.

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THE ARCHAEOLOGY AND GEOLOGY OF TWO EARLY SITES NEAR KILLARNEY, ONTARIO

EMERSON F. GREENMAN AND GEORGE M. STANLEY

INTRODUCTION

SINCE 1938 five sites for which a chronology has been established by their connection with raised beaches of Lake Huron have been found in the Manitoulin District of Ontario. Three have been described in some detail by the present authors (8-9). Of the two sites forming the subject of this paper the one first discovered is briefly described by the senior author in Man, 1941 (7); a digest of a paper that he gave at the Minneapolis meeting of the American Anthropological Association in May, 1941, appears in the Notebook of the Society for American Archaeology for August, 1941. These five sites are situated in the Frazer Bay region, north of the east end of Manitoulin Island.[1] Four of them are on the mainland within six miles of one another. The fifth is on Cloche Channel, an arm of Frazer Bay, fifteen miles to the west. The work here reported, which is part of an extensive survey of the Manitoulin District, has been made possible by grants from the Horace H. Rackham School of Graduate Studies. The present paper is a preliminary statement.

ARCHAEOLOGY

Of the five datable sites discovered on the shores of Frazer Bay and its offshoot, Lansdowne Channel, one was completely excavated in 1938, and the remainder are in a state of partial excavation. The first one is on Great Cloche Island, on the west side of Frazer Bay; it consisted of a small hearth covered by beach materials, at an elevation of 608 feet[2] (8). The four other sites are within two to six miles northeast of Killamey (Fig. 1). They have been designated by symbols indicating the names of geographical features, such as KB-1, CH-1 (9), and GL-1, 2 (George Lake Sites 1 and 2). George Lake is seven miles east of Killarney, and it was during a trip from that lake to the east end of Bay Finn in August, 1940, that site GL-1 was discovered. It is on a gravel beach at an elevation of 877 feet, about two miles inland. The beach (Fig. 2, Sections 1F, 1G) lies between two quartzite knobs and is some 500 feet long east and west, sloping from its crest southward about 300 feet to the brow of a gully that is evidently due to surface drainage since the formation of the beach. The beach proper appears to be about 100 feet wide, with its crest 20 feet from its northern border. It is at the top of a deposit of gravel and sand of undetermined thickness that partially fills the small valley between the two quartzite knobs, and has as its southern border the shore of a small lake known locally as Lake Lumsden, about a mile long and half a mile wide. The distance from the crest of the beach to the shore of Lake Lumsden is about 800 feet.

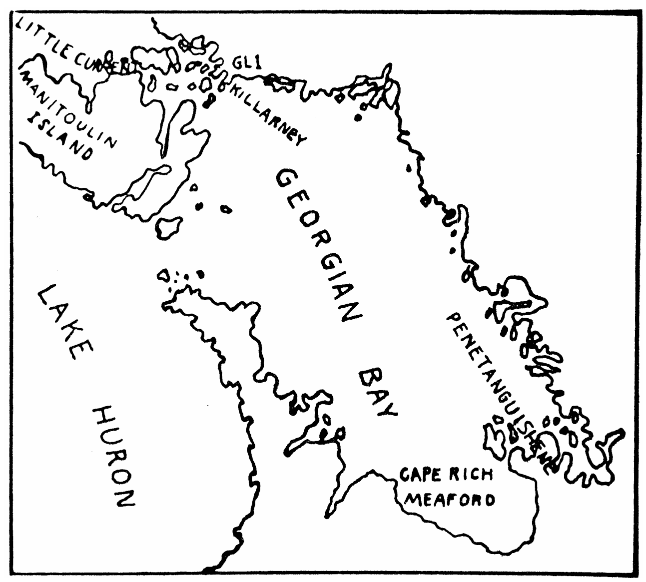

FIG. 1. Georgian Bay, Ontario. Site GL-2 is about half a mile from GL-1

Half a mile southwest of GL-1 is another site, GL-2, which was discovered during the season of 1941. Here artifacts of quartzite of the same types as those from GL-1 were found on the surface of a small, rather indistinct beach at elevations of 880 to 905 feet. The measurements were taken with a defective hand level and are subject to correction. The beach of GL-2 (Fig. 2, Section 1A) is likewise part of a valley fill of gravel and sand, which slopes down to the shore of Lake Lumsden and through which a gully has been cut.

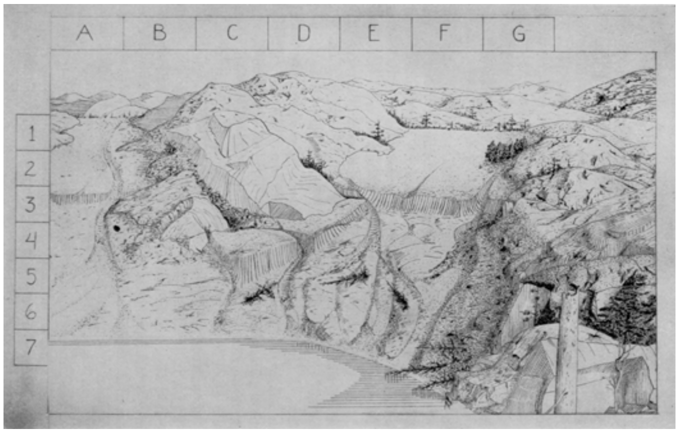

FIG. 2. The sites of GL-1 (at 1F-G) and GL-2 (at 1A), looking north at GL-1. A dense growth of trees in each valley is not shown in this sketch

When GL-1 was first found quartzite flakes were strewn on the surface of the beach in considerable profusion, and a dozen or more artifacts, broken and complete, were collected. The débris of occupation was most in evidence for 350 feet westward from its eastern end. The remaining western portion does not seem to have been occupied. In the first ten days of excavation this site was taken to be a workshop, since the implements were all of one material and since that material, quartzite, was available in the immediate vicinity; in addition, the implements, which were large and roughly flaked, corresponded to the forms usually known as "blanks" (2; 10). Only halves of semilunar knives were found at first, and though this type of implement had not been previously discovered in the Manitoulin District, the presence of a new type could not be certified for the region, since the semilunarity of the whole specimen was not clear from the half. It was not until worn or rolled specimens were found that it was realized that the implements and flakes were in all probability contemporaneous with the waters of Lake Huron when they were at a level 297 feet higher than they are at present and that a complex not previously known in the region was being investigated.

From the surface to a depth of about two and one-half feet the beach is composed of heavy gravel, with some stones as much as 0.8 foot in diameter but averaging about 0.2 foot. Farther down there is a succession of strata of stones of various sizes, and coarse sand. Artifacts (including flakes) occur from the surface to a depth of approximately 1.5 feet. Some several inches long and large flakes and quarry blocks are found at a depth of 1.0 foot, but the vertical measurements strongly suggest that those in the deeper part of the artifact zone are very small flakes that may have worked down from high levels by movements of the beach, although it has not been demonstrated that they would work downward rather than upward. At the present stage of investigation of this site speculations concerning the manner in which artifacts were covered by one or more feet of gravel are fruitless because of the variety of forces that have shifted the materials of the beach to that depth.

GL-1 was a quarry workshop, and probably a village or a camp site in addition if the results of a soil analysis taken in 1941 are confirmed by a second analysis now in process. In the first, made by Mr. Robert Prasil, a student in the Department of Anthropology, it was indicated that fine white claylike material adhering to most of the flakes, and occurring on the surface of the beach to a depth of a foot or more, contained a higher phosphate content than could have been derived from the rocks of the region. Bone is the only possible source of this chemical in such amounts. This type of analysis has already been applied by O. Arrhenius in Sweden (see 1; 20).

The typology offers little to confirm or to disprove the use of the site for domestic purposes. Most of the implements are broken, and though many are to be regarded as finished forms, they may have been fractured just before completion. Three flakes have been replaced in their original positions on two implements, and not one was found more than ten feet from the implement. But both specimens are blanks, and it seems significant that the attempt to replace flakes on finished implements has met with no success; they would naturally be carried away from the spot where they were made. Parts of six implements have been fitted together, but no two parts of a single specimen were more than fifteen feet from each other.

TYPOLOGY

The industry represented at GL-1 is typologically distinct from others found after four seasons in the Manitoulin District in an area about 180 miles long and 50 miles wide. The implements fall into six classes; in no class are there fewer than two specimens, and no material other than quartzite was used, though other materials, except flint, are present in the form of glacial boulders.

Semilunar Blades

The semilunar blades range in length from 11.3 cm. to 18 cm, in thickness from 15 mm. to 3 cm., but one blank is 4 cm. thick. This blank and a complete specimen indicate a type of blade with one edge fairly straight and the opposite edge deeply curved and with one end pointed and the other end rounded. Some are planoconvex. There is a definite tendency for the thickest portion of the implement to be closer to the straight than to the curved edge. The edges of most specimens are irregular jagged lines formed by large flake scars reaching a considerable distance inward. Flaking is very coarse for the most part, but three blades have been retouched along the edges, and two of these are much thinner than the rest from the site. These two are evidently halves, perhaps of other than semilunar types. They might be flakes, both faces of which have been trimmed down.

To date five complete semilunar blades have been found (including one blank). There are eight that are nearly complete, one of which may also be a blank. Thirty-three fragments represent both ends and mid-portions; one of them may be another blank. It is much worn on the faces and edges and also over the edges of the broken end (Pl. IB). In outline the semilunar blades are akin to the implements called “side-scrapers” by Burkitt (3, p. 71), from the European palaeolithic period. In Burkitt's opinion the convexity of one edge is clearly an essential feature, and he regards the type as purposely adapted to the scraping of skins.

Choppers

The choppers are triangular or oval-pointed, with straight or rounded bases. The range in length is from 11 to 19 cm. and in width from 8 to 10 cm. At least one, the largest, is probably a blank. A face of one specimen is a single-flake surface, but the opposite face comes to a peak. This is the only chopper that is planoconvex. The edges of these implements are coarsely flaked like those of the semilunar blades, and although the outlines suggest the hand axes of the European palaeolithic, there is no twist (i.e. the edges do not traverse the longitudinal cross section diagonally from base to point). One chopper, the smallest, has near the point four flake scars that may be the result of pressure rather than percussion. In addition to a large fragment, which may be a basal portion of an implement, there are five choppers; another piece found south of the beach at a lower elevation may be a fragment of an implement of this type. It has been lightly retouched along the basal half of one edge.

Ovate Blades

The term “ovate” is here given to a blade type that is similar in outline to the choppers but smaller, ranging in length from 8.5 to 14 cm. (Pl. IO, P). One is planoconvex in cross section, the flat side being a fracture plane. Another is apparently a reject. Still another is elliptical in outline, with the widest part a little to one side of the center. The chief characteristics of these implements are their narrowness, as compared with the width of the choppers, and the evident importance of the point. One of them with the basal end missing (unless the implement is complete as it is) is retouched around the point on one face, most of the remaining portion of which is a fracture plane. Plate IP has something of the appearance of an implement to be used in the hand as a dagger. Some of the specimens classed as fragments of semilunar blades may be points of implements of this type.

Quadrangular Blades

Eight of the thirteen quadrangular blades terminate at one end in a thick face at a right angle to the true faces, and may be only portions of blades. They range in length from 5.5 to 12 cm. (Pl. ID). One face of the longest consists of a single flake scar with a bulb. The ends of two that are better made than the rest are thin and more rounded. These are the only ones showing retouching at the edges. Both have the break at one end, and may be portions of ovate blades. It seems likely that these implements are knives or scrapers with outlines adapted to some particular purpose. Two other specimens classed under this head have outlines like those of some of the semilunar blades. One is shown as Plate IH. The small size of these two specimens forbids their classification as semilunar blades.

Retouched Flakes

Two retouched flakes are illustrated in Plate IM, N. There are at least three implements of this type, two with triangular outlines and one with a rectangular outline. All three are retouched on one side of one edge. On three spalls that fit one with a triangular outline the edge is continued in line, but the retouching stops.

Perforators

The designation perforators seems to be the only suitable one for four specimens. Two could scarcely have been used in any other way (Pl. IJ, K). The third could have been used as a small knife (Pl. I, I). The two smaller ones are quartzite slivers 2.4 and 3 cm. long and 8 and 12 mm. wide. The shorter tool, which has retouching on only one edge of one face, is planoconvex in cross section. The longer is retouched over at least three quarters of its surface, and is elliptical in cross section. The third specimen (Pi. I, I) is 7 mm. thick, with coarse flaking on both faces. The cross section is angularly elliptical. Another specimen of nearly the same proportions, perhaps retouched but without a point, resembles the “channel flakes” from the Lindenmeier site (12, pl. 4, lower right-hand corner).

Other Objects

There is a much-worn specimen that may be a scraper of the beaked type combined with a point to make it a multiple tool of the scraper-graver type like those reported from the Lindenmeier site (12, pl. 13h). The scraper edge and the point both have facets that could be of artificial origin, but its rolled condition leaves the matter in some doubt.

A large core was found on the surface about 500 feet south of the beach on the second terrace (Fig. 2, Section 3D). It is nearly square, being 15 by 13 cm., and is planoconvex. The plane surface, the inner (flake) surface, has coarse flake scars throughout the perimeter; at the central portion there is a broad flat area with a partly detached bulb. The striking platform has been trimmed off. A more typically Levalloisian tortoise core, about half as large, was found on the beach (Pl. IF). The coarse flakes were removed from the outer surface instead of from the flake surface, which is unaltered. This specimen is worn on all the edges and ridges.

Flakes

Several thousand flakes were collected within five-foot horizontal sections at intervals of 0.2 foot, beginning with the surface. The largest are as much as 15 cm. long, and the majority have more than two faces. Primary flakes, apparently detached by indirect percussion (6, pp. 27-29), are most numerous. The impression gained by examination of a large number is that they are squamous in appearance; on the average they are 4 cm. in both length and width, with a thickness of 4 mm. below the bulb. The platforms are very small and bulbs are weak. Bulbar scars and concentric ridges are rare.[3] The average platform, estimated to be about 1 cm. long and 5 mm. wide, is elliptical, mostly faceted; whether as a result of a blow or from intentional preparation cannot be said. Shatter marks are absent or invisible. Outer surfaces of most specimens are faceted. The lower edge (that opposite the platform) of a great many is broken; it consists of a narrow face and is curved in cross section in a direction opposite from that characteristic of a hinge fracture (i.e. it has the convexity toward the outer surface of the flake). But some of these edges are angular or flat in cross section.

The angle formed by the platform and the main flake surface is estimated to be from 90 to 100 degrees[4] in about 99 per cent of the material. Some flakes have a retroversion of the upper (bulbar) portion with the bulb set to one side of the central axis. They have much higher platform angles.

Large thin symmetrical flakes also have high platform angles. On eight of these that are from 5 to 12 cm. long the angle runs from 110 to 122 degrees. The one with the highest angle is a utilized flake, triangular in outline, with each face forming a single flake scar and with retouching along one edge (Pl. IN). The platform was struck three times before the flake was detached, as is indicated by that number of incipient cones of percussion. The platforms of these eight flakes are unfaceted. Another flake of this type is the Levalloisian tortoise core already mentioned, the unfaceted platform of which is at an angle of 135 degrees to the main flake surface. A single shatter mark indicates but one blow.

Dependence of the GL-1 people upon quartzite as material for the manufacture of implements, and perhaps a long acquaintance with it, are suggested by a comparison of their flakes with those from KB-1, a Woodland site six miles away at an elevation of 608 feet (9). Flint was available to the occupants of KB-1 within two miles. It was abundantly and expertly used, whereas all but one of the quartzite implements are poorly made, being relatively thick with outlines that are not well controlled. Thin primary flakes of quartzite are very rare, which suggests that implements were roughed out by detaching small blocks and slivers in a clumsy way, to be followed directly by attempts at retouching along the edges. The refuse of this quartzite industry is made up of very small flakes, splinters and small blocks with three or more faces. The quartzite implements are all small, being chiefly projectile points up to 5 cm. long and 1 to 3 cm. wide. The KB-1 quartzite is inferior to that of GL-1, as is indicated by the presence of a reddish tinge that is absent from the upper portions of the quartzite ranges in the Killarney area.[5] At CH-1 the large squamous primary flakes are present, indicating a relationship on this point to GL-1 rather than to KB-1. Flint is found only in the topsoil at CH-1. T hough the quartzite here was probably secured from higher levels, some of it is reddish. It is a little inferior to that used at GL-1 but superior in firmness of texture to that used at KB-1. The CH-1 and GL-1 people quarried large blocks and made large implements. The KB-1 people seem to have contented themselves with smaller pieces detached by erosion, and the implements they made were smaller.

No utilized material other than quartzite has been found on or in connection with GL-1. Apparently flint was not available in the region when the waters of Lake Huron were at the level of this beach, and other glacially transported materials were not used. None of the implements shows evidence of intentional grinding. No large hammerstones are found, probably because quartzite blocks of almost every size and shape lie around in profusion, having been detached from the main masses by erosion. The site yields no pottery or bone material, and so far no evidence of hearths or of dwellings has been seen either on the beach itself or on the quartzite hills around it.

Portions of seven artifacts and one large flake have been collected from GL-2, half a mile to the west of GL-1 and at an elevation of ten to thirty feet higher. Five of the fragments are parts of semi-lunar blades or choppers. Three are planoconvex in cross section. The sixth is either half of a semilunar blade or an ovate blade of the same type as those described for GL-1. The seventh comes from a blade of undeterminate type or a narrow flake with one short cutting edge (Pl. IL). This edge, 4 cm. long, has four parallel narrow flake scars that are so shallow and delicate that the pressure technique is implied. The opposite edge is a flat surface 1 cm. in width. The material from GL-2 is all quartzite. This site was first found in the summer of 1941, and no systematic excavations have yet been undertaken. It is very difficult of access and is covered with thick underbrush.

TRANSPORTATION OF ARTIFACTS BY SURFACE WATERS

Implements and flakes are found on the surface between both GL-1 and GL-2 and the shores of the small lake (Lake Lumsden) to the south and east in areas 5A, 6A, 5D-E, 6D-E, 7D-E of Figure 2. This condition was at first regarded as possibly a result of the spread of cultural materials as the occupants followed the receding shore line, but investigation suggests surface drainage as the cause.

Between GL-1 and the shore of Lake Lumsden there are two terraces, the surfaces of which are about 20 feet below the top of the beach proper (3D, 4C of Fig. 2). Apparently they are remnants of the sloping valley fill at the top of which the beach lies. They are notched by two deep V-shaped gullies. A few flakes and one of the two tortoise cores were found on the top of one of these terraces. Between the bases of the terraces and the shore of Lake Lumsden artifacts and flakes occur on the sandy surface, 75 to 85 feet lower than the crest of the beach where the main site lies. The two implements discovered at this lower level are typologically the same as those on the beach, and there is no sign of refuse material such as one would expect if this area was the camp site, at the shore of the lake, and if the site on the beach was merely the quarry workshop. The surface of this area is channeled throughout with shallow ditches and small watercourses, sinuous and branching, and it is at the edges and on the banks of these channels, which are dry during most of the field season, that artifacts and flakes are found. The water that cut these small channels came largely from the two gullies separating the terraces, and since the slope is very gradual in this area the heavy volume of water in the deep gullies was spread out, and in times of flood the whole area is probably one shallow freshet, moving to Lake Lumsden rapidly in some places and slowly in others. Under these conditions it seems obvious that the flakes and artifacts of this lower level were derived from the tops of the terraces and from points nearer the beach itself, and they show the results of transportation in the small fracture scars on the faces and broken edges. None of the implements so far found in this position have the heavily rolled appearance of those from the beach.

Artifacts have been collected close to flakes on this lower level, but none of them fit together to indicate that manufacture took place on the spot. In the summer of 1941, when this condition was first observed, most of the flakes were left *in situ*, and were numbered and photographed in order that any movement might be noted in the season of 1942. It is certain that the amount of water coming down this slope through the two gullies from the level of the beach and from a large area to the north of and above the beach is very considerable in the spring. This condition was approximated after an abnormally heavy rain in the season of 1941.

The situation at GL-2 is identical, except that in it there is but one gully, about 20 feet deep in its upper portions and extending from the top of the valley fill down to within 300 feet of Lake Lumsden, where, as at GL-1, the waters divide into innumerable small distributaries owing to the low gradient. There are a few flakes in this area, and one half of a semilunar blade, or the base of a chopper, found in the bottom of the gully adjacent to the site proper shows abundantly on its faces and edges the effects of battering. These transported materials from the two sites approach to within about 500 feet of one another, whereas the sites themselves are nearly half a mile apart.

There is no possibility that Lake Lumsden has ever been high enough to reach either beach. The whole valley that contains the lake is open to the southwest at a level about 25 feet above it, whereas the sites begin at 60 feet to 70 feet higher.

PATINA

Many of the artifacts and flakes from both sites are patinated (13). The color, which is brown, extends in from the surface to undetermined depths, probably not solidly from one face to another. It is sometimes darker on one face than on the other. There is an apparent correlation between patina and the presence or the absence of water wear or the degree of water wear. The color is identical with the iron oxide stain in the mixed sand and gravel of the beach one foot below the surface and on downward. In addition to this patina, about fifty per cent of the artifacts and flakes exhibit a glaze ranging from small specks to areas two or three centimeters across. The specks, which may occur at any place on the specimen, cannot be regarded as the result of use, since they are found on unworked pebbles of quartzite on the beach and on blocks of quartzite beyond the beach. They may be attributed to abrasion caused by soil flow and other movements of the beach through the action of frost and vegetation. The evidence for this interpretation can be clearly seen with a hand lens, which reveals the glaze at the tops of the minute irregularities of the surface, whereas the depressions between them are unglazed. The glazed areas are minutely striated. Most of the glazing is on flaked surfaces, probably unrelated to rounding, and unquestionably was acquired after the manufacture of the implements.

CHRONOLOGY

The situation of GL-1 with respect to the topography of the area is consistent with the view that the cultural materials belong to a period when the waters of the Great Lakes were at that level. At that time and from that level up to the level of Lake Algonquin (about 188 feet higher at GL-1) the coast in this area was a very rugged one formed by quartzite cliffs with ragged indentations and small rocky islands. The GL-1 beach, however, was in a doubly favored situation at the bottom of a bay about a mile from the main shore line and at the water front of a broad valley, access to which was easy from the beach. If the cultural materials at GL-2 are also contemporary with the lakes at that level, the beach of GL-1 was under water, provided the measurements taken in 1941 are not too far off. An evident preference for soil rather than a rock surface as a place to live is seen in the choice of these two sites. They are the largest level spaces of drift materials that have yet been observed in the area at their levels. From a view of the country over a radius of some forty miles, seen from the highest peak, it is apparent that at the time of their occupation these two sites were on a long narrow peninsula extending westward from the mainland.

The contemporaneity of the cultural materials of GL-1 with Lake Huron at that level is a deduction based entirely upon the worn condition of eleven artifacts, a considerable number of flakes, and one tortoise core. The implements comprise seven semilunar blades, two choppers, one ovate blade, and the scraper-graver, which may be entirely of natural origin. The tortoise core and eight of the artifacts are heavily worn on both faces and edges. It is scarcely conceivable that this condition would result from use, since some wearing occurs only on parts other than the edges and points and since by-products such as flakes and the tortoise core also exhibit the worn condition. It is also unlikely that it resulted from a desire to produce a ground implement because no fully ground implement was made and because one half of a semilunar blade is worn over the broken edge (Pl. IB). It does not seem likely that chemical action could be responsible. Alkaline solutions will attack and reduce quartzite under high temperatures (4, p. 478), and although GL-1 has been the scene of forest fires, the soil is not highly alkaline, and but a small proportion of the cultural materials lying on the surface are worn, some of them only on small areas.

Wave action is the sole explanation that fits the facts. Implements and by-products of their manufacture exhibit various degrees of wearing; they are found on a beach that was formed by the waters of the Great Lakes and that was the scene of violent wave action; the materials of the beach are large enough and heavy enough to do the grinding, which is similar to that on other raised beaches in the Great Lakes region comparable in duration of water action. It is frequently by such worn and rounded pebbles that abandoned beaches are first recognized.

The results of the action of water on artifacts are seen on two other sites in the Killarney area, and there is a marked correlation between the materials of the beaches of the three sites and the nature and the degree of the wearing. At KB-1 the beach material is almost entirely sand; only potsherds are worn. At CH-1 the beach, at an elevation of 636 feet, is composed of sand in one portion, of heavy gravel and large stones in another. Some artifacts of quartzite found in the former position are delicately but unmistakably worn, and quartzite flakes from the latter area that are believed to be of human origin are heavily worn. The occurrence of waterworn quartzite artifacts at CH-1, though similar ones are not observed at KB-1, would seem to be a result of the difference in the intensity of wave action. CH-1 has two components, that in the subsoil, believed to be contemporaneous with Lake Huron at that level, and that in the topsoil (also possibly contemporaneous), where flint and slate occur in addition to quartzite. KB-1 was occupied during the descent from Lake Nipissing (unless pottery and certain forms in stone have a much higher antiquity than is currently believed); it is possible that at CH-1 the subsoil component was laid down before the rise of water to the Nipissing beach, and it may be mentioned that this component has yielded a part of a blade the outline of which recalls the semilunar blades of GL-1. Thus the artifacts in the CH-1 subsoil component, if they were in place previous to the Nipissing Great Lakes, were subjected to wave action longer than those of KB-1, for the site was awash three times. The topsoil component of CH-1, although nonceramic (the site is nonceramic), is more closely related to KB-1 than it is to the subsoil component directly beneath.

There is a striking correlation in the degree of patina of the objects from GL-1 and the subsoil component of CH-1 on the one hand and KB-1 on the other. None of the quartzites from KB-1 show it; the majority of those at CH-1 are heavily patinated. At GL-1 some are heavily patinated, but most of the material in the upper foot of the site is white and fresh in appearance. It lies in the zone of pure white substance that is like clay in its texture. The beach of CH-1 is brown sand throughout, with strata of gravel of the same color. Glazed areas occur only on the artifacts at GL-1. If the cause of the glaze as given above is correct, its production would be mechanically nearly impossible at KB-1 and in the part of the CH-1 beach that is composed of sand.

At KB-1 and CH-1 artifacts are in and beneath strata that were formed by water. The condition is clearer at KB-1, where some of the strata consist of fine gravel and where the artifacts could not have been placed beneath their upper surfaces by excavation from the surface without the obvious displacement of strata. At CH-1 no excavations from the surface account for the presence of artifacts in the subsoil, but none lie beneath gravel strata. The evidence for contemporaneity here consists chiefly in the distribution of the flakes in conformity to the surface by water action and in the wearing of some of the specimens. At GL-1 cultural materials are found to a depth of 1,5 feet, and it is entirely possible that they were buried by the action of water, but this cannot be demonstrated at present. Stratigraphical conditions indicate no other cause, though the type of soil is not such that signs of excavations from the surface would be long maintained.

The belief in the contemporaneity of the cultural materials at GL-1 is based in the final analysis upon the presence of waterworn implements. The existence of another similar site close by (GL-2) at a somewhat higher level goes far to substantiate the high antiquity of both sites. It suggests that more will be found at this general level in the immediate region or elsewhere in the area of the postglacial tilt. It is noteworthy that these two sites are on the edge of what was once a geographical barrier some hundreds of miles long, the northern shore of a late Algonquin stage of the Great Lakes, and that the industry has never been observed south of that shore line.

CULTURAL RELATIONSHIPS

There are hints of a relationship between this complex and the Folsom. Channel flakes and scraper-gravers have already been mentioned in this connection, and to these traits may be added the semilunar blades. Dr. Frank Roberts has stated in correspondence that blades of this type are in the collection from the Lindenmeier site, and a portion of one is shown in the report (12, pl. 14 m). Another fragment, differing from the GL-1 semilunar blades in being under 5 mm. thick (material chalcedony), was found on the Clovis site (11, pl. 29).

Roughly flaked blades of quartzite, schist, and chalcedony with semilunar outlines have been recorded from four other sites, two of which are on raised beaches. One of the beaches is at Tadoussac, at the junction of the St. Lawrence and Saguenay rivers in Quebec (14; 22), and the other is at Windy Tickle, near Hopedale, Labrador (21, pl. 4g, h). The presence of projectile points at the latter site, small lozenge-shaped forms (21, pl. 4n-s), is in agreement with the supposition that this site is later than GL-1, if Labrador was beneath the ice sheet when GL-1 was occupied. At the two other sites heavy quartzite choppers and blades have been found, but the semi-lunarity is less evident. One, excavated by Mr. Douglas Byers and Mr. Frederick Johnson for Phillips Academy, is at East Killingly, Connecticut, and the other is on the shore of a small lake in Alberta, where Dr. Donald Leechman of the National Museum of Canada collected a few specimens in 1940.

GEOLOGY

GEOLOGICAL RELATIONS OF THE BEACH AT SITE GL-1

Though estimates of the age of the Nipissing beach are accepted as reasonably approximate, they are much less satisfactory for earlier stages of the Great Lakes. Perhaps extensive varve studies may sometime furnish fairly reliable dates for the earlier lakes and a much-desired improved calendar of the postglacial. At present it seems futile to give figures in so many thousands of years for the age of the beach at Site GL-1, since much leeway would be necessary and its limits would be uncertain. A fair picture of the geological events during and since the formation of this beach will show, however, that it has a far greater antiquity than is demonstrable for previous archaeological finds about the Great Lakes. And since knowledge of the ancient shore lines in the Killarney region is scanty, we must start elsewhere to present the matter.

Ancient Beaches in Southern Georgian Bay

The Algonquin and Nipissing are the strongest, most heavily developed, and most widely registered of all ancient shore lines in Georgian Bay and northern Lakes Huron and Michigan. There are also many weaker beaches that, though more difficult to identify from place to place, are highly important in the interpretation of the sequence of events and the passage of time. Some critical results derived from studies in southern Georgian Bay (16; 17) are presented in Table I.

The names of the beaches are listed in Table I in the order of their formation. In the second column are given the elevations of the principal ancient beaches found at Cape Rich, less than ten miles north of Meaford. In the third column are the vertical distances of each of these below the Algonquin, as derived by subtraction from the second column. In the fourth column are figures for slopes of the beaches as determined in the region of Penetanguishene. All the ancient beaches rise toward the north-northeast in consequence of the broad postglacial uplift of northeastern North America, a movement that reached from southern Michigan to Hudson Bay and from Winnipeg to Newfoundland.

TABLE I

CRITICAL RELATIONSHIPS OF ALGONQUIN AND LATER BEACHES IN SOUTHERN GEORGIAN BAY

Beach	Elevation in feet above sea level	Vertical distances below Algonquin	Tilt in feet per mile
Algonquin	801	0	3.38
Upper Algonquin group	801–762	0–39	. . .
Lower Algonquin group			
Wyebridge	718	83	undetermined
Penetang	684	117	3.00
Cedar Point	663	138	2.875
Payette	624	177	2.75
-------------------	?	?	?
(hiatus, with perhaps several later stages?)	?	?	?
-------------------	?	?	?
Nipissing	635	166	0.42
Post-Nipissing	635–580	166–221	. . .
Lake Huron	580	221	0.00

The upper Algonquin group comprises a series of closely spaced beaches and covers a vertical interval of about forty feet at Cape Rich. The Algonquin beach, the uppermost of the group, was formed when the discharge of Lake Algonquin was diverted southward past Port Huron by uplifting of the Trent valley outlet. The lower beaches in the group were formed successively as continued uplift was bringing land above water, and the Port Huron outlet maintained Lake Algonquin at a fairly constant level.

There is an interval in which beaches are lacking below the upper Algonquin group, and it signifies a relatively swift lowering in lake level, during which waves could not make good shore forms. This seems to be due to the abandonment of the Port Huron outlet as glacial retreat freed a lower channel toward the Ottawa valley. At the Wyebridge stage the lake level stabilized on some outlet long enough for good beaches to form, though the water must have fluctuated somewhat, as it does seasonally in our present lakes. At Cape Rich a series of beaches with a vertical range of twelve feet belongs to the Wyebridge stage; the principal and strongest beach is at the top. The Penetang, Cedar Point, and Payette stages are similarly represented, each by a short group of beaches at some places, or by a single strong beach at others, separated from the beaches of preceding or succeeding stages by a considerable barren interval in which beaches are absent.

An inspection of the tilts listed in Table I shows that a nearly parallel relation exists between the Algonquin and the lower Algonquin water planes. Only a minor amount of tilting took place between the Algonquin and Payette stages; very much more came later, although most of it antedated the Nipissing beach, which has a very gentle slope in comparison with the others. In view of the fact that the major share of the uplift of the Algonquin beach occurred in the interval between the formation of the Payette and Nipissing beaches, it may be inferred that this interval was a long one, perhaps several times longer than the post-Nipissing, which is generally estimated at about four thousand years. Yet to assign ages to all the beaches in proportion to tilt would involve an unwarranted assumption that tilting has gone on at a constant rate. Indeed, other considerations imply that the rate of uplift has decreased toward present time.

After the Payette stage the lake dropped to successively lower levels as new channels toward the Ottawa became available, and ultimately an extreme low was reached with the use of the Mattawa valley at North Bay. Thereafter only postglacial tilting was to modify the lakes, and as the North Bay outlet region was elevated it brought about rise of water and encroachment on the shore everywhere to the south. The south end of the lake reached and submerged the lower Algonquin shore lines one after another in a sequence the reverse of that in which they were formed. When the Port Huron outlet was attained and southerly discharge ensued again, the lake level came to the comparatively stable position that it has maintained since. It was during this transfer of outlet that the Nipissing beach was formed. The post-Nipissing series beneath it developed during the latest period of uplift. The post-Nipissing beaches bear exactly the same relation to the Nipissing beach as does the upper Algonquin group to the Algonquin beach. In some localities they comprise more than twenty individual beaches, but, regardless of number, the series covers the entire interval between the Nipissing and the present shore.

The Payette water plane was submerged by the Nipissing at Cape Rich. But northeast from there Algonquin and lower Algonquin planes together rise rapidly and draw away from the Nipissing; in the widening gap appear additional beaches not represented to the south.

Shore Lines on Manitoulin Island Studies on Manitoulin Island have identified the Algonquin and Nipissing beaches very well, but have not been detailed enough to correlate satisfactorily the lower Algonquin members with those in southern Georgian Bay. When this becomes possible, more definite interpretations can be made for Site GL-1 at Killarney. Of value for the present purpose is an Algonquin beach at 1,012 feet elevation on the brow of the high Niagaran escarpment about three miles south of Little Current. Its slope here is four to five feet per mile, which is somewhat steeper than it is farther south.

TABLE II

ANTICIPATED ELEVATIONS OF BEACHES AT LOCALITY A, KILLARNEY

Beach	*Elevation in feet above sea level*	*Vertical distance below Algonquin*
Algonquin	1,060	0
Wyebridge	965	95
Penetang	914	146
Cedar Point	883	177
Payette	835	230

An attempt can be made to project water planes north to Killarney and anticipate elevations for them there. A point is arbitrarily selected on the south slope of the Killarney hills a mile north of the head of Lamorandiere Bay and some three miles north and a little east of Killarney village (this is Locality A; see p. 525). The point is about nine to twelve miles north along the tilt line (depending on its exact direction) from the 1,012-foot Algonquin beach near Little Current. The projected Algonquin water plane might be expected here at an elevation of about 1,060 feet, and lower Algonquin beaches might be expected below it at intervals that are greater than those given in Table I in proportion to their respective divergent slopes. These expected elevations are given in Table II, but it must be remembered that they are only hypothetical and are subject to such corrections as more abundant work in the near vicinity, a thing much desired, may eventually bring about.

Shore Line Measurements near Killarney

The hills around Killarney are somewhat hostile to investigation of the ancient beaches; they are predominantly of very resistant rock and are thickly wooded and untraveled. So far only the Nipissing shore line can be definitely identified. The two best representatives of it that have been discovered in the vicinity and measured are (1) a well-formed terrace and bluff, elevation 663 feet, on the Tyson farm, less than a mile east of Chickanising Creek, and (2) a bar of well-rounded quartzite pebbles, elevation 667-668 feet, stretching for about 400 feet across the valley of a little creek at John Proulx's cabin and sugarbush, one mile northwest of the east end of Frazer Bay.

Levels were also run from Lake Huron to some of the higher beaches that have been found at a few places by searching among the hills. They are here described by localities, with elevations in feet above sea level.

1. Locality A, North Slope of Killarney Hills within One Mile North of Lamorandiere Bay

The geological features will be listed as they occur along the old Conley trail, about one-eighth mile west of the telephone line, starting northward from the bay: indefinite or weak beaches at elevations of 665, 744, and 771 feet; definite little beaches near trail by cliff at 839 and 842; a succession of beach ridges, the strongest being one of well-rounded quartzite pebbles that extends 250 feet south-southwest from cliff across trail to outlying rock knob, elevation 874-873; progressively weaker beaches below this at 869 and 866 and above it at 875, 878, 886, and 892; a rounded-pebble beach at 903, 75 feet long from cliff out to rock knob; trail turns northeast along base of cliffs, passing scattered little beaches or banks of rounded gravel against cliffs at 905, 908, 914, 916, 912, and 922; trail next passes over the two ridges of a double tombolo constructed southward from cliff to outlying rock ledges; west arm at 917 composed of well-rounded small quartzite pebbles; good beach of cobble and pebble at 921 along base of cliff overlooking this; trail dips down 15 feet after leaving 917 beach, then rises up over east arm of tombolo, which diminishes in elevation from 916 to 913 in its length of about 120 feet south from cliff and consists of very well rounded cobbles of quartzite; there is another marked ridge east of it at 914 and then a series of weaker beaches on eastward slope at 908, 905, and 886; at base of this slope Conley trail meets Killarney telephone line by creek, and telephone line crosses a little gravel beach at 892, 60 feet out from cliff; farther from cliff and immediately east of telephone line and creek is a strong gravel beach at 876 with an east-northeast trend; a shorter and weaker beach behind it at 878. To the north up the cliff and on the next "flat" two weak beaches were noted at 1,027 and 1,032, a little east of telephone line; their materials are very poorly rounded and assorted, so that they are much less striking than most of the lower beaches listed, but they are the highest beaches found near Killarney. Therefore one may doubt that a highest Algonquin beach was registered on the Killarney hills.

2. Locality B, Northeast End of Lumsden Lake at Site GL-1

The main beach, about 500 feet long and at an elevation of 876 feet, has already been described. Another beach was found about 1,000 feet south of the site and immediately south of a low quartzite knob; it is about 60 feet long across a small draw leading toward Lumsden Lake, composed of very well rounded quartzite pebbles, and at an elevation of 873. Locality B is about one and one-fourth miles north along the tilt line from Locality A.

3. Locality C, on Portage Trail from George Lake to Whiterock Lake

The trail crosses faint beaches at 737, 746, 758, 759, and 760 feet, a better beach of rounded pebbles at 775, strong ridges of rounded, pebbles and rubble at 791, 792, and 794; a faint beach at 807; broad gravel ridge at 810 on extensive flat, by cabin in sugarbush; back of flat at boulder-strewn rise at 814; boulder-covered benches at 835 and 855. The summit of the portage is a strong gravel bar at 883-882 extending 300 feet southwest from trail to rock ledges; south from southwest end of bar are good beaches at 878 and 873, bench at 839 cut into slope, broad gravelly flat at 812; just north of the summit a distinct bench at 878, and farther along trail a bench at 835 below steep 30-foot bluff; overlooking the 883-foot bar and just northeast of the summit of the trail is a poorly developed bench at 887. Locality C is about three miles north along tilt line from Locality A.

DISCUSSION AND RELATIONSHIPS

Even in favorable regions two or three localities could scarcely afford a complete picture of the entire succession of beaches because recognizable features have a habit of occurring only in the occasional spots favored by topography and a supply of beach materials. Yet the fact that outstanding beaches appeared in the 870-885-foot interval at all three of the localities described is one satisfying item of correspondence. Moreover, the difference between the strong beaches, 873 feet at A, and 883 feet at C, is quite commensurate with the three miles' distance (along tilt line) between them and a slope of about three feet per mile. From Table II this shore line would seem a likely correlative of the Cedar Point, but since this is not sure and since there is a rather definite selectivity of wave action at that level, we might give it a temporary name for future reference, "Chickanising beach," after the creek draining George Lake, about which it lies. There are good beaches at about 915 feet at Locality A that may correlate with the Penetang stage. Nothing striking was found to match with the Payette and nothing at all for the Wyebridge. But some post-Payette stage is indicated by the good beaches at 796-792 feet at Locality C.

The highest shore features found near Killarney (1,032, 1,027 feet) are certainly too low to belong to the highest Algonquin shore line, and they are surprisingly weak even for any of the lower beaches of the upper Algonquin group. Two days were spent in looking for beaches higher on the hills, but without results. A few "perched boulders" found at elevations of 1,200 to 1,350 feet on some of the higher slopes and summits prove that the lake never reached this level. They were released by melting of the glacier that brought them, and came to rest in unstable positions on the bare rock slopes, perhaps supported by a few smaller stones. Storm waves or winter ice would surely have dislodged them and toppled them downward had the postglacial lake ever been so high. Such perched boulders are a common sight along the coasts of Labrador (5) and Hudson Bay (18) above the highest limits of the postglacial sea. Tracing them downward to their lowest limit furnishes another means of approximating the highest water level; but at Killarney the boulders were not sufficiently numerous to give this method much promise. Search for the highest Algonquin beach elsewhere along the "north shore," north of Great Cloche Island, has likewise been fruitless (15). There are indications, too, that the Algonquin shore line ran out northward against glacial ice not far north of Goulais, near the southeast corner of Lake Superior (19). It seems most probable, therefore, that the Killarney hills were still covered or obstructed by ice while the Algonquin beach was being registered a few miles farther south. This has an interesting bearing on the environment of the people who fashioned the artifacts at Site GL-1.

A train of geological events may now be reconstructed. The locus of Site GL-1, where no beach yet existed, was uncovered by the retreating glacier or by outlying masses of ice after the Algonquin beach had been abandoned, probably before the lake had dropped to the Penetang stage. This locus was then covered by water instead of ice. The lake dropped to the Chickanising stage (Cedar Point?) and good beaches were developed at Site GL-1 and near by. During this stage artifacts were left on the surface of the beach, and some of them were rounded by wave action before the waters withdrew farther. Wave working of the artifacts may have been accomplished within a period of a few centuries or a thousand years after the abandonment of the Algonquin beach and while the ice front was but 50 or 100 miles distant, for the glacier still occupied the east coast of Lake Superior and the Mattawa Valley. The lake continued to drop to lower levels until it was probably more than 300 feet, perhaps over 400 feet, below Site GL-1. A long period of tilting and slowly rising water brought the lake back to the Nipissing beach, 208 feet below Site GL-1. The tilting continued for 4,000 years after this before the artifacts were discovered.

Thus there seems to be a definite association of artifacts with the time of formation of an ancient beach that is almost 300 feet above present Lake Huron and two and one-half miles inland from it. The time of formation of this beach is exceedingly remote as compared with the time of occupancy of other archaeological sites about the Great Lakes. It was toward the close of the Pleistocene ice age, late in the Wisconsin glacial stage.

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[1] See Map 351 A, Canada Department of Mines and Resources, Mines and Geology Branch. The Bay Finn referred to in the text of this paper is called "Narrow Bay" on this map. Lansdowne Channel, not designated on the map, parallels Badgeley Point on the south.

[2] The elevations given are above sea level. The elevation above the level of Lake Huron is obtained by subtracting 580 feet. The exact elevation of the surface of Lake Huron above sea level in July, 1939, was taken as 579.7 feet by the United States Lake Survey Office in Detroit.

[3] In the literature on stone techniques quartzite materials have been described (if at all) in terms of flint, and though the quality of the two materials is similar, quartzite is less firm in texture and the effects of percussion are more diffused, with the result that the typical lithic landmarks are less pronounced.

[4] Not "a little less than 90 degrees," as was erroneously stated by the senior author in *Man*, 1941 (7).

[5] Map 221A (Collins Inlet Sheet), Canada Department of Mines, Geological Survey.

POSTSCRIPT

The season of 1942 produced three new types of artifacts from the crest of the beach of GL-1: a hammerstone, a long, narrow leaf-shaped point, and a large punch or pick. One face of the last object is a single flake surface, and if the outline was intentional, it shows high skill in shaping the implement before its removal from the Levalloisian core by one blow. One fragment of a semilunar blade is waterworn. The other half, unworn, was found within ten feet of it in 1941. Where the broken ends fit the worn piece is one millimeter thinner than the unworn piece, which indicates the amount of quartzite that was removed by wave action. No movement had taken place among the flakes on the low ground between GL-1 and Lake Lumsden, though some were turned a little. An unusually dry winter may be the reason. The flakes were not removed. The area excavated at GL-1 was a workshop. Since the hammerstone lay in three pieces not more than three feet apart it suggests that all objects were rather close to their original positions. Three of the twenty artifacts found in 1942 and one large flake are water-worn. The lowest point at which artifacts occur at GL-2 was 890 feet above sea level.

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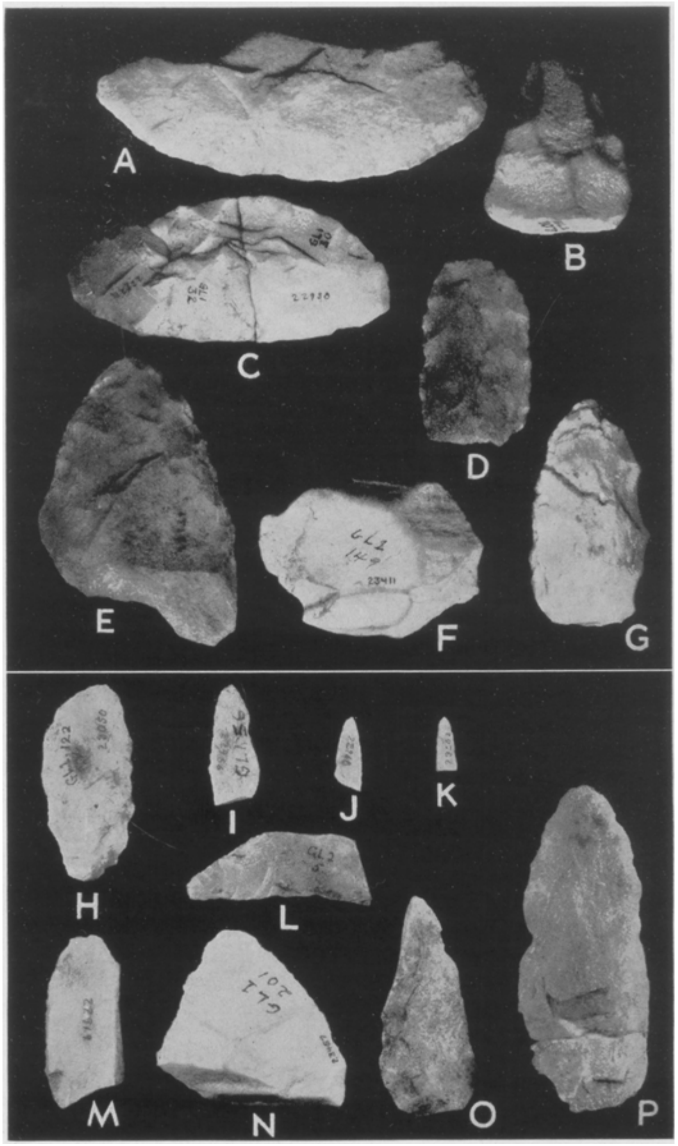
GREENMAN AND STANLEY PLATE I



ARTIFACTS FROM THE GEORGE LAKE SITES

A, C, semilunar blades; B, half of a semilunar blade, rolled; D, quadrangular blade; E, chopper; F, tortoise bore; G, ovate blade; H, quadrangular blade with semilunar outline, smaller than the semilunar blades; L J, K, perforators L, M, N, utilized flakes; O, P, ovate blades. All artifacts are from G-L1, except L, which is from GL-2. Scale of A-G, $^{3}/_{10}$; scale of H-P, ⅓

THE CERAMIC SEQUENCE WITHIN THE GOODALL FOCUS

GEORGE I. QUIMBY, JR.

IT IS my purpose in this paper to construct a synthetic chronology as a temporal frame within which to view the ceramic content of a prehistoric Indian culture complex that I have elsewhere called the Goodall focus.[1] This focus consists of ten components or sites in northwestern Indiana and southwestern Michigan. All these sites were burial mounds or groups of burial mounds that contained various artifacts and other traits with a high degree of similarity. The Goodall focus belongs to one of the aspects of the Hopewellian phase,[2] which is distributed along the river valleys of the eastern United States from the Gulf of Mexico to Canada.

Archaeological evidence and studies of distribution indicate that the Hopewellian phase did not originate in northwestern Indiana or southwestern Michigan; therefore that part of this phase which is the Goodall focus must have entered its area of occupancy by some means of cultural diffusion.[3]

The ten components of the Goodall focus (Fig. 1) are distributed from south to north as follows: The Goodall site is within the drainage of the Kankakee headwaters in northwestern Indiana; the Sumnerville, Scott, and Marantette sites are in the St. Joseph River drainage; the Gratten, Converse, Norton, and Spoonville sites are in the Grand River drainage; and the Brooks and McNeal sites are along the Muskegon River Valley. North of the Muskegon Valley there are few, if any, Hopewellian sites increasing. Although the Goodall site is the only one from the northern Kankakee drainage area considered in this paper, there are, nonetheless, many others in that area.[4] Consequently, distribution, frequency, and cultural similarity indicate that the diffusion of the traits of the Goodall focus into northwestern Indiana and southwestern Michigan was essentially a south-to-north movement.

Translating the south-to-north spatial distribution into a temporal distribution, we see the sequence of culture change within the Goodall focus would be represented by sites ranging in date from those of the Kankakee drainage in the earliest period to those along the Muskegon in the latest period. The total span of time that can be assigned to this focus is probably not less than ten years and perhaps not much more. Such estimates, however, are based on no concrete evidence. If the assumed chronology is correct then the occupancy of each drainage system would reflect a short period of culture. Named after their respective drainage systems, these would be first, the Kankakee, then the St. Joseph period, next the Grand River period, and finally the Muskegon period. These four periods are the temporal frame within which one can analyze the ceramics of the Goodall focus.

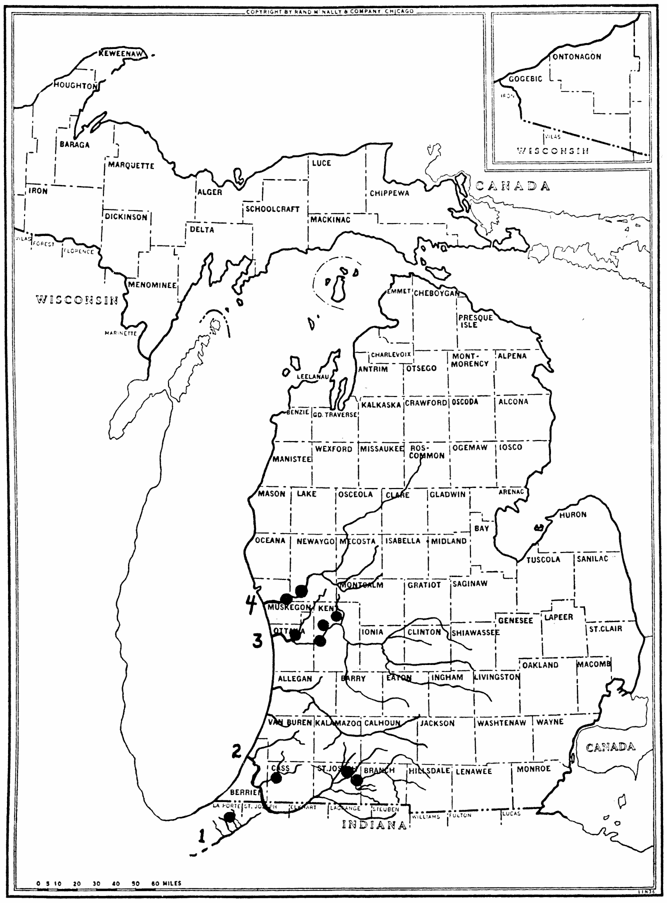


FIG. 1. Distribution of the Goodall focus mounds (indicated by solid circles) along the major drainage systems of southwestern Michigan and northwestern Indiana: (1) the Kankakee, which flows southwesterly into the Illinois River; (2) the St. Joseph; (3) the Grand River; (4) the Muskegon River. The south-to-north mound distribution is indicative of the movement of the Hopewellian culture into Michigan from Indiana and Illinois

In a previous paper I described and named the pottery types characteristic of the Goodall focus.[5] These types were based upon a classification of thirty-three vessels and a number of sherds. For the purpose at hand the sherds have been eliminated, because they were not always saved by the excavators of the various sites, whereas whole or restorable vessels were. To the total of vessels there has been added another of the Norton crosshatched type, from the Brooks site.[6]

The distribution of these vessels by periods and types is as follows:

KANKAKEE PERIOD: 1 Hopewellian zone-stamped; 4 Goodall dentate-stamped.

ST. JOSEPH PERIOD: 1 Hopewellian zone-stamped; 2 Goodall dentate-stamped; 5 Sumnerville incised; 1 generalized Woodland; and 1 unclassified, undecorated vessel.

GRAND RIVER PERIOD: 2 Hopewellian zone-stamped; 3, Sumnerville incised; 1 generalized Woodland; and 3 Norton cross-hatched.

MUSKEGON PERIOD: 1 Hopewellian zone-stamped; 1 Sumnerville incised; 1 generalized Woodland; 5 Norton crosshatched; and 2 Brooks plain.

Pottery is generally considered the most sensitive indicator of culture change in space or time or both; therefore ceramic traits suggestive of culture change are probably much more obvious and easier to deal with than nonceramic traits. The graph, Figure 2, expresses by means of bar segments the percentages of the pottery types by periods. It possibly indicates some significant trends in ceramic sequence within the periods of the Goodall focus. Hopewellian zone-stamped is persistent throughout all four periods and probably represents an importation directly into the Goodall focus. The excellence of this ware as well as the limestone tempering prohibits the idea that it was manufactured locally. The most popular ceramic type of the Kankakee period was Goodall dentate-stamped. It is waning in the St. Joseph period and is not found in the later periods. The Sumnerville incised makes its appearance in the St. Joseph period and is declining in popularity during the Grand River and Muskegon periods. Norton crosshatched first appears in the Grand River period and is increasing in relative frequency in the Muskegon period. Brooks plain is a pottery type found only in the Muskegon period. Were there a period later than the Muskegon, there is a strong probability that Brooks plain would be present and increasing in popularity. The generalized Woodland pottery is found throughout all four periods, although I have listed it only for the St. Joseph, Grand River, and Muskegon periods. It does, however, occur at Hopewellian sites in the Kankakee drainage,[7] and its listing would not change the trends indicated by the graph.

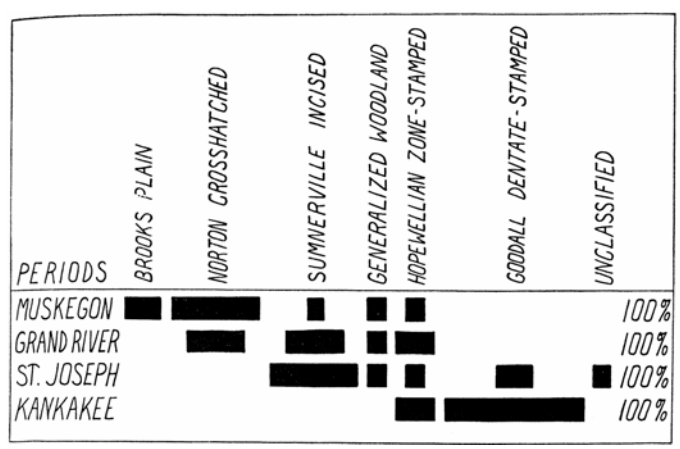


FIG. 2. Graph showing the relative increase or decrease or the stability of pottery types by periods. Each bar segment expresses the percentage of a given pottery type for a given period, and the total of the segments in each horizontal row is 100 per cent. The vertical arrangement of the segments illustrates the increase, decrease, or stability of each pottery type, from the oldest period (at the bottom) to the youngest one (at the top)

The trends implied by the graph can have a number of explanations. The more or less uniform persistence of the Hopewellian zone-stamped has already been suggested as a direct importation. The generalized Woodland, which persisted, is most easily explained as a manifestation of the Woodland base that became Hopewellianized by diffusion. Goodall dentate-stamped seems to be an early introduced type that did not last throughout the life of the Goodall focus.

Sumnerville incised seems to have been largely the result of an imported idea, since it occurs in other Hopewellian foci. It is not, to my knowledge, found in the Kankakee period. This suggests that the Kankakee period had terminated by the time that Sumnerville incised concepts reached the St. Joseph Valley; otherwise the type should be found in sites within the northern Kankakee drainage. The type persisted throughout the remaining periods of the Goodall focus.

Norton crosshatched, for the most part, is probably an attempt by local potters to copy Hopewellian zone-starnped. Its greatest popularity is in the Muskegon period, which appears to terminate the life of the Goodall focus. Another Muskegon period type, Brooks plain, is also likely to have been a copy or a reaction to the stimulus of finer wares.

Incomplete Hopewellian manifestations are known to occur in the Saginaw Valley of eastern Michigan. Although no excavations have been made and no Hopewellian artifacts have been found associated with mounds, pottery sherds of the types Goodall dentate-stamped and Sumnerville incised, are represented in surface collections in which generalized Woodland sherds were predominant. If, then, the Hopewellian influences in the Saginaw Valley can be associated with the Goodall focus, they must have entered the Saginaw Valley during the Kankakee and St. Joseph periods.

Synthesis upon a broader scope may find these periods and ceramic trends of the Goodall focus to be at fault. The present analysis and interpretation have largely excluded data from other Hopewellian foci. Nevertheless, at the present time the ceramic sequence within the Goodall focus, as here described and interpreted, seems to have some foundation.

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[1] Quimby, George I., Jr., “The Goodall Focus, an Analysis of Ten Hopewellian Components in Michigan and Indiana,” Indiana Historical Society, Prehistory Research Series, Vol. II (1941), No. 2.

[2] The terminology and the system of classification have been described by W. C. McKern, “Midwestern Taxonomic Method as an Aid to Archaeological Culture Study,” *American Antiquity*, 4: 301-313. 1939.

[3] Cf. Eli Lilly, “Prehistoric Antiquities of Indiana” (Indianapolis, 1937), p. 28. J. A. Ford and Gordon Willey, *Crooks Site, Marksville Period Burial Mound in La Salle Parish, Louisiana*, Anthropological Study No. 3, p. 141 (Department of Conservation, Louisiana Geological Survey, New Orleans, 1940); James B. Griffin and Richard G. Morgan, “Contributions to the Archaeology of the Illinois River Valley,” *Transactions of the American Philosophical Society*, N. S., Vol. 32 (1941), Part I, p. 47; Quimby, *op. cit*., pp. 144-147; and James B. Griffin, “Additional Hopewell Material from Illinois,” Indiana Historical Society, Prehistory Research Series, Vol. II (1941), No. 3, p. 213.

[4] McAllister, J. Gilbert, “The Archaeology of Porter County,” *Indiana History Bulletin*, Vol. X (1932), No, 1. See also Lilly, *op. cit*., pp. 86-92.

[5] Quimby, George I., Jr., “Hopewellian Pottery Types in Michigan,” *Pap. Mich. Acad. Sci., Arts, and Letters*, 26 (1940) : 489-494. 1941. These pottery types are subject to revision. The trends described later in this paper will remain about the same even if the pottery types are changed. They also remain about the same when groups of individual pottery traits are used instead of pottery types.

[6] This vessel is in the Muskegon County Museum.

[7] Lilly, *op. cit*., p. 90. With this exception the Goodall site is the only one considered in this paper.