THE REAL CAUSE OF THE ICE AGE

By - Chester Davis *

A NEW APPROACH TO THE DEEPER UNDERSTANDING OF SOME PLEISTOCENE FEATURES AND PHENOMENA NOW REVEALS THAT A COMET'S SHATTERING IMPACT WITH EARTH WAS THE ACTUAL CAUSE OF THE ICE AGE.

Drift evidence, or all of those features which are composed of sand, gravel, clay, rocks and boulders, which have been used to justify the existence and actions of the hypothetical Keewatin, Patrician and Labradorian glacial sheets, can be interpreted from a mechanical viewpoint to suggest and even show the diverse impacting actions of a comet.

Several of the "drift" features, which were formerly considered as being products of either glacial ice movement, its melting, its retreat or its re-advance, can now equally well -- and more logically from a mechanical viewpoint -- be shown to be the products of fallen impact debris. A cross-reference chart is presented to show how twenty of the various features can be correlated to the comet's impact debris.

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A second cross-reference chart shows how a number of other Pleistocene formations and effects, most of which were previously ascribed to glacial action, can now be traced to the forces that were derived from the movements of materials by the comet. Blast-action and fallout debris from the comet's impact are indicated as having caused the immediate extinction of some "Pleistocene" animals within the blast and fallout area. Disturbances of the crust of the Canadian Shield may have provided some heat to melt part of the existing ice cap of that time. Meltwater then helped to cause severe flooding and the rapid formation of many "glacial lakes". While we cannot consider all of the important Pleistocene changes which were made at that time, we will consider how the impact site and the opening of the immense crater, which now underlies and forms a portion of the bottom of what is now Hudson Bay, could have provided the necessary source of geothermal energy to evaporate ocean water. This evaporation process could then have caused rapid precipitation of snow and the beginning of Ice Age conditions.

INTRODUCTION

From the finding that a single catastrophic impact, which possibly occurred as recently as 11,225 years ago, we can now throw some new light on many Plesitocene mysteries. Of course, the first and most important of these mysteries is determining the cause of the Ice Age. This cause, however, can now be traced to the modification of Earth's climate as a result of a comet's impact, which made a gigantic perforation through and under the crust of the North American Continent. This impact site is where Hudson Bay and James Bay are now located. The penetration of the crust by the colliding body, resulted in a vast exposure of hot, magmatic material. Then, there were large masses of ice from the Arctic ice cap which contacted this source of geothermal energy. Finally, through many newly made straits and channels, an inexhaustible supply of water from the North Atlantic and Arctic Oceans began to flow into the crater. Another interesting mystery concerns the sudden extinction of such animals as,the mammoth, columbian elephant, horse, giant sloth -- in all, 28 genera for North America.

Although the size of the comet is most difficult to determine at this time, it is tentatively estimated to have been 300 kilometers, (186 miles) in diameter, or about half the shorter diameter of Hudson Bay. Such a comet would have had a volume of 14,137,200 cubic kilometers, (3,395,100 cu. mi).

The impacting body caused the scattering of material so incredibly far, and it has assumed such a strange variety of forms, that we can at last understand why the "drift"(fallout) has been so logically, yet so hopelessly misunderstood by those who have not heretofore considered the alternate hypothesis of a cosmic impact as being a possible cause of the Ice Age.

Since the days of Agassiz, thousands of Earth scientists have roamed over the drift and considered the deposits which exist throughout northeastern and northcentral United States, as well as over vast areas of Canada. From the information that they have gathered, analysed and discussed, they have almost invariably arrived at the same conclusion: that North America had experienced the actions of huge glaciers -- just as Agassiz had proposed -- which produced the various drift features during a prolonged Ice Age. Because of such reasoning, the distribution of impact debris, which fell over a very large portion of what is now the Canadian Shield and particularly over a very large portion of what are now the contiguous 48 Unites States of America, has been mistakenly ascribed to the movements of the supposedly vast Keewatin, Patrician and Labradorian glaciers, which they conceived as moving southward from Canada four times during the Pleistocene.

While the many "drift" landforms, which we will tentatively consider as being fallout features, have understandably been used for over a hundred and fifty years as unquestionable evidence for the widely accepted idea that there were vast glaciers, we must now prepare ourselves for a shock: for in a chart, which we will soon examine, we shall find that only three basic types of material were hurled by the comet to suddenly make a family of crustal features.

By an understanding of the various mechanisms that were involved in the production of the fallout features, one may now see that these mechanisms adequately serve as logical proof of the comet's impacting actions. There is thus a logical sequence of cause and effect that is not contradictory, as was some of the evidence when it was interpreted as having been moved by the inscrutable actions of such vast glaciers as were necessarily envisioned.

CORRELATION OF THE EVIDENCE

CHART I, shows that fallout features, 1 through 16 , (previously known collectively as glacial drift, or otherwise related to some form of glacial action) can be quickly correlated to the fallout materials. Certain other formations and phenomena in the chart are related either directly, or indirectly, to the fallout materials. A sub-section of CHART I shows some additional features that were involved with, or produced by, impact debris.

CHART I CORRELATION OF IMPACT MATERIALS TO FEATURES PRODUCED		IMPACT MATERIALS									
		ICE			PERMA-FROST			SOLID CRUST			
		CHUNKS	FINE	MELTWATER	STRATIFIED	UNSTRATIFIED	SHATTERED	UNFROZEN CRUST	MASSIVE CRUST	CRUSTAL BLOCKS	PULVERIZED
FEATURES PRODUCED		A	B	C	D	E	F	G	H	I	J
ATTENUATED BORDER	1	●	●	●	●	●	●	●			
BLOCKED RIVER CHANNELS	2				●	●	●	●	●	●	
BOULDERS	3						●	●	●		
DRIFTLESS AREA	4	●	●	●			●				●
DRUMLINS	5				●	●					
ESKERS	6	●	●	●	●	●	●				
GREAT LAKES	7	●	●	●	●	●	●	●			
INDICATOR FANS	8								●		
KAMES	9				●	●	●				
KETTLES	10	●									
KAME AND KETTLE TOPOGRAPHY	11	●	●	●	●	●	●	●			
LAKE BASINS	12	●			●	●	●	●	●		
LOESS	13										●
MELTWATER LAKES	14	●	●	●							
MORAINES	15	●	●	●	●	●	●	●			
OUTWASH PLAINS	16	●	●	●	●	●	●	●			
PITS	17	●									
VALLEY TRAINS	18			●	●	●	●	●			
SPECIAL FEATURES											
BAYS	19	●				●					
CRATERS	20								●	●	

CHART I Three basic forms of impact debris are shown: ice, then the permafrost which existed beneath the ice, and the deeper material comprising the crust. These are further sub-divided and listed A through J. The cross-reference dots indicate the involvement of these materials in the production of the different fallout features which are numbered 1 through 20.

COLLISION

As the comet passed through Earth's thin atmosphere, some of the atmosphere was compressed. It became intensly heated and then moved rapidly outward from around the periphery of the intruding comet.

As the comet collided with Earth, it first contacted a portion of the Arctic ice cap. Ice broke up and began to be rapidly pushed away from in front of the comet. Thousands of huge pieces of ice were accelerated over many arching trajectories for long distances.

Going deeper, the comet contacted the frozen crust, (permafrost) which existed immediately beneath the ice cap. While some of this permafrost was shattered and moved along with much of the shattered ice, there evidently were thousands of massive pieces of stratified and unstratified permafrost which could not break up completely, and these were also hurled (catapulted) through the air for long distances to fall upon the crust in many places, to make uncountable thousands of hilly crustal features that are known to geologists as "drumlins" and "kames". Such features were formed throughout a broad belt, stretching over an arc from Nova Scotia to North Dakota. By this hurling of permafrost through the air, and then its falling and spreading over the crust, there were some exceptionally notable drumlin fields made in Wisconsin, Michigan, New York and Nova Scotia -- all of which exist at approximately 1530 kilometers, (950 miles) from the impact site. (See Figure 1).

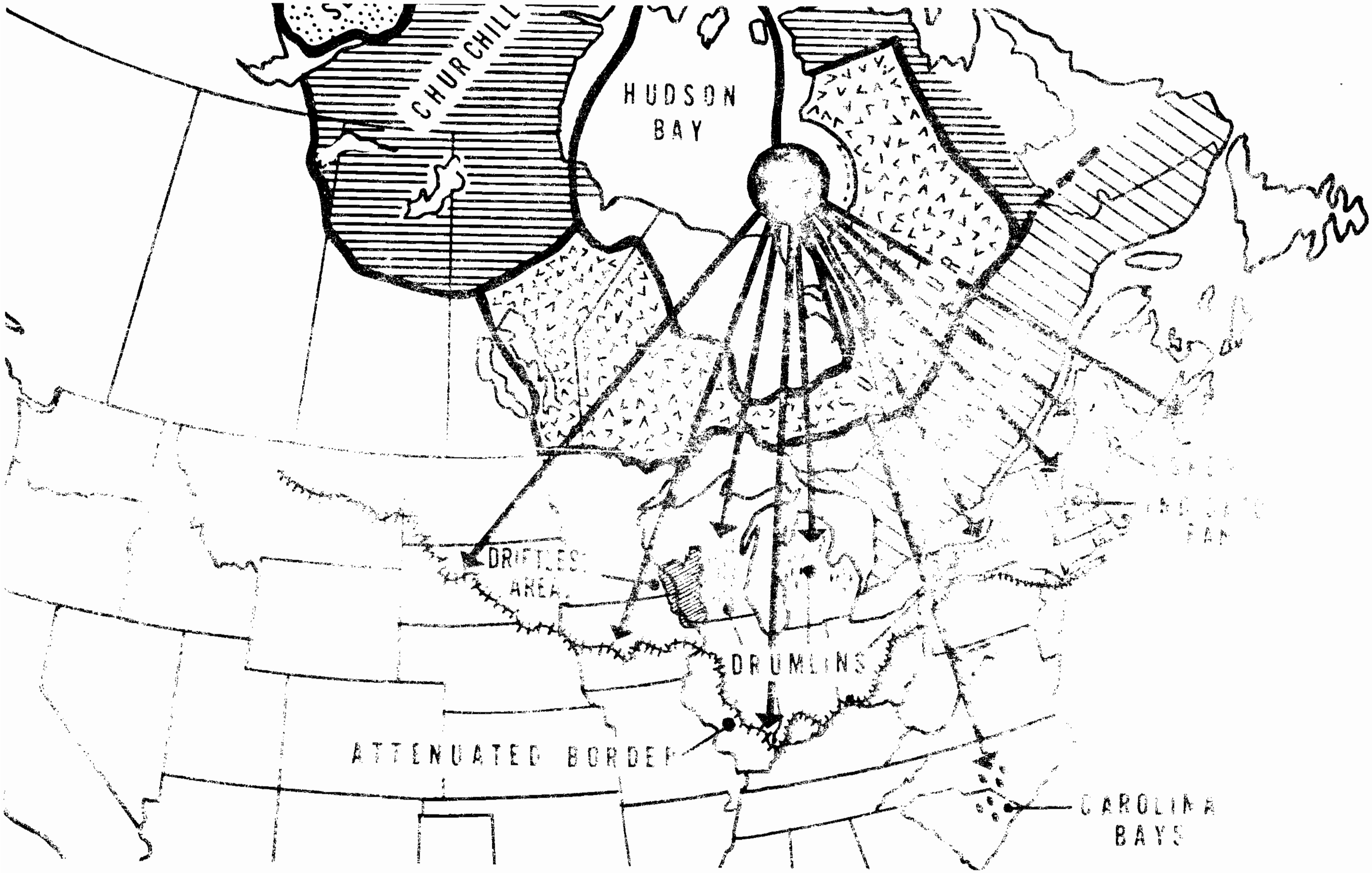

FIGURE 1. The site of the comet's impact is shown at what is now the location of Hudson Bay. The long arrows indicate the directions that materials were hurled to make different fallout features. And the hatched-line represents what is called the attenuated border which has long been accepted as being the limit of glacial action. However, there is much evidence that erratics and other materials were hurled beyond this border, reaching such present far southern states as Mississippi, Alabama, Georgia and Florida.

Going still deeper, the comet catapulted some large pieces of the crust. Some of these pieces fell in scattered places to produce secondary impact craters. However, Canadian astronomers and geologists who have investigated some of these craters have considered them to be "fossil" impact craters, because some of the material within them is very old. Other pieces of the crust that were moved over higher velocity trajectories were broken up when they impacted, and the materials then scattered rapidly over diverging paths to make wedge-shaped paths of rock. Geologists have traced these boulder-strewn paths in the New England states for long distances. (See Figure 1).

As the comet's penetration of the crust was almost complete it caused enormously large quantities of different materials to be fragmented thoroughly. While some of this material was thrust ahead of the comet and was moved to great depths, other material was blasted upward, to soon fall over widespread areas. Possibly some of this pulverized crustal rock is known as loess.

The removal of all of the foregoing materials from the comet's impact site formed the excavation that has since then become filled with water, and it is now known as Hudson Bay.

Finally, as the comet attempted to move beneath the crust, it then heaved upward a tremendously large area of crustal material that formerly occupied most of the site of what has since then become James Bay.

EXPLANATION OF IMPACT MATERIALS

In CHART I, listed under IMPACT MATERIALS, three basin materials are shown in the order of their movement. ICE, PERMAFROST and SOLID CRUST. These are then subdivided and lettered A through J.

Listed under ICE are, (A) chunks, (B) fine, and (C) meltwater. these refer to massive chunks of ice as big as houses and even as large as city blocks; to various smaller and finer pieces of ice; and then to meltwater from some of the ice.

Then, listed under PERMAFROST are, (D) stratified, (E) unstratified and (F) shattered. These terms refer to the layered, unlayered and fragmented permafrost masses which were hurled, but which had formerly been the perpetually frozen material beneath the Arctic ice cap.

Finally, listed under SOLID CRUST are, (G) unfrozen crust, (crust which had existed beneath the permafrost and possibly consisted of some boulders, small rocks, sand, clay and limestone.) (H) Massive crust refers to portions of the crust as large or larger than mountains. (I) Crustal blocks refers to portions of the crust with dimensions of a few kilometers. (J) Pulverized crust refers to portions of the crust which had become somewhat fragmentized by the crushing action and the continued onslaught of the comet.

By carefully examining the cross-reference chart, one can see the relationship of these several materials to the various "drift" or fallout features. This gives us an overall insight into how the features were made; an insight which could not previously be glimpsed as long as the features were considered as being produced by the inscrutable actions of glaciers.

CORRELATING IMPACT MATERIALS TO FALLOUT FEATURES

ATTENUATED BORDER 1 - ABCDEFG. In Figure 1, it may be observed why the attenuated border, or the hatched-line indicating the fallout limit exists far southeastward and southward of Hudson Bay. Such widespread distrubation of the fallout is what we could expect, because the comet was so large that its broad curved front -- impacting at an estimated incident angle of about 57° gave the material a somewhat preferred direction of movement. While much material was hurled in all directions around the impact site, some of it moving into the Atlantic Ocean to presently exist upon the Continental Shelf, the most southern lobe of impact debris seems to have fallen directly to the south of the impact site. This location of the southern lobe is due to the high trajectory of the hurled material, its flight time, and to the rotation of Earth while the material was air-borne. Thus the lobe of erratic fallout moved westward and as far south as the present state of Kentucky. But other material was hurled even farther -- as far as the states of Mississippi, Alabama, Georgia and Florida !

While the "drift" has always seemed to logically point to the repeated advances and retreats of glaciers during the Pleistocene, it is suggested here that the abundant "drift" evidence existing throughout northeastern and northcentral United States and adjoining areas of Canada (with the exceptions within high mountainous areas) has been grossly mininterpreted. This misinterpretation of the drift is suspected when we note that G. Frederick Wright (1920) had hopes at first of tracing a distinct terminal moraine across the continent. But he finally had to abandon this view, since he found that the deposits were more evenly spread, ending in some cases in what he considered to be an extremely attenuated border.

This shocking inconsistency, of Wright finding such a terminal moraine as he had not expected, indicates that something was wrong with his theory; because it is entirely reasonable that huge glaciers should actually leave distinct terminal moraines. However, as Wright and others (1920) disappointedly discovered, this was not the case. But Wright quickly overcame the inconsistency by proposing four periods of glaciation rather than one. Thus he and others became bogged down in a quagmire of contradictions.

Since the impact debris would have had some large degree of mixing, sliding and distribution upon the crust as it fell, it becomes understandable why some of the disturbed layers of drift were so quickly misinterpreted as being the results of repeated glacial actions.

BLOCKED RIVER CHANNELS 2 - DEFGHI. Various kinds of crustal material were catapulted through the air to land and effectively block some of the former river channels. This action sealed off vast ponding areas for water accumulation. Thus it soon became necessary for new river courses to become established. These, of course, cut through many of the older drift-filled channels.

BOULDERS 3 FGH. Massive portions of the crust, which consisted of a variety of materials, were broken up into many large and small chunks by the impact of the comet. Then, while they were being accelerated through their different trajectories, many of the chunks of material collided with others, to either become broken, chipped, rounded or scratched. Many boulders possibly became roughly rounded in mid-air, by their rapid spinning and bumping against other boulders of nearly equal size. Finally, as the boulders fell over various regions of the south, they became further modified as they collided with the crust and sometimes with other, previously fallen boulders.

By the acceleration of boulders from the impact site, and by their mid-air abrasion, we can account for the distribution of erratic boulders that are rounded, scratched and even broken; boulders that were never drug along beneath a massive glacier. Now we can also account for some boulders that are unworn, while others are highly angular; boulders which were never carried upon the back of a glacier.

DRIFTLESS AREA 4 ABCFHJ. While extremely large quantities of impact debris -- such as sand, gravel and boulders arched through the sky, all of which are so easy to identify -- and then fell in layers which formed various thicknesses of drift over widespread areas to the east and to the south, there were naturally countless pieces of baked and glazed material that were also hurled. All of these baked, glazed and even melted pieces contain iron. There was also much sand that was hurled, and this sand now makes up many of the hills of the Driftless Area. Further, this sand is laden in places with the iron-contaminated pieces of baked and glazed sand. Some of the hot, iron-charged sand has even formed layers and streaks that run at angles throughout much of the sandstone.

A paradox existed for a time, concerning the Driftless Area, because there was a great contrast in the quantity of erratics within the area as compared to the abundance of it in surrounding areas. At first the investigators of the area noticed a complete absence of the usual erratics, which they had noticed so abundantly elsewhere. However, the Driftless Area, which covers parts of Wisconsin, and smaller parts of Minnesota, Iowa and Illinois, does contain some of the usual recognizable drift. It has been found in some areas of what has been called glacial Lake Wisconsin; an area which exists entirely within the Driftless Area. A few other localities within the Driftless Area of Wisconsin also contain erratics. (For the locations of some erratics, see pp. 338, 9 , THE PHYSICAL GEOGRAPHY OF WISCONSIN, (1965) Lawrence Martin)

DRUMLINS 5 - DE. Drumlins are huge streamlined mounds of earth, containing sand, gravel, clay, boulders and other materials. While they have long been considered as somehow being formed by advancing glaciers, we may soon find that they were not formed by glaciers within the fallout area at all, but more logically -- as seen from a mechanical viewpoint -- by the falling masses of stratified and unstratified permafrost, that were first accelerated from the comet's impact site by the transfer of momentum from the rapidly moving comet, the outward movement of the highly compressed atmosphere and by the expansion of high pressure steam.

While the comet was still breaking up ice and hurling it, the permafrost zone was penetrated. Immediately there were huge irregularly shaped masses of frozen crust, consisting of sand, gravel, clay and other materials, which were forced to accelerate in various southward directions. Large swarms of these hurdling masses of permafrost tended to rotate and their protruding edges were broken off.

Then after traveling through a trajectory for approximately 1850 km, (1150 miles) many of these masses impacted with the crust in what are now the New England States. But large flocks of them also impacted in what are now the states of New York, Michigan, Wisconsin and Minnesota. In all, they formed a broad, crescent-shaped drumlin belt which extends from Nova Scotia to North Dakota, and they almost invariably have their long axes pointing toward the junction of Hudson Bay and James Bay.

Approximately 10,000 cigar-shaped drumlins were formed east of Rochester, New York. Most of these have a length of about a half mile, but a few of them reach a length of two and three miles. While many of these cigar-shaped drumlins are made of sand, gravel and scattered boulders, a few are comprised of clayey material, while others have rock cores.

In and around Boston, Massachusetts, there are several lenticular - shaped drumlins, which are known either as a Hill, a Mount, or as a Height (Wright, 1920, Figure 86, p.281). These drumlins tend to have an axial alignment that runs northwest to southeast, similar to the axial alignment of Hudson Bay and the Carolina Bays — unless the drumlins have had their forms compounded and their alignment altered by having one mass of permafrost impact in some way upon another previously positioned mass.

From a mechanical viewpoint of how the different shaped drumlins were made, we may consider that if the permafrost was first arched high in a trajectory during its acceleration by various forces at the impact site, and then fell at an equally steep angle, then it would have tended to produce a crater. But with sufficient material, it would also have left an oval-shaped, or lenticular mound of earth. However, if some of the permafrost moved swiftly over a low trajectory, it would have been distributed over an elongated path, to form a cigar-shaped drumlin. (For an excellent picture of such drumlins, see Shelton, 1966, Figure 220.)

It has been, and still is, a formidable challenge to understand the mechanisms by which a glacier can make different shaped drumlins. But from falling masses of permafrost, it can be mechanically understood how a single mass of permafrost would fall to make a single cigar-shaped drumlin; how two independent masses would fall close together, or side-by-side, to make parallel "twin" drumlins; how three masses of permafrost could fall one after another at a single point to make a "triplet" drumlin, having one head and three tails; and how small masses of permafrost could have later landed on the sides of larger drumlins to appear as though they had been "plastered" there. By what mechanisms could a glacier have made such drumlins?

If geologists will continue to investigate the various drift features, they may find several mechanical principles by which to interpret them as being products of falling material, rather than to have been formed by some actions of either advancing or receding glaciers.

It is a widely recognized fact that many broken rocks are found in drumlins and kames. However, some of these rocks will reveal definite signs of an impact mark! Anyone who will carefully remove these broken rocks from a freshly exposed edge of a sand and gravel pit, which has not been recently disturbed by machinery, will further notice that the edges of the broken rocks are positively sharp and unworn.

While we will all concede that glacial action can round and polish rocks and also break rocks, then there is a contradictory situation which presents itself in the drift rocks of the fallout area. If the glaciers broke the rocks, then why can so many of them be found in drumlins and kames that still have sharp edges? Did the glaciers suddenly stop their advancement, and their rounding and polishing action on these uncountable sharp-edged rocks at the very instant in which they were broken ?

The writer has found many such rocks near Williamson, Michigan; Canton, Ohio; Whiteface Mountain in New York; and Mexico, Maine. These are of the typical Precambrian material that can be found so abundantly throughout Ontario and Quebec. The question that pertains to these rocks is this: If the Keewatin, Patrician and Labradorian glaciers pushed down into what is now United States territory, then how did these sharp-edged rocks miraculously excape the powerful and prolonged grinding action of these glaciers ? If the glaciers ground most of the rocks, then why did it not grind the broken ones ?

By our considerations of the shapes, and unusual compounded shapes of some drumlins in western New York, it becomes possible to understand the clear-cut, cause-and-effect relationship of how they were made by the impaction of permafrost masses. We further see how rocks, which still exist in drumlins, were broken as they impacted with one another while they were being distributed. We further see why the sharp-edged rocks have retained their freshly broken appearance and their sharp edges.

ESKERS 6 - ABCDEF. An immense quantity of ice, consisting of various sized chunks and particles, along with huge quantities of shattered permafrost, could have been catapulted in various directions over the existing ice cap, and out over vast areas lying far to the south of it. Thus these various materials, cascading from the sky in sheet after sheet, may have formed a layer of fallout of varying thickness, which we may consider as being a "blanket". Soon, the ice began to melt and the permafrost began to thaw. Some of the resulting meltwater, being unable to immediately penetrate and wash away beneath the frozen material, necessarily formed a stream on top of the blanket. As the meltwater washed across the upper surface of the frozen blanket, there were sand, gravel and other materials which became loosened, to start washing and rolling down and over the variously inclined surfaces in countless places.

By the continued melting of ice and thawing of permafrost, sand and gravel became stratified, while the meltwater either became ponded to form meltwater lakes, flowed away as streams or slowly drained downward beneath the bed of material. Thus, the somewhat sorted and stratified materials of the eskers appear to have been positioned -- all without the need of any glaciation.

While eskers in North America (within the fallout region) have previously posed a most perplexing problem as to the manner of their formation, this explanation may account for those eskers which are sometimes associated with drumlins, sometimes cross over drumlins and kames, and do not always follow stream courses.

GREAT LAKES 7 ABCDEFG. The Comet hurled an exceptional variety of material, which was scattered widely in areas not only now occupied by the waters of the Great Lakes but in vast regions around the present Great Lakes. Thus it appears that the actual ponding of water at the time of the Comet's action and shortly thereafter, to make Lake Agassiz and Lake Algonquin,was the original reason for retention of such vast areas of water. However, the subsequent opening of several drainage channels has reduced the original extent of water to that now within the present Great Lakes.

The five Great Lakes, as is known, have long been considered by Earth scientists — especially geologists and glacierists — as having been made by the irrestible force of rock-shod glaciers, (Atwood, 1940, p. 214.). The weight of the glaciers has been considered as being the means of depressing the basins. (Hunt, 1967, p. 236.). But not so strangely, there have been other equally qualified writers who questioned the movement of ice as causing the excavation of the basins. (H. L. Fairchild, "Ice Erosion Theory a Fallacy ", Geol. Soc. Amer. Bull., 16 (1905), pp. 13-74.) F. T. Thwaites, Outlines of Glacial Geology (1st. ed., 1927), pp 42-44, (2nd ed., 1934),p.20.

Such logical ideas as the movements of glaciers and their weight have been necessarily and readily accepted as leading to the formation of the Great Lakes, especially with their actions apparently so well substantiated by the extensive "drift" deposits to to the south. But since we have several indications that there were no Keewatin,Patrician and Labradorian glacial sheets responsible for producing the eighteen fallout features, these hypothetical glacial sheets could neither be responsible for scooping-out the Great Lakes basins, depressing them with ice, nor for filling them with meltwater.

Please consider the following questions : First, how could the Great Lakes basins have been scooped-out or even modified to some major extent by rock-shod glaciers, when the Brent Crater, only 240km, (150 miles) north of Lake Ontario, and the Holleford Crater,only 72 km, (45 miles) north of Lake Ontario, have not been obliterated ? (Please see their locations in Figure 6, p.49. Second, how can the actions of such glaciers be justified; glaciers which were supposedly capable of distributing drift material over hundreds of thousands of square kilometers... when these small but highly significant craters have been marveled at by Canadian astronomers and geologists because their deeper material and rims are evidently of great age, and they have neither been obliterated nor filled-in with glacial drift?

Such conflicting evidence tells us that something has been wrong. So the possible answers to the above questions may go as follows: From the fact that the Brent and Holleford Craters have not been obliterated, this tends to negate the movement of the glaciers. And, from the fact that the craters have not been leveled-over by the drift transporting capability that glaciers are known to have, then this fact also negates the existence of those glaciers. Therefore, the existence and actions of the glaciers are no longer tenable. We are thus forced to conclude that the Keewatin, Patrician and the Labradorian glacial sheets never actually existed -- except in the minds of the former investigators and writers.

From Figure 2, it will be observed that there appears to be major crustal disturbances around and under the five Great Lakes basins. However, I urge caution in judging these basins, and strongly suggest that the distortion of the crust of the Great Lakes region occurred during a previous catastrophic time This is because the writer believes that the distortion of the crustal layers beneath the Great Lakes basins is related to the folding of the Appalachian Mountains. And since the Applachians contain numerous deposits of sand and gravel -- which would be considered as drumlins or as kames if they were anywhere else -- these deposits tend to prove that the mountains were there before the comet hurled this material upon them.

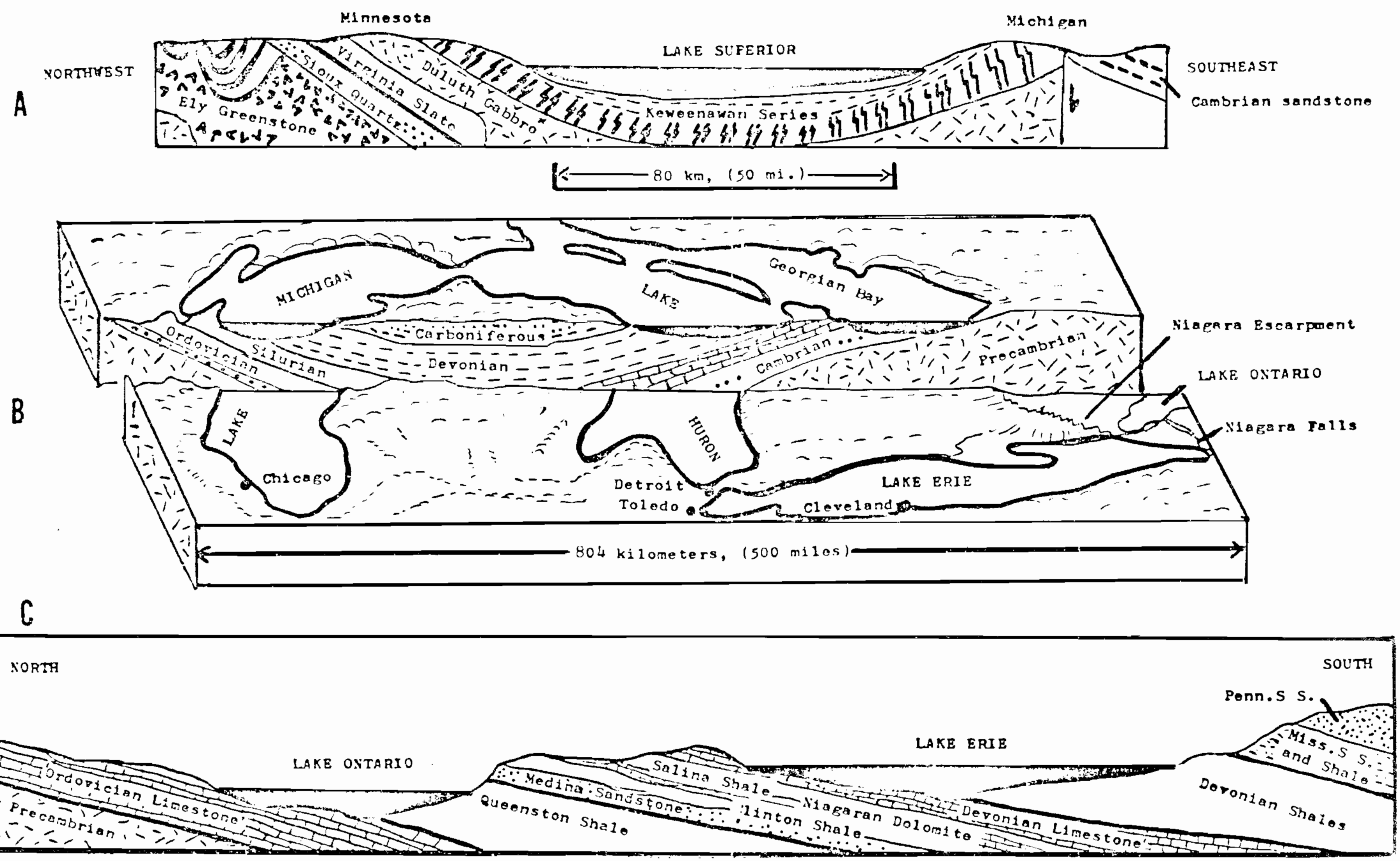

FIGURE 2. (For caption, see next page.)

FIGURE 2. Cross-sectional views of all five Great Lakes are shown. Note in cross-section A, how the basin beneath Lake Superior consists of an extensive syncline with very intense folding towards the northwest, and with faulting at the southeast end.

In cross-section B, note how Lake Michigan and Lake Huron occupy a tremendous synclinal area.

In cross-section C, Lake Ontario and Lake Erie appear to occupy a very broadly tilted area.

In all three of the cross-sections vast quantites of anticlinal material has vanished. It is possible that its removal was possibly caused by a very powerful underthrusting, while the lower layers were being pushed away by some previously catastrophic force. [A, and B, drawn after Hunt, C. B., 1967, Figure 12.8, p.213., and C, drawn after Hough, J. L. 1958.]

(These illustrations of the Great Lakes basins are grossly exaggerated. To obtain a more true perspective of the basins, please consider this: The length of Lake Superior, from Duluth, to Sault Ste.Marie is 534.3 km. and the greatest depth of the lake is 396.8 meters. If we divide the depth of the lake into its length, we obtain a depth to length ratio of 1:1346 Now let us consider this ratio in another way by drawing things to scale.

If we let the width of a line that is made by a ballpoint pen represent the depth of the lake, and the line is .5mm wide , the length of the line which represents the length of the lake would be 67.3 centimeters. This means of drawing things in proportion proves to us that it is really impossible to make a scale drawing of the cross-section of Lake Superior and then to print it in a standard size book. It further shows us how very little crustal warping had take place and how only a small amount of fallout could have blocked the old drainage systems for ponding the water of Lake Superior.)

INDICATOR FANS 8 - H. Some large masses of rock and minerals from within the solid crust were hurled in various directions. Naturally upon their impact, some of these masses pressed deeply into the earth, while smaller portions of them broke up into angular pieces which scattered onward. Possibly, in some cases, there may have been some local material that was impacted upon by the falling material, and this local material was also scattered along for some distance.

From the fact that there are several distinct indicator fans (sometimes called boulder trains) of considerable length and width which have been traced in the New England States, it follows that the hurled material must have been moving at a very high velocity. This high velocity action to account for the fans is indicated because of the tremendous power of the comet, and because the six New England States lie exactly on a line which, if extended northwestward in the direction that the fans generally tend to point, then it would point to Hudson and James Bay.

From where "parent ledges" of such materials as quartzite, syenite, felsite, agate and other distinctive rock type minerals were lodged, such materials were instantly broken up and rapidly spread in southeastward directions over hills and valleys, to produce their fan-shaped paths. The diverging angles and lengths of these mineral-strewn paths would depend on such parameters as: the types of material, their incident direction and angles of impact, and their velocities to thus produce these unique fallout patterns. (For the locations of some indicator fans in the New England States, see Flint (1957) Figure 7-16, p. 126.)

It is known, of course, that the paths of indicator fans cross one another. Such crossing has been supposedly explained by Flint (1957), p.123, as not having been produced contemporaneously.

Since this is a crucial matter, the reader is asked to seriously consider whether indicator fans could be made to cross each other by the actions of one or more glacial sheets. Could this crossing of material be distributed contemporaneously, or even by the action of another glacial sheet at a later time? The fact that Flint essentially suggests that the indicator fans were not produced contemporaneously, shows that he did consider their crossing to be a problem. Yet we can see that the insertion of a period of time between glacial actions still does not solve the basic mechanical difficulty.

If a glacial sheet has any eroding and distributing power at all — and it evidently would have or it would not be making an indicator fan — the glacial movement taking place in making the second indicator fan would obliterate the first one. But such obliteration of crossing indicator fan material in Rhode Island and Massachusetts is evidently not the case. For in these states, one narrow fan of Iron Hill (peridotite) crosses a large, broad fan of Diamond Hill(agate), Flint, (1957), Figure 7-16, p. 126.

It is suggested that all of those indicator fans of the New England States which do not cross each other, as well as those which do cross others and in some places exist inside of fans, were made almost at the same time by masses of minerals which had been hurled from the impact site. Then, after falling upon the crust toward the southeast, these minerals instantly broke up into numerous large and small angular blocks which tumbled onward. Thus we can account for the simultaneous production of wide fans; narrow fans; crossing fans, and fans which exist within other fans — all produced without any need for the existence and movement of glaciers.

KAMES 9-DEF.(Kame", as used here, should not be confused with the older term "esker", as it was first used in Europe.)

Numerous chunks of frozen, stratified crust were catapulted, to soon impact in various places within the fallout area. Such huge impacting masses, which were frozen and may have been somewhat stratified to begin with, impacted upon the crust so as to become more or less fragmented throughout the mass. Thus it may be possible to see why such material -- stratified to begin with -- might still retain a small degree of its original stratification even after spreading out to form a kame.

But an even more probable mechanism of producing stratified layers within kames appears to be related to the distribution process; such as the rapid sorting action that possibly took place within the pulverizing masses which were being quickly spread out in nearly horizontal sheets over the eastward moving crust. Thus, in practically all sand and gravel pits within the fallout area, we can find sharply defined layers of sand and layers of gravel, or graded bedding which often forms random sequences, with cobbles and boulders often scattered throughout the overall formation.

The stratified conditions of material within kames has been generally accepted as having been produced by water. This stratification is the chief distinguishing characteristic between kames and drumlins. However, it is possible to find sand and gravel pits containing material that has both stratified and unstratified material within them. Thus it may be possible to infer that this stratified condition of kames, and the unstratified condition of drumlins, tends to indicate that the main difference of their internal structures may merely be due to the degree of thoroughness with which the masses of permafrost were broken up and distributed.

(The writer has examined and photographed sand and gravel formations in Vermont which indicated that the crushing and rapid distribution of sand and gravel was not the same in all places. While some graded layers are level and some are gently sloped, other layers are steeply inclined.)

KETTLES 10 - A. After the break-up of a portion of the Arctic ice cap by the comet's impact, there was an upward steam-catapulting of massive chunks of ice. These masses of ice -- " missiles from the Arctic" — soon bombarded the crust to the south, and explosively made many thousands of large depressions known as kettles.

Since other materials were hurled along with the ice, the final distribution of these materials left some buried and some almost buried masses of ice. Then, after the melting of the ice, there was left either a kettle or an irregular-shaped depression that was formed because of the collapse of overlying and adjacent material. However, in some deep,explosively-made depressions the subsequently scattered material which fell failed to completely fill them.

On Cape Cod, in Massachusetts, there are some typical ice impact depressions. While many of them are irregularly shaped, some of them still have an elliptical shape. (For a picture of such kettles, see Shelton(1966)Figure 213, p.223)

If anyone will careflully check the alignment of these kettles, it will be found that the more perfectly shaped kettles have a northwest to southeast axial alignment. And if one extends a bisecting line through these kettles, or lakes, it will be found that the line points directly toward the junction of Hudson Bay and James Bay.

KAME and KETTLE TOPOGRAPHY 12 [illegible] this feature is quite possibly the result of a falling mixture of large chunks of ice, large chunks of permafrost, and a great quantity of shattered permafrost which consisted of sand, gravel, large rocks, clay and other related materials. While the kettles are the products of the ice, the surrounding hilly area is the product of the various masses of permafrost.

By refering to the Correlation Chart 1, it may be immediately noted that this fallout feature corresponds almost exactly with Antenuated Border 1 - ABCDEF, ESKERS 5 - ABCDEF, MORAINES 13- ABCDEF, and OUTWASH PLAINS 14- ABCDEF. Thus at this point, we begin to see that not only are these several features related to the materials which made them, but that they are necessarily related to each other.

It appears that the only differences between kame and kettle topography, eskers, moraines and outwash plains are due to the original proportions of the materials which fell, along with the distribution mechanisms which immediately acted and those which subsequently acted. The pre-existing conditions of the terraine upon which the impact debris fell was also of some importance.

LAKE BASINS 12 - [illegible] impact material toward the south at that [illegible] appears that massive chunks of falling ice could have naturally made many depressions in the crust which soon became filled with meltwater. Some of the massive quantities of crustal material may have also blocked former drainage channels in many places, thus forming dams by which additional lake basins were established. Still other widely distributed material would account for the very irregular terrain which may have contributed [illegible] numerous water-retaining basins.

Vast areas of Canada which surround Hudson Bay and James Bay are positively peppered with lakes and, of course, it is known that many thousands of lake basins tend to be concentrated near the Great Lakes in all of the states which adjoin the Great Lakes.

This lake-concentration tendency may mean that the topography of these areas was so modified by the fallout that basins were established which, in an over-all manner, helped to impound the waters of the Great Lakes.

Without the concept of the comet's actions, we can see why so many lake basins and lakes had been previously attributed by geologists to the theorized movements and melting of those hypothetical glacial sheets.

LOESS 13 - J. It appears that almost immediately after the comet had penetrated the ice and the permafrost layer, and was still in the process of hurling these materials out of its way, that it contacted the more solid layers of the crust.

Of course, large masses of the more solid crust may have been hurled to form the indicator fans, to scatter large angular boulders, and to even distribute angular fragments among the general fallout. But the greater resistence of the deeper rocky layers possibly caused them to become more thoroughly broken up and to become pulverized by the irrestible force of the comet.

Then, sometime after other catapulted materials had fallen into place, some of this finely divided rock dust drifted slowly from the sky to cover vast regions. Thus, exceptionally large areas in what are now southcentral Canada and northcentral United States were possibly covered with such fine rocky debris that is known as loess.

(While the Rockies, the Andes, the Alps and the Himalayas all contain deposits of loess, the action of comets are not directly necessary for this material. It is strongly suggested that mountain disruption forces are called for in these area to produce the loess.)

MELTWATER LAKES 14 - ABC. While meltwater lakes have been heretofore considered by Earth scientists as being the products of glaciation, the reader may be justified for wondering and questioning at this time, just why is it that meltwater lakes could possibly be considered as fallout features.

There are four reasons. First, the crust was drastically modified by being covered to a considerable depth in many places with a layer of fallen materials. The irregular terrain which was produced served to make many catch basins for meltwater and rain. Second, there was much ice distributed widely, with the larger chunks making numerous deep pits and kettles. Third, there was an almost immediate flooding of the basins by the rapid melting of catapulted ice, and because the time in which this event occurred was evidently at the sudden close of the genial Tertiary Period. And fourth, as we will possibly grant, there was a very torrential rain -- something else that we might consider as being a special "fallout" material of that time.

As a result of the melting of the ice and the heavy rainfall, very large lakes could have been formed, such as, Lake Agassiz,(for its location and size, see (Atwood, 1940, Figure 97, p. 212,),and Lake Algonquin which covered a former area that is now largely the sites for Lake Superior, Lake Michigan and Lake Huron.

Lake Agassiz and Lake Algonquin were possibly formed quite suddenly because fallout had helped to make some boundaries for the lake basins, while most all of the old river channels had been blocked, changed or filled, thus preventing the immediate run-off of the rapidly rising water.

We now have four reasons for believing that several large lakes were formed at the beginning of the Ice Age.

MORAINES 15 - ABCDEFG. Moraines, as explained here, will necessarily include all morainal features within the vast fallout area, but exclude those morainal features which would normally be developed in glaciated mountainous regions. The morainal features considered here cover what has been considered as being ground moraines, lateral moraines, end moraines and recessional moraines.

It may be noted again, as shown by the cross-references of CHART I, that a number of features are related. Attenuated border, eskers, kame and kettle topography and outwash plains are formed from exactly the same impact debris as moraines.

It is probable that the Comet's compression of the atmosphere had caused a considerable amount of heat, which quickly melted some of the finer paticles of ice. The resulting meltwater, falling along with unmelted ice , tended to form a slush, which possibly helped in the final leveling and spreading of materials over the eastward moving crust. These actions, in combination with the more concentrated masses of fallout in some places, would possibly account for the different conditions of the various moraines.

The various features that appear as moraines were often and necessarily rough, pitted, irregularly contured, having been made up of ice, permafrost masses of considerable size, and scattered permafrost which consisted of sand, gravel, clay and boulders. (For a picture of moraines, see Shelton, (1966), Figure 218, p. 228).

OUTWASH PLAINS 16 - ABCDEFG. The watery distribution of fallout could have led to the formation of the features that are known as outwash plains.

Within some of the expanses of terrain of the attenuated border area, there was possibly a rapid distribution of impact debris. But the material was possibly aided in its distribution, not only by meltwater from the fallen ice, but by meltwater that had been almost instantly produced by the high temperature of the compressed atmosphere and by the conversion of ice into water by the explosive power of the comet's impact.

Those materials which were necessarily unconsolidated at that time,were very easy to erode and move about to produce the outwash plains. But these, as we see, are plains which were not produced by melting glaciers. (For a picture of outwash plains, see Shelton, 1966, Figure 213, p. 223.)

PITS 17 - A. Within what we have been considering as being the fallout area, (see Figure 1) there are numerous pits of various size. A number of these pits are almost round, some are elliptical shaped, while others have compound shapes. Some are partially connected to underground drainage systems, and many of them are sometimes filled with water after a heavy rain.

It would seem to be readily understandable from a mechanical viewpoint why some of these pits were formed by large masses of ice which impacted with the crust, or, which fell along with other materials and then kept those materials away until the ice melted.

VALLEY TRAINS 18 - CDEFG. A considerable amount of the general fallout was possibly moved by the combined floodwaters from melting ice and by the exceptionally heavy rain that soon began to fall.

Washing over the slopes of many of the newly formed hills and through the many newly forming valleys, this rapidly rising water, this turbulant , muddy, rock-laden water began moving abnormally large quantities of available material. Various sized masses of permafrost that had temporarily tended to block former streams were thawed and washed away. Boulders, cobbles, gravel, sand, clay and silt -- all so easy to erode from their fresh deposits -- were moved. Thus the sudden flood of water established long trains of impact debris down the numerous valleys.

With an abundance of material and water surging down the river valleys, the material spreads out to floor the valleys with rising quantities of material until at last it forms the highest terraces. Then as the volume of material decreases,the water, dropping back to narrower channels, cuts and recuts into the previously deposited material to form the lower terraces.

The formation of valley trains is now seen to be something that the melting of glaciers over periods of thousands of years could not have done. This is because the water from the melting ice would have had a more steady flow, and materials would also have been more firmly consolidated.

BAYS 19-AE. Bays, produced by falling masses of ice which contained large clinging masses of sand, are the first of two special fallout features listed in CHART II. These bays, such as the Carolina Bays, (see Prouty, 1952) have probably not been heretofore seriously considered by anyone as being closely related to the various other "drift" features.

There are an estimated 500,000 of these elliptical-shaped bays along the east coast of the United States, which extend from Massachusetts to Florida. Some of the largest ones are in North Carolina and South Carolina. They are up to 1.5 km. wide and 3 km long. Some of these water-filled "bays" can now be found as far north as Cap Cod, where they have been previously considered as being ice made depressions in an outwash plain, (Shelton, 1966, p.223).

As for the formation of the Carolina Bays, let us consider the following possibilities. As the comet struck the Arctic ice cap, it began the catapulting of an area of ice, estimated to have been 90,580 sq. km., (35,000 sq. mi.) to various regions.

Many chunks of ice with sand were hurled upward and accelerated in various southeastward directions. Their upward movement was largely aided by the rapid expansion of the atmosphere that was first compressed when the huge mass of the comet approached Earth's crust. The chunks of ice with its sand were powerfully accelerated by the expansion of extremely high pressure steam. This is because the heated atmosphere would have produced steam from the ice. The high velocity impact would also have produced movement of some permafrost, which was stuck to the ice.

While the frozen masses still scattered upward, the intense crowding, rotating and bumping of the chunks caused them to become abraded and rounded. Jostling against each other, moving slowly back and forth, the icy and sandy masses gradually spread over an increasingly broader path as they continued to arch high over the darkening land below.

A large number of the rounded chunks were distributed in the same south-southeasterly direction that the comet had been moving. Thus many of the masses initially moved out over the Atlantic Ocean. But due to Earth's rotation they essentially shifted westward while in their trajectory, and many of them impacted with explosive force upon the eastern portion of what is now the United States of America.

Such impaction and explosion of the ice upon eastward moving soil naturally tends to account for the westward sliding of the material during its southeastward spreading. And although some of the chunks penetrated deeply, the spreading action was sufficiently prolonged and "magnified" so that the larger bays definitely show that they do not have a perfectly elliptical and symmetrical shape. (See Figure 3.)

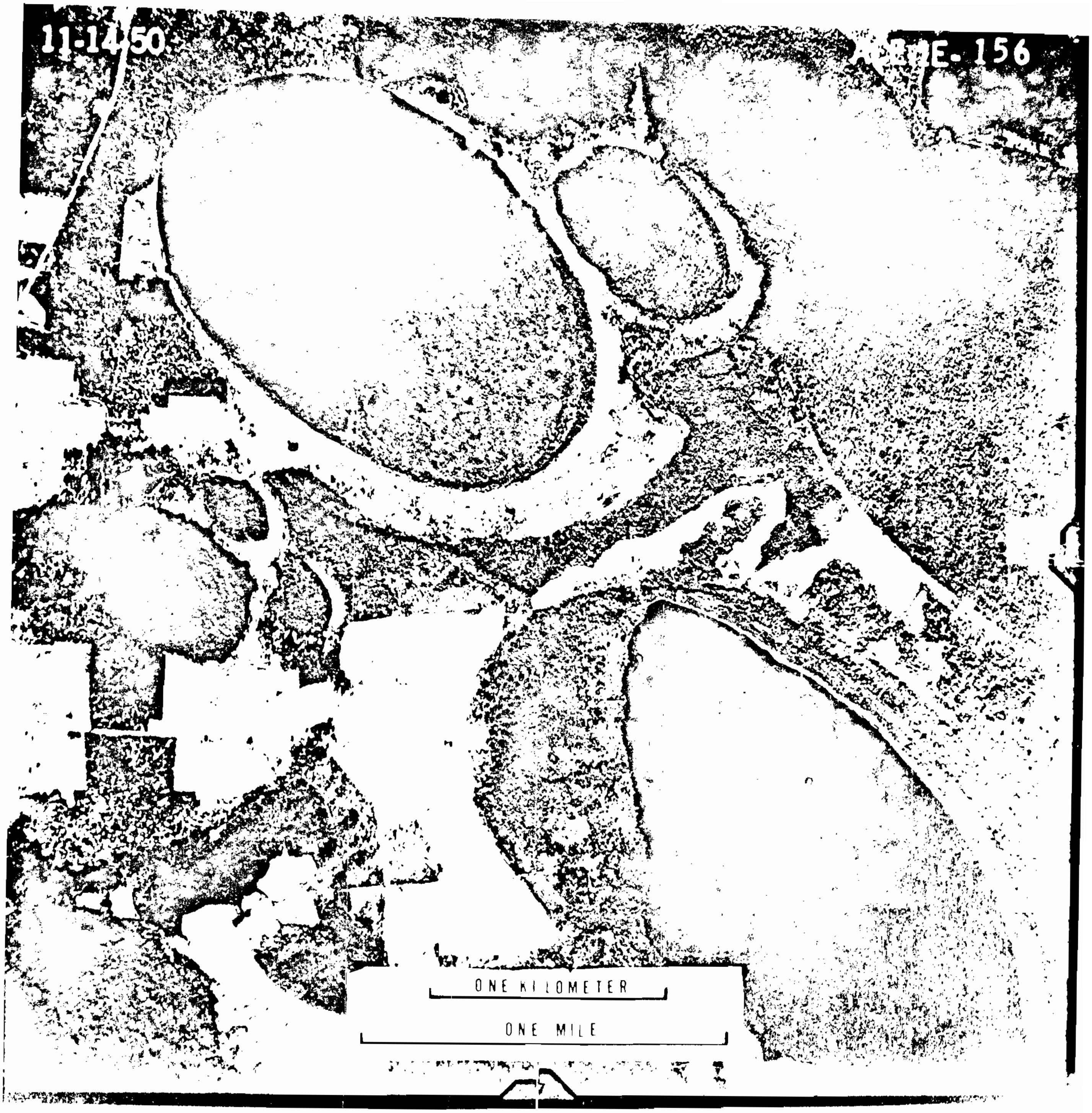

FIGURE 3. Carolina Bays, Cumberland County, North Carolina

These large bays were formed by huge chunks of falling and exploding ice. Sharp, angular gravel and iron-contaminated gravel has been found at several of the bays. Note the similar northwest to southeast alignment and the white sand swirls. Photo by U. S. Department of Agriculture (1950).

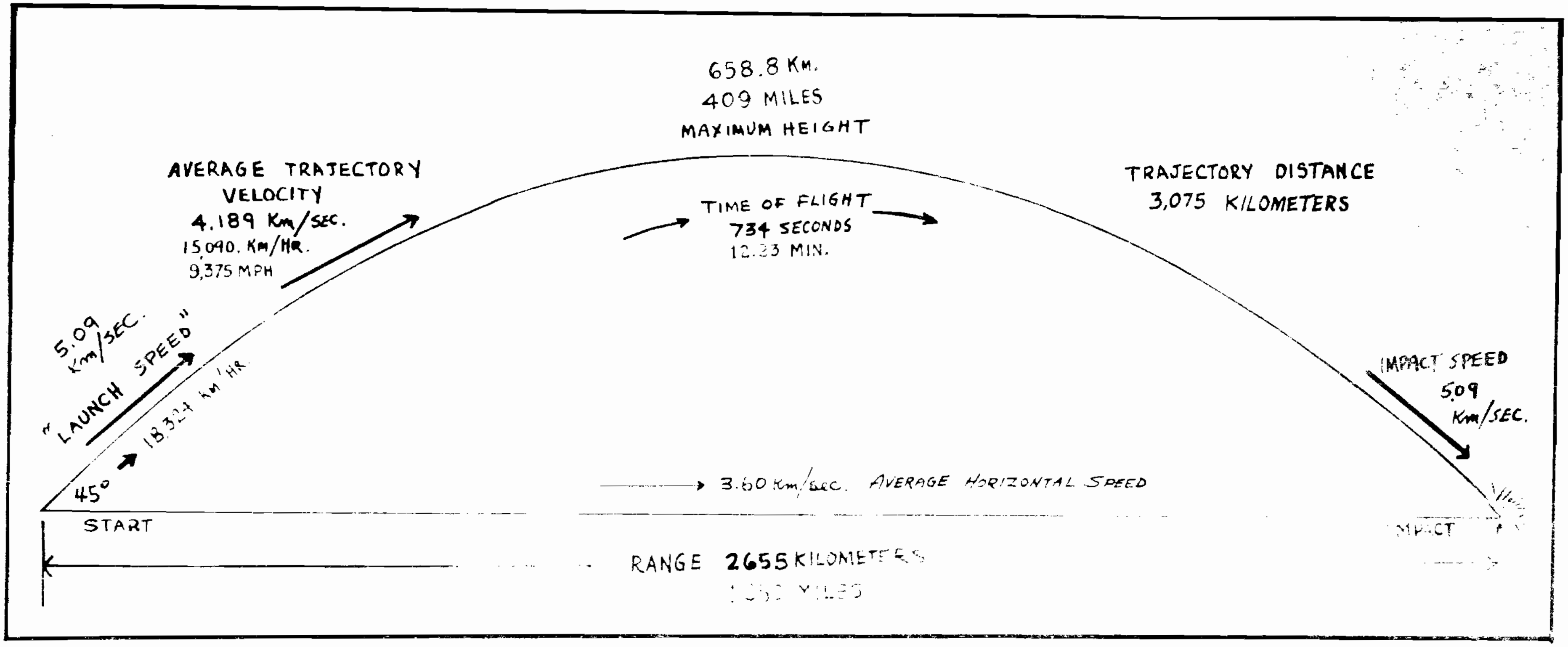

FIGURE 4. Dr. R. Lester Anderson, Head of the Physics Department of Marietta College at Marietta, Ohio, has calculated for the writer that some of the large chunks of ice and sand which exploded in Bladen County, North Carolina had a "launch speed" of 5.09 km/sec, and that they reached a height of 658.8 km, (409 miles). They traveled for a distance of 2,655 km, (1650 miles) and moved with an average trajectory velocity of 4.189 km/sec, or 15,090 km/hr, (9,375 mi/hr.) for 734 seconds, (12.23 minutes).

The summation of the following seven conditions of the Carolina Bays will be seen to prove that they could have been made only by impacting and exploding masses of ice which contained sand.

1. **Location.** While ice impact craters can be found in many places, (recognised as pits, kettles and lake basins) the main concentration of Carolina bays is in the proper direction from the Comet's impact site. While going in a spreading direction towards the south-southeast, the masses of material which left the impact depressions amid the scattered sand would have naturally "drifted" westward during their flight because of Earth's slow rotation toward the east. Thus many of them fell upon the coastal region rather than all of them falling into the Atlantic Ocean.

2. **Shape.** The highly elliptical shape of the Carolina Bays is the most probable crater shape that would have been produced and left by the falling and exploding masses of ice and sand, which had impacted at an angle with the crust.

3. **Alignment.** The long northwest to southeast axial alignment of the bays is noticeably different from the original south-southeastward movement of the ice at the time it was catapulted. This leftward turning of the masses for some 27 degrees is accounted for by recalling that Earth's atmosphere moves eastward along with the crust, and at a higher velocity toward the Equator. Thus the increasing velocity of the atmosphere, as the ice and sand approached its impact area, was powerful enough to change the flight course of the ice.

An important fact concerning the alignment of the bays, as shown by W. F. Prouty (1952) p. 186, is that the bays do gradually change their orientation. In the northern portion of the bay area they run with an axis extending south 55 degrees east, but in the area toward the southwest the axis runs south 15 degrees east.

To us, this means that the longer the masses of ice were in their flight toward the southeast,the longer the masses encountered the wind,and the higher and more powerful its velocity became. Thus it is seen that the more windpower from the west that was applied to these icy masses while they were still in flight,the more they gradually changed their direction toward the east.

(In the central portion of the area of most abundant bays, the velocity of the atmosphere,or wind from the west, is calcualted to have been 532 km/hr., (330 mph.), as based on the velocities of <u>former</u> latitudes -- <u>before</u> Earth's lithosphere was moved.)

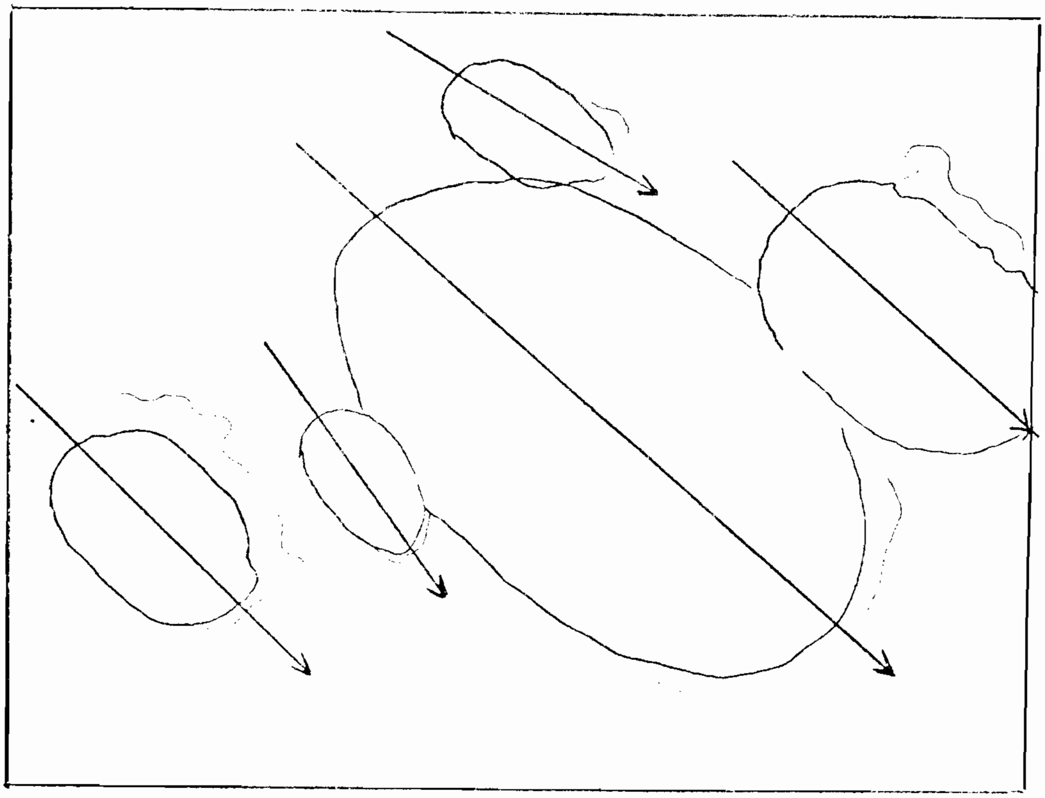

FIGURE 5 Overlapping bays, Bladen County, North Carolina. A long axis has been drawn through each of these bays, starting from the northwest and running each bisecting axis towards the southeast. Note how the two small bays, which are near the largest bay, have their axes displaced, with one turning to the right approximately 12°30' and the other turning to the left a similar number of degrees. [Drawn from photo plate 9, Carolina Bays and their Origin, (Prouty 1952)]

4. **Displaced Axes.** From an examination of Figure 5, it is seen that the displaced axes of the smaller bays, with one turning to the right of the larger bay approximately 12° 30', and one turning to the left a similar number of degrees, is a rather good indication that there was some powerful interference by blast action, that was both timely and effectively enough in both cases to divert each of the smaller masses of ice from its intended impact site just before it actually did impact.

5. **Overlap.** The overlapping of bays can be accounted for by masses of ice impacting and exploding one after another, so that a second mass of ice was somewhat thrust aside by the presence of the first mass. A third mass of ice, landing either on the first mass or second mass of ice was also diverted, and so on. Of course, meteors could possibly do this too, but there is no evidence of meteorites of the stony, or the nickle-iron types, in or near the bays.

6. **Sand Piles.** The pushed-up sand piles at the southeastern rims of the bays indicate that ice would have very naturally elevated this area of the bays the most, because the ice was headed in this direction. Then, too, the high velocity explosion, interacting with the "winds" from the west, could have caused spinning of the ice and swirling shape of the sand piles, as can be seen from Figure 3. These sand swirls are most noticeable at the southeastern ends of two of the bays.

7. **Asymmetry.** Although the bays are elliptical shaped, and show a high order of symmetry, there is a noticeable asymmetry of the larger bays, as can be seen from Figure 3. A close examination of the larger bay reveals that the northeast rim has a slightly greater curvature, while the southwestward rim has somewhat less curvature. This apparently indicates the inertial tendency of the exploding and spreading ice to move relatively westward because of its impaction upon the eastward moving crust.

With these seven conditions of the Carolina Bays facing us, what are we to believe ? Can we continue to believe that the bays were made by meteors, and even by air shock waves from exploding meteors, when there is absolutely no meteorites of the usual kind to be found ? Or, can we believe that the Carolina Bays were made by falling and exploding masses of ice ?

The fact that the bays have been considered as being produced by meteors is logical, and is acceptable providing we can conclude that by "meteors" we mean objects which fell through the air, for the falling masses of ice could thus fit the definitions and actions of meteors.

In summing up such evidence, we may grant that the Carolina Bays were made exactly as has been determined: that is, by falling masses of material which moved through the air, thus qualifying them as meteors. But that such meteoric bodies were nothing more nor less than massive chunks of catapulted ice which contained large quantities of sand, along with some gravel.

During the writer's visits to the Carolina Bay area in 1974 and 1975, many deformed gravel of various sizes, colors, and compositions were collected. These are similar in composition to some of the broken gravel that are commonly found in drumlins, kames and outwash plains. Thus it is possible that they could have been frozen in the bottom layer of the ice along with some of the sand -- because the ice had naturally existed upon permafrost.

Upon a close examination, the gravel revealed that each of the deformed gravel is deformed in some special way. The range of deformations includes nicks, chips, conic fracture, scratches and fragmentation. While such deformations can be made during stream transport, these gravel were not picked up near a stream, yet all of the deformed gravel have some very sharp edges.

Could this gravel be the evidence of impacting and exploding bodies that produced air shock waves ? Are they suitable to be called "meteorites"?

It becomes possible that when the ice exploded that the various gravel were hurled about at high velocity, to impinge against one another, then the deformations of the gravel were made.

If such gravel can be found throughout the area of abundant bays, and if we can rule out the possibility that all of them have been damaged by wheeled vehicles, then perhaps the long searched for fragments of exploded meteors have been found.

CRATERS 20-HI. This feature is the second of the fallout features which can now be explained; but features which could neither be attributed to, or explained by, the action of glaciers.

Massive portions of the crust with dimensions ranging from one to ten kilometers, appear to have been tossed about in various directions from the Comet's impact site. These fell with such force that they became fractured throughout, and made deep depressions, only to largely fill up these depressions while simultaneously forming raised rims about the impact site. These craters, scattered over the Canadian Shield, contain breccia from the native rock of which the hurled masses were composed.

Let us examine just two of these impact craters and see what we can discover.

The Brent Crater is 3.2 km in diameter, (2miles) and is located at 46°04'.5 north latitude and 78°29'.0 west longitude, or approximately 275 km, (170 miles) north-northeast of Toronto, Ontario.

The Holleford Crater is 2.33 km in diameter, (1.46 miles) and is located at 44°47' north latitude and 76°30' west longitude, or approximately 96 km,(60 miles) southeast of Ottawa, Ontario. (Please see Figure 6 for their locations.)

From the types of material that the Brent Crater contains, it is indicated that it may be 400 million years old. And the Holleford Crater gives evidence which would establish an estimated minimum age for it of 450 million years, but could have a probable Precambrian age of 500 to 1000 million years. These craters have thus been considered as being fossil meteorite craters. (Middlehurst and Juiper 1963)

While these craters have been considered as produced by meteors, there has been no meteorite material found in or around them. Nickle-iron and stoney material has not been located, despite the search for it. Still, we must grant that these craters must be considered as being impact craters of "meteor" origin; for the impacting material — like the material which made the Carolina Bays — did fall through the air from a great height and at a high velocity.

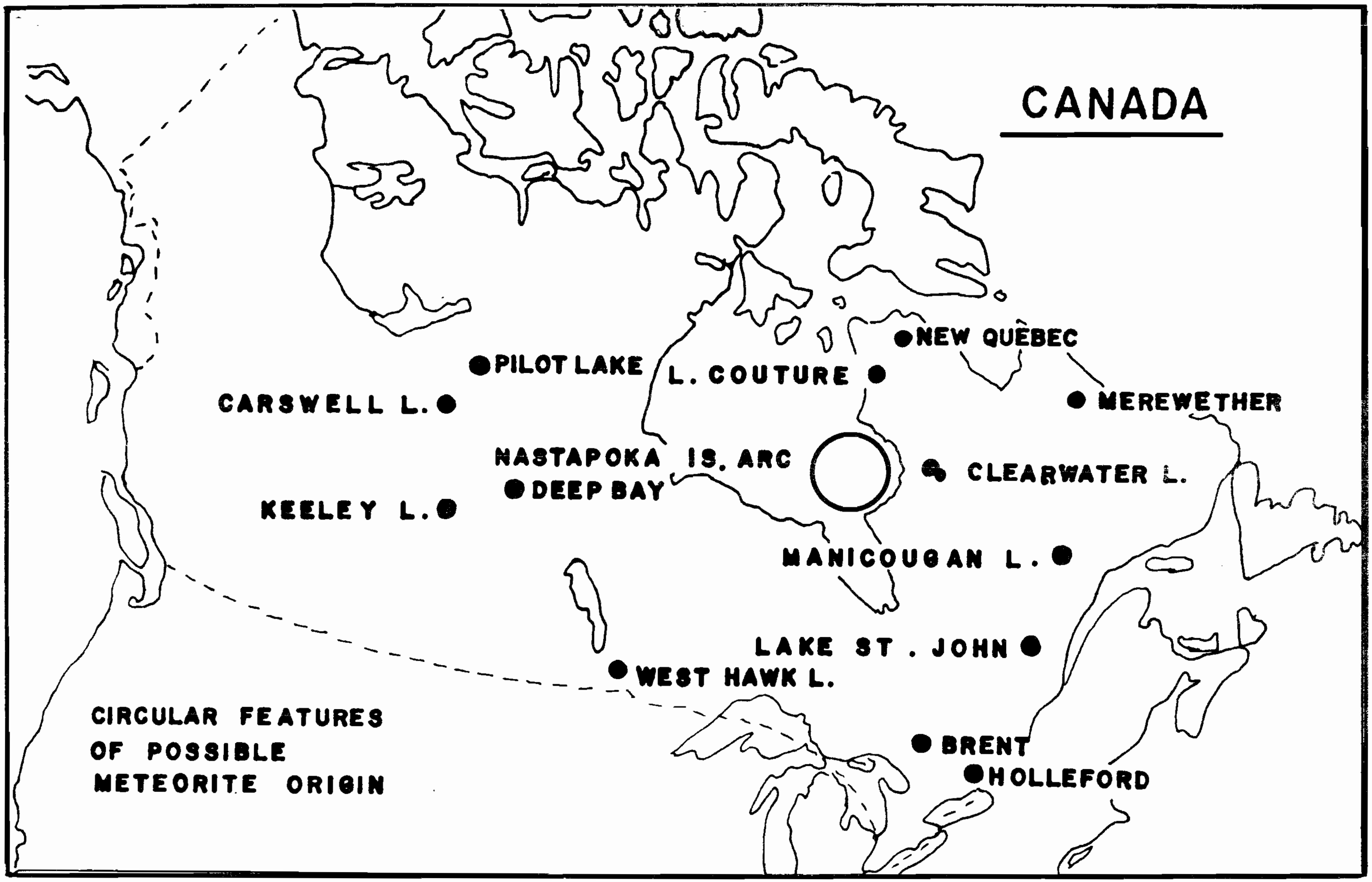

FIGURE 6. The locations of the Brent and Holleford craters are shown just north of Lake Ontario. Also shown are a number of other crater locations, all of which have been considered as being fossil meteor craters. Drawn after Figure 1, p. 2, CONTRIBUTIONS FROM THE DOMINION OBSERVATORY Vol.6, No. 1, RECENT ADVANCES IN METEORITE CRATER RESEARCH AT THE DOMINION OBSERVATORY, Ottawa, Canada, By - M. J. S. INNES

The fact that falling pieces of the Earth's crust, which had been hurled over high trajectories by the comet, would naturally make secondary impacts, and that much of this falling material — and even the crust where it impacted upon — would be broken up, makes it mechanically understandable just why these craters have raised rims, contain nothing other than country rock, and have brecciated material that extends to a considerable depth. It is further understandable why these craters do not contain the usually expected meteorite evidence. However, from corings, it has been discovered that small spots of magnetite is present. Could this magnetite, which has no nickel, be related to the iron that is found in so many specimens of the fallout ?

If the foregoing is correct, then we can see why the craters appear to be so very old — as old as some of the other material of the Canadian Shield. We also gain some further insight into why Canadian astronomers and geologists have understandably been amazed at the durability of these apparently fossil craters.

As for the age determinations of core material from the craters which would at first seemingly tend to disprove the recent actions of the comet... it is suggested that they are somewhat irrelevant. Just because the Brent, Holleford and other Canadian craters do contain very old material, this fact need not mean that these craters are old, or that they were made at the same time as the material of which they are composed. The extreme age of the material of the craters could mean that these so-called "fossil" craters are really young features, that are the recent and secondary impact products that were made by means of some very old material.

Furthermore, the continued existence of these craters strongly negates the actions of glaciers in central North America. This is for the reason that if the Keewatin, Patrician and Labradorian glaciers had actually existed and had moved southward four times during the Pleistocene, then it becomes inconceivable just how these small craters could have escaped complete obliteration by such powerful bull-dozing actions that glaciers are known to exhibit.

SUMMARY FOR CHART I

With the tentative concept of a comet's impact upon North America, in which ice and crustal materials were hurled about, not only by the direct force of the impacting mass, but by the outward movement for a time of the compressed atmosphere and by expanding steam from exploding ice, we no longer need to waste time,as was formerly done when the inscrutable actions of glaciers were used to account for the drift features. We can at last see the overall relationship of the several fallout materials, which made either directly or indirectly the various "drift" features. We can relate the three types of material (ice, permafrost and crust) that were hurled widely and over high trajectories as they were accelerated from the comet's impact site. We can now calculate the different velocities and different fallout times which the different materials had, not only while the materials were being accelerated, but while they cascaded through the sky to be distributed widely over the crust.

We are now ready to find how other related phenomena of that time were possibly produced by some of the comet's actions. Let us consider the forces that would be inherent in the movements of material,and correlate them to the crustal features and other effects that were produced, as is shown in CHART II.

EXPLANATION OF FORCES AND MOVEMENTS OF MATERIAL

Listed in CHART 11 under MOVEMENTS OF MATERIAL are, AIR, ICE, CRUST, MAG. (magma) and EARTH. It was the energy of motion (kinetic energy) of these materials, coupled with all of their subsequently derived forces, which could have made formations and caused some effects which were largely not the results of scattered impact debris.

Listed under AIR, is blast-action. It is possible that the comet's entry into Earth's atmosphere would have caused a large area of the atmosphere to have been immediately compressed, with the subsequent result that the air was not only intensly heated, but that it expanded outward and upward with a considerable velocity in every possible direction from around the periphery of the impact site. (Some rather convincing evidence of the heating and expanding of the atmosphere is suggested by the various glazed, baked and recrystalized pieces of material which the writer has found in several states. See Figure 7.)

Listed under ICE, is flotation. Many large sections of the former Arctic ice cap could have become covered with the various forms of impact debris. Some of these large sections of ice near the border of the continent could have become icebergs and they could have transported debris to distant shores.

Listed under CRUST are contortion, overthrusting, stressing, subsidence, underthrusting and uplifting. All of these movements of the crust are concerned with paticular actions or motions which produced many features which are not the result of fallout. These movements of the crust will soon be given further consideration.

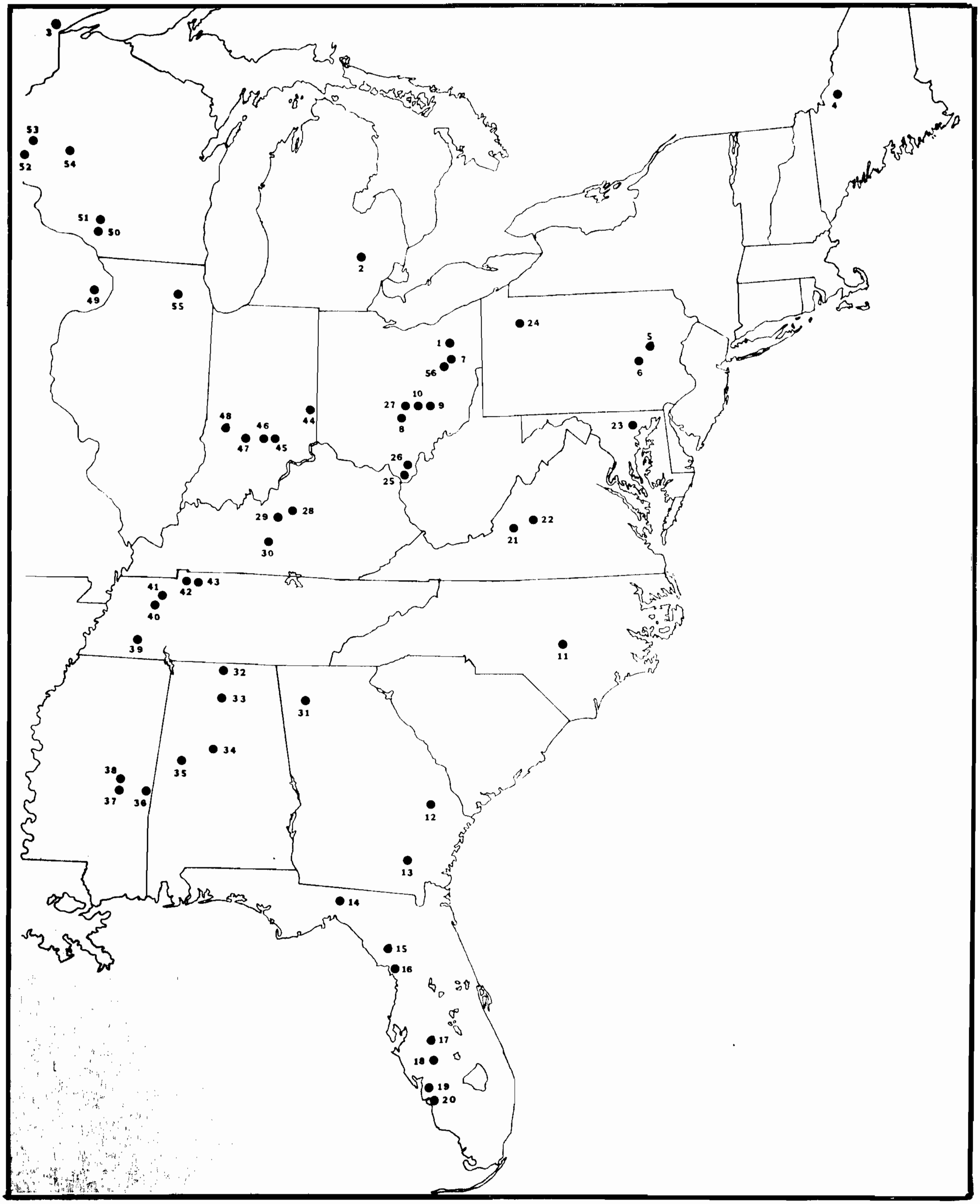

FIGURE 7. The sites where either burnt, baked, hardened or vitrified materials have been found are shown. This is approximately only one-third of the sites that have been visited. All materials from these sites are heavily coated or mixed with iron. The descriptions of these materials and their numbered locations begin on page 90.

Listed under MAG. (magma), is heat of interior. The high temperature of the material beneath the crust could have served to produce one of the outstanding effects of that time, which was **WATER EVAPORATED 30-X** , as is listed under **FEATURES** and EFFECTS PRODUCED.

Listed under EARTH, is nutation. This was a strong wobbling motion of the Earth that was the result of the comet's impact in a polar region, and at nearly a right angle to Earth's direction of rotation.

While the foregoing list may seem to be complex, it is essentially simple; for we are to be concerned only with the forces, or the energy, or the ability of these materials to do something.

Potential and kinetic energy of the mechanical and thermal varieties, as is known, are most always involved with the movement of matter. Thus with an exceptionally large volume of material rapidly forced into various upward directions, as well as the horizontal thrusting of crustal layers, these materials -- through their momentum -- began to serve useful purposes in modifying vast areas of land in very drastic ways.

FEATURES AND EFFECTS PRODUCED

BOULDERS (transported) 20 - PQ. At the time of the comet's impact, we can see why large quantities of fallout would have been scattered over some of the outlying portions of the Arctic ice cap. At such distances, the ice cap would possibly have been fractured and broken up into gigantic pieces. Later, near the ocean, many of the icebergs floated such erratic material to distant shores. Thus it would appear probable that by such actions that icebergs were the means by which erratics were floated to the coastal regions of Europe. An examination of some of the gravel and boulders, keeping in mind that some of them may be coated in spots with iron, burnt, baked or even glazed, may reveal that they came from the Canadian Shield.

DRIFT SHEETS 21 - PSV. The heating of material by the blast-action, and by the sudden outward movement of the highly compressed atmosphere, is possibly responsible for producing the yellow drift that has been found to be highly oxidized.

Deep underthrusting of the more resistant layers of the crust in remote regions could be responsible for some of the long striations that were found on bedrock, and for the shifting of ancient soils.

Thus, where yellow, highly oxidized fallout, general fallout and subsequent modifications of these materials have been made — possibly by water movement — and where ancient soils have been either disturbed, concentrated, intertongued or buried, it is now understandable why up to four prolonged glacial periods have been indicated in some places.

(The evidence of four glacial stages in other parts of the world -- particularly in Europe -- can possibly be accounted for, but it is beyond the scope of this paper.)

DRUMLINOID TOPOGRAPHY 22 - S. From the thrusting of portions of the Arctic ice cap in various directions around the impact site, there could have been produced various low-lying patterns of elongated crustal features, (interspersed with lakes at present) which are known as drumlinoid topography. This crustal feature may have been additional modified in many places with several forms of fallout.

We can see in this case that such topography was quite possibly produced by ice movement, that is, by the overthrusting of portions of the Arctic ice cap, but <u>not</u> by a glacial sheet's movement.

FAULTS 23 - RTUW. From the perplexing conditions of the vast tectonic provinces of Canada, we may reasonably assume that a combination of powerfull forces acted over wide regions to produce a variety of faults and fault -related features. For throughout what is now the Canadian Shield, Stevenson (1962), there is a vast network of faults, rifts, fault-zones, crustal trends, stress systems and other such features, all of which could have been produced with ease by the very strong forces which acted at that time.

GROOVES IN BEDROCK 25 - SV. In some of the outlying areas from the comet's impact site, overthrusting of portions of the ice cap could have caused deep cuts to be made in permafrost layers; producing a number of parallel grooves.

Then, somewhat to the south, in regions outside of the permafrost zone, some of the ice could have been overthrust, or even hurled, to produce long, deep gashes in the crust's soft layers. Where these gashes are still observable they resemble furrows.

Other material was at first grooved, then quickly compressed, and later hardened to remain as intricately curved and spiraling formations. See, Wright, (1920, Figure 79, p.264)

Since we have excellent reasons for believing that glaciers did not act within the Great Lakes Region, we are now reasonably assured that glaciers could not have produced another formation that still exists on Kelley's Island — which is located in the southwestern portion of Lake Erie. It is worth seeing.

This intricately-carved limestone formation appears to have been formed by a powerful, intermittant, thrusting and extruding movement. And its somewhat straight yet compounded and twisted condition, along with a small upwardly spiraled portion in one place, strongly tends to negate the action of a glacier.

PLEISTOCENE EXTINCTION 26 - PS. One of the most powerful and least expected of forces to have had a large part in causing the sudden extinction of many of the so-called Pleistocene animals of eastern and central North America, was that of blast-action; an exceptionally large explosion that was caused by the comet's passage through Earth's atmosphere. This explosion could only be adaquately described and understood by the use of superlatives that are exponentially magnified!

As the huge comet penetrated Earth's atmosphere, it forced a calculated volume of 1,470,933 cubic kilometers, (353,250 cu. mi.) of atmosphere away from its path of entry. The air was highly compressed and heated, but it soon expanded rapidly; moving with a velocity possibly equal to that of a nuclear bomb's explosion, with an overall force possibly many millions of time greater.

Of course, simultaneously, while violent movements of ice and crustal layers were taking place, many animals were knocked to their feet and even buried; for many complete skeletal remains of them have been found. But due to the rapid expansion of the atmosphere and its high velocity, millions of creatures were tossed and tumbled about so violently that tusks were snapped off, teeth were knocked out, bones were broken, bodies were skinned, and many carcases were completely dismembered!

The proof which is offered, and which the reader may accept, for such violent blasting action, consists of the numerous finds of the disarticulate remains of many of the so-called Pleistocene animals, see, Oliver P. Hays, (1923), which we might immediately concede were actually Tertiary animals. That is, they were neither Quaternary nor Pleistocene animals, even though remains of them have been found buried within superficial "glacial drift". (Please see Figure 8 , for the locations of a very few of such remains.)

From the book, THE PLEISTOCENE OF NORTH AMERICA , Hays,(1923), the following evidence is given pertaining to the buried animal remains of New York State : Richmond County, molar of a mastodon; Kings County, mastodon skeleton; Jamaica County, fragment of mastodon or elephant tusk; Suffolk County, part of a mastodon jaw with teeth; New York County, portion of a Mastodon"s tusk; New York City, supposed mastodon's tusk... and so it goes... for fifty-five more entries ! (One must consult the book for the full gruesome details of these animal remains in New York State and other states.)

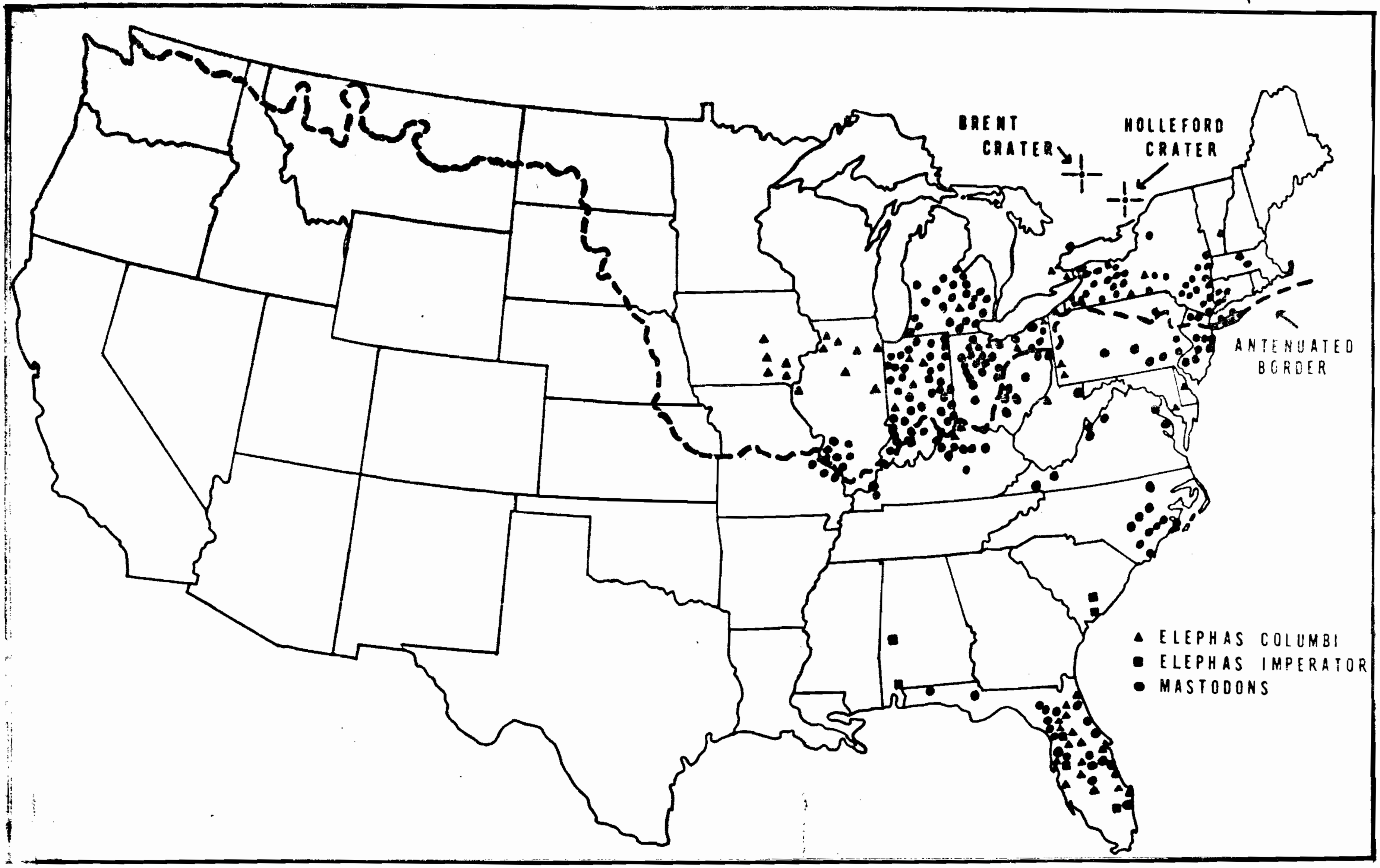

FIGURE 8. Shown above are several of the locations where animal remains have been found, such as, the Columbian Elephant, Imperial Elephant and the Mastodon Most of these remains are mere skeletal remanents. Note how they are more numerous in the northcentral portion of the United States. For those who wonder why there are so many of such remains in Florida, please compare the shape of Florida with that of James Bay. [The Locations of these animal remains are from the book, The Pleistocene of North America, Hay, O. P. 1923.]

Any remaining animals which were outside of the area of violent action, and that were not torn to bits by the blast-action or buried beneath the falling material, were subjected to some of the very severe conditions that immediately followed the comet's collesion. Their food supply was largely destroyed. Rain, snow, highwinds, dust, volcanic gases, fires, floodwaters and earthquakes continued to plague them. It is no wonder that they could not survive. Thus, we can now glimps into the past and see why, that because of such a gamut of death-dealing conditions, some of the quadrupeds suddenly became extinct,while others, living only a little longer, also became extinct.

The foregoing event, happening at the sudden,catastrophic close of the Pliocene Epoch, occurred at the close of the Tertiary Period, and at the time the Pleistocene Epoch began. Thus it may be possible that what has long been considered by Earth scientists as being Pleistocene animals did not die out gradually because of the slow enroachment of the hypothetical glacial sheets, nor did they become extinct because of the long enduring Ice Age conditions.

RIVER CHANGES 27 - RSTUVW. A variety of crustal movements (and fallout) served to modify the courses of numerous rivers. While many older valleys and river courses were suddenly changed, and perhaps completely obliterated in places, new ones were necessarily formed.

The St. Lawrence River, for example, was apparently changed; for the entire St. Lawrence River region evidently subsided after the Comet's impact. Then, water from the Atlantic Ocean backed up into the St. Lawrence valley and was so extensive that it formed the Champlain Sea. (For the extent of the Champlain Sea, see Atwood, (1940), Figure 103, p.219.) Since the time of the sea's existence, however, the crust has slowly risen, and the Champlain Sea has vanished, to leave the present St. Lawrence River.

The Monongahela and Allegheney Rivers previously flowed northward, or so it would seem, from an examination of Figure 9 . But since the time of the comet, with its drastic disturbances of the crust and the blocking of river channels with fallout, these rivers now flow southward, to combine their waters and create the northern end of the Ohio River which now begins at Pittsburgh.

But possibly the most amazing river formation was that section of the Ohio River, which now extends from Louisville, Kentucky to Pittsburgh, Pennsylvania. It could be that some combination of uplifting, subsiding and disecting by horizontal overthrusting has caused the formation of the Ohio River Valley and its vast water-shed. But there is another most important means by which the Ohio water-shed was formed; and this means is based upon two recent findings by the writer.

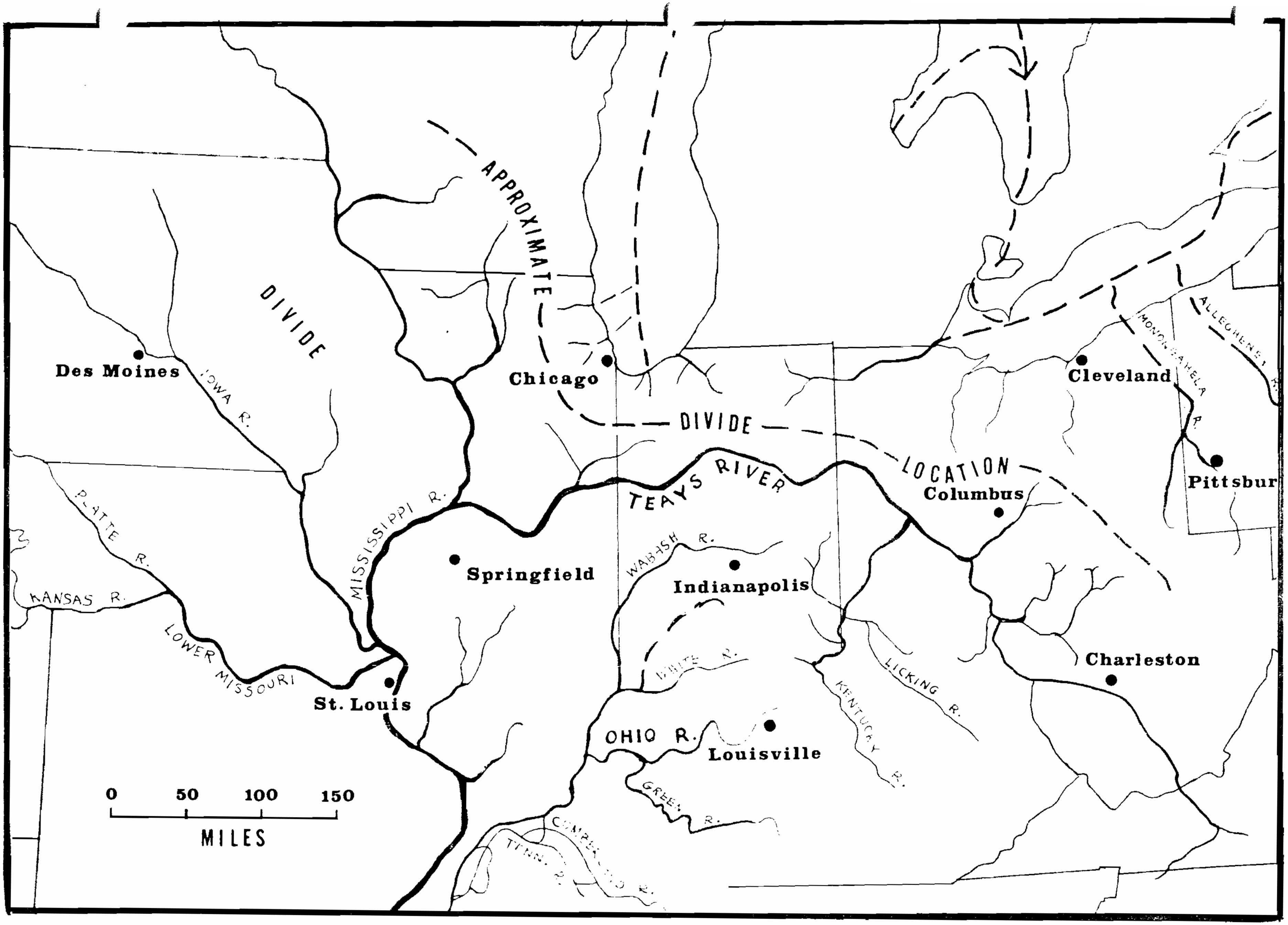

FIGURE 9. Some of the former and present river sourses are shown. Note the former extent of the Teays River and the Ohio River. [Drawn after Figure 12.1, p. 215, Regional Geomorphology of the United States, By - William D. Thornbury]

From a sand and gravel pit just south of Canton, Ohio and within what has been called the drift area, there are millions of stones which have a very brown exterior. While many of them have a shell that is slightly cracked, some of them have part of their shell missing. Many of the sharp-edged fragments of shells can be found there.

All of the glazed stones and other varieties of similarly heated material, (see Figure 7 .) have been given a chemical test for indicating the presence of iron. All tests have been positive. However, a chemical test for indicating the possible presence of nickel has always given negative results.

South of Canton, along I-77, all the way to the Ohio River and existing outside of what has been called the glaciated area, there is at present many shale and sandstone hills. The material of them appears to have formerly fallen into place and thus rapidly distributed in nearly level layers, and these layers are intermingled. These mixed conditions of the red, gray and green shale at the interfaces, as well as their blending and inter-tonguing in places, along with the sometimes abrupt deposits of sandstone in places, and the condition of the powdered, pulverized and foliated coal, testify to the action of some unusual force. The positioning of all this material is something which would have been most difficult -- if not impossible -- to accomplish either by sedimentation or by other Uniformitarian processes. Thus it becomes evermore probable that impact debris has greatly modified the water-shed of a large region and has helped to form a large section of the Ohio River.

In the central portion of Ohio there was also an unusual event which lead to the obliteration of a former river. Large sections of the Teays River were completely leveled over. This river began in what is now the state of Virginia, flowed northwestward through the present states of West Virginia and Ohio, and then westward through Indiana to meet the Mississippi in Illinois. It possibly ceased to exist because its bed was so thoroughly buried and blocked in places by the fallen masses of sand, gravel and rock.

An impelling idea of the drastic river changes which were made at the close of the Tertiary and the sudden beginning of the Quaternary can be attained from an examination of Figure 9.

STRIATED ROCKS 28 - PSV. It becomes very probable that blast-action and then the movement of one portion of crustal material to another could have produced much striation or the grooving of bedrock. Small rocks could easily have been severely scratched at the time they collided with one another while still in trajectory, and then again as they finally became positioned and were scratched with numerous parallel marks by other falling rocks which were coming to rest. Of course, many rocks were broken at such time, and these remain with sharp, unworn edges.

Falling masses of permafrost have also produced much striation of the numerous Precambrian outcrops,which can be seen over wide areas of Ontario and Quebec. And when one uses a compass and a map, and checks the direction of the parallel striations on the different outcrops, it will be invariably found that the striations tend to converge in a direction which points to either the Hudson Bay, James Bay, or their junction.

It has heretofore been inconceivable how scratched rocks, which are normally found in glaciated regions, could have been marked by anything other than by some form of glacial action. Thus the striated rocks, which have been found so abundantly in the "till", have been unavoidably interpreted as a positive and acceptable indicator of multi-glacial action in northeastern and northcentral United States, and of course, other places the world over. We may now have sufficient reasons to change some of the long-held views on this matter of just how rocks can be striated.

VARVES 29 - PSVXY. Banded layers of silt and fine sand, called "varves", have been considered by Anteves, (1928) as being the annual deposits washed into lakes from nearby glaciers. But, as in so many other cases, we have good reasons for believing that varves within the fallout area of North America were quite possibly formed by other means, rather than entirely by the annual melting of glaciers.

Once it is granted that a comet could have collided with Earth, and that crustal material was moved about by blast action and by overthrusting and underthrusting of the crustal layers, not only in North America but in other places — then it becomes reasonably clear why an abundance of fine material was available for varves at the same time when other essential conditions were available for varve production. By "essential conditions" it is meant an abundance of water, either meltwater or rain, and a <u>means</u> of quickly distributing the material and water, such as could be accomplished by Earth's nutation.

(wobble) and after considerable worldwide flooding which occurred at that time, an abundance of water was still available to wash layer after layer of varve-making material into ponding areas. The varves thus produced are evidently not entirely the product of annual melting of glacial sheets, but the product of an abundant supply of fine, loose material, water, and a back-and-forth nutating motion of the Earth.

Evidence, which we will consider, appears to show that varves were not entirely the result of annual melting of glaciers, and that in some areas glaciers may not have been essential to the varve production; for as we proceed, the foregoing may be possible to substantiate.

Because of the falling impact debris, it may now be possible to tentatively date the approximate time of the comet's impact. For, from radiocarbon dating of tree trunks that fell in a southwesterly direction, and obtained from beneath what has been considered as "very late Wisconsin till", (Woodford, 1965, Table 16-2, p. 437), it is roughly suggested by averaging the ages of only ten of the several wood sample ages given, that either by the blast-action, the movement of ancient soils, or by the fallout — or a combination of these — that such materials knocked down and buried these trees about 11,200 ± 610 years before the year 1950. However, varves found in the same area have indicated a deposition period of 18,000 to 19,000 years. (Woodford, 1965, p. 441.) It is seen that Woodford was possibly concerned and perplexed by the descrepancy which suggests that there are more varves than there are years to account for them. At least, it seems to become very clear that something is wrong. If there were no glaciers, as we now have reason to believe, then how could their annual melting produce varves in Wisconsin ?

I must hasten to add that, while I readily concede that many varves of America and of Europe were formed during the waning glacial period, some evidence suggests that not all of the varves of America were formed during the Pleistocene Epoch. This is suggested because I have seen a picture in a book in which varves were shown turned over on edge, with a dip of 90 degrees. (Coleman, 1926, p. 232.) However, such varves may have been formed during the Pleistocene and somehow turned over by folding or by subsidence of some land areas. Although it is possible that such varves could have been formed previously to the impact of the comet, and then turned over on their side by the comet's contortion of the crust.

WATER EVAPORATED 30—X. In addition to the opening of the white-hot crater by the comet, the opening of many straits and channels by a vast contortion of the crust, could have occurred in areas northeast, north and northwest of the impact site, such as the Hudson Strait and the numerous channels existing among the Queen Elizabeth Islands. Such disection of the continental block would have then permitted water from the Atlantic Ocean and the Arctic Ocean to enter them and to soon contact the highly heated magma of the crater. Thus, the immense quantities of ocean water could have boiled and steamed violently; to explosively evaporate water into the atmosphere.

We may also realize that what is now the Canadian Shield could have had considerable quantities of hot plutonic and metamorphic material thrust upward through fissures which were made by the powerful ramming-action of the comet. And then, as meltwater and ocean water contacted such hot material it was soon boiled rapidly into the atmosphere. Thus,the atmosphere became highly saturated with moisture.

(It has been essentially suggested to me that any scientific work of value should be considered from a quantitative standpoint; that the energy, masses and velocities of the materials be stressed. Ordinarily this would be true. But even if an attempt was made to determine the quantity of heat energy that was made available by the crater and by the unknowable plutonic exposures in other areas, the calculation would only be an approximation. It would be impractical and quite beyond any appreciation. The same applies to the determination of the quantities of ocean water and meltwater which were so quickly boiled into the atmosphere, and soon precipitated as rain and snow for an extended but indeterminable time.

With our finding that the so-called "glacial" drift features of northeastern and northcentral United States and of vast areas of Canada are possibly -- and more logically from a mechanical standpoint -- the products of impact debris than they are of glacial action, we have, through the demonstration of mechanical principles, indirectly substantiated the impacting actions of the comet, while often negating the actions of the assumed glaciers.

As scientists, educators and many others continue their evaluation of the probable happenings which were derived from the comet's impact, and do occasionally weigh and reflect upon the conflicting glacial concepts which have been held too long to account for the movement of the drift of North America, then it will possibly become evermore apparent that by the opening of the deep impact crater, and by the production of several straits which could lead ocean water to it, that we have at last the "weather machine" for the beginning of an Ice Age. This is because an acceptable source of heat would have been made available from Earth's hot, magmatic interior; a source of thermal energy that would have been quite adequate to evaporate ocean water which subsequently was precipitated in the form of rain and snow.

With the abundant boiling of ocean water at the impact site, this would have soon spread to severely affect the weather all over the Earth.

A large degree of substantiation for the intense source of heat and its rapid evaporation of ocean water -- so necessary for snow and ice production -- may be obtained when one carefully notes in Figure 10 , that the most heavily glaciated regions of Europe lie exactly in the same parallels of latitude as the Hudson Bay and the numerous straits of northern Canada.

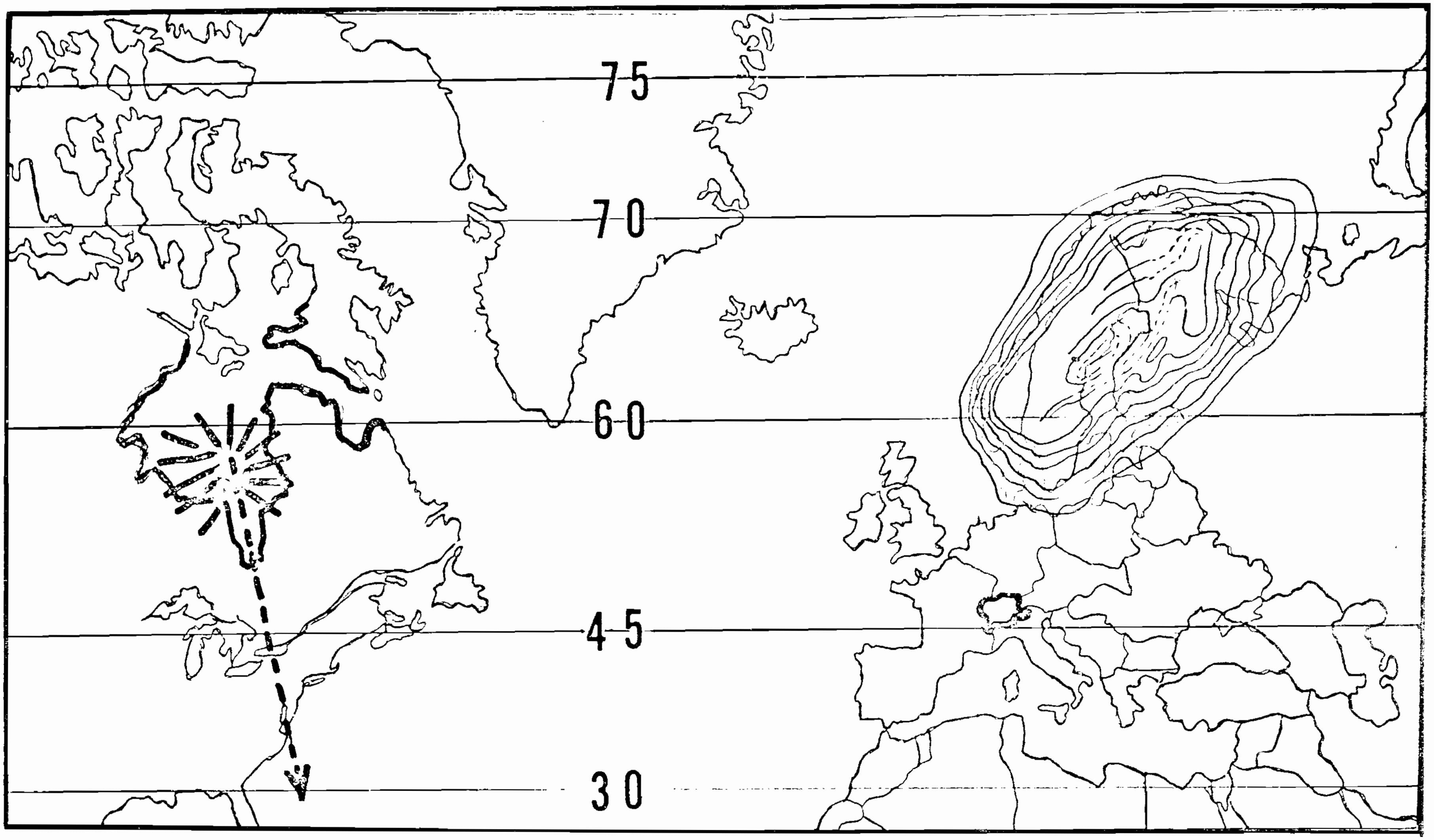

FIGURE 10. While this map does not show all of the glaciated areas of Europe, and of North America, it does illustrate the area of greatest ice accumulation and the area of greatest crustal depression of Fennoscandia. Note how this area of Europe lies in the same parallels of latitude as the Hudson Bay, and the numerous straits and channels north of Hudson Bay. Ghe glaciated area of Fennoscandia drawn after Figure 28, page 47, CHANGING WORLD OF THE ICE AGE, By- R. A. DALY.

While the climate possibly cooled gradually in the lower latitudes — as limnological findings have suggested — severe frigid conditions must have almost immediately prevailed in the higher latitudes. This is evident from the still frozen animal remains that have been and are still to be found so abundantly within the very deep permafrost deposits of Siberia and Alaska.

It is suggested that where these deep permafrost deposits now extend below sea level, that they were not all formed on land; but that the deeper portions of such material was largely accumulated by ocean water movement, to be deposited within former basinal areas of the ocean.

These accumulations of water-borne materials were piled up into such incredible thicknesses that they not only filled up deep areas of ocean basin, but piled up so that they now extend above sea level. They form large areas of level sea coast in many places of the north.

It is thus seen that such material, which contains a conglomeration of animal remains and tree trunks, is a catastrophic deposit. It need not have been deposited after being eroded from highlands — as has been suggested by others. Nor need it have been deposited entirely upon lowlands. It may be that during such a catastrophic time, any land area, even an ocean basin, could have provided a suitable repository for the conglomeration that now makes up these thick muck deposits.

SUMMARY FOR CHART II

It becomes increasingly evident that it is neither impossible nor improbable that Earth's encounter with a colliding body could have caused a number of related things to happen, but things which were formerly explained as having occurred as a result of the action of uniformitarian forces over prolonged periods of time; or, in some cases, by the actions of repeated glaciation. It is further seen that the concept of the comet's collision now goes far beyond the former concept of the glaciers. The comet's impact now provides us with a more probable -- and possibly a correct means of interpreting the "drift". It has given us a bonus, by further providing us with a means to find answers to a whole family of Pleistocene mysteries, such as those which follow:

1) One of the strangest turn-around findings that we have made is that the basins of the so-called "glacial" lakes were more probably not formed by the movements of glaciers, and that they were filled to their overflowing brims at the very beginning of the Ice Age, rather that by the slow melting of glaciers at its end.

2) The immediate and ensuing conditions of the Comet's impact led to the extinction of 28 genera of Tertiary animals in North America alone, as well as many genera in other parts of the world. And with this realization, we suddenly discover that many of the so-called Pleistocene animals, which supposedly lived and gradually died out during the Ice Age, more probably died out at the very beginning of the Ice Age.

3) The wide distribution of falling impact debris of that time now affords us with a new insight into the probable cause of some river changes that were suddenly made. This is especially applicable where old river courses were completely buried with drift, only to be re-cut in places by the sudden excessively large quantities of meltwater and rain. Such inundating volumns of water quickly washed over some of the fallout features and helped to make extensive tracts of nearly level land in some places and also helped to produce what has been considered as being outwash plains.

4) Varves have been accepted as being indicators of yearly melting of ice in Europe, but they need not be an indicator of yearly melting of ice in America. For if we accept the melting of ice over a period of 18,000 to 19,000 years as forming varves in Wisconsin, then how can we really consider this length of time as logically being a period for the rapid recession of glaciers?

5) One of the Pleistocene mysteries that we have thrown some much-needed light on is the finding of a suitable and adequate source of heat and water, which could have increased the moisture in the atmosphere, and was necessary for the production of snow and ice during the Ice Age.

DISCUSSION

In order to clear up any possibly misunderstandings which could lead to the rejection of a portion of this paper, or even the entire paper, I would like to briefly clarify a few things.

Earth was most probably not experiencing an Ice Age prior to the comet's collision. This is for the reason that geological and glacial literature the world over accept the Tertiary Epoch as having a genial climate. Thus, since the Pliocene Epoch was a genial one, then the comet's impact could not have taken place upon any portion of such improbably ice masses as the Keewatin, Patrician and Labradorian glaciers. But since the comet did hurl ice,which made the Carolina Bays, many lake basins and pits throughout the fallout area, then it must have impacted upon a portion of the Arctic ice cap.

With the genial climatic conditions prevailing during the end of the Pliocene, the Arctic ice cap was small. It could not have extended to the present latitudes in which Hudson Bay now exists, even though I have mentioned that it struck the Arctic ice cap. This seems like a shocking contradiction. So, to immediately clarify this point, it must be mentioned that much evidence which is considered in a paper entitled, " Discovered: Eleven Global Forces", shows that Earth's lithosphere was moved over the mantle at the Athenosphere for an estimated distance of 2,784 kilometers along the 60th Meridian West. Thus the impact site was originally farther north, and was moved southward when Earth's entire crust was forcefully moved over the interior for approximately 20 degrees by the very powerful impact and thrusting actions of the comet.

To continue... the comet did not collide at Hudson Bay. This, too, seems like a shocking contradiction. While it may be shocking, it is not a contradiction. For when the comet collided with the North American Continent in the Arctic region, it suddenly made the compound crater which is now the combined and watery-disguised sites of Hudson Bay and James Bay. Before the collision these bays did not exist.

CONCLUSION

In disproving the existence and actions of the Keewatin, Patrician and Labradorian glacial sheets, it is not intended to disprove the existence and actions of the cordillerian glaciers, nor those of Greenland and Alaska. Also, it is not intended to disallow the later existence of a partial ice cover over the Canadian Shield and some of the fallout regions within what is now United States territory. It is only intended to disprove the seeming existence and apparent actions of hypothetical glaciers which have been so necessarily envisioned as being up to 9.6 kilometers,(6 miles) thick, and that supposedly waxed and waned four times during the Pleistocene -- as read by the investigators -- to account for the positioning and conditions of the drift.

Of course, it may undoubtedly be contended by a very few unconvinced and persevering glacerists, that from their thorough reading of the literature, and from their explorations and observations of the drift which exists to the south and west of the Great Lakes, that such drift constitutes irrefutable evidence of the repeated advances and retreats of huge glaciers.

It is readily admitted... that in view of the immensity of the drift and its complexity, and the fact that glaciers do move material, this would logically seem to be so. But it is suggested that the drift sheets of central North America have been misinterpreted. They are not the products of advancing glaciers, stagnant ice, rapidly melting ice, retreating ice, and up to four seemingly distinct periods in which glaciers overrode vast areas of the continent for some never-explained reason.

It is also suggested that the complex drift sheets are largely the fallen, overlapped products that were formed by a combination of conditions, such as, blast-action, heating of material, oxidation of material, and the forced sliding of different layers of ancient soil. It is further suggested that the catapulted materials were scattered and torrentially layed down to blanket the eastward moving crust. It was by this action that the various drift features were produced.

Is it any wonder that stones were blackened, burned, melted and contaminated with iron; that stones and rocks were broken, chipped and scratched while there were moved and then again as they finally came to rest; that sand and gravel were graded as they quickly settled into place; that masses of material were stratified by slushy ice and water, and that bedrock was often scoured by falling and sliding material ?

The Ice Age theory, largely advanced by Agassiz, was a great success.It became very popular and did wonders to expedite geological research in America and Europe. Much was accomplished because the theory lightened the spirit and ambition of educators, explorers and scientists. They all eagerly sought to investigate the drift and to interpret its meaning. Their visualization of the vast glaciers to the north could not have been more effective in stimulating participation. Thus the minds and bodies of thousands of researchers have vigorously persued investigations of the drift for over a hundred and seventy-five years. They determined the extent of the drift, its various forms, and its internal structure. Their efforts have been very worthwhile. Thus, this writing has not been presented in order to discredit in any way the hard factual evidence which they have found. But it is largely presented to show that the concept of the glaciers cannot explain as wide a range of Pleistocene phenomena as the concept of the comet. With this alternative concept, it is suggested that many more pieces of the Pleistocene puzzle may eventually be fit into their rightful place.

DESCRIPTION AND LOCATION OF IRON-CONTAINING SPECIMENS

A short description and the location of some of the many iron-containing materials, quite a number of which have been baked and even vitrified by the intense atmospheric temperature and pressure produced by the intruding comet, are given below.

1) A portion of a clay rock with a thick baked shell, found on the shore of Brady Lake, 3.2 Km, (2 miles) northeast of Kent, Ohio.

2) A variety of erratics, along with baked rocks, and shells from such rocks, were collected from along route 104 near Williamson, Michigan.

3) Typical erratics, along with baked rocks with shells from along route 33, northwest of Duluth, Minnesota.

4) A large piece of quartz having a bubbly surface in places, and which contains iron, was found along U. S. 201, about 11 Km, (7) miles, south of Jackman Station, Maine.

5) A chunk of quartz conglomerate with iron-containing spots found along 1-81, at mile marker 138/18, in Pennsylvania.

6) Iron-bearing and encrusted quartz sticking to ferriferous sandstone, found along 1-81, at mile marker 107/26, in Pennsylvania.

7) Erratics and rocks with baked shells, also a football-size piece of very white quartz with shiny and hard spots of iron-rich material. Found at a sand and gravel excavation site back of an upholstering shop near 1-77, at Canton, Ohio

8) Many chunks of sandstone of several hues, with highly distorted and dark brown, vitrified streaks, collected at the base of a sandstone hill by the Ames Tire Shop, along route 33, at Lancaster, Ohio.

9) Several heavily iron-charged "concretions", from along I 70, east of Columbus, Ohio, at mile 146.1.

10) Erratics and baked pieces of shell broken from heated masses of clay. Obtained from along 1-70 west, east of Columbus, Ohio, at mile 112.9.

11) Erratics, along with several hard, brownish-red pieces which have a wide variety of indescribable shapes. Obtained from along U. S. 421, 20 Km, (12.1 miles) southeast of Sanford, North Carolina.

12) Approximately 200 baked and glazed lumps of red and white sand were collected at the U. S. routes 25/301 interchange for I-16, north of Claxton, (Fruit-Cake) Georgia.

13) Irregularly shaped lumps of red and white sand, which are hardened and baked brown on the surface, found along U. S. 1/23 just north of Waycross, Georgia.

14) A variety of colors of iron-stained sandy clay, and some very hard, iron-rich slabs of various configurations. One mass of sandy-clay adjoins another mass of a different color along a vertical line, not a horizontal line.

15) Several brown, iron-containing lumps of baked, limy-sand were found at the Chiefland, Florida sanitary land-fill site.

16) Tan-colored, fossiliferous limestone with hard, brown surface, having melted beads, was found along routes 19/98, 7.2 Km, (4.5 miles) north of the city limit sign at Inglis, Florida.

17) Iron-rich lumps of clay and phosphate rock were collected at a phosphate mine between Brewster and Green Fort, Florida.

18) Very brown, iron-containing limestone rocks, which were used for construction and decorating of a roadside restaurant, along U. S. 17, 16 Km, (10miles) north of Arcadia, Florida.

19) Burnt and baked pieces of irregular shape, which contained sea shells, obtained from Charlot County land-fill site, along highway 41, north of Fort Myers, Florida.

20) Very brown, iron-rich dolomitic sandstone and limestone along Route 41, south of Fort Myers, Florida, near a camp site.

21) Iron-stained erratics and mica-containing clay were collected along Route 43, between Buchanan and Eagle Rock, Virginia. This material was collected from a very new road cut.

22) Baked lumps of material and some ferruginous conglomerate were collected east of Buna Vista, Virginia

23) A few erratics and two iron-cemented clusters of gravel, were picked up from the surface area of the Padonia Rock Quary, along I-83, just north of Towson, Maryland.

24) Many erratic gravel and several gravel clusters, which were coated and cemented with black, iron-containing material, were gathered at an excavation site for a new building complex on the flood plain below the bridge along U. S. 62 at Hunter Station, Pennsylvania.

25) A piece of kidney ore, some pieces of red and white sandstone and some gray sandstone which had brown, iron-containing streaks were collected from a road cut along route 93, and a short distance north of route 141, near Ironton, Ohio

26) Burnt and baked rocks containing iron, from a coal mining area, past the Etnae Furnace location, along a road leading off Route 93, north of Ironton, Ohio.

27) Various erratics, along with a few thin, brown, striated castings from baked rocks, were collected along I-70, east of Columbus, Ohio, at the end of the access strip from Reynoldsburg, Ohio.

28) Iron-hardened castings from baked rocks, iron-laden coal and sand were collected from along the Blue Grass Parkway, 19.3 Km, (12 miles) west of the Hodgenville - Bardstown exit, in Kentucky.

29) Several erratics and baked rocks with iron-hardened shells were picked up from a creek bed along the Blue Grass Parkway at milepost 6, east of Elizabethtown, Kentucky.

30) Small baked balls of sand, along with angular pieces of red and white sandstone, pulverized coal and gray, clayey shale were collected along I-65 south, in Kentucky, 1.6 Km, (1 mile) from Route 31 W and the Mumfordville exit 65.

31) Baked lumps of sand and limestone gathered from a large excavated lot near the Imperial Carpet Mills Inc., along U. S. route 41, between Cass and Adamsville, Georgia .

32) Samples of iron-laden limestone, sand, and rock rubble were collected from the abundant deposit at the sanitary land-fill site at Athens, Alabama.

33) Iron-laden red and white sand conglomerate, along with iron containing concretions, were gathered from a recently graded building site along route 31, at the north edge of Tarrant City, Alabama.(Such red and white sandstone, sometimes found with white gravel the size of a hen egg, has been collected from a number of far scattered sites. It is readily evident that this red and white sand is not a normal sedimentary deposit, for it is not thoroughly mixed, and it shows no signs of stratification.)

34) Angular pieces of chert and pea-size pieces of baked sand were found and collected at the western edge of a small town along route 5 and U. S. 11, southwest of Bessemer, Alabama.

35) A conglomerate of iron containing rubble, along with tan and brown sand, were collected from a road cut of U. S. 11 and route 43, southwest of Tuscaloosa, Alabama, 13.3 Km, (8.3 miles) from the I-20 and I-59 junction, or about 100 Km, (62 miles) from the Mississippi-Alabama state line.

36) Iron coated gravel, quartz pebbles, baked lumps of sand, and dirty pulverized coal were collected from a road cut near the first rest stop and tourist informaation place along I-20 and I-59 S in Mississippi, just past the Alabama-Mississippi state line.

37) Iron streaked concretions, from along Route 15, between Decature and Union, Mississippi.

38) A wide variety of oddly shaped and baked pieces of a very rusty appearance, with some of them showing a bubbly surface, were collected near Union, Mississippi.

39) Iron-laden concretions, brown chert, iron-laden sandstone, and some iron-containing red and white sand. Such red and white spots has been found at sites number 11, 12, 13, 14,and 33, but also along route 505N(?), leading from I-20 toward Decature, Mississippi, and at the Marion County Sanitary Landfill at Ocala, Florida.

40) Iron-hardened concretions were picked up which were lying on top of red sand, and a deposit of white clay was observed at the Cal-Gas Appliance Propane Company, along route 79, at Paris, Tennessee.

41) Glazed balls of sand and baked shells from clay balls were found along route 79, 4.4 Km, (2.75 miles) south of the city limit sign at Paris, Tennessee.

42) Broken chert, iron-rich clay, sand,and gravel are exposed in an excavation site along U. S. 79, at Dover, Tennessee.

43) There are very large quantities of iron-laden clay, broken chert, chert balls and rock rubble at the Stewart-Montgomery County landfill site along route 79, about 16 km, (10miles) west of Clarksville, Tennessee.

44) A piece of rock the size of a football, having a very brown and hard shell that was broken, was collected from the sanitary landfill site at Richmond, Indiana.

45) A few small pieces of angular baked shells from rocks were collected from along route 46, 3.54 Km, (2.2 miles) east of the Brown-Bartholomew County Line, west of Columbus, Indiana.

46) Pieces of hardened clay and a large piece of iron-layered clay which had a series of shells, was collected from along route 46 at the Brown-Bartholomew County Line.

47) Numerous small brown balls of baked clay, with rusty brown and rusty red material, which is neither clay, sand, nor shale, but has the combined qualities of all of them, was collected from along route 46, about 1.6 Km, (1 mile) north of Bloomington, Indiana.

48) Some angular, Iron-containing rocks were gathered from a quarry along route 46 , near Clay City and Brazil intersection, about 35Km, (20.2. Mi.) from Terra Haute, Indiana.

49) Baked casting from rocks, along with iron-hardened gravel clusters were found at a sand and gravel pit, which is located about 1.6 Km, (1 mi.) off route 61, and about4.8 Km,(3mi.) south of Welton, Iowa. (The landfill site at Welton had two boulders of iron ore, or possibly magnetite.)

50) Rock rubble and dirt, along with burnt material, seen and collected from along U. S. 61, 8.2 Km, (5.1 mi.) south of Boscobel, Wisconsin. (This is in the so-called "driftless" area.)

51) Some pieces of iron streaked sandstone, which is very similar to that which was found north of Ironton, Ohio, and at Lancaster, Ohio, along with some red sand, and white sand, were collected along County road **S**, .9Km, (.6mi.) from Route 61, which is somewhere between Boscobel and Soldiers Grove, Wis. (This site is also in the "driftless" area.)

52) Some small,baked balls of sand, which are very brown, were dug out of massive, cream colored sandstone, at the southern edge of La Crosse, Wisconsin, along Route 35, at the junction of U. S. 61 and U. S. 14. **(Driftless Area)**

53) Some iron-containing concretions, along with quartz and chert erratics, were picked up at the base of a large, white, sandstone hill, 9.6Km, (6mi.) east of La Crosse, Wisconsin, and on the north side of I-90. **(Driftless Area)**

54) Material that is similar to site 53 was also found along I-90 at mile markers 36.5 and 52. (In these three sites, and others, the hills are made up of very white sand, with some layers running at angles of approximately 50 degrees, as would be measured from the vertical. **(Driftless Area)**

55) Stones with baked shells, erratics, and massive chunks of iron-laden conglomerate are at the Kane Sand and Gravel Pit, Kane County, Illinois, on Route 47, a short distance from Sugar Grove, Illinois.

56) An abundance of sand and gravel, along with many thousands, if not millions of clay rocks having very hard and brown shells, often vitrified and shiny, showing a reflection of rainbow colors, are at a sand and gravel pit along I-77, south of Canton, O.

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