NORTHERN COLORADO'S First Settlers

By ROY G. COFFIN
Foreword

This report presents the results of independent investigations conducted by the Geology Department of Colorado State College in cooperation with the actual discoverer of the Lindenmeier Site of Folsom Man in Northern Colorado, and sketches the history of its exploration. As this discovery was made in 1924, research has extended intermittently over a period of 13 years.

I made the first formal report to the United States Geological Survey February 26, 1934, but as the result of evidence secured prior to 1930, I have since that year been presenting this evidence to my geology classes in our study of paleontology and assuring them that it constitutes the basis for speculation that Northern Colorado might have been the "Garden of Eden" of the Western Hemisphere.

Requests are continually being received for information relative to the discovery and for descriptions of the type Folsom point with its associated artifacts. At times this has become quite burdensome and it is hoped that this publication may serve to answer the questions most often asked.

A record of only a few of the great variety of the cultural objects we have obtained at the site is available at the present time. I wish therefore to present in detail the record of our early exploration and to suggest some conclusions as to the possible significance of certain phases of this research.

R. G. Coffin

May 30, 1937
Fort Collins, Colorado

Acknowledgment.—I wish to acknowledge with thanks the work of Noland R. Fry in making the careful and accurate drawings of Folsom points and bases for this manuscript.

—The Author

Cover sketch represents an "air view" of the area where Folsom man's workshop remains are being unearthed.
PREFACE

Artifacts recording Folsom Man's occupation of the Lindenmeier Valley were found in 1924, two years before the discovery of the Folsom Site in New Mexico. The author of this booklet, the late Professor Roy G. Coffin, records the discovery and the early work done by the Coffin family prior to their invitation to Dr. F. H. H. Roberts, Jr., to bring in his Smithsonian group for full-scale exploration of the site. Major Coffin, as he was known to his many friends, was a scientist who found endless challenge in the field; consequently he did not take time to publish his findings until 1937, after several other publications had appeared.

The discovery of the Lindenmeier Site was no mere coincidence; Major Coffin and his brother, Judge Claude C., were assiduous students of the early inhabitants of northern Colorado and southern Wyoming and few if any potential sites escaped their painstaking investigation. In "Northern Colorado's First Settlers", the picture of the life and work of the Folsom people at this workshop reflects a depth of understanding which could have been developed only through many years of thoughtful and devoted study. This, in addition to the record of the discovery and early work, necessitates the re-publication of this worthy paper which has had but limited distribution. No less important, it will revive the memory of a man whose life was synonymous with services—to his students, neighbors, and friends.

Since this paper was published, additional work has added significantly to our knowledge of Folsom Man in northern Colorado. Notable are the works of Bryan and Ray (1941), additional reports by Roberts (1937, 1940, 1951), and Haynes and Agogino (1960) who obtained a radiocarbon date of 10,780±375 years B. P. for the occupation of Lindenmeier Valley. These and other pertinent papers have been added to the bibliography.

By D. V. Harris, Head Department of Geology, Colorado State University

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Northern Colorado's First Settlers

By R. G. COFFIN, Associate Professor of Geology,
Colorado State College

The discovery and development of the Lindenmeier Site of Folsom man provide a contribution to the knowledge of our early Americans which gives promise of furnishing valuable information that will allow a more accurate interpretation of the existing Folsom cultural objects. It may also stimulate careful study of promising areas.

The Lindenmeier Site is unique in that with the characteristic fluted dart point which has definitely identified the assemblage, there has been recovered a great variety of associated artifacts. These exhibit many variations in technique and form; from the beautifully chipped and ground chalcedony and jasper blades to very crudely fashioned quartzite implements.

Published reports showing points found at the Lindenmeier Site include many fragments that have resulted from unsuccessful attempts at construction and are not portions of completed points that have been hafted and used. These rough and unfinished points do not reveal the details of the finely wrought artifact that is characteristic of the site.

Location.—The site is within 2 miles of the Colorado-Wyoming state line in Larimer County and is 28 miles north of Fort Collins. It is about midway between the two highways that enter the county from the north. It can be reached by an ungraded road from either the Laramie-Fort Collins or the Cheyenne-Fort Collins highways.
The road north from Fort Collins through the town of Waverly leads to the site.

**Geological History.**—Several times during the Tertiary Period the river systems of the Rocky Mountains in Northern Colorado have been rejuvenated as a result of the repeated arching of the Front Range areas.

Each period of renewed activity of the streams built alluvial fans extending from the base of the mountains eastward over the plains. During the Oligocene Epoch considerable volcanic activity accompanied the warping of the mountain area and thus volcanic material, largely ash, was the principal sediment transported and deposited over a large portion of the western plains region.

This material is, locally, often referred to as "chalk," "soapstone," etc. It is light yellow, almost white in color, and in addition to the clay materials,—kaolin, bentonite, etc.,—it contains some lime and grains of glassy volcanic materials.

Late in Tertiary times after this Oligocene mud terrace had been dissected by streams, it was covered by very coarse (arkosic) gravel derived from the granite highlands north and west. To this gravel was added resistant cherts, flints, and chalcedonies from the exposed outcrops of the Pennsylvanian limestones of the foothills.

In some areas of Northern Colorado this upper gravel has been partly removed from the stream beds of earlier times. It is along one of these uncovered east-west valleys that our ancient hunter made his camp. The terrace of consolidated gravels about a quarter of a mile north forms a protective escarpment some 400 feet high.

As the limey-clay stratum is quite impervious to water it seems probable that seeps occurred along the valley floor and under slightly more humid conditions quite a stream might have flowed through the narrow valley. An arroyo has later cut through the valley rim from the south and captured the drainage and cut the water table. The springs thus produced in this gulch and another farther west now furnish the only natural water supply in the district.

During the time that ancient man occupied the valley and since that time, his camp sites were gradually covered with dark-colored humus-bearing residual soils augmented by silt and gravel wash from the nearby tableland to the north.

Along the south rim the contact between this black stratum and the white clayey substratum has been exposed by recent rain and wind action thus disclosing the preserved camp debris which led to the discovery. The basal few inches of the black soil layer, from the discovery point for a distance of about 1500 feet westward, has yielded most of the various cultural objects and the associated bones of the animals killed some 10,000 years ago.
History of Discovery.—Many years ago my brother, Claude C. Coffin, (now judge of our district court) and I became inspired with the idea that the foothills and adjacent plains region with their abundance of Indian camp sites offered many interesting research problems. Little was known of the Northern Colorado cultures of prehistory. A most careful study of all possible evidence will still leave much of this story untold. As a hobby and also in connection with my vocation, much of our spare time has been devoted to local archaeological studies.

During the summer of 1924, Judge Coffin, his son A. Lynn, and C. K. Collins returned from a trip near the Colorado-Wyoming line with several odd, similarly shaped, artifacts, all secured from the surface in a small area on the so-called ‘chalk’ formation. The natural conclusion was that they were of Indian origin and were for some specific purpose. They, therefore, presented a very definite problem and as the result of three trips we secured from an area of less than 30 by 50 yards a total of 34 specimens of this same type. During this survey, however, we found in this limited area none of the arrow-head types which are common to the many Indian camp sites in the neighborhood. Thus our assumption of Indian origin did not suffice. In our attempts to learn the significance of the finds we became the first local students of what, 2 years later, became designated as ‘Folsom Points.’
Part of the first group of artifacts secured at the Lindenmeier Site in 1924. The assumption that these represent a distinct type led to continued research.
Identification.—In the summer of 1930, Dr. E. B. Renaud of the Department of Anthropology of Denver University, while engaged in a study of Northern Colorado cultural sites, inspected my collection of artifacts and singled out our odd-shaped points as of Folsom type.¹ We were referred to articles of Harold J. Cook which appeared in the Scientific American between 1926 ⁶ and 1931 ⁷ and it was apparent that the Northern Colorado points were of the pattern discovered at Folsom, New Mexico,⁸ associated with prehistoric bison skeletons. Dr. Renaud visited the site with me on June 29, 1931, when two of the distinctive point fragments were found. ²

Description of the “Point”.—The characteristic structural feature which identifies the point is that both sides are fluted to produce wide longitudinal channels which may extend nearly the entire length or only part way from the base. Either face, therefore, has two ridges near to, and parallel to the edges, making a blade that is thin along the axis. The base is concave or broadly U-shaped. The points of the U are a prolongation of the axes of the lateral ridges.

The tip of the blade is thin and rather bluntly pointed while the edges are nearly parallel or very slightly divergent for one-half or two-thirds of the distance from the base. Minute retouching produced an edge that is very smooth and a feature that early attracted our attention was that about one-third of each edge near the base was further smoothed by grinding. This grinding is present on all the specimens in our collection that show evidence of having been completed. If the blade was first constructed with parallel edges, the grinding in many cases is sufficient to account for the fact that the base is often slightly narrower than the mid-section.

The length of the type blade can only be approximated as the specimens found at the site are almost exclusively discards, consisting of fragments, mainly bases, or imperfect specimens that have not satisfactorily yielded to the various constructional operations. Of course, it is to be expected that camp refuse would contain only portions of used points that have been cast aside when removed from the haft. Many are heat-fraclatured, showing that they might have been actually thrown in the fire. It seems probable
that few of the points, when first constructed, exceeded 2.5 inches in length while the most common widths vary but slightly from .75 of an inch.

While the side fluting may be said to be the most distinctive feature of the point, this groove as later explained is not always present. In the very thin blades it may be short and confined to the basal end, and in others all evidence has been obliterated in the final form.

Though the shape of the point varies somewhat, the greatest variation is in the outline of the base; usually concave, it may range from the deep U-shape, with long, sharp points, to a very thin, squarely built form.

It must be understood that the features enumerated are taken from a survey of the Coffin collections secured at the Lindenmeier Site and may not represent general characteristics of the Folsom group.

**Exploration.**—Our early visits to the site had convinced us that the artifacts found were made "on the ground," but after Dr. Renaud’s identification,¹ and the knowledge that Folsom man was at this time known only as a mysterious hunter, we definitely undertook to determine if we had discovered a home of this early American.

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¹ Dr. Renaud's identification refers to the identification of the site as a possible home of Folsom man.
On hands and knees, with broom and rake, we thoroughly inspected the few square rods of the area that seemed most productive as well as adjacent areas. In addition to the fact that all the bladed artifacts secured were of the same Folsom type, we found that the materials used in their construction were essentially different from the materials represented in the artifacts secured in nearby Indian camp sites. The jaspers and chalcedonies used could all be duplicated in the associated fragments. After each rain or wind, a multitude of “chippings” could be secured, many of which were almost microscopic, indicative of the carefully wrought retouching of the edges.

A great variety of other cultural objects were found, representing the same unusual technique, and made from like materials. However, the finding of many of the long, thin, side-flakes proved conclusively that the ancient craftsman who shaped the fluted artifact and its associated objects was at home here.

Construction of the Point.—As our collection contains many partly completed points and others broken during various stages of the manufacturing process, it is possible to visualize the sequence of operations used to produce the point. A thin disc of suitable size was first roughly shaped in the desired elliptical form while at the end designed as the base, an axial projection was left, commonly between the two “ears” that were often roughly shaped during this step. The side flakes were then removed by the application of sufficient pressure to this projection as a fulcrum.
Some specimens show that flakes as much as 3 inches long were produced. Many points found were evidently broken during this operation. The careful shaping of the blade and the final retouching were followed by the grinding of the edge near the base. In the final shaping, the channels of some points were partly or completely obliterated.

At present the mechanics of producing the fluting seems to defy satisfactory explanation just as at one time did the process of heat-treatment for hardening copper as used by some of the later North American cultural groups.

Not only did our craftsman find it possible to accomplish the phenomenal, but his skill in directing the fluting operation produced a very thin flake that was uniform in thickness and width its entire length. Over 100 specimens of these flakes in our collection testify to his ability, while others show that a second equally thin flake exactly paralleling the first could be produced.

Certain inferences seem justified in explaining the purpose of the smoothing of the edge. In mounting the point in the end of a split, or more likely a notched, shaft the wrapping was probably green sinew which tightened as it dried. The special construction of the Folsom point would necessitate wrapping over the edge which was smoothed to lessen the likelihood of cutting the binding.

Source of Materials.—Much of the material used was secured near at hand from chalcedony-flint concretions and geodes derived from the gravels referred to under Geological History. About 4 miles northwest of the site a semi-transparent chalcedony is in place in the Ingleside limestone and is of the type commonly represented in the artifacts. Two pieces of obsidian found must have come from the Yellowstone region or from a more remote point. The nearest source from which I have been able to duplicate the oolite used is near Wamsutter, Wyoming, but the abundance of this particular material in some refuse zones suggests a nearer source. The petrified wood used could have been secured from the nearly basal Dakota sandstone while the beautiful red jasper suggests Sunrise, Wyoming, as its source. Local quartzite from the Dakota formation was also used.

Origin of Artifacts.—Continued study convinced us that the artifacts were not derived from scattered surface camp waste like that furnished by the recently occupied Indian camps of the neighborhood but were of sub-surface origin. The position of the finds indicated that their source was the horizon at or near the contact of the lowest black soil with the whitish clayey volcanic ash. The presence in this zone of many bone fragments, some of which were charred, suggested the presence of other types of material under-ground.
After a certain amount of shallow excavating we began to realize what might happen to valuable records under our untrained hands and with the limited time at our disposal.

Record of Report.—As Dr. Renaud and Director J. D. Figgins of the Colorado Museum of Natural History had become interested in our explorations, the greater part of our collection was loaned to Dr. Renaud for his records after which it was displayed at the Museum. In December, 1931, Judge Coffin supplied Dr. Jesse L. Nusbaum with photographs of the points collected and a few weeks later A. Lynn Coffin and I visited him at Santa Fe, New Mexico, to acquaint him with the results of our research up to that time.

As a result of our 10 years' work we were convinced that the project had real merit and it was agreed that I should report the results of our investigations to Dr. John B. Reeside, Jr., of the United States Geological Survey. This was done under date of February 26, 1934, and we asked to be referred to some one who might be interested in cooperating in the furtherance of the project so that our work might become a matter of record.

Quoting from his answer:

"I have talked to some of the anthropologists here about your find of artifacts. They say that if you have found a Folsom culture-site, as is so strongly suggested by the number of specimens, you have something very new and very much worth publication. All of the Folsom finds to date have been of a sporadic, incidental nature,—more or less accidental preservation of a few dart points where kills have been made, etc. The amount of material you have and its variety indicate more than an accidental preservation. Nothing is known about the Folsom people themselves except the inferences drawn from the dart points. The anthropologists here would like very much to see some photographs of specimens or better still, if it is feasible, some of the specimens themselves. If you can send either photographs or specimens it will be greatly appreciated."

My second report to Dr. Reeside included photographs of many of our artifacts, photographs of the terrain and the contact horizon in the arroyo. As one particular area seemed to promise more bone materials than elsewhere, enough digging was done to obtain a vertebra and a few bone fragments which were forwarded with the report. These bones were identified as bison,—species unknown.

The land is owned by Wm. Lindenmeier, Jr., who kindly gave us permission to undertake the sub-surface work. Later a lease was obtained and the site has been officially designated as the Lindenmeier Site.

Through the kindness of Dr. Reeside, our reports were transmitted to the Bureau of American Ethnology. As a result, Dr. Frank
H. H. Roberts, Jr., was designated by the Smithsonian Institution to investigate. After an interchange of letters he was invited to undertake such exploration as he saw fit under our lease.

Development of the Site.—During the summers of 1934, 1935, and 1936 a party under the supervision of Dr. Roberts has conducted explorations and his reports have been published under the title of "A Folsom Complex," in Smithsonian Publications numbered 3333 and 3390.

Director Figgins of the Colorado Museum of Natural History was invited to participate under the lease and his party secured a very representative collection.

The area of exposed bones at the site remained undisturbed until the summer of 1935 at which time I opened a small pit and obtained several well-preserved bison bones. Director Figgins recognized that out of the group, five were corresponding leg bones from as many animals. These were all secured from a very small pit.

This pit was taken over by the Smithsonian workmen who secured, among quite an assemblage of bones, a completely articulated front leg of one animal and a vertebra in which was seated a Folsom point—first definite proof that the ancient hunter had actually made a kill. According to estimates made at the time the fore limb
was uncovered, this massive bison stood about 7 feet tall at the shoulder. As these bones were secured from well within the lower limey horizon, they were better preserved than those obtained from the black humus layer above.

Use of Point.—Archaeologists have concluded that the bow and arrow were introduced in America by the late Basket Maker Culture, near the beginning of the Christian era. It is assumed that more ancient peoples must have used a spear or a dart, thrown with a throwing stick. Thus Folsom man must have killed his large Arctic bisons at rather close range.

As the Northern Indian uses both spear and the dart and is known to have "ground" some of his points, it seemed possible there might be found some connection with our Folsom culture. In quest of possible correlative evidence, I went to Alaska in the summer of 1935. Through the kindness and help of Father Kasheverof, Curator of the Juneau, Alaska, Museum which is housed in the Capitol Building, I made a careful inspection of the cultural objects represented there. Also at the Museum of the University of Alaska

Many bones of the massive bison of the late Ice Age have been secured by the author from various locations at the site. The pencil lends a basis for comparison of sizes.
the staff assisted me in the inspection of thousands of artifacts obtained from many areas in Northern and Western Alaska, but I found nothing in common with the Folsom point.

However, we may profitably make some comparisons. The Northern Indian uses a heavy spear usually fitted with a short bone or ivory fore-shaft into which is carefully mounted the stone or metal point.

The side grooving with the resultant thinning would certainly allow a more efficient mounting than otherwise possible. A heavy spear, 5 to 20 pounds, similar to that used by the Eskimo, would help us visualize our "Man of Mystery" in the act of felling a large bison or mammoth. 11

Art.—No human remains of the Folsom man have as yet been found and little can be learned of his habits. However, one of the common objects recovered is hematite pebbles which invariably are scored showing that they have been abraded to secure red paint, leading to the belief that he was an aesthetic individual, having at this very early time introduced the use of rouge in Colorado.

The first art object we found was a portion of a circular or elliptical disc of about the thickness of a penny and fashioned from a grey soapstone. Both faces are uniformly indented along the edges and show evidence that they were highly polished and inscribed with some formal design. As no occurrence of this type of material is known locally, it, like many other kinds, must have been obtained during his travels.

Later Dr. Roberts and the Colorado Museum of Natural History each secured bone discs of this same general pattern, each between 1 and 2 inches in diameter.

No evidence of pottery making has been found, in keeping with the general understanding that the "Late Basket Maker," at a much later date, was responsible for its inception.
“Frugal Folsom.”—That frugality was a virtue of our early Coloradoan is shown by the many points and discarded fragments which definitely indicate that after a tip was broken a concerted effort was made to re-point the blade by reshaping. Thus it might be restored without removal from the shaft. Other finds represent instances where a base was re-formed after the blade had been broken near the base. The uniform thickness of the point would allow its resetting in the same shaft after its reconstruction. Many other ill-formed points indicate that attempts to restore them to their usefulness were not successful.

Other Artifacts.—While many thin, pointed artifacts and other discoidal and elliptical-bladed choppers or knives have been found, the most common tool throughout the area is the end scraper, variously designated as “hide-scraper,” “snub-nosed scraper,” “thumb scraper,” etc. Our initial sub-surface exploration at the location where the first artifacts were found, produced 26 of these utensils, with much fragmentary material, in an area 9 by 12 feet.

The fact that so many of these thick, heavily made tools evidently were broken while in use, suggests that they must have been mounted and used in a manner allowing the application of considerable pressure.

The finding of such numbers of both broken and complete scrapers having the same, more or less wedge-shaped pattern, fits in again

![End scrapers, 4 above, are the most common artifact secured at the site. Though many other types were used by ancient Coloradoans.](image-url)
very nicely with the use made by the Northern Indians of a scraper made from rock and of almost identical design. In the museums at Juneau and the University of Alaska at Fairbanks are various modifications of scraper "mounts," constructed of ivory, bone, metal, or of wood.

The tool is designed to operate like a carpenter's plane with the scraper seated in a forward groove or aperture constructed to accommodate the wedge-shaped base. The scraper is held at an angle with the flat side downward. Many of these devices are so skillfully carved as to give a perfect fit to the hand.\(^\text{12}\)

The dulling of the scraper edge would necessitate a resharpening which would shorten the implement and eventually lead to its replacement and the discarding of the original, thus accounting for the many found with the camp refuse.

This particular type of end scraper noted in the Northern cultures and at the Folsom site is found generally throughout the Indian camp sites that we have visited in Northern Colorado and while its use might have varied, it is supposed to have been employed in removing hair and flesh in the process of curing and tanning hides.

Worthy of note is the fact that being right-handed is rather an "ancient custom" as indicated by the study of these scraper-holding devices and the atlatl (throwing stick) of early man.\(^\text{13}\)

Folsom points are found in the surrounding districts often associated with the cultural objects in camp sites of the recent Indians. As we have made several such finds and many more have been reported to us, it appears that these skillfully fashioned tools saw service in the hands of more than one race and may have, in this manner, become more widely distributed than were the people who made them.

**Antiquity.**—Colorado's peoples of prehistoric times have been many and the sequence of the cultural groups is quite definitely established back to the Early Basket Maker whose occupancy of the Southwest archaeologists place at about 1500 B. C. With the discovery of the Gypsum Cave man of Southern Nevada\(^\text{18}\) and the widely distributed Folsom man, both of whom hunted animals long extinct, the problem of antiquity of man in America becomes geological in its scope, and it is recognized for the first time that the New World is given a race which is contemporary with men of the "Old Stone Age" in Europe.

The correlation of varying geological conditions during the late Glacial Age (Pleistocene Epoch) with the characteristic animal life will eventually furnish a time table by which more accurate dating will be possible. The termination of the last glaciation is variously
The dark contact stratum furnishes the assemblage of Folsom cultural objects with much fragmentary bone.

estimated as having taken place 10,000 to 50,000 years ago. It is not known how long climatic conditions locally were such as to maintain the animal types of that time. As Folsom man was associated with these animals, the time of his appearance here is speculative. The problem is further complicated by the fact that the fluted blade of this hunter is distinctly North American as are many of the animals he knew.

A Speculation.—The securing of the massive bison of that period and the associated mammoth must have presented a real problem. Fossils of these and similar species secured from Central Alaska and other parts of the "Frozen North" show that these animals were provided with a protective coat of dense wool and coarse hair. The points, which are variously called arrow-heads, spear points, javelin points, etc., represent an essential part of the device by which these animals were killed.

Evidence shows that these animals were present in great herds. It, therefore, seems quite probable that the hunting was done by stampeding the animals over a cliff or into a ravine, as was done by our local Indians before the days of the horse. Concealed pit-falls, or bogs, could have been used to entrap; the fluted point,hafted on a heavy lance, would have served efficiently in dispatching a maimed or trapped animal either by driving it into a vital organ or inflicting a wound sufficient to cause death by bleeding.
Conclusion.—The "Lindenmeier Site" is the first residential area discovered of the earliest known Coloradoan who represents a part of a widely distributed cultural group now designated as "Folsom."

The animals upon which he depended for food included many that became extinct at the time of, or shortly after, the retreat of the last (Wisconsin) glacial ice sheet from the higher mountains of the "Rockies," 10,000 to 15,000 years ago.

He was a superior artisan, displaying a proficiency in the shaping of his flaked implements that rivals the best known in the Eastern Hemisphere and eclipses all later Indian cultures of this region.

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The following article "Sources and Origin of Northern Colorado Artifact Materials", also by the late Professor Coffin, is included as an Appendix because it contains closely related information.
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APPENDIX

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SOURCES AND ORIGIN OF NORTHERN COLORADO ARTIFACT MATERIALS

By Roy G. Coffin

A comparison of materials used by the various Indian Cultures that visited Northern Colorado with the materials which predominate in the artifact collections from the Mississippi River Valley shows very few materials in common. Not only are the cherty flints of the valley region seldom represented in the artifacts of the foothills, but every camp-site adjacent to our mountains presents such a variety of materials that almost the entire range of the crypto-crystalline quartz minerals may be found in a small area. Many types and great color variation in each type is common.

Volcanic rocks such as obsidian, rhyolite and basalt may be found in a “work-shop” or other camp-site with the various quartz types.

Since most of the materials used for the construction of arrow-heads, knives, scrapers, etc., are crypto-crystalline varieties of quartz they are all of secondary origin and are only occasionally found in place among the primary and metamorphic rocks of the mountains.

Little use was made of the primary crystalline varieties of quartz. Massive “milk quartz,” some rock crystal and smoky quartz have been noticed, especially in the higher altitudes where they were probably used because of a lack of more suitable materials.

These secondary varieties that were found useful are the product of many profound geochemical changes and are therefore confined largely to the oldest members of the sedimentary series of rocks. They are erratic in their occurrence within the limestones and sandstones on the flanks of the mountain masses where the sediments have been folded and tilted and later exposed by erosion. The history of these sediments starts in mid-Paleozoic times when a shallow sea-way occupied the site of what is now the Rocky Mountain area.

A very irregular granite coast-line furnished small bays protected from the muddy waters entering the ocean from the highlands to the westward, allowing the lime-secreting organisms to build thin deposits of limestone which were later covered with wind-blown sands along the shoreline while the whole continental platform was being raised at the end of Poleozoic time.

During the following early Mesozoic Era these limestones with their sandstone covers became the swamplands of the dinosaurs, and as the advancing Cretaceous sea deepened, the early sediments were covered with a thickness of over two miles of ocean clays and sands. At the end of the era this series of sedimentary rocks became arched, broken and tilted as the Rocky Mountains were raised high above sea level, and became the backbone of the American continent.
After erosion had cut through the arched sediments into the underlying granites, an erosional system much like our present foothill terrain was produced while the mountain ridges enclosed extensive fresh water lakes. Many of these lakes were large, shallow, inland seas; others were small and deep.

During mid-Tertiary times excessive volcanic action took place along and adjacent to the Front Range. The torrential streams became overloaded with volcanic materials, much of which was ash. This action covered much of the foothills region and many of the lake basins with fine volcanic silt and some of the higher lands with thick deposits of volcanic gravels. During the time the later sediments were accumulating, some of the underlying limestones and other calcareous sediments were many times subjected to the solvent action of acidic ground-waters which left many zones porous, honeycombed or cavernous.

The action of atmospheric waters on the mantle of volcanic materials through the process of weathering (kaolinization) was such as to subject the sedimentary materials to the action of alkaline waters. In the words of the chemist, "The pH (hydrogen ion concentration) had been greatly decreased," thus allowing the migration of the silica (quartz) in the rocks saturated with such a solution. When these solutions became saturated either as a result of having maximum silica present or through a change of the pH, part or all of quartz might be deposited.
While no well defined classification of the silica (quartz) materials is possible from the standpoint of the mineralogist, they may roughly be listed as to origin into the following groups: 1. Direct Chemical Precipitates, (cavity and spring deposits); 2. Concretionary Materials; 3. Mineral Replacements, and 4. Organic Replacements, both of which are sometimes known as pseudomorphs; 5. Metamorphic Products.

The cavities and porous nature of the early limestones and sandy sediments furnished reservoirs for the silica solutions. Openings were either lined or filled with a deposit of chalcedony. Some authorities suggest that these forms may have been deposited first as a silica-gel and later, by the loss of water became chalcedony. By retaining some of the water as "water of hydration" the mineral is opal. A distinct banding may often be produced in chalcedony forms and as the bands vary greatly in porosity they may become colored at the time of deposition or later with iron or manganese compounds which are soluble under similar conditions to those which are responsible for dissolving silica. The agates thus produced were one of the principal minerals used by the Indians and were mined in the outcrops of the basal limestones of the region. Examples of some of these chalcedony mines have been noted at Guernsey, Wyoming, Marshall, Wyoming, (has several extensive mines), Specimen Hill, near Little Medicine, Wyoming, Upper Boxelder Basin in Northern Colorado and Southern Wyoming. Large areas of carnelian types are found near Rawlins, Wyoming. All forms of quartz are very resistant to weathering so the chalcedonies, like other forms, were secured from the Tertiary gravel terraces along the foothills and the western plains.

The chalcedonies are characterized by a distinct waxy luster and are usually more subject to patination than are most of the other varieties of silica.

Flint is described as usually of concretionary origin and its purity, texture and luster depend largely upon the nature of the material in which the concretion is formed. If the enclosing limestone is compact the flint may be impure, when it is commonly known as chert. If the growth takes place in chalk, marl or porous limestone the resulting flint is usually of a light gray to white in color, though drab-yellow and reddish types are not uncommon. Flint is translucent and breaks with a smooth conchoidal fracture though the cherty varieties are more or less gritty.

Flints were mined in the Guernsey and Marshall districts in Wyoming but were usually obtained from boulders in the Tertiary gravels in both Colorado and Wyoming, where they originated from the oldest limestones of the Madison (Mississippian) Formation. While these concretions are in place near Marshall they seem to have internal stresses that make their direction of fracture unpredictable so their use was rather restricted. Some of these forms possess a color banding that is phenomenal.

Some micro-organisms such as diatoms and radiolaria secrete a skeleton of silica and deposits of these plant and animal remains become compact cherty flint, usually white in color. Some of the more recent sediments of Northeastern Colorado furnished a limited amount of this artifact material.

The chalcedonies, flints, cherts, petrified woods and other cryptocrystalline varieties—due to their porosity—are often highly colored by the addition of various iron compounds, and when the coloring is so intense as to
make the mineral opaque or nearly so it is known as jasper. The usual colors are red, brown and yellow, and these are often associated with the chalcedonies and flints. In the Sunrise-Guerney district and at Marshall, Wyoming, the Indians developed extensive jasper mines. We are told that the famous Colorado Fuel and Iron Company's hematite mine at Sunrise was first a jasper and rouge mine opened up by the Indians. At Marshall an Indian jasper mine was later a manganese mine.

Many of these mines produced materials which were mixtures of two or more varieties, as chalcedony-filled cavities often became the nucleus about which a concretion of flint, jasper or chert was formed. In very cavernous limestones as at Marshall and Little Medicine, Wyoming, after the massive agates were deposited the inclosing limy material was replaced by jaspers and flints giving mottled masses so large that the outcrops were mined with difficulty by means of the large basalt hammers used by the natives.

Along the shore line of the Green River Lake of Tertiary times thick oolitic sands accumulated. After being covered they became replaced by chalcedonic silica and flint like concretionary forms. This type of material was extensively mined in the Delaney's Rim district both north and south of the highway west of Wamsutter, Wyoming. The same material was secured southeast of Farson, Wyoming, where it caps the mesa near the Boar's Tusk. The workshops of these areas are littered with the oolite, and Folsom man of the Lindenmeier site used it.

In the fresh waters of the same lake, large heads and reefs of limestone were formed by algae which became altered in the muds to compact, brown flint-like forms with minute inclosures of chalcedony. The artifacts of Dr. E. B. Howard's Finley site at Farson, Wyoming, which yielded the long blades of the Yuma type were made of this silicified algae. It has been found among the artifacts of the Lindenmeier site, and north of Green River, Wyoming, near the Oregon Trail, workmen hammered the rock from masses yet in place to shape both the Folsom and Yuma artifacts leaving great quantities of work-shop refuse.

The mineral replacements of organic materials is best represented by the petrified woods. The Tertiary gravels of Weld County, Colorado, and adjacent territory furnished the Indians with much beautiful gray, yellow and brown agatized wood, while the upper Cherry Creek district southeast of Denver has unusually large logs of compact jasperized and agatized wood which is very common artifact material in the region.

The metamorphic forms of quartz—namely, quartzites—probably furnished more material for artifacts than any other form. Most quartzites are profoundly altered sandstones though other forms of silica may undergo a like recrystallization producing this form. The grainy texture varies greatly and the variance in color is unlimited.

The famous "Spanish Diggings" near Lusk, Wyoming, furnished the Indians with tons of material in the deep pits over many acres of sandstone mesa and the great piles of broken rock can be used as a criterion. While the mother rock is white, the large irregular concretionary masses vary in color from light gray through yellows, pinks, reds to brown tones. These quartzites are among the coarsest materials used by our local tribesmen. This form of quartzite is produced by the filling-in of the pore space between grains of the sand with crystalline quartz. The process takes place
much like concretionary growth and forms more or less rounded forms which the Indians were able to free from the inclosing soft sand.

Most of the sandstone formations, from the oldest to the recent, of the Rocky Mountain region have their sheet zones of quartzite so it was easy for the Indian to secure such material, which he used for artifacts that did not require refinement. The entire area of gravels in northwestern Colorado and southern Wyoming were sources of compact boulders of many grades of quartzite. The Snowy Range district of southern Wyoming furnished mountains of this material.

A special variety of quartzite was extensively mined at Specimen Hill, near Little Medicine, Wyoming. It was formed from a very fine grained sandstone by the addition of opalite and chalcedony as a filling-in cement giving it a smoother fracture and a more brittle structure. The upper Boxelder Creek district near the Colorado-Wyoming state line furnished this type where it was easily secured from large outcrops.

In many places the fine grained sandstones of the Upper Dakota hogbacks of the foothills contain sheets of very compact, light gray quartzite which was used locally.

The nature of the fragmentary materials in and around the mine pits indicate that the artifacts were usually not completed at the mines but that elliptical disks were fashioned to be taken to the more permanent camps. Many caches of such objects have been found at the camp-sites of the region. The tools used at the mines were hand-hammer stones of fine grained gabbroid material. The pyroxene having been altered to chlorites and serpentinite to such an extent as to give the rock a toughness that withstands impact. Some of these mining stones that weigh as much as twenty pounds have been found though most of them are rounded and small enough to be used in one hand.

Materials other than quartz varieties used in the construction of artifacts include obsidian and fine grained basalt with an occasionally large tool made from rhyolite. Obsidian, of black color, is common in many camp sites and must have been obtained from the Yellowstone deposits or from a greater distance to the south or west. Fine grained basalts are common in the recent lavas of the high mountains of northern Colorado but seem to have been used sparingly, probably only when the quartz types were not available.

Compact rhyolite quartz porphyry was sometimes used as hammerstones at the camp sites and in the construction of large crude tools and could be found in the river gravels and in the gravel terraces of the plains as many of the recent lavas of the high country are of this rock.

The principal source of the local artifact materials is the outcrops of the thin beds of Paleozoic limestone, when found in contact with the Precambrian granites and metamorphics. The much used, compact varieties of the chaledonies, jaspers, flints and quartzites were mined along the base of the mountains of the Laramie Range and adjacent to other mountains of southern Wyoming. While practically all types of material found at the Indian camp-sites of the foothills region of northern Colorado could have been obtained at the mines herein noted, there are, without doubt, many deposits of these and like minerals in areas not visited.