
GEOLOGY OF BLACK HAWK COUNTY.

BY

MELVIN F. AREY.

GEOLOGY OF BLACK HAWK COUNTY.

BY MELVIN F. AREY.

CONTENTS.

	PAGE.
Introduction.....	410
Location and area	410
Previous geological work.....	410
Physiography.....	412
Topography.....	412
Altitudes.....	417
Drainage.....	418
Geological formations.....	419
General relations of strata.....	419
Table of formations.....	420
Devonian System.....	420
Wapsipinicon stage.....	420
Cedar Valley stage.....	421
General section of the Cedar Valley limestone.....	438
Geest.....	439
Pleistocene System.....	439
Kansan stage.....	439
Kansan drift.....	439
Buchanan gravels.....	441
Iowan stage.....	443
Iowan drift.....	443
Loess.....	445
Alluvium and terraces.....	445
Cretaceous material in drift.....	446
Soils.....	446
Deformations.....	447
Unconformities.....	448
Economic products.....	448
Building stone.....	448
Lime.....	449
Brick clay.....	449
Road materials.....	450
Water supply.....	450
Water power.....	452
Acknowledgments.....	452

INTRODUCTION.

LOCATION AND AREA.

The fourth from the Mississippi river and also the fourth from the Minnesota line, Black Hawk county lies four square, the only irregularity in its outline being an offset of one mile made by the correction line which passes through the middle of the county. The row of sections immediately south of this line are reduced about one-fourth in area, thus making the area of the county about five hundred and seventy square miles. Bremer county bounds it upon the north; Buchanan on the east; Benton and Tama on the south and Grundy and Butler on the west. The only known indurated rock within its bounds is the Devonian; and of the unconsolidated materials, alluvium and Iowan drift are the only representatives at the surface excepting a small area of loess in Waterloo township. Wherever there is any considerable depth of mantle rock, however, its greater bulk is Kansan drift, the Iowan being everywhere comparatively thin.

In this county no very serious geological problems present themselves, nor does the rock or drift offer any unusually interesting phases of expression or development, yet to the observant and thoughtful no inconsiderable part of the wonderful geological story is told in a clear and very entertaining manner.

PREVIOUS GEOLOGICAL WORK.

Since neither the rock nor the surface of Black Hawk county affords striking or obviously important characteristics, such as would challenge the attention of those who were making an examination of an extensive region with limited opportunities at their command, the history of geological work within its bounds is a brief one.

Worthen passed through Cedar Falls in 1856 and in his report to Hall makes the following note: "At Cedar Falls the only rocks exposed are in the bed of the river, forming a ripple across the stream at this point. The lowest stratum exposed is a brown, arenaceous limestone from fifteen to eighteen inches in thickness, overlain by some thin strata of buff and gray limestone. No fossils were detected in the rocks here, and the exposure was not sufficient to afford an interesting section."*

*Report on the Geol. Surv. of Iowa, by James Hall and J. D. Whitney. Vol. I, Part 1, p. 181, 1858.

Mr. O. H. St. John, a resident of Waterloo, made some collections of fossils at that place, which contributed materially to the knowledge of the ancient life in this region. In 1866 Mr. R. P. Whitfield spent some time at Waterloo, Raymond and other localities in neighboring counties and made quite an extensive collection of specimens. In the 23d Annual Report on the State Cabinet of New York, from the data thus obtained, Hall and Whitfield attempted to correlate the rock formation of Black Hawk and adjacent counties with the Devonian formation of New York.

The futility of such an effort has been set forth very plainly by Calvin in his report on Buchanan county.* The present writer can do no better than to quote from Calvin. "It is worth noting that some years ago the quarry stone at Raymond was referred to the Schoharie, the coral-bearing beds at Waterloo were called Corniferous, the limestones at Independence were assigned to the Hamilton, and the Lime Creek shales were called Chemung. Now the Lime Creek fauna is found in shales below the Independence limestones, and so, judging from the fauna, the Independence shales are also Chemung. Furthermore, the coral-bearing beds of Waterloo are younger than the limestones at Independence, for they lie above them, and the quarry stone at Raymond is still younger than the coral beds that were referred to the Corniferous. Beginning with the Independence shales, the actual order of the strata of Iowa, according to the correlation referred to, would be (1) Chemung, (2) Hamilton, (3) Corniferous, (4) Schoharie- a complete reversal of the order observed in New York."

No allusion to Black Hawk county geology appears in White's report. McGee in his Pleistocene History of Northeastern Iowa† mentions the county along with many others in describing their streams, common characteristics, etc., much of which is interesting reading to the student of geology of the county. Calvin has visited portions of the county and makes incidental reference to its geology in some of his reports on sister counties.

*Calvin: Iowa Geol. Surv., Vol. VIII, p. 205, and 221-222.

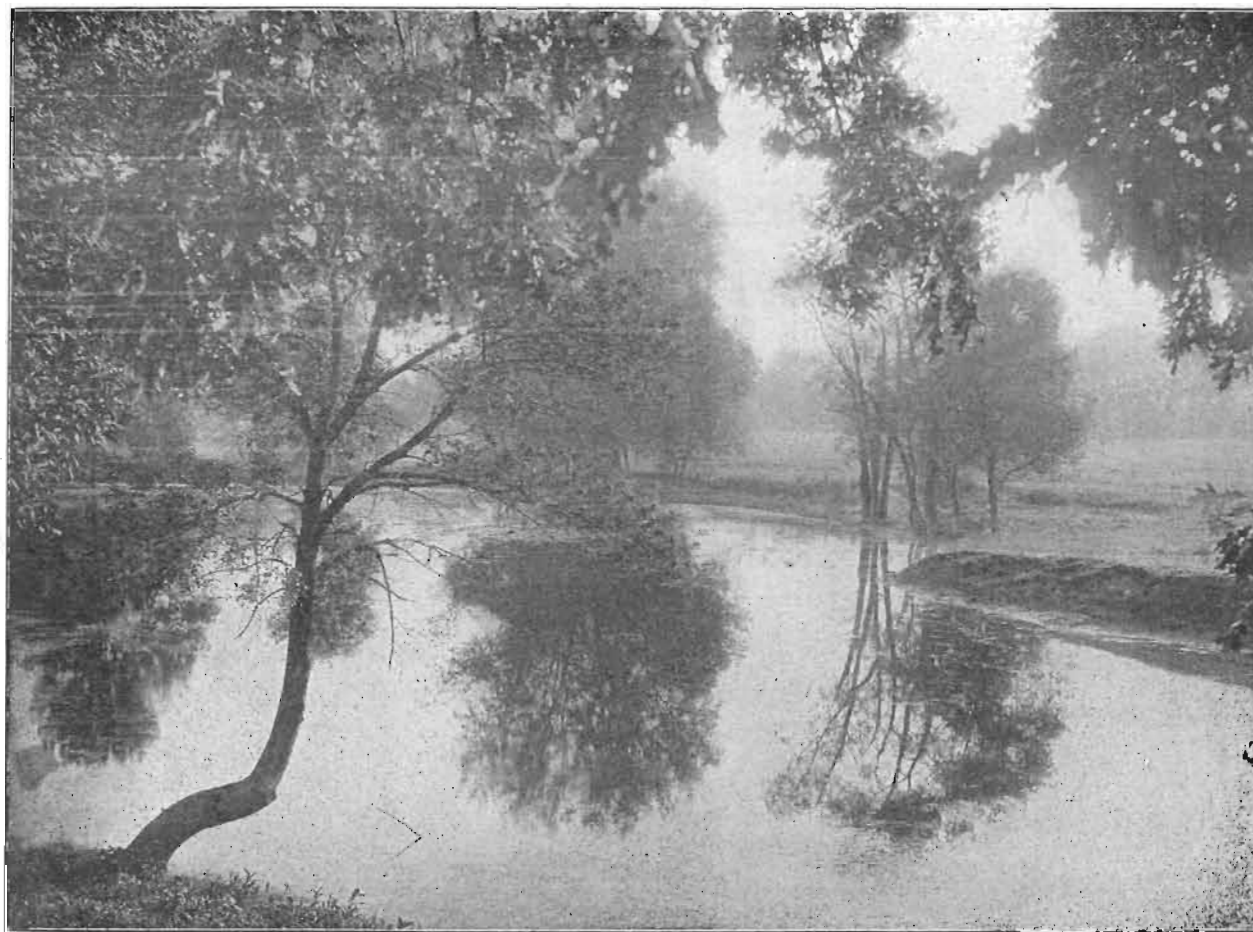
†McGee: Eleventh Ann. Rept. U. S. Geol. Surv., pp. 202, 210, 223, 406, 481, et al.

PHYSIOGRAPHY.**TOPOGRAPHY.**

The surface of this county is made up chiefly of the valleys of the Cedar and the Wapsipinicon rivers and their larger tributaries, and the Iowan plains which lie between and on either side of these valleys. Low bluffs rise near the south side of the West Fork of the Cedar, and also along the south side of Beaver creek at a varying distance from the stream. These bluffs at first are low, but increase in height eastward, and merge into the higher and more precipitous bluffs of the Cedar. For two miles above Cedar Falls the bluffs rise immediately from the river banks to an average height of sixty feet. At Cedar Falls they sweep away from the river, leaving a level area on which the older part of the city is built. They then give way for the passage of the waters of Dry Run. Then at once recovering their height they pass in a southeasterly direction, receding from the river and gradually losing their height and steepness of slope. Beyond Waterloo they maintain a distinct line between the valley and the drift plain for many miles, though at a considerable distance from the river and with a marked diminution in altitude.

These bluffs are gashed by numerous ravines such as characterize the Kansan drift areas, and which evidently owe their origin to the pre-glacial erosion interval. Between Cedar Falls and Waterloo the Kansan drift features are further manifest in rounded hilltops crowned with loess, though Iowan drift appears in thin veneerings in the immediate neighborhood, and sound granitoid boulders are frequently seen. Thus in sections 16, 17, 20 and 21 of Waterloo township the prevailing topography is essentially Kansan. The same can be said, though in a less emphatic way, of sections 11, 12, 13 and 24 of Orange township and of sections 18 and 19 of Cedar township. In the sections named, and in a more or less extended area adjacent to them, the Iowan drift deposit is thin at best and only partially, if at all, obliterates the effects of the extended erosion period preceding the Iowan ice invasion.

Once beyond the region mentioned above, the Iowan plain appears and constitutes the surface of the greater part of the



Mullens Pond—A portion of one of the old shut-in channels of the Cedar river Characteristic of the Cedar river
valley. Near Cedar Falls.

townships of Cedar Falls, Orange, Cedar and Big Creek and the whole of Black Hawk, Lincoln and Eagle townships. The latter townships are remote from the river and, excepting the narrow, sinuous channels of a few small streams, scarcely show a scar anywhere upon their surface, so gently have the erosive agents dealt with them since the withdrawal of the last great ice sheet that visited this region.

On the north and east of the Cedar the valley plain rises very gradually and usually imperceptibly to the general level of the drift plain. It is for the most part three or four miles wide, level and sandy, and was once wood clad, but now much of it has been deforested. There are numerous indications that nearly every part of the valley proper has been traversed at some time by the river. Many large oxbows are still in connection with it at ordinary stages of the water. Narrow, curved bodies of water, locally known as lakes, some of them two or three miles in length, as in Cedar township, often in line and connected more or less completely, plainly locate former channels (Pl. VII). These lakes, often fringed with bushes and trees, contribute to the beauty of the scenery along the river and, being stocked with fish in many instances, are favorite resorts with those who would seek recreation apart from their wonted scenes of activity. Depressions of every gradation of size, but always similar in shape and trend, are so abundant as to make their occurrence a remarkable feature of this valley. At the time of freshets, not only does the river fill the old channels, but it occupies much of the intervening valley.

A little before the river leaves the county, the valley narrows and loses to some extent the characteristics it presents elsewhere. There is also a noticeable constriction of the valley at Waterloo. In the northeastern part of the county the entire townships of Union and Washington are in the valleys of the Cedar and its tributaries. The topography of Union township is materially different from that of any other. The winds seem to have had an unimpeded sweep previous to its settlement and gathered the sand into dunes of considerable height and extent, giving the region a broken aspect unlike that of any other part of the county. The poplars, burr oak and other trees and

shrubs of similar habitat, have taken possession of many of these dunes, and all are now covered with vegetation of some kind, though the early settlers say that when first they knew the country, there were stretches of naked sand still at the mercy and sport of the winds.

The same features that characterize the valley of the Cedar may be observed, though in modified form, in the valleys of its larger tributaries, as well as in the valleys of the Wapsipinicon and its tributary, Crane creek. Spring creek which runs not far from the eastern border of the south half of the county is an exception in that its valley is narrow and with moderately sloping sides for most of its course, as if it had been the last born of the streams of the county.

In Bennington and Barclay townships, in the north half of Poyner and in the western two-thirds of Fox township, the Iowan drift plain appears at its best, there being no large streams to interrupt the seeming endless succession of low, wide-arched ridges and shallow concavities along the lowest part of which, grassy and most gently descending, the surplus water from the heavy rains and melting snows finds its way as best it can. The other townships are mostly within the valleys already described. In a part of East Waterloo, Poyner and Spring Creek townships the river approaches the eastern border of its valley and the level of the drift plain is reached by a somewhat abrupt slope, though at no such great height above the river valley as is the case on the other side of the river.

There is little in the topography of the county that is exceptional and distinct from the features described above. An occasional kettlehole occurs in Lester and Bennington townships and perhaps elsewhere, but they present nothing worthy of further notice. In the northwest quarter of section 24, Eagle township, is a prominent ridge extending northeast and southwest, having little soil upon its crest and upper slopes. The greater mass of the elevation is limestone and is the only rock in a wide area, embracing the whole southwest quarter of the county. It was doubtless one of those islands in the sea of Iowan ice mentioned repeatedly by Calviu in earlier volumes of the Iowa Geological Survey.

The other exceptional elevations in the county, which occur in Cedar, Orange and Waterloo townships, are capped with loess and are composed for the greater part, if not wholly, of Kansan till.

ALTITUDES.

The elevation of the principal places as given in Gannett's Dictionary of Altitudes, is as follows:

STATION.	FEET.	AUTHORITY.
Cedar Falls.....	854	B. C. R. & N. R. R.
Dewar.....	889	C. Gt. W. R. R.
Dunkerton.....	945	C. Gt. W. R. R.
E. Waterloo.....	843	C. Gt. W. R. R.
Hudson.....	883	C. Gt. W. R. R.
Jacobs Siding.....	982	I. C. R. R.
La Porte City.....	812	B. C. R. & N. R. R.
Mona Junction.....	865	I. C. R. R.
Normal Hill, Cor. Normal and 24th Sts.	937	T. R. Warriner
Norris.....	864	B. C. R. & N. R. R.
Raymond.....	885	I. C. R. R.
Washburn.....	827	B. C. R. & N. R. R.
Wilson Junction.....	870	C. Gt. W. R. R.
Winslow.....	884	B. C. R. & N. R. R.
Janesville.....	891	I. C. R. R.
Jesup.....	982	I. C. R. R.

Janesville and Jesup are reported, though not in the county, since they are close upon its borders. It is interesting to note that Jesup and Jacobs Siding, near the eastern and western limits of the county respectively and on nearly the same parallel, have the same altitude, 982 feet. Janesville on the Cedar at its entrance into the county has 891 feet, and La Porte City, seven miles from the place where it leaves the county, has 812 feet elevation, a difference of 79 feet. The winding course of the Cedar between the two points is about thirty-seven miles, making the average fall of the river about two feet per mile.

Jacobs Siding is the highest elevation given in the county. It is about two miles west of Cedar Falls on the Illinois Central Railway and has long been unfavorably known among the railroad men as the Cedar Falls Hill. Recently it has been avoided by the railroad company by the construction of a new line nearer the river, which reaches the level of the country between Cedar Falls and New Hartford by a much easier grade.

From the elevation of Fairbank, which is not far from the northeast corner of the county, that part of the county has an elevation equal to if not greater than, Jacobs Siding.

DRAINAGE.

The drainage of the county is accomplished almost wholly by the Cedar river system. The Wapsipinicon with its tributary, Crane creek, cuts the northeast corner of the county, the only townships affected by their agency being Lester, the east half of Bennington and the northeast corner of Barclay.

The Cedar, as it is known in Black Hawk county, is the product of the union of three nearly equal streams, the Cedar from the north and east, the Shell Rock from the northwest and the West Fork from the west. The two latter, however, effect a junction about one mile above their junction with the Cedar. From this point, which is within a mile and a half of the north line of the county, the Cedar pursues its way, in size and importance second only to the Des Moines among the rivers within the borders of Iowa. Excepting for a short distance below the dam at Cedar Falls and also at Waterloo, its bed is in unconsolidated material. Little indurated rock outcrops anywhere along its banks, even the high bluffs in the neighborhood of Cedar Falls and Waterloo being apparently made up wholly of drift material. Its course for the first four or five miles is nearly south, then southeast until at Gilbertsville it again takes a southward direction for four or five miles when it bends to the southeast keeping that direction for the remainder of its passage through the county.

Proceeding southward the tributaries from the west are Beaver, Dry Run, Black Hawk, Miller, Big and Rock creeks. On the east Elk, Indian and Spring creeks are the principal tributaries. It is worthy of note that each of these streams approaches the Cedar at nearly a right angle, in marked contrast with the tributaries of the Wapsipinicon and the Iowa. The hydrographic basin of the Cedar is therefore much wider proportionately than is that of either of the other rivers named. Along the north line of the south row of townships in Buchanan, Black Hawk and Grundy counties the Cedar valley extends fully sixty miles east and west. This width it maintains very nearly from

the north border of the state to the neighborhood of Cedar Rapids, beyond which its valley narrows very rapidly by the approach of the Iowa with which it unites in Louisa county. The head waters of Spring and Elk creeks are within two miles of the Wapsipinicon river and Crane creek respectively, while the Black Hawk takes its rise within five or six miles of the Iowa. Thus it may be seen that the Cedar dominates nearly the entire territory between the Wapsipinicon and the Iowa.

Naturally those townships where the Iowan drift prevails are not so well drained as are those near the rivers. But nowhere are well established stream courses so remote that excessive surface waters may not be taken care of readily by artificial drainage.

GEOLOGICAL FORMATIONS.

General Relations of Strata.

The geological formations in Black Hawk county are few and comparatively simple in their manifestations. Heavy deposits of drift conceal the indurated rocks in the northeastern and southwestern parts of the county. The rock exposures are mainly along the margins of the valley of the Cedar or outcrop in the banks of the lower courses of its tributaries where they have cut their beds in order to reach the level of the main stream. The valley of Spring creek affords an exception as has been stated already, since rock is found throughout two-thirds of its course, the drift being thin and not concealing the erosive effects of the preglacial activities of this stream. Only rarely does indurated rock appear at the surface apart from the water courses.

In many exposures no fossils appear, or, if any are found, they are so fragmentary or indistinct as to render very little assistance in determining the relations of the rocks in which they occur. Fortunately, however, the frequent and widespread occurrence of the lithographic limestone, the lithological features of which are very constant and easily recognizable, makes it possible to fix the horizon in many instances where other means are wanting entirely.

The indurated rock belongs wholly to the Devonian system so far as is known, though it is quite probable from the trend of the eastern border of the Carboniferous as revealed elsewhere in the state, that rock of that system underlies the thick glacial deposits of the southwestern corner of the county. No material from the wells that have penetrated the rock of that region has been accessible, however, and therefore the Carboniferous appears only hypothetically in the table introduced below to show the taxonomic relations of the strata in Black Hawk county.

TABLE OF FORMATIONS.

GROUP.	SYSTEM.	SERIES.	STAGE.
Cenozoic	Pleistocene	Recent	Aeolian
			Alluvial
		Glacial	Loess
			Iowan
			Buchanan Gravel
Paleozoic	Carboniferous? Devonian	Mississippian?	Kansan
		Middle Devonian	Kinderhook?
			Cedar Valley
			Wapsipinicon

DEVONIAN SYSTEM.

WAPSIPINICON STAGE.

The only definite, satisfactory exposure of rock observed belonging to this stage is a natural outcropping in the bed and slope of the bank of a small tributary of Spring creek in the northwest quarter of section 13, Fox township. It represents the uppermost part of this stage, the *Spirifer pennatus* beds. No section could be made as the exposures along the hillside were interrupted by deposits of soil. But a few feet above the stream bed, in the flat, rock surface of which fossil corals and brachiopods were quite abundant, were the *Spirifer pennatus* beds composed of the soft, light gray limestones so often referred to by Calvin. The fossils obtained here were *Cyrtina hamiltonensis* Hall, *Spirifer pennatus* Owen, *S. bimesialis* Hall, *Atrypa reticularis* Lin., fine ribbed variety, *A. aspera* Schloth and *Paracyclas* sp. In the road eight or ten feet above these beds, *Acervularia profunda*, one or more species of *Favosites*, *Cyathophyllum* and *Zaphrentis* occur. Evidently this is the

Acervularia profunda zone, the lowest member of the Cedar Valley stage. As stone appears occasionally in the road surface at several points in this neighborhood, a closer survey of it, possibly would reveal other outcrops of the *Spirifer pennatus* beds.

CEDAR VALLEY STAGE.

The lowest member of the Cedar Valley stage of the Iowa Devonian, the *Acervularia profunda* zone, is well represented in a quarry in the southeast quarter of section 25, Waterloo township.

The following section is shown:

	FEET.	INCHES
7. Sandy soil.....	5	
6. Gæst with mingled fragments of limestone.....	4	6
5. Shaly parting containing unusually large specimens of coarse-ribbed <i>Atrypa reticularis</i>		2
4. Thin, irregularly bedded, buff limestone with much mingled residual earth, all highly ferruginous.....	4	6
3. Soft, drab to buff, earthy limestone with a more or less well defined parting three feet from its lower limit. The upper three and one-half feet crowded with <i>Acervularia profunda</i> , a species of Favosites, <i>Cladopora magna</i> , <i>C. palmata</i> , <i>Cystiphyllum</i> sp., <i>Zaphrentis</i> sp. small branching corals, and a few brachiopods, all weathered and iron-stained.....	7	
2. Shaly parting.....		2
1. Soft, gray limestone with a narrow shaly parting near the middle.....	4	

A few rods farther eastward is another quarry affording a similar section. The stone is a little firmer in texture, and the beds have been exposed some two feet below the floor level of the former, without revealing anything of added interest, however. For many rods west of these quarries is a strip of waste ground grown up to weeds and bushes and showing scarcely a trace of rock in place, but from which stone has been taken until recently during nearly all of the years since the first settlement of Waterloo. It is a fossil coral reef and has been very rich not only in corals, but in brachiopods and other forms of Devonian life. Ever since the visits of St. John and Whitfield, its reputation has attracted geologists and curiosity seekers, and it may be looked upon almost as classic ground to the

geologist. Whitfield's list of fossils gathered here and in the immediate vicinity is a surprisingly large one and as a matter of common interest is quoted below from the 23d Annual Report.*

"Among the most common forms at this place are *Stromatopora erratica* of this paper, *Acervularia Davidsoni*, *A. profunda*, *Favosites*, sp., like *F. polymorpha*, *Cystiphyllum Americanum*. C. n. sp., **Zaphrentis gigantea*, *Chonophyllum* sp. apparently the same one as in the Upper Helderberg of New York, and at the Falls of the Ohio, *Amplexus Yandelli*, *Streptelasma* n. sp., *Aulacophyllum sulcatinum*, *Syringopora* sp. having large cells, three species of *Cladopora*, two species of *Aulopora*, one very large. Of the brachiopoda we find the following; **Spirifer euruteines*, **S. oweni*, **S. manni*, *S. subvaricosa* n. sp., *S. pennatus* only one individual, *Cyrtina Hamiltonensis*, *Atrypa reticularis*, A. n. sp., *Pentamerella arata*, **P. obsolescens*, *Gypidula laeviuscula*, *Rensselaeria johanni*, *Terebratula romingeri*, **T. elia*, **T. jucunda*. There are also several forms of fish teeth known to occur in these same beds."

Those of this list marked with an asterisk are species which according to Calvin do not occur in this county. A considerable number of others have not been recognized for this report, though a more diligent search might have revealed them. Undoubtedly the present quarry is not as rich in variety of forms as were the earlier ones.

In the report referred to above, Whitfield referred these beds to the Corniferous of New York. The error into which he fell in attempting to correlate the Devonian limestones of Iowa with those of New York is well set forth by Calvin in his report on Buchanan county. His language was quoted under the head "Previous Geological Work" and need not be repeated here.

In the southeast quarter of section 24, East Waterloo township, in the east angle between the track of the Chicago Great Western railroad and the track of the Illinois Central railroad running to the machine shops, is a pit-like quarry of the *Acervularia* zone, but ranging a little higher than the West Waterloo quarry.

*23rd Ann. Rept., N. Y. State Cab., Nat. Hist., p. 223, et seq. Albany, 1878.

If Calvin's section at Littleton, Buchanan county*, be taken as a standard, the section at West Waterloo seems to correspond to the *Acervularia* zone numbers 1 to 4, while the East Waterloo quarry seems to include numbers 5 to 7. In the latter the rock is firmer in texture and much less ferruginous. No good opportunity of examining the quarry has occurred and no section was made. Careful study might change the estimate of its relations to the West Waterloo quarry.

In the northeast quarter of section 1 of Barclay township, very near the county line, is the only rock exposure in all the northeastern part of the county. Some fifteen or twenty years ago Mr. Purtell operated a small quarry here, but since its abandonment the loose earth has covered most of the quarry face, and bushes springing up have completed the effacement of the quarryman's work. The upper rock is a soft, yellow, argillaceous limestone, thin and irregularly bedded, below which is a harder, lighter colored rock somewhat crystalline and more heavily bedded. This exposure is in the edge of a low bluff rising above the narrow valley of the Wapsipinicon river, and is within three miles of an outcropping in the bluffs on the opposite side of this river in Buchanan county. From the meager data obtainable it may be inferred with reasonable assurance that the rock here is the same as that of the upper part of number 2 in the section "along the river bluff a short distance above Littleton"† made by Calvin and said by him to lie "above the beds described in the section below the mill at Littleton". On the same page Calvin incidently remarks "that this is the level of the quarry stone at Raymond, in Black Hawk county". The quarry here referred to is in the southeast quarter of section 36, township 88 N., R. 12 W., not more than half a mile east of Raymond station, and affords at the present time the following section:

	FEET. INCHES.	
9. Residual soil with many rock fragments.....	1	6
8. Drab, compact layer, breaking with a suggestion of lithographic stone.....	2	6
7. Hard, brittle finely crystalline bed, gray on fracture, but yellow where exposed.....	1	6
6. Thin layers of limestone similar to numbers 3 and 5, but softer, weathering more readily, becoming thinner above and more jointed below (thickness not determined).		

*Oalvin: Iowa Geol. Surv., Vol. VIII, pp. 232-233, 1897.

†Calvin: Iowa Geol. Surv., Vol. VIII, p. 234.

	FEET.	INCHES.
5. Rock similar to number 3, but with flattish, irregular cherty nodules many geode like (thickness not determined)		
4. Fragile and very fissile rock	3	
3. Soft, yellowish-gray, heavy bedded rock	3	
2. Beds everywhere buried in quarry debris	10	
1. Quarry floor containing worn valves of <i>Stropheodonta demissa</i> everywhere over the surface, also a <i>Spirifer</i> , probably <i>S. parryanus</i> , <i>Atrypa reticularis</i> , <i>Cladopora</i> stems, etc.		

Nos. 5 and 6 represent a thickness of several feet, but it was not exactly determined. It would seem that number 1, represents number 8 of Calvin's section below the mill dam at Littleton, and his number 1 in the section along the bluff above Littleton, while the other members correspond in part to number 2 of the same section, judging from their superposition and lithological character. They are entirely unfossiliferous so far as could be observed.

Within one-half mile northwest of the last is another small quarry in which all the rock is quite similar, yellowish in color and barren of fossils. The lower three and one-half feet were much jointed while the rock above was so free from joints as to form a roof, overhanging in one place fully six feet. It corresponds to the upper part of number 2 mentioned above.

About one mile south of Raymond the east side of the road where a small creek had worn its bed into the weak rock, a section was obtained as follows:

	FEET.	INCHES.
5. Black loam	1	
4. A meager trace of Buchanan gravel		
3. Clay much like Kansan till	6	
2. Geest with limestone layers more or less well defined in lower part	3	4
1. Buff limestone, soft below with a thin, cherty layer, above which the rock contains calcitic nodules and <i>Stropheodonta demissa</i> as in the floor of the Raymond quarry, above the creek bed	5	

In the northwest quarter of section 14, East Waterloo township near the track of the Illinois Central railroad and a little above it is the Bartlett quarry, operated by the Waterloo Stone Company. The beds are unfossiliferous for the most part. A

few crinoid stem fragments, a few specimens of *Atrypa reticularis*, coarse ribbed type, other fragmentary and indistinct forms, and an excellent specimen of the jaw and teeth of the ganoid fish, *Onychodus sigmoides*, have been found here (Fig. 48). The section shows the following:

	FEET.
5. Iowan drift.....	6
4. Geest, including stony fragments.....	4
3. Firm, drab limestone of somewhat conchoidal fracture, freely intersected by calcite veins.....	1
2. Soft limestone, the upper four feet of which is irregularly bedded.....	6
1. Limestone, buff where weathered, but blue on fracture, quite heavily bedded and having flinty nodules and pockets of calcite in the upper eight feet.....	10

A little northeast of this is an old quarry showing a similar section but with some slight modifications of the texture of some of the beds.



Fig. 48—Jaw and teeth of an ancient fish—*Onychodus sigmoides*—from the Devonian limestone.

In the northeast quarter of section 14 is the Morganton quarry from which stone of good quality is taken. The lowest beds

have numerous oblique, open joints in which deposits of a beautiful buff travertine occur. In the upper part is a firm, drab rock of the lithographic type and which is the same as number 5 in the Bartlett quarry. This bed affords the best stone in the quarry. In a yellowish, decomposing shaly limestone three feet above this bed is found the only fossil, an *Atrypa* very much resembling the fine ribbed variety of *A. reticularis*. In one part of the quarry this bed contains many large concretions which under the hammer often reveal a lining of unusually fine calcite crystals.

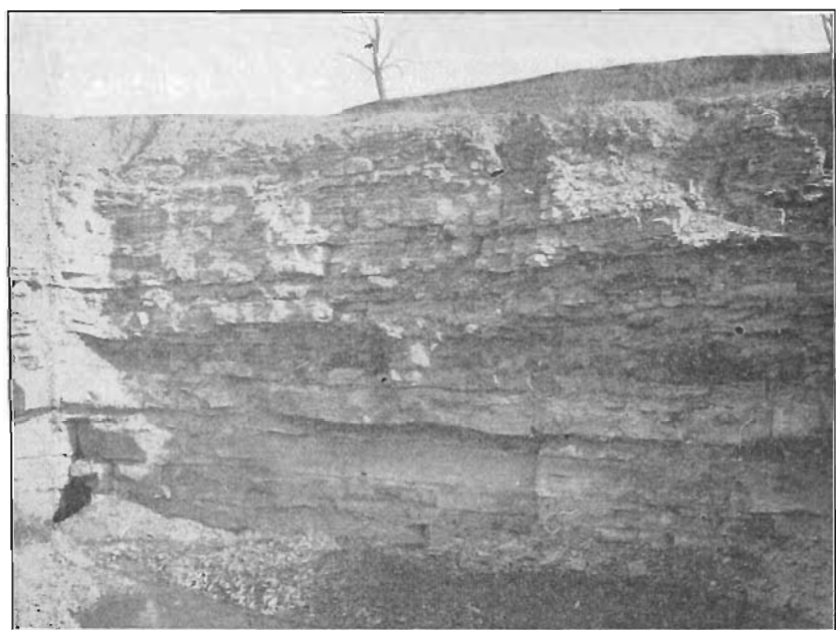


Fig. 49—Quarry in Cedar Valley limestone, Cedar Falls.

From the lithographic features and from the order of superposition, as compared with the quarry in the angle of the railroad tracks not far away, it is judged that the horizon of these quarries is the same as that of the quarry stone at Raymond.

In the road two and one-half miles due north from the Bartlett quarry is an outcropping of loose, shaly limestone not worthy of notice except as an evidence of the thinness of the drift in this vicinity.

In the northeast quarter of section 15, township 89 N., range XII W., a small quarry has been worked the rock in which is much broken up by oblique joints running at all angles, and the bedding planes of which are so confused as to render tracing of them impossible. Nowhere in the county is found better evidence of crushing than here. The exposure represents number 1 of the Bartlett quarry and possibly a part of number 2. Specimens of *Atrypa reticularis* appear sparingly.

In and around Cedar Falls are several quarries. One of these, the Carpenter quarry (Fig.49), has furnished a large quantity of stone, but it is no longer operated on account of the increasing cost of stripping, the work having advanced well into the high bluff. It is located a few rods south of the Dry Run wagon bridge near the center of section 13, Cedar Falls township. The following section appears:

	FEET. INCHES.	
12. Coarse, ferruginous Buchanan gravel overlain by Iowan drift.		
11. Thin-bedded, fragmental limestone such as is usually found at the top of the rock exposures in the county and which illustrates well the effects of weathering, wherever the drift is thin. The stone in these layers varies considerably from top to bottom as if originally they made up several distinct beds. Near the top are numerous small, simple stemmed corals and good specimens of <i>Idiostroma gordiacum</i> A. Winchell.	7	
10. Thin, shaly parting.		
9. Vesicular limestone, gray, brittle, the small cavities yellow lined.	7	
8. Limestone, the lower half of which is in one layer, the upper in very many thin layers, about.	1	6
7. Shale and rock intermingled promiscuously, the layers manifest in places and elsewhere lost. Color varied; weathering since exposure, in a weak, earthy rock may account for the peculiarly varied conditions of this bed.	3	10
6. Hard, brittle rock with conchoidal fracture; yellowish.	1	6
5. Greenish shale.		2
4. Limestone, lower half compact and homogeneous, but upper half much checked and in some places nodular to such an extent as to appear like a conglomerate. Thickness undetermined.		
3. Shale, in three layers, (c) green shale two inches, (b) whitish, somewhat indurated, calcareous shale four inches, (a) green, jointed shale twelve inches.	1	6

	FEET.	INCHES.
2. Limestone of variable appearance and texture. In general the upper half is a soft, yellowish, earthy rock, the lower a hard, dark drab, granular rock. In some places in the quarry this stone is in three or four layers, in other places it is in one bed, yet everywhere as it nears the top becoming more and more argillaceous until it blends with number 3	2	
1. Variable bed, mostly firm in texture, drab below, yellowish and somewhat jointed and vesicular above. The line between the several layers everywhere markedly wavy.....	5	

Variability is the most striking feature of this quarry. Fossils are absent everywhere except in number 11, and, since these are in the beds that have been most affected by the agents of disintegration, they are generally imperfect. A few small colonies of *Idiostroma* have been well preserved, though deeply stained. Their presence is the only guide to the proper horizon of this exposure other than its position relative to the quarries of Waterloo. The *Idiostroma* horizon is just below the lithographic beds, and though the lithographic limestone is not well developed anywhere in Cedar Falls, it is found beyond question in a natural exposure in the bank of Dry Run one-half mile farther southwest. A few rods farther up the creek bed the stream has eaten into the bank, exposing a section of some interest. In the stream bed is a thin, whitish layer having over its surface many stems of the small coral found in number 11 of the Carpenter quarry, the rock, ringing clearly under the hammer and breaking freely with conchoidal fracture, promptly suggesting its relationship to the lithographic limestone. Above this are many thin layers, much jointed obliquely and vertically, usually lithographic in character, but evidently undergoing change by exposure. Near the top the coral stems appear again and six inches below these are imperfect casts of *Newberria johannis* Hall, the only brachiopod found in the rocks at Cedar Falls. A slight fold is evident in this rock. Four or five rods south is a quarry owned by Mr. C. A. Round. The floor of this quarry is very uneven showing marked unconformity with the beds above. A section represents the following:

	FEET.	INCHES.
13. Thin layers of rock for the greater part lithographic in character.....	4	
12. Light gray, earthy rock in about seven layers.	9	

	FEET. INCHES	
11. Fissile, earthy limestone, having a narrow granular band midway.....	4	8
10. Excellent lithographic bed in two layers.....	2	
9. Bed in two layers the upper containing many small masses of <i>Stromatopora</i> two or three inches in diameter, much weathered upon the outside, but usually very compact and hard within.....		8
8. Granular rock, with pockets of calcite, the upper three inches shaly and nodular. Partings occur, but not continuously, or uniformly.....	2	5
7. Shaly partings.....		1
6. Earthy rock, upper part more calcareous and firm, with pockets of calcite.....		11
5. Shaly parting.....		1
4. Gray limestone in numerous layers, becoming yellowish and earthy in places.....	2	
3. Shaly parting.....		1
2. Heavy-bedded limestone, gray to white, with rusty spots, granular and firm where gray, but earthy where white, in two beds with a shaly parting of five inches between.	4	
1. A fairly good quality of limestone, lithographic in character, in three layers.....	1	3

In number 13 occur the coral stems referred to elsewhere. *Stromatopora* is abundant in places. Overlying the loose rock at the top of number 13 is about sixteen inches of Buchanan gravel and above this, three feet of sandy loam. Midway between the Round and the Carpenter quarries is a quarry belonging to the Harris and Cole Company. The rock here is softer, joints are wide, oftentimes filled with geest; small cavernous openings are not uncommon. Here were found a few massive stromatoporoids, and also a few colonies of *Idiostroma* among the weathered rock fragments in the eastern edge of the quarry and a single specimen of *Straparollus cyclostomus*. Lithographic features are not very manifest. Some layers are beautifully ornamented with dendrites, and in the creek bed near, at the same horizon as the upper layers of the quarry, are slabs containing numerous mud cracks.

A few rods northeast of the Carpenter quarry, between the Rapid Transit track and Dry Run, is a small quarry belonging to Mr. N. Olson, the floor of which is a little lower than that of the Carpenter quarry. A section is here given:

	FEET.	INCHES.
14. Iowan drift.....	2	
13. Buchanan gravel lower part highly oxidized, coarse, upper part less ferruginous, stratified, some layers a fine sand, uppermost layers much reddened.....	10	
12. Jointed, geest-like clay, the base of which is red brown, the rest yellow.....		6
11. Dark drab, crystalline rock.....		5
10. More or less indurated shale.....	1	9
9. A bed whose upper half is less compact and uniform than the lower.....	2	4
8. Green shale.....	1	8
7. Soft rock, whitish, saccharoidal, deteriorating upwards.	2	
6. Very dark drab rock, compact and smooth on fracture...	1	
5. Light gray rock, soft and in two layers, having much calcite finely distributed throughout.....	1	6
4. Rock very much like number 1		8
3. Soft, shelly, mud colored limestone.....	1	
2. Dark drab, finely saccharoidal limestone	1	
1. Dark drab, finely saccharoidal limestone, thickness not ascertained.		

There is little in common between this and the other quarries of Cedar Falls in the lithological character of the rock excepting in a general way. The horizon is believed to be in part the same. The lower eight feet of this quarry appear to lie below the floor of the Carpenter quarry. No fossils were recognized.

About one-eighth of a mile west of the Carpenter quarry, and also west of Main street, is J. Nielson's quarry which affords the following section:

	FEET.	INCHES.
18. Firm, yellowish stone with intermingled geest, not continuous throughout.....	3	
17. Lithographic limestone, somewhat nodular, more or less weathered and inconstant.....	2	
16. Yellowish clay shale, with interbedded stone in places, very variable in thickness, averaging.....	1	4
15. Limestone in three layers (a) finely laminated, slightly iron-stained, six inches, (b) like (a) but lighter in color, two inches, (c) gray, fine-grained, smooth, often weathering oddly near seams, makes good lime, averaging	1	6
14. A variable stone, sometimes splitting easily into layers, sometimes firm and even textured, finely crystalline, with earthy streaks, rusty in patches, crystals in pockets and calcitic sheets intersecting one another and thus, being more resistant than the amorphous portion, making pitlike areas along the joint planes, averaging.....	1	

	FEET.	INCHES.
13. Fine-grained, bluish-gray limestone with occasional patches of crystals, quarried in sheets, and used for window and door sills and caps, and ashlar.....	10	
12. Bluish gray stone of good quality, earthy at the lower surface.....	5	
11. Shaly parting.....	1	
10. Gray, finely brecciated limestone, with seams of crystals below, upper part yellowish, earthy. If quarried in cold weather, it is reduced to fragments readily, but, if dried out before freezing, it makes a durable stone.....	9	
9. Firm, fine-grained, bluish-gray limestone with occasional pockets of crystals, in two layers. Makes an excellent range stone. The lower layers yield fine large flags....	1	
8. Uniformly fine-grained limestone, yielding flags.....	7	
7. Heavy-bedded limestone, shelly on the under side, abounding in crystals, bluish-gray.....	1	4
6. Fine-grained limestone more or less streaked or banded..		9
5. Like number 6.....		11
4. Lighter colored stone, with a possible parting in upper part along an irregular line.....		9
3. Stone still lighter in color than number four, which often washes out in a remarkable way, yet makes a durable stone once it has been dried out.....		9
2. Yellowish stone, full of pockets.....	1	
1. Soft, chalky stone.....		

Numbers 1 and 2 are no longer quarried, not comparing favorably in value with the other beds. Numbers 3 and 4 are the same beds found under the open channel of Dry Run and which everywhere have extensive, tortuous canals dissolved out and worn away by attrition, making it possible for the water in the upper course of Dry Run to disappear from the surface channel in the lower course excepting in times of flooding.

North and northwest of Cedar Falls are a few rock exposures, all of limited extent. The horizon is about the same in every instance it being that of the *Stromatopora*s and lithographic limestone. In Union township just east of Finchford is Beatty's quarry. It is shallow, and little fresh exposure appears. Four feet of rock is noted. It is irregularly bedded, much jointed, finely granular, grayish on fracture, but yellowish on the surface, iron-stained in places, rough, the upper layers becoming mere fragments in the mass. Some of these fragments were somewhat spherical *stromatopora*ids with laminae in very irregular wavy lines, and where broken the planes were thickly

tubercled. Others were masses of small cylinders, rarely branching, running at various angles but incorporated together, stromatoporoid in structure, the stem always rising above the plane of the matrix wherever exposed. Immediately above the geest were six inches of Buchanan gravel. In the road one-half mile east and at a little greater elevation the rock is of a decidedly lithographic type in some layers. The dendroidal Stromatoporas were here, together with a few Cladopora stems.

In the northeast quarter of section 5, Union township, twenty five or thirty feet above the water of West Fork, is a hard, brittle, yellow rock. It has many crinoid stems, a few cyathophylloid corals, often weathered to the merest skeleton outline, brachiopods and traces of other fossil forms, embossed thickly over the surface, giving it a strangely harsh feel. The crinoid stems interpenetrate the rock at right angles to the bedding planes, as if the calcareous mud had filled about them while still *in situ*. Below two feet of this are three feet of limestone, whitish where exposed, but gray within. Dendroidal Stromatoporas plentifully emboss the surface, and sometimes make up nearly the whole substance of the rock. Where organic structure is not apparent the rock is lithographic in character, but very seamy and readily weathers into small irregular fragments rendering it unfit for any economic purpose. In a channel cut by a small stream were loose pieces of lithographic stone, but such rock was nowhere found in place. The fossils here would indicate that the dendroidal Stromatoporas were below the massive, laminated ones, and the crinoidal layers were above them.

One-half mile south of Winslow station a small quarry has been opened. The floor is about ten feet above the river, and about nine feet of rock in vertical section is shown. The rock is mostly in thin layers, often earthy, unfossiliferous. A few Stromatoporas were loose in the debris of the quarry floor, but none were found in place.

The only rock noted in Washington township was at a point a little north of P. Negley's residence, in the southeast quarter of section 10. Years ago some rock had been removed from an outcrop in a low bank, but loose soil and vegetation have healed the scar so nearly that little could be observed. Stromatoporoids

were found. These and the lithological character of the rock fragments unite in confirming the evidence gained from the topographic relations that the horizon is the same as that of the exposure in Union township.

Along the western side of Mt. Vernon township are two old quarries from which have been taken a good quality of stone for local purposes. One is in section 18. No fossils were found here and the lithological character of the stone gives little clue to the horizon. In a small creek bed near by, a gray, firm, finely granular stone occurs, one bed of which by weathering develops an edge showing numerous laminae with many minute pores, as if it were stromatoporoidal in structure, but a fresh surface gives no proof of such a structure unless faint, yellow lines near together and parallel, may be so regarded. The other quarry is in section 30. Much of the rock in place here was under water at the time it was visited. A specimen picked up at random is gray, firm, granular and effervesces reluctantly with cold acid. Traces of iron oxide are everywhere diffused throughout the stone. The behavior with acid is unusual with limestone in this county. Another specimen is of the concretionary, lithographic type.

In the southwest quarter of section 36, township 87 N., range XII W., is the Buchan quarry showing the following section:

	FEET.	INCHES.
2. Limestone, full of seams and joints, so uncertain as to make any attempt at tracing of beds unprofitable. In the lower part occurs <i>Acervularia</i> , a cyathophylloid coral and <i>Cladopora prolifera</i> . A <i>Favosites</i> is dimly apparent in places.	8	
1. Limestone, chiefly dark drab, but bluish in upper part, sometimes granular, with calcite crystals interspread at times making fine specimens of dog-tooth spar. The first five feet develop three or even four layers, but in the upper portion layers are uncertain. The quality of the stone in this quarry is variable. It is soft, earthy and much broken in some beds, firm and comparatively free from joints in others.	15	6

In the southwest corner of section 25, on land owned by J. Robertson, is a quarry from which much good stone has been taken. The flood of this quarry is clearly exposed over twenty-five or thirty square rods and shows a decided dip to the southeast. For thirteen feet above the base of the quarry is a lime-

stone in about eight layers. A thin, shaly parting separates the fourth and fifth layers. The beds below this are blue on fresh faces, yellow or brown in the seams. All show numerous and sometimes large pockets of dogtooth spar or solid masses of calcite. The upper beds are buff, ironstained along seams. Parallel, yellowish-brown streaks run persistently through some

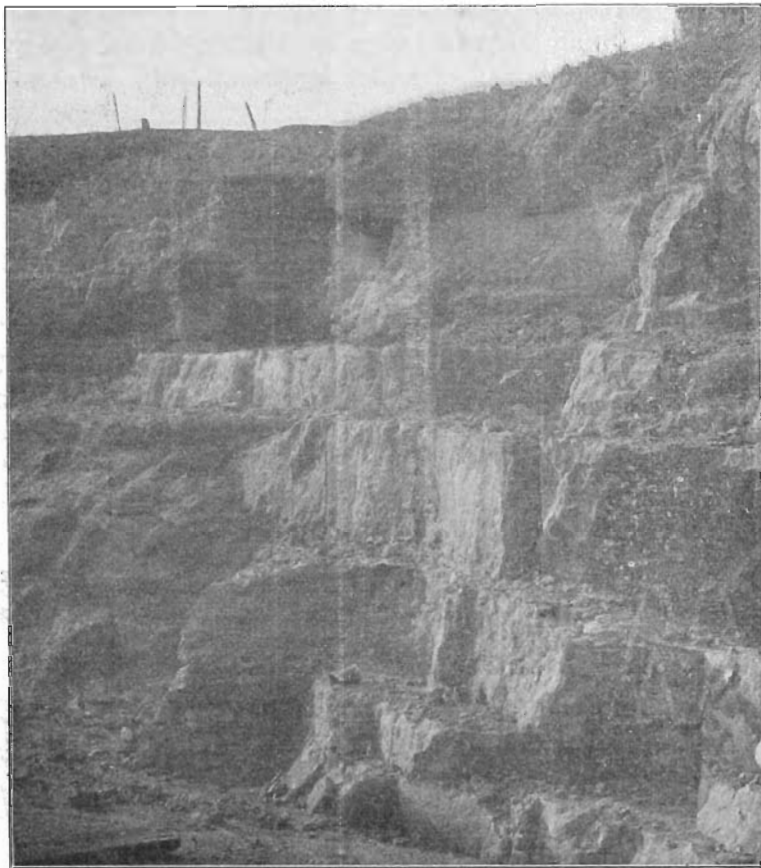


Fig. 50 Quarry in Cedar Valley limestone, near La Porte.

layers. The uppermost layer bears favosite, cup and acervularian corals, not in as good condition as in the West Waterloo quarry, but the stone is of better grade. A single specimen of *Atrypa reticularis* was found here. Above this layer are thin

layers of bluff limestone, becoming thinner and more irregular toward the top and ending with a thin layer of chert in nodular masses, or in angular fragments.

In the northeast quarter of section 35, is a quarry belonging to A. K. Longaker (Fig. 50) which shows a section as follows:

	FEET	INCHES.
6. Top soil with a few limestone fragments.		4
5. Soft, light gray stone, much broken.	2	
4. Soft, buff stone with cherty nodules. The chert more dominant and the calcareous matrix softer as the upper layers are reached.	2	6
3. Rock similar to number 4, but with less chert.	1	6
2. Cherty layer, loose angular fragments, white or rusty brown		4
1. Soft, buff stone, heavy-bedded, with joints running at various oblique angles with exposed faces, red-brown and with yellowish-brown streaks, usually parallel with the bedding planes, but sometimes wavy and even in concentric lines. Stone similar to this is found in Mitchell, Howard and other counties, but in this quarry some layers have an unusual development, making a very attractive appearance, about.		4

The floor of this quarry consists of a stone similar to number 1. No fossils were seen. The whole section is above the *Acerularia* bed of the Robertson quarry, the cherty layers at the top of the latter being the equivalent of number 2 in this quarry. The equivalent of the heavy beds of number 1, being near the top in the Robertson quarry, are thin-bedded and otherwise affected by their nearness to the surface.

In the northwest quarter of the northwest quarter of section 20, Spring Creek township, in the bluff rising from the river plain, is the Camp quarry from which considerable quantities of a good grade of stone have been taken, although no quarrying has been done here for some time. The stone is quite heavily bedded. The lower two and upper six feet are lithographic in character. These beds are known locally as limestone, while the intervening eight feet which are granular in texture, are called sandstone by the local observers. These upper beds are much jointed, especially in the higher layers, where they are yielding more or less to weathering influences, while the lower beds bear numerous calcitic patches in a gray, soft limestone. A quarter of a mile northwest is a

quarry owned by C. R. Harmon. The lower layer is a gray, soft stone with calcitic blotches and lines everywhere throughout it. This bed is the equivalent of the beds in the Camp quarry lying immediately above the lower lithographic bed. Above this are seven feet of rock, gray below and buff above, the latter part being much jointed and somewhat weathered, thus very much resembling the similarly situated beds of the Camp quarry. No fossils were found in the last named, only the edges of the stone being exposed, but in the Harmon quarry this upper bed has *Atrypa reticularis* in it. A quarter of a mile still farther northwest is a small quarry where the same beds are exposed. *Atrypa* occurs here also.

In the valley of Indian creek, one mile above its junction with the Cedar, the lithographic beds are found in a natural outcrop. Loose blocks of this stone were observed in a roadside ditch one mile north of Gilbertville. They had the peculiar whitish color of this rock when weathered and evidently had been washed out of the gust so often found overlying a firmer rock, when near the surface.

In the southwest quarter of section 11, township 88 N., range XII W., a small quarry very nearly duplicates the upper part of the Camp quarry, having the granular calcite bearing beds below, then the beds more or less decayed, above which are lithographic beds. Here, however, the latter have distinct shaly partings not shown in the others.

On Mr. F. A. Buttke's land in section 15, Spring Creek township, a ridge has in it stone very near the surface and a local supply of building stone has been removed from two or three different places. The rock quarried was mainly of the lithographic type. The floor of one pit was a soft, buff, fissile limestone, above which were two feet of a yellowish, soft, calcite-bearing stone. The uppermost bed of this quarry contained stromatoporoid masses of all sizes up to a foot in diameter. There were also short, cylindrical stems roughening the surface, much resembling the dendroidal *Stromatoporas* of the outcrop on the West Fork in Union township. There are several other outcroppings along Spring Creek from near its mouth to the north border of the township, in all of which the lithographic

stone appears. The occurrence of the *Stromatopora* and lithographic beds east of Cedar river, with *Acervularia* beds outcropping on both the east and west sides of them without any material change of elevation, would imply that they lie in a shallow syncline and this view is supported by the fact that at the Robertson quarry on the west is a very decided dip to the south-east. The dip of the *Acervularia* beds on the east could not be determined as only an outcropping in a bank was noted.

In the northwest quarter of the northwest quarter of section 24, Eagle township, is a ridge due to an outlier of limestone. The country north and west is unusually level, while that east and south presents very little unevenness of surface. Two quarries have been opened here from which large quantities of stone have been taken, since a wide extent of country finds here its only supply of stone except such as may come from the Iowan boulders which in some sections are not plentiful. In a quarry in the field west of the road the following section is shown:

	FEET. INCHES.	
13. Thin-bedded, broken stone.....	7	
12. Two layers of limestone, blue where unchanged	4	6
11. Three layers of hard, compact limestone, of good quality, durable, brittle, having conchoidal fracture, with drab nodules of varying sizes, and in the upper part with stromatoporoid masses thoroughly coalescent with the rest or the rock.....	5	
10. Bluish, earthy limestone, much jointed and irregularly bedded.....	3	
9. Dark drab stone, calcitic at top..	1	6
8. Blue stone, buff where exposed, calcite plentiful, in seven or eight layers.....	1	10
7. Drab limestone.....		9
6. Buff, earthy limestone, finely streaked with yellow lines..	2	2
5. Shaly partings with very wavy lines of contact above and below.....		3
4. Hard, brittle, drab limestone, middle portion developing layers.....	3	2
3. Blue limestone of good quality, firm, finely crystalline, with pockets of crystals, thickness not taken.		
2. Gray, finely crystalline limestone, yielding good flags..		6
1. A good stone, gray, somewhat crystalline, fracture coarsely conchoidal.....	2	6

Below is given a section from the quarry east of the road:

	FEET. INCHES	
7. Thin-bedded stone such as usually occurs near the surface.....	7	

	FEET. INCHES.	
6. Like No. 5 in appearance, but readily weathers into fragments, joints readily developing.....	1	6
5. Good quarry stone, drab, dense, brittle, resistant to weathering influences.....	2	6
4. Buff, iron-stained, soft in places.....	5	
3. Thin-bedded, much jointed, buff, calcite bearing.....	1	6
2. Like No. 3, upper six inches very fragile and fissile.....	3	
1. Firm, drab, compact, in two layers, upper argillaceous.	4	

The stromatoporoid masses in number 11 of the west quarry, together with the lithological character of certain beds, makes it reasonable to conclude that the beds of these quarries are of the same horizon as those of the Cedar Falls quarries. Aside from the *Stromatopora* and an undetermined brachiopod very sparingly occurring in a part of number 3 of the east quarry, these beds are entirely barren. A characteristic of these barren beds, whether found in East Waterloo, Cedar Falls, or Eagle township, is the marked variability of most of the rock, sometimes even in the same quarry and always in near-by quarries. A very few features, like the pockets of crystals, yellow streaks in a soft, earthy stone, blue limestone, yellowing under the weather, may be traced at fairly well established horizons. Otherwise little can be used in correlation and even these without sure reliance, unless the *Stromatopora* and lithographic beds chance to be found overtopping them.

Stratigraphically the lowest horizon in the county is the outcropping in an intermittent stream bed in the northeast quarter of section 13, Fox township, which is referred to the upper part of the Wapsipinicon stage of the Devonian. No thickness can be assigned as only a partial section could be made. In the bank adjacent three or four feet of this zone were exposed.

GENERAL SECTION OF CEDAR VALLEY LIMESTONE.

A general section of the rocks of the Cedar Valley stage in Black Hawk county may be arranged in order as follows:

	FEET.
3. Lithographic and stromatoporoid beds, somewhat variable in character, but everywhere maintaining certain unmistakable features. In places a nodular or even brecciated phase is found. Excepting the stromatoporoids, few fossils occur.....	20

- | | FEET. |
|--|-------|
| 2. Beds which, for sake of identification in reference to them may be called the Raymond quarry beds, since they have long been known there, distinctively barren, excepting an occasional coarse-ribbed <i>Atrypa reticularis</i> , a few fragments of another brachiopod, a few crinoid stems and the fish jaw found at the Bartlett quarry. Cherty layers, pockets of calcite and geode-like masses occur with considerable regularity..... | 26 |
| 1. The Acervularia beds which scarcely admit of definite differentiation in most of the places where rock of this zone occurs, unless it be in the outcropping above the Wapsipinicon horizon in Fox township..... | 7 |

Number 2 is the horizon referred to by Calvin as being "Along the river bluff, a short distance above Littleton"* and which is there about sixty feet in thickness.

GEEST.

In no quarry has it been necessary to do much stripping in order to secure the stone needed to supply the local demands, the natural exposure that first attracted the quarryman's attention being located where the overlying unconsolidated material was thin. This condition, however, has favored rock decay in its various phases, with the result that the sound rock is invariably covered with the insoluble products of rock decomposition to a depth varying with the circumstances. In one instance five or six feet of this dark red, stiff, clayey residuum was observed, though usually from one to three feet measures the extent of the geest, as this form of rock waste is often called, and the lower half of this is mingled with the more resistant remnants of the original rock. Sometimes the activity of the erosive agents is continued along the joint planes to a depth of twenty feet or more, widening them out and leaving the spaces partially filled with geest.

PLEISTOCENE SYSTEM.

KANSAN STAGE.

Kansan drift.—The oldest observed representative of the Pleistocene is the Kansan drift. This covers almost four-fifths of the area of the county and in turn is covered practically everywhere with the Iowan. Its maximum thickness in the county

*Calvin: Iowa Geol. Surv., Vol. VIII, p. 234.

is not known, but in Lincoln township where the mantle rock has a thickness of 270 feet, the maximum for the county, more than nine-tenths of this material is Kansan till, judging from the few exposures made by the erosion of the streams and excavation of railroad cuts. The dense, blue clay which invariably forms the basis of this drift when unweathered, is accompanied always with other constituents, of ever varying nature, form, size and proportions, so that any section through or into it discloses to the careful observer some detail of special interest. Calcium carbonate, often too finely reduced to be noted with the eye, quartz grains, pebbles and larger masses of other minerals, especially of greenstone, and disintegrating granitoid masses are very common. Pockets of sand and gravel as well as streaks and layers of these materials, running in all directions, are numerous. This feature of the Kansan was unusually manifest in the excavations for the Auditorium and Gymnasium buildings of the State Normal School. Here, too, were found pieces of coal and other carbonaceous matter, calcareous septaria, ferruginous concretions with a clayey nucleus, sometimes reaching boulder dimensions, and in one instance at least beautifully polished and striated. In the cut made by the Illinois Central railway one mile or more northwest of Cedar Falls a mass of native copper weighing four and one-half pounds was found deeply bedded in the Kansan till, giving unquestionable evidence as to the direction from which this part of the till must have come. When exposed, or near the surface, oxidation changes the color of the clay to a yellow, brown, or gray, the lime and some other ingredients are leached out and the granitoid masses readily fall in pieces.

Calvin, Savage and others note the presence of a layer of pebbles on the top of the Kansan drift, where it rises in ridges, and beneath the Iowan. This is very common in Black Hawk county, almost invariably to be seen where the roadmakers have cut into the more abrupt ridges, beginning part way up one side, passing over the top and partly down the other side. It seems to be a result of post-Kansan erosion. The soluble and finer constituents of the drift having been removed, the pebbles, having settled down together, readily attract attention.

Since the Iowan is everywhere coincident with the Kansan in this county, all distinctive topographical features of the Kansan have been obliterated over by far the greater part of the county. The high bluffs in the vicinity of Cedar Falls are gashed with short V-shaped ravines deeply cut into the Kansan by the pre-Iowan streams as they sought a passage to the river over the steep escarpment. As has already been stated under the head of Topography, for a distance of seven or eight miles south-east of Cedar Falls quite pronounced Kansan topography manifests itself through the thin veneer of the Iowan, if the latter be not entirely wanting in some parts of this area.

Buchanan gravels.—Since Calvin first recognized the Buchanan gravels as a distinct Pleistocene deposit, writers on the Pleistocene of northeastern Iowa have given them due attention. They are well described and their genesis closely and reasonably accounted for in the report on Howard county.* In every township one or both phases of these gravels may be found some of which to be sure are very thin and show little stain or other evidence of weathering, but their position makes their relationship quite certain.

Along the banks of Dry Run and its branches are numerous extensive deposits. The first to appear as one proceeds southwestward from its mouth is at N. Olsen's quarry where the upland phase has a thickness of ten feet. The lower part is deeply iron stained and coarse. The upper part is less ferruginous, stratified, some layers being a fine sand. The uppermost layers are highly ferruginous. At Carpenter's quarry the gravel is much thinner and lighter in color, but more uniformly coarse. On the east side of the creek one-half mile directly east of the Normal School is the most extensive deposit observed anywhere in the county (Fig 51). It is of the valley phase, very uniform in size of particles which is that of a fine gravel, or coarse sand, of a yellowish color and very distinctly stratified except in the upper part. Large quantities have been removed by the Chicago Great Western railroad company for ballast. It is twenty or more feet thick and is many acres in extent. In fact, the whole valley in this neighborhood along

*Calvin: Iowa Geol. Surv., Vol. XIII, pp. 64-68.

the main stream and its tributaries is more or less filled with this material. In one place it is a very dark red brown and hardened into rock-like sheets; in another it consists of pebbles and cobble-stones of chert, jasper and other forms of quartz, greenstone, etc., all deeply stained with iron. But for the most part it is rather of a sandy nature, though more deeply stained

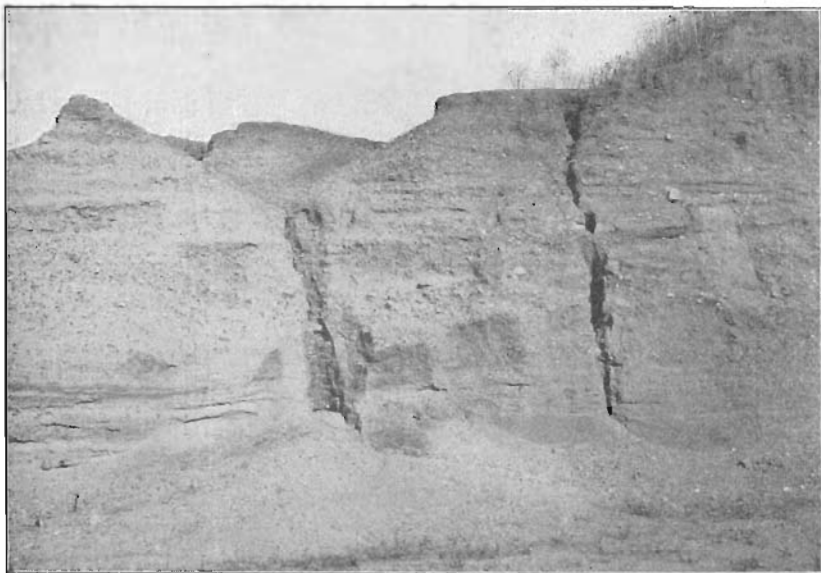


Fig. 51—Buchanan gravel, Cedar Falls, east of Normal School.

than in the pit of the railway company. At the time of the melting of the Kansan ice there must have been quite an area of still water here on reaching which the burdened floods at once deposited the coarser part of their loads. The upland deposits which overlie the limestone bounding the sides of the valley were deposited while the valley itself was still filled with ice.

On the interurban line of the Rapid Transit railway where it cuts into the bluff is a deposit ten feet in thickness, containing pebbles and cobblestones, rotten granite, iron concretions and cemented gravel, all deeply stained. In the gravel are masses of very fine grain, or without apparent grain, spherical, lenticular and plate-like in form. This deposit is interesting **for the variations** occurring within short distances, both in vertical and lateral extension.

In some localities the farmers have recognized the value of this material for improving the character of the roads. It is surprising that so many are still content to contend with mud, while in so many instances there is within easy reach so effectual a means of relief.

IOWAN STAGE.

Iowa drift.—There is nothing peculiar in the character of the Iowan drift deposit in Black Hawk county. Calvin's description in his report on Delaware county may well be accepted as most characteristic. "The Iowan drift is a light yellow, highly calcareous clay, unchanged by weathering and oxidation even at the surface."

As compared with the Kansan, it is everywhere very thin. On the bluffs between Cedar Falls and Waterloo and elsewhere along the margin of the Cedar valley it is scarcely a foot thick. Over the tops of the ridges even in the great Iowan drift plains, it is scarcely more in many instances. On the Normal School campus it is from five to seven feet thick. In the railroad cut one-half mile northwest of Voorhies the following section is shown:

	FEET.	INCHES
8. Very light ash-colored clay with sand and pebbles..	1	
7. Darker, more clayey layer containing scattered pebbles..	2	
6. Ordinary Iowan drift	3	
5. An extremely meager line of gravel, probably residual...	2	
4. Oxidized Kansan.....	6	
3. Light ash-colored layer.....	1	
2. Dark gray layer	1	
1. Less oxidized clay in which is a line of very irregular calcareous nodules sometimes with quartz pebbles included as in a conglomerate....	4	

In a cut southeast of Voorhies the Iowan is four feet thick, below which are six feet of oxidized Kansan made up of clay, sand and gravel. Here, too, the nodules mentioned above occur. Under this is a somewhat indurated thin layer making an abrupt line in the slope, succeeding which are three feet of the blue Kansan till. These cuts are in the midst of a very characteristic part of the southwest Iowan drift plain, and, while the material in the upper part of the Iowan drift is not typical, its thickness may be taken as a fair average of the Iowan in the

more elevated portion of this plain. One-half mile northeast of Voorhies, where the road crosses a small creek, Buchanan gravel appears under two and one-half feet of the Iowan. Similar conditions exist over the great Iowan plain between the Cedar and the Wapsipinicon rivers where it is most characteristic, as in Bennington and Barclay townships, and in the west half of Fox. There are localities where no drift of any kind can be found. Near the middle of the boundary between sections 34 and 35, Mt. Vernon township, in the road is an outcropping of limestone. In the next level above it is a thin layer of gravel and pebbles, Buchanan perhaps, and near are Iowan boulders. There is nothing in the topography to account for this isolated outcropping of limestone, the topography all about it being the typical Iowan. Other localities where no drift appears have been mentioned under the head of Topography.

The Iowan drift abounds in boulders. They are chiefly granitoid, though gneiss, greenstones, basalt, quartzite and even sandstone and limestone are more or less common. A large quartzite boulder with surface corrugated with ripple marks slid out of the Iowan down the slope of the railroad cut just below Cedar Falls during a flooding rain in the summer of 1902. Blocks of sandstone very much like, if not of, the New Richmond sandstone, are occasionally found. Sometimes many of these kinds may be found scattered over a small area, though the parent ledges must have been at considerable distances apart, thus showing how thoroughly were these constituents of the drift mingled as they were detached and borne along by the resistless power of the great ice sheet. Their distribution over the county is by no means uniform. Long stretches of the plain are entirely destitute of them. Elsewhere their presence in great numbers and in notably large specimens is a striking feature of the landscape. Again they are few, small and scattered. Nearly every township gives proof of this unequal distribution, though Eagle, Lincoln and Big Creek seem to have larger areas free from boulders than other townships, those which lie wholly or in large part in the river valleys being excepted.

Loess.—Covering all of the higher parts of the region of Kansan topography between Cedar Falls and Waterloo is a light gray, homogeneous material consisting of a fine clay and very minute grains of sand. Unquestionably it is a loess. It is noticeably without any tinge of yellow, usually so characteristic of the loess of Iowa. There are few places where the loess is penetrated to the underlying material. So far as observed there is a zone of light colored clay, bearing pebbles or even cobble stones, just below it. In the cut of the Rapid Transit railway mentioned under the head of Buchanan gravels, these gravels have immediately above them the pebble bearing till which must therefore be Iowan. The Iowan borders this whole region and tongues of it run up into the lower levels among the hills. It is probable that a thin deposit of Iowan drift underlies much of the lower loess deposit, if not all of it. The thickness of this loess is from one or two to eight feet at least. No loess occurs elsewhere in the county as far as observed.

ALLUVIUM AND TERRACES.

The larger valleys have been flooded at seasons of high water ever since they assumed their present character. Each overflow leaves its increment of sediment, usually a fine silt, the wash from the adjacent fields and bluff sides. Sand is the most abundant material of these valleys. Coarser sands and gravels are variously mingled in places where the stronger currents have run over the plains. Then, too, the shifting stream beds have left coarse materials in considerable quantities here and there throughout the river flats.

It is very difficult to determine accurately the depth or superficial area of the alluvial deposits, since tongues of Iowan clays sometimes underlie the sands, and the drift borders the alluvium with a very irregular line of lobes and sinuses. There is some reason to believe from wells and other excavations that a pre-glacial stream has cut its channel into the rock, well below the present rock bed of the Cedar, but the evidence is too meager to warrant any effort to trace its course.

Along the margins of these valleys low terraces occasionally appear, but nowhere are they a very noticeable feature of the topography of the county.

CRETACEOUS MATERIAL IN THE DRIFT.

In the first volume of the Survey reference is made to Cretaceous material found in the drift in different parts of the state.* As a contribution to the subject there discussed, the following items are given without any attempt to account for the occurrence of the finds in the locality and situation where they were discovered.

A small, soft, ferruginous sandstone well filled with casts of Pinnae and gastropods of at least two species was found just above the blue clay, eight feet below the surface, in laying a sanitary sewer, on Olive street near Professor Parish's residence on Normal Hill. Small pieces of a conifer were found near it. A slender belemnite judged to be Cretaceous was unearthed in excavating for the new Gymnasium of the Normal School. An impression of what appears to be *Prionocyclus wyomingensis* was found in another excavation on the campus five feet below the surface.

Soils.

The soils of Black Hawk county may be placed in a general way mainly in two classes, that of the larger stream valleys and that of the Iowan drift plains. The latter, a rich, deep loam with a clay subsoil, has often been described in the reports on the counties where it prevails, and it presents no marked variation in this county. Those townships where the features of the Iowan drift dominate the landscape are readily recognized as rich farming districts by every indication by which we may judge of the prosperity of a community. The marvel is that any man in these days of labor saving machinery, rural free delivery and telephone consents to exchange the freedom and independence of such homes as abound over these portions of the county for the questionably superior advantages of the town, all things being taken into consideration.

The alluvial plains of the Cedar and its larger tributaries are productive in seasons when there is an average amount of rainfall well distributed through the growing time of the year, but suffer first in dry times and therefore are less to be depended upon for uniformly good crops than the more favored region of the Iowan drift plains; though where drainage is imperfect,

*Keyes: Iowa Geol. Surv., Vol. I, p. 125.

these latter are the sufferers in the wet years. The advantage lies with the latter, however, for tiling and ditching relieve the situation very readily in most cases. Already the bowlders that embarrassed the cultivator and to the thrifty eye disfigured the otherwise fair fields to a great extent, have been utilized in building, or have been removed to the boundaries of the farms, where, lying in grim ruggedness, they continue their mute testimony to the reasonableness of the glacial theory and the wonderful activities of nature in the days long gone by.

The drouth resisting capability of the drift plains is indeed remarkable and ought not to be disregarded in any mention of their characteristics. No better test of this could be made than the series of dry seasons that succeeded each other a few years ago. Though the farmers, disheartened by the long prevailing unfavorable conditions, long before harvest time gave way to gloomy forebodings, the crops were happily disappointing in the average results. The clays underlying the rich top soil, slowly but persistently, yielded up their store of moisture by capillarity, no matter to what depth the zone of ground water retreated.

While this cannot be true in the same degree of the valleys of the Cedar and Wapsipinicon, the sandy element which is in excess in some parts of them, by its readier drainage permits an earlier cultivation and by its greater warmth promotes a more rapid growth, thus making them specially adapted to the growth of some crops in the cultivation of which the farmer finds no slight compensation for those qualities of the drift plains which his land is denied. There are intermediate soil conditions between these two types the details respecting which need not be given here.

The comparatively small area of Kansan topography affords a third type of soil, which is fertile, warm, drains readily, has good capillarity and is easily worked. It is specially adapted to the growth of garden truck, small fruits and orchards as well as the standard field crops.

Deformations.

The rocks of this county have been little affected by folding. a low anticline brings the Acervularia horizon into notice on

the west side of the Cedar from Waterloo to the county line on the south, while the rocks on the east side of the river over the same distance are all of a higher horizon stratigraphically, though the altitude at which they occur is no greater than that of the rock on the west, if, indeed, it is as great in some places.

The Acervularia horizon reappears at the surface on the east along Spring creek. Small narrow folds appear in one or two places along Dry Run in Cedar Falls.

Unconformities.

The floor of the Round's quarry in Cedar Falls shows a distinct unconformity with the bed that had overlain it. Similar unconformities, presumably at the same horizon, were noted in several other localities, though, being in or near the base of the barren beds, no certain means of determining the exact horizon of the several unconformities present themselves.

ECONOMIC PRODUCTS.

Building Stone.

Rock outcroppings are so distributed over the county as to bring within easy reach of a large part of the population an abundant supply of stone suitable for all ordinary constructive purposes. Nowhere, however, is it of such a grade as to warrant quarrying operations on a scale beyond the supply of the immediate local demands. Stone buildings are not common. The few good ones, however, indicate the possibilities yet undeveloped. The best range rock and flagstones are obtained from the Neilson quarry already described. Naturally the quarries that have been worked most extensively are those in the vicinity of La Porte City, Waterloo and Cedar Falls. The Berry quarry in Eagle township supplies a wide range of country as it furnishes the only limestone occurring in that locality.

The Iowan boulders furnish an excellent stone and are used quite largely both in the town and country. The walls of the First Presbyterian church in Waterloo are built of granite taken from a single boulder two or three miles from town. The Congregational church in Cedar Falls is built of boulders gathered from the neighborhood. These are not only most substantial

buildings but pleasing to the eye as well. The range of the varieties of crystalline rocks in the walls of the Cedar Falls church is truly remarkable. Mr. A. D. Barnum of Cedar Falls contracted to furnish large blocks of stone necessary for the lower foundations of the state capitol, and filled his contract from a few large bowlders in the neighborhood of that city.

Lime.

No lime has been produced in this county for many years. Formerly there were kilns in several localities. The rock used was usually taken from the stromatoporoid horizon, and a good grade of lime for immediate use is reported, but its readiness to deteriorate in a short time destroyed its value for commercial purposes.

Brick Clay.

The glacial clays afford little promise at present of furnishing material for the manufacture of superior brick, and since other clays are not accessible in this county the prospects for brick making on an extensive scale are not very promising. The small loess region between Cedar Falls and Waterloo yields a material that is utilized by Stead Brothers and Guenther in the northwest quarter of section 21, Waterloo township, in the manufacture of a good quality of common brick. At present the round, down draft kilns are used. The stiff mud process is employed. A Freeze and Eagle repress machine is used. The present capacity of the plant is from fifteen to twenty thousand daily. A ready market is found for all their output and the proprietors are planning a considerable increase in the capacity and facilities of their plant.

The Waterloo and Cedar Falls Brick Company have a plant in the northeast quarter of section 13, Cedar Falls township. The material used here has been Iowan and Kansan drift. At present they are using loess with satisfactory results. They have four round, down draft kilns, ample first class drying facilities, use the stiff mud process and have a capacity of twelve thousand daily. They, too, find ready market for their entire product.

Road Materials.

Much of the limestone of the county is too soft to use as road material. Where used it has pulverized in a short time forming a limey dust that has proven very disagreeable to travelers. The stromatoporoid and lithographic beds, where available, would give better results. When this is not at hand, in place of crushed stone, the Buchanan gravel is available in many localities, and, as has been stated already, it is a most excellent material for improving the roads. Dry Run channel has afforded large supplies of superior gravel which has already been drawn upon freely for the improvement of the streets of Cedar Falls and the roads in its neighborhood. The Cedar and the Wapsipinicon and their larger tributaries have sorted and deposited in bars, so that it is easily accessible, large quantities of good gravel which in some instances has been used in repairing the roads of the vicinity. With judicious preparation of the roadbed by proper drainage and building up, most of the roads of the country in a few years could be made firm and dry at all seasons with little, if any, greater expenditure than is now employed. The work should be done on a well formed plan and adhered to throughout a series of years.

Water Supply.

No very large areas in this county are remote from perennial streams which afford water in abundance for all ordinary purposes. By wells, water of good quality is easily obtained in the great majority of cases. The wells in the river valleys reach a layer of gravel at a depth of ten to thirty-five feet and stop there. On the Iowan drift plain water is obtained at from sixty to two hundred and eighty feet. Some of these stop in the blue clay. Most of them reach a layer of gravel or pass into the rock a few feet before they terminate. The uniform excellence of the water in most cases is noteworthy.

In Waterloo the supply of water has been taken from the river, but this has not proved satisfactory and a deep well is being put down in the expectation that a copious supply of good water will be secured. A depth of 731 feet has been reached where a firm limestone has been struck just after leaving a

shale. This undoubtedly is the Maquoketa shale, and the next advance will be in the Galena-Trenton. It is hoped by the company that an adequate supply of water will be found in the Saint Peter sandstone, but they are prepared to go into the water bearing strata below to the depth of 2500 feet if necessary. Waterloo is in the Dubuque-Sioux City section and there is reason to believe from the record of the wells already sunk in this section, that there will be a full supply of water without the necessity of pumping from any great depth. The United States Geological Survey and the Iowa Geological Survey are receiving sample borings as the work progresses, and in due time a complete section will be published.

In Cedar Falls the water works are owned by the municipality. The supply is obtained from large fissure springs near the mouth of Dry Run. An analysis of the water made July 1902 gave total solids in solution 294 parts per million or 17.150 grains per gallon; January 22, 1905, 297 parts per million or 17.325 grains per gallon. No trace of organic matter appears. The supply is abundant. Even in the extremely dry seasons of a few years ago there was no perceptible diminution in the flow. It is difficult to determine the strata from which the water comes, but it is believed to be the Devonian. The lower beds in this neighborhood are much channeled, as if water currents were common. Limestone could not be expected to furnish so large an amount of quarry water and these channeled beds are suggestive of small subterranean streams that, following the dip, seem to center in the vicinity of these springs. The Union Mill Company in making improvements at one of their Cedar Falls mills in the fall of 1904, quarrying into the limestone, uncovered a considerable fissure from which issued a large stream of water. These streams must be fed from a considerable intake which is situated probably mainly on the east side of the river, as the bed from which the Mill company's spring broke out is below the river level. The sandy plain of the Cedar valley would give the proper type of soil for such an intake and would prove a complete filter, thus accounting for the absence of organic matter. While the waters of Dry Run disappear beneath the surface two miles or more above these springs, they do not reach

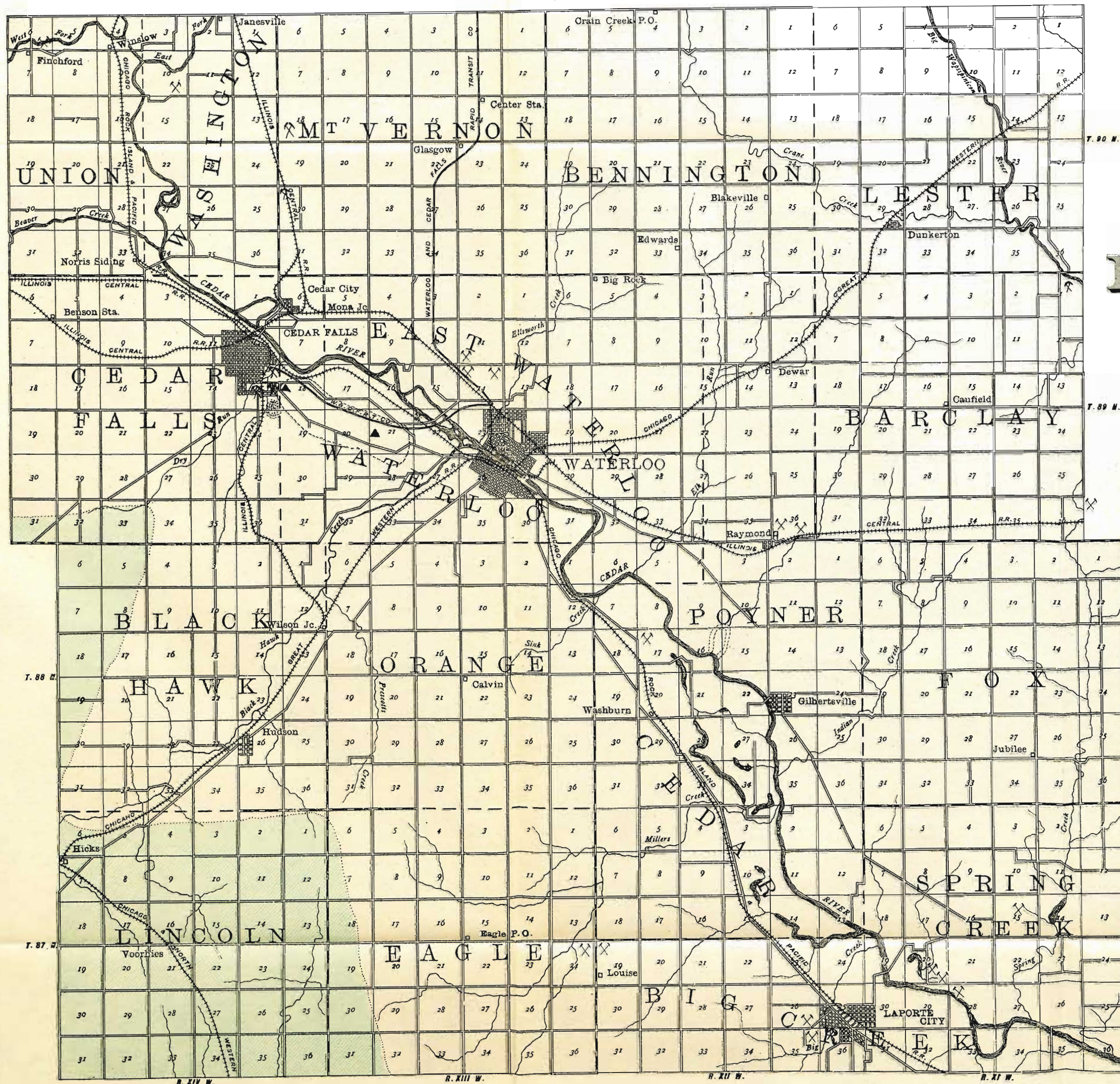
them, as is indicated by the absence of organic matter which would certainly appear from surface waters passing so short a distance through well worn water ways. Nor could the flow in this small creek supply a tithe of the water daily pumped from these springs. Occasionally in times of very high water the immediate vicinity of the springs is overflowed and the city water is affected by this surface water, but this passes with the conditions that caused it. No city is more highly favored with an abundant supply of pure water than is Cedar Falls.

Water Power.

A dam across the Cedar has been maintained for many years at Cedar Falls and also one at Waterloo. The control of the power is in the hands of the Waterloo and Cedar Falls Union Mill Company. About 6000 horse power is available at each place and practically all of this is utilized in the operation of the mills belonging to the company. These flouring mills are thoroughly equipped with machinery of the latest approved type for the production of flour by the best modern methods. There is also a small mill at Finchford on the West Fork.

Acknowledgments.

The writer is under special obligations to Professor Samuel Calvin, former State Geologist, and to Professor Frank A Wilder, the present State Geologist, for assistance and advice which have been given very freely and without which this report would not have been prepared. Rodney M. Arey, Principal of Muscatine High School, was a valued volunteer assistant during the gathering of data from the field. To these and the many others who so readily assisted by giving information and material aid in other ways our hearty thanks are given.



IOWA GEOLOGICAL SURVEY

GEOLOGICAL MAP OF

BLACK HAWK COUNTY, IOWA.

BY

M. F. AREY.

1905.

Scale 1:25000

0 1 2 3 4 5 Miles
0 1 2 3 4 5 Kilometers

LEGEND GEOLOGICAL FORMATIONS

KINDERHOOK

CEDAR VALLEY

THE DOTTED LINE SOUTHEAST OF CEDAR FALLS
ENCLOSES LOESS COVERED AREA

INDUSTRIES

QUARRIES

CLAY WORKS

GRAVEL PITS.



DRAWN BY F. C. TATE