

ART. XXXV.—*The Minnesota Devonian and its Relationship to the General Devonian Problem of North America*; by CLINTON R. STAUFFER.

The Devonian of Minnesota has long been known and roughly mapped, but a detailed study of the rocks belonging to this system has been very much neglected. This is probably because the area in which it occurs is a drift-covered plain that has been only partially dissected by erosion and the outcrops that may be found are neither frequent nor very satisfactory. But the country has now been settled for a longer period than when the early surveys of Minnesota counties were made, hence more wells have been drilled and more quarries have been opened in the region so that the rocks of this system are now very much better known than they were thirty or forty years ago. Moreover certain parts of the Devonian have been found to be filled with fossils thereby making the age determination a certainty.

In all about 1,200 square miles of southern Minnesota are covered by Devonian rocks. This area lies in Fillmore, Mower and Free Born counties* (1). In the northern and western parts of this region, much of the surface is comparatively level and well covered by drift so that it is not always possible to trace the Devonian border in those directions. On the east side it approaches the driftless area and the mantle of glacial debris is reduced to a thin film, often insufficient to conceal the bed rock, and the possibilities for satisfactory stratigraphic work are much improved. Enough outcrops can be found to make it certain that the Devonian is slightly more extensive in this region than it is indicated to be on the present geological maps. Numerous masses and fragments of fossiliferous Devonian rock are known or have been picked up in the drift of central Minnesota, even as far north as Todd and St. Louis counties. Some of these masses are quite large (2). This has suggested that possibly there are other areas of Devonian, existing as outliers, which have not yet been recognized or which may be entirely drift covered. It is noticeable, however, that the larger frag-

* For references see the end of this article.

ments are all found in southern Minnesota and may indicate a somewhat greater extent of the present Devonian-covered area rather than the existence of other Devonian areas. Over the great ridge area of the buried Minnesota mountains the Devonian fragments in the drift are somewhat smaller and usually less abundant. Hence it seems probable that these scattered limestone bowlders and loose Devonian fossils have been brought down by the Pleistocene glaciers from the great outcrops of Devonian in the vicinity of Lake Winnipegosis and Lake Manitoba, and that the Minnesota Devonian deposits are confined to the southern part of the state.

The Devonian, as outcropping in the southern part of the state of Minnesota, consists chiefly of limestones of varying purity. Probably the great body of it runs as high as 17% to 18% $MgCO_3$, but occasionally layers are found with 97% to 98% $CaCO_3$, and only a fraction of a per cent of $MgCO_3$. The best outcrops are to be found in the central and southern parts of Fillmore county where the Devonian is usually exposed in every highway cut. Where both the top and the bottom show, the Devonian apparently rests disconformably on fossiliferous Maquoketa shale (Ordovician) and usually has no covering other than the drift. In the vicinity of Austin, however, the uneven upper surface of the Devonian limestone is covered by eight to ten feet or more of rather soft gray to red clay which has usually been classified as a Cretaceous(3) deposit, and which it probably is as clays and lignitic beds of that age have been reported in the deeper wells of Freeborn county to the west. However, some of the similar clays of central and southern Minnesota contain glacial pebbles and are undoubtedly of glacial origin. It has been suggested that a remnant of the higher Devonian shales may occur in western Mower county and perhaps in certain parts of Freeborn county, but up to the present this has not been certainly determined. The Western margin of the Devonian is lost under a covering of drift which in Freeborn county has been estimated to have a thickness of one hundred feet,(4) with perhaps even greater thicknesses in the adjacent county(5) to the west. There is thus little hope of continuing the Minnesota Devonian section, except by the drill,

to the upper shales which are so well developed a short distance to the south of the state line. It seems entirely probable that these upper beds thin out in Iowa before the Minnesota line is reached. The limestones therefore carry the whole of the known Devonian record, as far as Minnesota is directly concerned. These rocks dip gently to the west and south thus bringing in higher beds along a line from northeast to southwest.

Much of the Devonian is a porous, weathered, impure, buff limestone but it changes rapidly in color and character as it is followed to the southwest. Where this former character is prevalent it is undoubtedly to be assigned, in large measure, to the leaching and weathering of a rock quite different from that which is now exposed. Following the direction of dip there are numerous shades and grades between a porous, abundantly fossiliferous buff rock, and a sparingly fossiliferous blue, or a non-fossiliferous compact gray to white rock. A number of sections were measured for detailed study and others might have been added. A few of them are given herewith to show the Devonian section of the state. They include some of the more important outcrops and give a good idea of the above mentioned variations as well as of the changing character of the fauna which seems to attend it.

*Section along the South Bank of Bear Creek at Hamilton,
Fillmore County, Minnesota.*

Pleistocene and Recent.	Thickness
7. Soil and drift	6' 0"
Devonian (Cedar Valley limestone)	
6. Limestone, gray to buff, containing the following fauna.	
Athyris fultonensis (Swallow) (c)	
Chonetes scitulus Hall (r)	
Productella subalata Hall (a)	
Schizophoria striatula? (Schlotheim) (r)	
Trochonema sp. (r)	15' 4"
5. Limestone, gray to buff or brown, massive, abundantly fossiliferous.	

	Athyris fultonensis (Swallow) (r)	
	Atrypa histryx Hall (c)	
	Atrypa spinosa Hall (r)	
	Chonetes scitulus Hall (c)	
	Cyrtina hamiltonensis Hall (c)	
	Gypidula læviuscula Hall? (r)	
	Martinia sp. (c)	
	Productella subalata Hall (a)	
	Schizophoria striatula (Schlotheim) (c)	
	Spirifer bimesialis Hall (a)	
	Spirifer iowaensis Owen? (c)	
	Stropheodonta demissa (Conrad) (r)	
	Stropheodonta halli musculosa Cleland (?) (r)	
	Bellerophon perplexa Walcott (c)	
	Pleurotomaria sp. (r)	
	Trochonema sp. (c)	
	Coleolus sp. (r)	
	Proetus sp. (c)	
	16' 0"
4.	Limestone, partly covered	10' 8"
3.	Covered interval	11' 4"
Ordovician (Maquoketa shale)		
2.	Limestone, buff to brown, shaly, containing <i>Strophomena fluctuosa</i> Billings	10' 0"
1.	Shale, buff to brown, massive, extending to the level of Bear creek. It contains the following fauna	
	Dalmanella testudinaria (Dalman)	
	Lingula elderi Whitfield	
	Plectamonites sericeus (Sowerby)	
	10' 8"

These same Devonian beds outcrop abundantly around Spring Valley, Etna, and southward into Iowa. In Spring Valley the old city quarry, at the corner of Church Street and Broadway, exposes about eighteen feet of slightly higher limestone, but Larsen's quarry in the southwestern part of town is essentially the same horizon and affords better collecting.

*Section of Larsen's Quarry in the Southwestern Part
of Spring Valley.*

Pleistocene and Recent.	Thickness
4. Soil and drift	1' 0"
Devonian (Cedar Valley limestone)	
3. Limestone, gray to brown or buff, badly weathered, containing <i>Atrypa reticularis</i> (Linnaeus) (c) <i>Productella subalata</i> (Hall) (c)	5' 0"
2. Limestone, buff, massive, with abundant fossils of which the following are the more important: <i>Atrypa reticularis</i> (Linnaeus) (c) <i>Cyrtina hamiltonensis</i> Hall (c) <i>Gypidula laeviuscula</i> Hall, (r) <i>Productella subalata</i> Hall (aa) <i>Nuculites</i> sp. (r) <i>Murchisonia</i> cf. <i>dowlingi</i> Whiteaves (r) <i>Trochonema</i> sp. (r) <i>Trochonema monroei</i> Cleland? (r) Crinoid stems (c)	
1. Limestone, brown to buff, with fossils common <i>Chonetes scitulus</i> Hall (c) <i>Cranæna iowaensis</i> (Calvin) (c) <i>Cyrtina hamiltonensis</i> Hall (t) <i>Productella subalata</i> Hall (a) <i>Reticularia fimbriata</i> (conrad) (r) <i>Spirifer bimesialis</i> Hall (r) <i>Spirifer iowaensis</i> Owen? (a) <i>Spirifer</i> sp. (r) <i>Stropheodonta demissa</i> (Conrad) (c) <i>Paracyclas</i> sp. (r) <i>Bellerophon</i> sp. (c) <i>Trochonema</i> sp. (r) <i>Coleolus</i> sp. (c) <i>Proetus</i> sp. (c)	3' 4"

Somewhat higher beds occur along the state line highway. About five miles west of Granger the surface is strewn with fragments of the Devonian limestone and in some of the fields there are great heaps of rock that have been gathered from the surface in clearing the land for

cultivation. At no place is this part of the Devonian well shown but there is a fair section shown on Mr. Grimm's farm where it sticks out along the road and in the field.

Section on Mr. Charles Grimm's Farm Five Miles West of Granger.

Recent.	Thickness
4. Soil	0' 6"
Devonian (Cedar Valley limestone)	
3. Limestone, rough brecciated, brown in color.....	3' 0"
2. Limestone, fairly massive, rough, and gray to brown in color. It contains occasional masses of chert, and cavities filled with calcite crystals. Fossils are abundant.	
Cladopora magna Hall and Whitfield (r)	
Cladopora sp. (c)	
Favosites sp. (c)	
Zaphrentis solida Hall and Whitfield (a)	
Polypora sp. (c)	
Atrypa reticularis (Linnaeus) (c)	
Camarotæchia sp. (r)	
Cyrtina hamiltonensis Hall (c)	
Gypidula laeviuscula Hall? (c)	
Spirifer asper Hall (r)	
Stropheodonta demissa (Conrad) (r)	
Nucleospira sp. (r)	
Schuchertella chemungensis arctistriata (Hall) (c)	
Conocardium sp. (c)	
Leptodesma sp. (r)	
Palaeoneilo sp. (r)	
Bellerophon perplexa Walcott (a)	
Cyclonema sp. (r)	
Eunema sp. (c)	
Murchisonia dowlingi Whiteaves? (c)	
Pleurotomaria sp. (c)	
Raphistoma terrelli Cleland (r)	
Hyolithes alatus Whiteaves (r)	
Orthoceras sp. (r)	
Poterioceras 2 sp. (r)	
Phacops sp. (r)	
Proetus sp. (r)	
.....	10' 0"

1. Limestone, gray to brown, rough, with numerous corals and stromatoporoids
 Acervularia davidsoni Edwards and Haime (c)
 Favosites sp. (c)
 Stromatoporella erratica (Hall) (c)
 3' 0"

Along the same highway, about two miles farther west, fourteen feet of brown to buff limestone outcrop in section 34, York Township, Fillmore County, and lie at a higher horizon than those beds given in the preceding section. Although these layers are not exceptionally fossiliferous, the fauna found here is rather large and consists of the following forms—

- Idiostroma sp. (r)
- Dictyonema 2 sp. (r)
- Zaphrentis sp. (c)
- Polypora 2 sp. (c)
- Semicoscium rhombicum Ulrich? (r)
- Taeniopora Exigua Nicholson? (c)
- Atrypa histryx Hall (c)
- Atrypa reticularis (Linnaeus) (c)
- Chonetes scitulus Hall (c)
- Chonetes manitobensis Whiteaves (r)
- Cyrtina hamiltonensis Hall (c)
- Gypidula comis (Owen) (c)
- Pentamerella multicostata Cleland? (r)
- Productella sublata Hall (r)
- Reticularia fimbriata (Conrad) (r)
- Spirifer asper Hall (r)
- Stropheodonta arcuata Hall (r)
- Stropheodonta halli musculosa Cleland? (r)
- Stropheodonta perplana (Conrad) (cc)
- Stropheodonta variabilis Calvin? (r)
- Stropheodonta sp. (r)
- Phacops sp. (c)

The next beds above this are apparently those outcropping in the vicinity of LeRoy where the following section occurs—

Section of the Fowler and Pay Quarry One Mile East of LeRoy, Minnesota.

Pleistocene and Recent.	Thickness
11. Soil and drift	3' 6"

Devonian (Cedar Valley limestone)

10. Limestone, gray to brown, thin bedded, probably somewhat disturbed	4' 0"
9. Limestone, gray to white, usually weathering to brown, fairly massive. It contains a few fossils among which are the following:	
Crinoid stems (r)	
Leptaena rhomboidalis (Wilckens)? (r)	
Stropheodonta demissa (Conrad) (r)	
Nucula sp. (r)	
Pleurotomaria sp. (r)	
.....	2' 0"
8. Limestone, gray to brown, with occasional traces of fossils	1' 3"
7. Limestone, gray, fairly fossiliferous	
Crinoid stems (c)	
Athyris fultonensis (Swallow) (c)	
Cyrtina hamiltonensis Hall (c)	
Spirifer orestes Hall and Whitfield (c)	
.....	0' 10"
6. Limestone, gray to brown, containing indistinct masses resembling stromatoporoids	0' 8"
5. Limestone, gray to white, compact and apparently containing no fossils	2' 5"
4. Shale, green to gray, calcareous, irregular in thickness	0' 6"
3. Limestone, gray to white, compact, rather massive. It contains a few fragmentary fossils.	2' 4"
2. Covered interval	1' 0"
1. Limestone, gray to brown, apparently lower than the beds given above	7' 0"

Recent drilling in this vicinity indicates that the total amount of the high-grade white limestone may exceed sixty feet. How much of the brown magnesian limestone may be interstratified with it is not definitely known but it is probable that there is as much in the deeper strata as there is mingled with the beds exposed at the surface. Certain layers of the limestone of this locality resemble the lithographic beds of Iowa and they may possibly represent the same horizon.

Higher beds occur in the vicinity of Austin. It is quite probable, however, that there is a covered interval of importance between this outcrop and the one just dis-

cussed. There is at least a marked change in sedimentation between the light gray to white limestone near LeRoy and the impure "cement beds" characteristic of the Austin region. The best outcrop in this latter region is along Rose Creek, about three miles south of Austin, where quarrying has been carried on for many years. Formerly this rock was used as a building stone but it weathered badly hence it has long been abandoned as a construction rock. It is now used only in the manufacture of a natural cement.

*Section of the Fowler and Pay Cement Quarry along
Rose Creek, Three Miles South of Austin.*

	Thickness
Pleistocene and Recent.	
4. Soil and drift, the latter chiefly gravels.	2' 0"
Cretaceous?	
3. Clay, blue and red, in pockets over the uneven surface of the limestone	5' 0"
Devonian (Cedar Valley limestone)	
2. Limestone, blue to gray, weathering to buff, and containing a few fossils— Athyris fultonensis (Swallow) (r) Spirifer iowaensis Owen? (r) Fish plates and scales (r)	10' 0"
1. Limestone, gray to buff, rather massive, containing some chert and with pebble-like masses of limestone occurring in some of the lower layers. These beds extend to the level of Rose creek	15' 0"

The beds which appear to be the highest of the Devonian limestone section in Minnesota, outcrop along Cedar River in the southwestern part of Mower County.

*Section along Cedar River, Three Miles West of Lyle,
Mower County.*

	Thickness
Recent.	
4. Soil	5' 0"

Devonian (Cedar Valley limestone)

- | | |
|--|--------|
| 3. Limestone, gray to buff, massive to thin bedded, it contains an abundance of a few fossil forms—
<i>Athyris fultonensis</i> (Swallow) (aa)
<i>Atrypa reticularis</i> (Linnaeus) (r)
<i>Murchisonia</i> sp. (r) | 4' 0" |
| 2. Limestone, gray to buff, or brown, rough, hard, and massive. Fossils very abundant in some layers but limited to one form
<i>Atrypa reticularis</i> (Linnaeus) (aa) | 10' 6" |
| 1. Limestone, gray to brown in color, partly covered, to the level of Cedar River | 6' 0" |

It is quite impossible to present a complete section of the Minnesota Devonian at the present time. In fact it may never be possible to complete it satisfactorily unless at some future time the region should be drilled for water or other natural resources that may seem worth while. But it may be pieced together, from scattered outcrops and other information in somewhat the following manner.

General Section of the Minnesota Devonian.

- | Devonian (Cedar Valley limestone) | Thickness |
|---|-----------|
| 9. Limestone, buff to brown, massive, coarse, fossiliferous. These are the beds exposed along the river just west of Lyle | 20' 6" |
| 8. Limestone, blue to brown, argillaceous, forming the cement beds south of Austin | 30' 0" |
| 7. Covered interval | 10' ± 0" |
| 6. Limestone, gray to white, compact, fine-grained, often alternating with coarser brown beds | 22' 0" |
| 5. Covered interval | 12' ± 0" |
| 4. Limestone, brown, brecciated, with no fossils | 6' 0" |
| 3. Limestone, gray to buff, massive, fossiliferous | 10' 0" |
| 2. Limestone, gray to brown, massive, full of corals and stromatoporoids | 3' 0" |
| 1. Limestone, buff, massive, abundantly fossiliferous | 20' 0" |

It is noticeable that all portions of this section are not equally fossiliferous and that the fauna is not uniform

for the whole formation. Thus the lowest beds are full of fossils and the species, the most abundant of which is *Productella subalata*, belong chiefly to the various genera of Brachiopoda. These beds are succeeded by others which are also quite fossiliferous but the number of species is small and they belong mostly to the Anthozoa. Then comes the most widely varied fauna of all in the beds which have been made the third division of the general section. Although the Brachiopoda are still abundant the conspicuous forms are Gastropoda and the whole fauna differs decidedly from that of both the basal beds and those higher in the section.

The brecciated beds appear to contain few if any fossils. The fine-grained compact limestone and the associated brown beds are sparingly fossiliferous. The argillaceous limestone beds of the cement quarry near Austin contain fish remains and an occasional *Spirifer*, while the uppermost portion of the section is again fairly fossiliferous but the number of species is small. These latter are chiefly *Athyris fultonensis* and *Atrypa reticularis*. The brecciated beds, or the unknown deposits which doubtless occur between the outcrops from which the section herewith was made, may represent important breaks in sedimentation during which marked faunal changes occurred, but the evidence so far obtained is not sufficient to determine that point. It is perhaps significant that similar faunal changes have been observed in the equivalent beds of Iowa (6).

The following is a list of the genera and species that have been collected from the Devonian outcrops of Minnesota.

Fauna of the Minnesota Devonian.

- Dietyonema 2 sp.
- Idiostroma sp.
- Stromatoporella erratica (Hall and Whitfield).
- Acervularia davidsoni Edwards and Haime.
- Cladopora magna Hall and Whitfield.
- Cladopora sp.
- Favosites sp.
- Hederella filiformis (Billings).
- Zaphrentis sp.
- Crinoid stem.

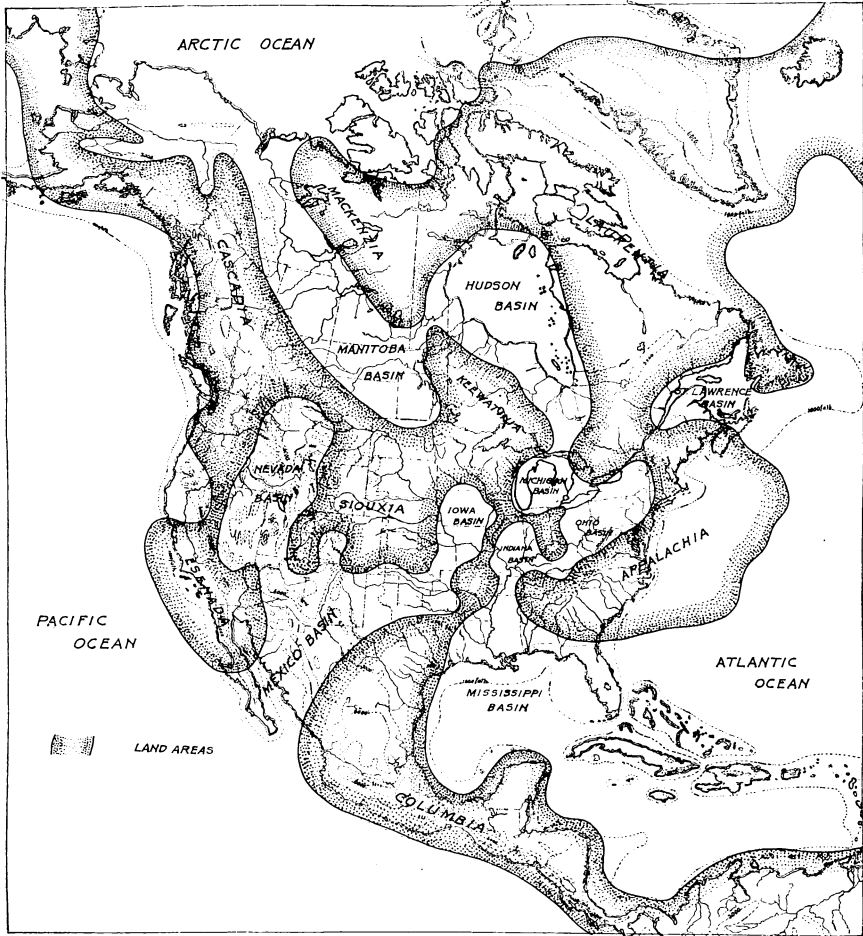
Polypora sp.
Semicoscium rhombicum Ulrich?
Taeniopora sp.
Athyris coloradoensis Girty.
Athyris fultonensis (Swallow).
Atrypa histryx Hall.
Atrypa reticularis (Linnaeus).
Atrypa spinosa Hall.
Camarotœchia sp.
Chonetes manitobensis Whiteaves.
Chonetes scitulus Hall.
Cranæna iowaensis (Calvin).
Cyrtina hamiltonensis Hall.
Gypidula comis (Owen).
Gypidula læviuscula Hall?.
Leptaena rhomboidalis (Wilckens) ?.
Martinia sp.
Nucleospira sp.
Pentamerella multicosta Cleland?.
Productella subalata Hall.
Reticularia fimbriata (Conrad).
Schizophoria striatula (Schlotheim).
Schuchertella chemungensis aretistriata (Hall).
Spirifer asper Hall.
Spirifer bimesialis Hall.
Spirifer euryteines Owen.
Spirifer iowaensis Owen?.
Spirifer orestes Hall and Whitfield.
Spirifer pinonensis Meek?.
Spirifer sp.
Stropheodonta arcuata Hall.
Stropheodonta demissa (Conrad).
Stropheodonta halli musculosa Cleland?.
Stropheodonta perplana (Conrad).
Stropheodonta variabilis Calvin?.
Stropheodonta sp.
Tropidoleptus occidentens Hall.
Conocardium sp.
Nuculites sp.
Nyassa parva Walcott.
Palaeoneilo sp.
Paracyclas sp.
Bellerophon perplexa Walcott.
Bellerophon sp.
Coleolus sp.
Cyclonema sp.
Eunemia sp.

Loxonema sp.
 Murchisonia dowlingi Whiteaves?
 Murchisonia sp.
 Pleurotomaria cf. koltubanica Tschernyschew.
 Pleurotomaria sp.
 Raphistoma disciformis Tschernyschew?
 Raphistoma terrelli Cleland.
 Straparollus clymenoides? Hall.
 Trochonema monroei Cleland?
 Trochonema sp.
 Hyolithes alatus Whiteaves?
 Tentaculites sp.
 Orthoceras sp.
 Poterioceras 2 sp.
 Phacops sp.
 Proetus sp.
 Fish scales.

In all the Minnesota Devonian is known to contain seventy-seven species and some of them are probably new. The formation continues southward into Iowa where it is said to have a much larger fauna. It is apparently the equivalent of the Cedar Valley limestone of Iowa and this is a satisfactory formational name in Minnesota because much of it is found outcropping in the valley of Cedar River and its tributaries. It is possible, however, that the limits of the Cedar Valley limestone of Minnesota do not correspond exactly to those of the same formation in Iowa if the entire Minnesota Devonian is included in that formation.

The Devonian of Manitoba and the Mackenzie valley carry a few of the same fossil forms that are common in the Cedar Valley limestone of Minnesota. Unfortunately the fauna of that northern region is not as well known as might be desired. Whiteaves studies (7) have given a very good idea of several divisions especially that of the *Stringocephalus* zone in Manitoba and a fair knowledge of the same zone at the "Ramparts" on the Mackenzie River (8). Although the finding of two drift specimens of *Stringocephalus burtini* has been reported in Minnesota (9) the species is not known in the Devonian limestones of this state. In fact the Cedar Valley limestone fauna of Minnesota has nothing in common with the *Stringocephalus* zone except certain long range species that are likely to be found in the Middle Devonian of most any

part of North America. A comparison of the Minnesota fauna with that of other northwestern Canadian localities, as mentioned by Whiteaves (10), gives no more encouraging results. Whiteaves himself says, of his whole list



PALEOGEOGRAPHIC MAP OF THE NORTH AMERICAN REGION DURING LATE MIDDLE DEVONIAN.

from the Mackenzie valley, ten species are common to the Iowa (11) Devonian while twenty-two species are found in the Hamilton of Ontario and New York. This is a very significant suggestion as to the relationships of the north-

western Devonian faunas but there are still others equally suggestive. Of those common to the Iowa Devonian half are general Hamilton forms while most of the others belong in the fauna of the Lime Creek shales and are hardly to be considered the most characteristic Iowa Devonian fossils. And at any rate the Lime Creek fauna is quite different from the Cedar Valley fauna and decidedly a later development as far as North America is concerned. The *Stringocephalus* zone of Manitoba carries about 20% Onondaga forms but less than 5% Cedar Valley species. The later Devonian faunas of the northwest are also decidedly different from that of the Cedar Valley and appear to have even less in common with it. In short, so remote is the relationship between the fauna of the Minnesota Devonian and that known from Manitoba and the Mackenzie valley that the idea of a direct sea connection between these two regions, during the deposition of the Cedar Valley limestone, should be abandoned. Unless the studies at present being pursued in Canada by Dr. Kindle, in Iowa by Professor Thomas, and in Missouri by Dr. Branson, should show a closer relationship for the upper beds than is indicated by our present knowledge it is probable that the supposed sea connection across Minnesota during Upper Devonian should also be abandoned.

The buried granite ridge, which crosses central Kansas (12) in a north-northeast direction, was land during Devonian time and probably an extension of the land area of the Lake Superior region. In fact the pre-Cambrian of this latter region crosses Minnesota as a buried ridge and disappears, under the Sioux quartzite, near the southwestern corner of the state. While the sea evidently crossed part of this old mountain range during certain periods such as the Upper Cambrian and the late Cretaceous, there are no definite indications that any part of it was submerged during the Devonian and the lack of the expected relationship between the Devonian faunas on either side of the ridge seems to indicate that there was a land barrier in that region during the life of these faunas.

The Devonian is represented by 8000 feet of limestone and shale in the Great Basin. Its fauna is only partially known but Walcott (13) found it to be a large and varied

one with many similarities to that found typically in the Onondaga of New York and Ohio, but Hamilton and Chemung species are apparently not lacking in it. This relationship cannot be wholly accidental. But perhaps the most significant fact about this Devonian deposit is that it carries such a large percentage of species not known as a part of the eastern fauna. Many of these occur in the Iowa Devonian fauna especially in the upper beds. But there is still a considerable residue of forms most of which have not been specifically identified. It is in this latter that hope lies in an attempt to trace the Cedar Valley fauna, which probably has its ultimate origin in the Devonian of Russia and western Europe, or some region which supplied emigrant to all three of these areas. About 20% of the Minnesota Devonian species occurs in the fauna of the Great Basin Devonian and 30% more of it may be the same as those listed by Walcott (14). In the 6000 feet of limestone, which make up the lower division of the Devonian of the Great Basin, nearly the whole of Walcott's collection came from the lower 500 feet, thus leaving more than 5000 feet of massive limestone almost unexplored and a fruitful field for future research. The relationship that exists between the fauna of the Cedar Valley limestone of Minnesota and that of the Devonian limestone of the Great Basin, and somewhat more remotely of the middle Devonian of some of the Alaskan islands, has suggested the Paleogeographic map which accompanies this paper. It is in part a modification of one of Professor Schuchert's Devonian maps but it contains much for which he bears no responsibility. A map of this sort can only be suggestive of the conditions as they probably existed during any period or epoch. This follows from the fact that there has been so much erosion during subsequent time and this has probably removed all traces of the older deposits over wide areas, while land barriers that once existed have been likewise obliterated. Such maps are therefore subject to constant revision as new facts are discovered and new relationships become evident. The most striking fact that comes out during this study is the remoteness of the relationship between the fauna of the Cedar Valley limestone of Minnesota and that of the Devonian of Manitoba.

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