

## A Geological Palimpsest

Iowa is very, very old — as old as the hills, and older. So old, in truth, is this fair land that no matter at what period the story is begun whole eternities of time stretch back to ages still more remote. Seasons without number have come and gone. Soft winds of spring have caressed a dormant Nature into consciousness; things have lived in the warmth of summer suns; then the green of youth has invariably changed to the brown and gold of a spent cycle; and winter winds have thrown a counterpane of snow over the dead and useless refuse of departed life. For some creatures the span of life has been but a single day; others have witnessed the passing of a hundred seasons; a few giant plants have weathered the gales of four thousand years; but only the rocks have endured since the earth was formed. To the hills and valleys the seasons of man are as night and day, while the ages of ice are as winter, and the millions of years intervening as summer.

Through stately periods of time the earth has evolved. Mud has turned to stone, the sea has given place to land, mountains and molehills have raised their heights, and tiny clams have laid down their shells to form the limestone and the marble

for the future dwellings of a nobler race. Since the first soft protozoan form emerged in the distant dawn of life, myriads of types from amoebas to men have spread their kind through endless generations. By far the greater number have lived true to form; but a few have varied from the normal type the better to maintain themselves; and slowly, as eons of time elapsed, old species died and new ones came into existence. Thus mice and mastodons evolved.

"All the world's a stage" for the drama of life wherein creatures of every kind — large and small, spined and spineless, chinned, and finned — have had "their exits and their entrances" along the streams, on the plains, among the mountains, in the forests, and on the floor of the ocean. The theme of the play has been strife, and all through the acts, be they comic or tragic, two great forces have always contended. The one has aimed at construction, the other has sought to destroy. The air and the water were ever at odds with the earth, while the principal objects of animal life have always been to eat and escape being eaten. No one knows when the play began, no one knows the end; but the story as told by the rocks is as vivid as though it were written by human hand. This drama of life is the history of Iowa before the advent of man.

The record begins at a time when Iowa was under the sea. The only inhabitants were plants

and animals that lived in the water. Very simple in structure they were: it was the age of the algae in plant life while in the animal kingdom the noblest creatures were worms. The duration of time that the sea remained is altogether beyond comprehension. Slowly, ever so slowly, the dashing waves crumbled the rocks on the shore and the rivers brought down from the land great volumes of sand to be laid on the floor of the ocean. Ten millions of years elapsed, perhaps more, until at the bottom of the sea there lay the sediment for thousands of feet of proterozoic rock. This is the story as told by the Sioux Falls "granite" in northwestern Iowa.

After a great while the sea over Iowa receded. Then, for possibly two million years, the rocky surface of the land was exposed to wind and rain. Over the vast expanse of barren territory not a sign of life appeared. No carpet of grass protected the earth from the savage attacks of the water; no clump of trees broke the monotony of the level horizon: the whole plateau was a desert. As the centuries passed deep gorges were carved by the streams, and at last the down-tearing forces succeeded in reducing the land almost to the sea level.

Gradually from the south the sea encroached upon the land until all of Iowa was again submerged. Its history during the next ten thousand centuries or more is told by sandstone cliffs in Allamakee County. All sorts of spineless crea-

tures lived in the water. Crab-like trilobites swam to and fro, ugly sea worms crawled in the slime of Cambrian fens, the primitive nautilus "spread his lustrous coil" and left his "outgrown shell by life's unresting sea," while jellyfish and sponges dwelt in quiet places near the shore.

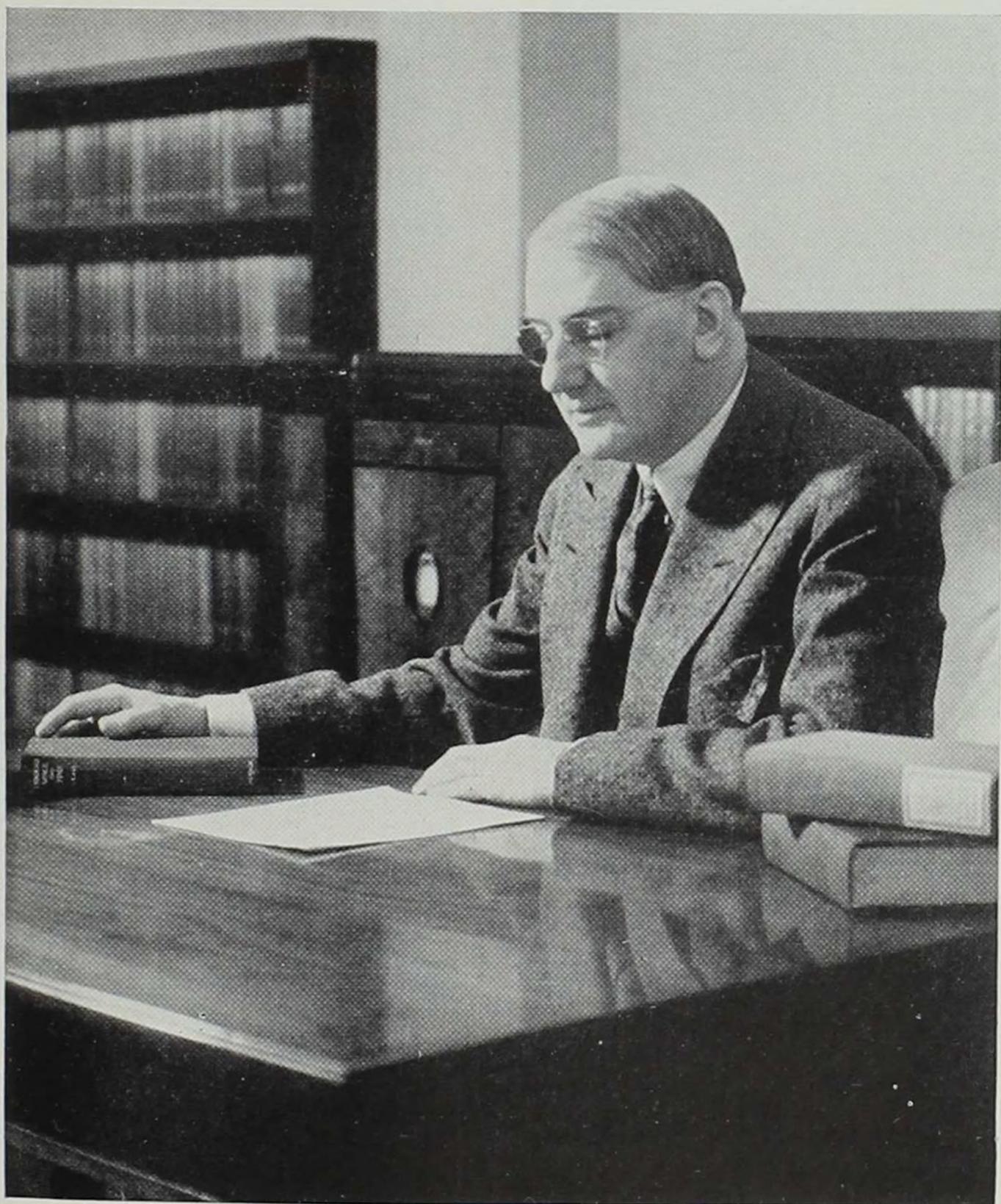
At last a new age dawned. The all-pervading sea still held dominion over nearly all of North America. So small was the area of land that the sand carried away by the streams was lost on the bed of the ocean. The principal upbuilding forces were the primeval molluscs that deposited their calcium carbonate shells in the shallow arms of the ocean. By imperceptible accretions the Ordovician limestones of northeastern Iowa were formed. Gradually the water receded and the newly made rocks were exposed to the weather. As the floods from summer showers trickled into the earth during the ages that followed some of the minerals were dissolved and carried away to be stored in cavities and crevices to form the lead mines for Julien Dubuque. That was millions of years ago.

Centuries elapsed while the Iowa country was a desert-like waste. Then again the sea invaded with its hosts of crabs, corals, and worms. Thousands of years fled by while shell by shell the Anamosa limestone grew. But as the world "turned on in the lathe of time" the sea crept back to its former haunts and the land once more emerged.

No longer was Iowa a desert. The time had arrived when living things came out of the water and found a home on the land. The ferns were among the first of the plants to venture ashore and then came the rushes. Forests of gigantic horse-tails and clubmosses grew in the lowlands. Slimy snails moved sluggishly along the stems of leafless weeds, while thousand-legged worms scooted in and out of the mold. Dread scorpions were abroad in the land.

It was the age of the fishes when the ocean returned and the process of rockmaking was resumed. Endless varieties of fish there were, some of them twenty feet long, and armed with terrible mandibles. Enormous sharks infested the sea where now are the prairies of Iowa. The crinoids and molluscs were also abundant. It is they, indeed, that have preserved the record of their times in the bluffs of the Cedar and Iowa rivers. He who will may read the chronicles of those prehistoric days in the limestone walls of the Old Stone Capitol.

Then came a time when the climate of Iowa was tropical. Vast salt marshes were filled with rank vegetation. Ugly amphibians, scaled and tailed, croaked beneath the dripping boughs and left their trail in the hardened sand as they fed on the primitive dragonflies millions of centuries ago. Cockroaches and spiders were plentiful, but not a fly or a bee had appeared. Giant trees, enormous ferns,



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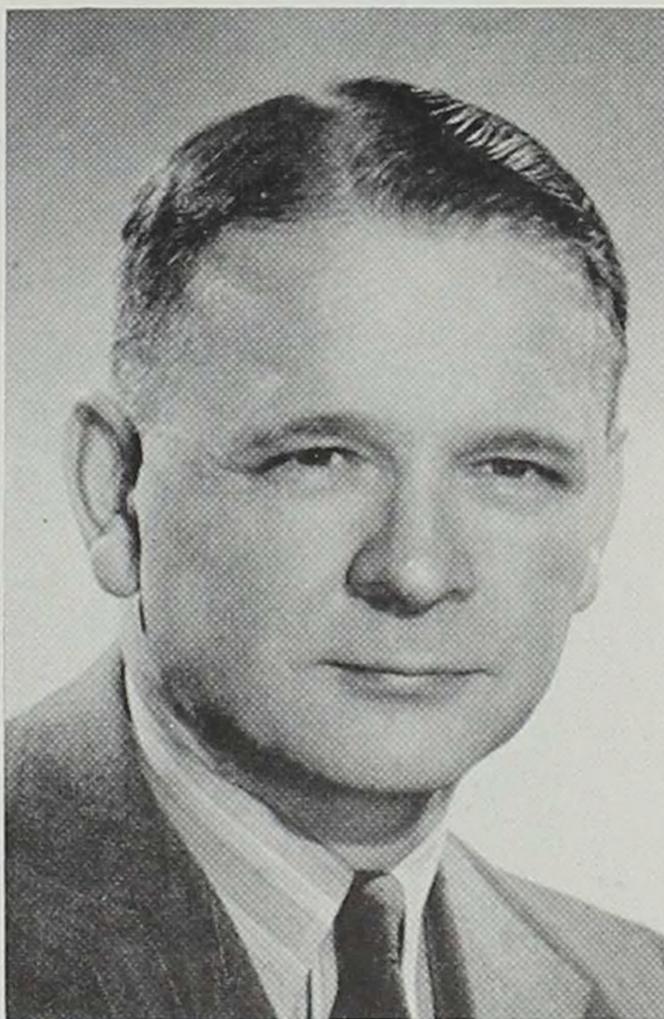


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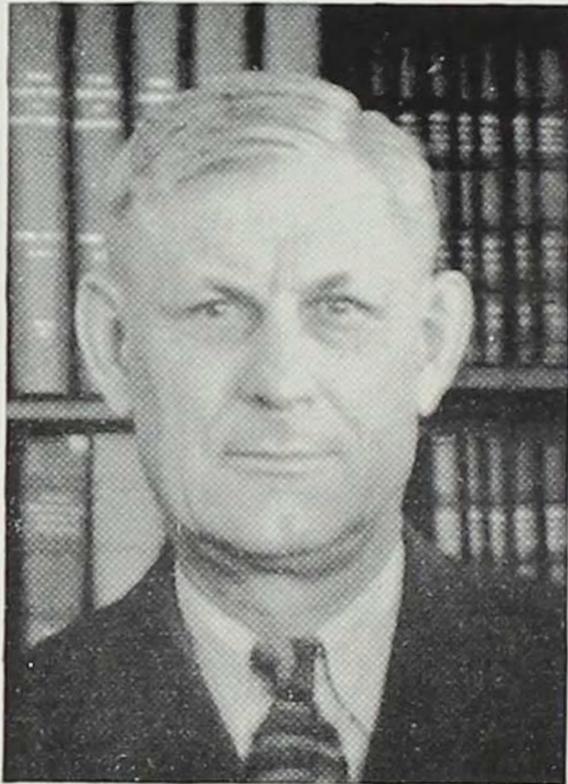


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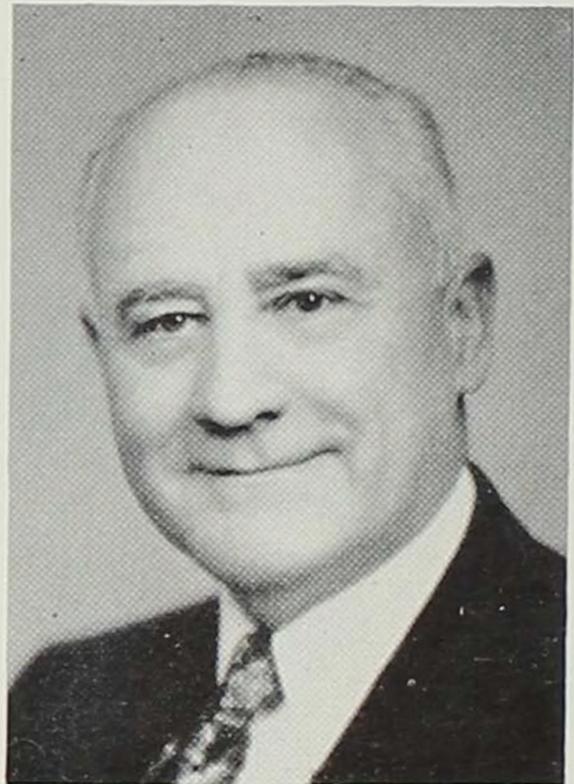


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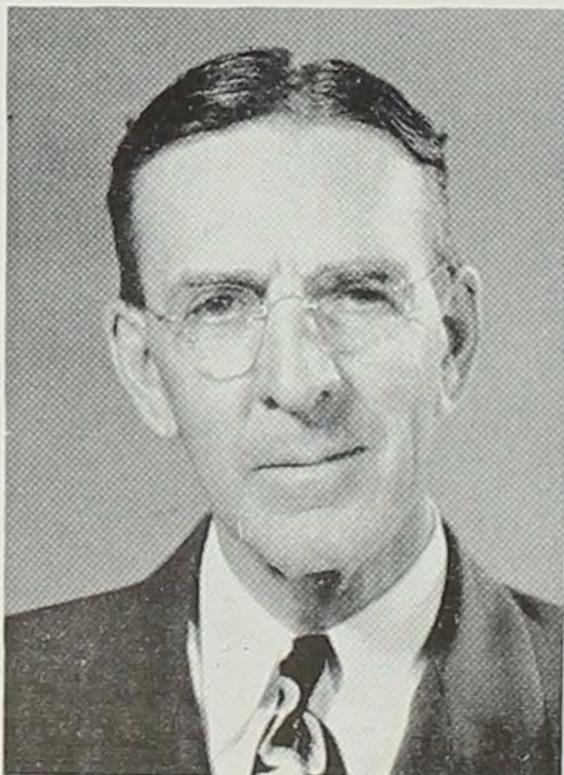
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and ever-present rushes stored up the heat of summer suns and dying, fell into the water. As thousands of years went by, the reedy tarns turned into peat bogs and slowly decomposition continued until little but carbon remained. Such is the story the coal mines tell.

But the old earth heaved amain, the Appalachian mountains arose, and here and there a great salt lake or an inland sea was formed. The supply of fresh water was exceeded by evaporation and so at the end of a long period of time only a salt bed remained or an extensive deposit of gypsum. So it has come to pass that in the age of man stucco comes from the Fort Dodge gypsum mines that were prepared at the end of the Paleozoic era.

Enormous segments of geologic time elapsed during which the sea had receded and Iowa was exposed to erosion. At first the climate was arid so that plant life was scarce, but as humidity increased vegetation developed apace. In the animal kingdom the reptiles were dominant. Crocodiles, lizards, and queer looking turtles were here in abundance. Gigantic and ungainly monsters called dinosaurs roamed over the land, while from the flying Jurassic saurians the birds were slowly evolving.

During countless ages the wind and water were engaged in their persistent work of destruction. Gradually the land was reduced to the sea level and the ocean crept in over Iowa. This time the

water was muddy and shale and sandstone resulted. As sedimentation progressed great marshes appeared by the seashore and finally the ocean receded, never again to encroach upon Iowa. In the west the lofty peaks of the Rockies were rising.

Permanently disenthralled from the sea and possessed of a favorable climate Iowa became the abode of the flora and fauna of Tertiary times. To the east the Mississippi River probably followed its present course, though its mouth was much farther north, but the streams of interior Iowa were not in all cases where we find them at present. The valleys were young and the drainage was very imperfect. Luxuriant forests of oak, poplar, hickory, fig, willow, chestnut, and palm trees covered the hills, while moss-mantled cypresses grew in the marshes. There were flowers for the first time in Iowa, and with them came the bees and the butterflies. The ancestors of squirrels and opossums busied themselves among the branches while below on the ground there were creatures that took the place of beavers and gophers. Giant razor-back swine and something akin to rhinoceroses haunted the banks of the streams. In the open spaces there were species that closely resembled cattle, while from others deer have descended. An insignificant creature with three-toed hoofs passed himself off for a horse. All sorts of dog-like animals prowled through the forests and howled in the moonlit wastes. Stealthy panthers and fierce

saber-toothed tigers quietly stalked their prey, while above in the branches large families of monkeys chattered defiance to all. Bright colored birds flitted in the sunny glades or among the shadowy recesses. Snakes, lizards, and turtles basked on half-submerged logs or fed upon insects.

The majestic sweep of geologic ages finally brought to an end the era of temperate climate in Iowa, and after hundreds of thousands of years ushered in the era of ice. It may have been more than two million years ago that the climate began to grow rigorous. All through the long, bleak winters the snow fell and the summers were too cool to melt it. So year by year and century after century the snow piled higher and higher, until the land was covered with a solid sheet of ice. The plants and animals suffered extinction or migrated southward.

As this ponderous glacier moved over the surface of Iowa it ground down the hills and filled up the valleys. Slowly the ice sheet moved southward, crushing the rocks into fragments and grinding the fragments to powder. At length there came a time when the climate grew milder and the ice was gradually melted. Swollen and turbid streams carried away the water and with it some of the earth that was frozen into the glacier, but much of the debris was left where it lay. Even with the slow movement of glaciers, still there was time during the ice age for huge granite boulders

to be carried from central Canada to the prairies of Iowa.

The first glaciation was followed by an interval of temperate climate when vegetation flourished and the animals returned as before. But the age of the glaciers was only beginning. Again and again the ice crept down from the north and as often disappeared. Twice the glacier extended all over Iowa, but the three other invasions covered only a part of this region. Rivers were turned out of their courses. At one time an ice sheet from Labrador pushed the Mississippi about fifty miles to the westward, but in time the river returned to its old course, and the abandoned channel was partly appropriated by the Maquoketa, Wapsipinicon, Cedar, and Iowa. Again, as the ice retreated great lakes were formed, and once for hundreds of years the waters of Lake Michigan flowed into the Mississippi along the course of the Chicago drainage canal.

The earliest glaciers laid down the impervious subsoil of clay while the later ones mingled powdered rock with the muck and peat of the interglacial periods to form the loam of the fertile Iowa farms. Probably a hundred thousand years have fled since the last glacier visited north-central Iowa, but the region is still too young to be properly drained, so nature is assisted by dredges and tile. It was during the glacial period that mankind came into existence, but no man trod Iowa soil un-

til after the last glacier was gone. Compared with the inconceivable eons of time since the first Iowa rocks were formed, it was only as yesterday that the ancient mound builders flourished.

Such is the geological history of Iowa. No one can say when the first record was made, but the story through all of the ages is indelibly carved in rock by the feet and forms of the mummied dead that lie where they lived. Age after age, as the sea and the land contended and the species struggled to live, the drama of the world was faithfully recorded. Sometimes, to be sure, the story is partly erased, sometimes it is lost beneath subsequent records, but at some place or other in Iowa a fragment of each act may be found. The surface of Iowa is a palimpsest of the ages.

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