Geology
of the
Snake Mountain Region.

James P. Tolman

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In the western part of Addison County, Vt. along the Lake shore, are patches of Utica slate, lying on Trenton limestone. Both dip westward. The Trenton limestone is slaty in its structure, very dark colored, and contains some characteristic fossils, the Leptaena sericea, Trinucleus concentricus, and Graptolites. East of the Trenton limestone is the Chazy limestone, lighter in color, and more compact in structure. It contains in places many fossils. The Maclurea magna is especially abundant, and there are many specimens of an Orthoceras. In this Chazy limestone, two or three miles from the lake, is an anticlinal axis. The report of the State Geological Survey says that this anticlinal is sufficient to bring up the Calciferous sandrock from beneath, at the village of Addison. I regret that I did not succeed in finding it, for I should have liked to compare specimens with the Snake Mt. sandstone.

In Panton the limestone is quarried for flagging, and the sidewalks of Vergennes are made of it. In Ferrisburgh there is a quarry where the stone is got out in very good shape for building. East of the Chazy the Trenton limestone appears again, retaining its former characteristics, but of course dipping east this time. The Trenton is overlaid by Utica slate, hard and black, and this is followed by Hudson R. slates and limestones.

This whole Champlain valley is very flat, and the rock is almost entirely covered by clay. The streams are very few and remarkably sluggish. So the opportunities for observation are not good, and in some places it is almost impossible to discover what the rock is. The Hudson R. limestone is the only well exposed rock, and that is seen in a series of little ridges, often nearly bare.

East of the Hudson R. formation comes the Snake Mt. a mass of sandstone, red above, and grey beneath. It is very hard,

and tough, and strikes fire with steel. It stands up in a ledge several hundred feet high, offering on the west side a blank red precipice, on the face of which may be seen from a long distance, the edges of the beds of stratification. The foot of the cliff is piled up with fragments of the same stone, to such a height that it is impossible to see what stone lies beneath. Though at some places in the ascent a black slate may be seen. And in the northern part of the state it has been clearly proved that the stone is resting unconformably on a black slate. The dip of the sandstone is about the same as that of the limestone west of it. The edges of the rock are arched, falling down to the north and south, and have about the same curve as the surface of the hill. The mountain ends in spurs to the north and south, being prolonged southerly for some distance in a series of bluffs having nearly perpendicular western faces, and very much resembling the parent mountain

in form. The eastern side of all these mountains is a wooded slope. The inclination is about that of the dip of the stone, not far from 20°. The crown of the mountain is wooded, except only a narrow belt along the top of the precipice. Half way down on the eastern side is a little flat place, two or three acres in extent, barren of trees, and surrounded by tall spruces. The soil here is a floating bog. It is a mat of roots and leaves, and is covered with cranberry vines and pitcher plants. A pole may be pushed through this root mass, and then goes very easily down its entire length. Poles as much as sixty feet long have thus been pushed down, without reaching bottom, or meeting with any increased resistance. When withdrawn they are wet, and perfectly clean. Stamping on the bog makes it vibrate for a long distance around. This large opening, high up on the side of a mountain, is regarded with much interest in the neighborhood. It is very likely a cleft caused at the time of disturbance when the rock

was thrown into its present position.

East of the red sandstone is a metamorposed limestone, named by Prof. Hitchcock, Eolian. This appears to lie directly on the sandstone, and to conform to it in stratification. This Eolian limestone is of great thickness. Several miles east of Snake Mt. there is a synclinal axis. The stone which comes up beyond the limestone is a quartz rock, but it is not certain that there may not be a slate between, for the junction is covered by a belt of Tertiary clays a mile wide. The quartz rock is followed by bands of talcose slate, and talcose conglomerate, and then a gneiss.

North-east of Snake Mt. is Buck Mt. also of red sandstone. This has north and south spurs like those of Snake Mt. Thus there seems to be a sort of break between the two mountains. The line drawn along the face of the cliffs of the Buck Mt. range would pass east of Snake Mt. and the line drawn along the cliffs of Snake Mt. would be parallel to the other, and about

two miles west of it. North of Snake Mt. the slates and limestones curve round, the strike changing by degrees from north to east. The curve is then reversed, and the rocks take their original strike parallel to the mountains.

The geological position of the red sandstone has for years been a subject of controversy. It appears to lie stratigraphically over the rocks of the Hudson period. The difference in dip is not great, and the appearance of the rock is not unlike that of the Medina group. The thickness of the formation is about the same as that of the Medina period in other places. The color is the same, and both rocks are almost barren of fossils. Moreover the formation is a continuation southward of the Quebec group of Canada, which was designated by the Canadian Survey as belonging to the Medina period. This arrangement has always been mistrusted by some, and has now been given up by the Canada Survey.

There is no apparent unconformity between this stone and the Eolian limestone next above, and if this were Medina, that should be Clinton, but the Clinton limestone is eminently fossiliferous, and this is almost without them. It has been maintained therefore that the limestone and sandstone together form one group, and that the Medina. The Vermont State Survey coincide in this view, so near as it expresses any opinion, and calls the rocks east of here Upper Silurian and Devonian.

There is probably no doubt that the quartz rock which appears east of the Eolian limestone is an older rock. So far as I can discover, no fossils have been found in it, except the Scolithus, and a Lingula. The received opinion has long been as published by the Profs. Rogers in 1841, that this was Potsdam sandstone. And where the fossils are so characteristic, it would be difficult to place it elsewhere.

The quartz rock is interstratified and

so closely connected with the talcose conglomerate which lies east of it that there is no question of their immediately joining. Yet I think the State Survey make a mistake in supposing a fold in the quartz rock. For this either makes the talcose rocks newer than the quartz rock, or supposes the whole of the red sandstone and limestone formation to have been overturned. That this whole formation has been overturned supposes an unwarrantably great commotion. Besides there are fossils rain marks on the sandstone, always right side up. And the talcose rocks on the east are succeeded by a gneiss evidently Azoic. We must then imagine the fold to have been supposed purposely to give ground for the Survey's theory that these Azoic rocks were much more modern. The Survey supposing the gneiss to belong to Hudson R. period or thereabouts. This whole theory has recently been relinquished in a pamphlet by one of

the heads of the Survey, which overthrows the positions taken, and the arguments drawn, throughout nearly the whole of a volume, by calling them typographical errors.

The rocks of the Potsdam period, where most fully developed, in the Appalachian range, consist of a conglomerate followed by a slate, then the white sandstone, or Potsdam sandstone proper, and the period closes with a second slate. These different rocks are not always fully developed; sometimes the whole group may be represented by one rock.

The lower part of this formation is represented in Vermont by the talcose conglomerate and talcose slates, followed by the quartz rock, which corresponds to the Potsdam sandstone. The upper part of the system is represented by the clay slate and Georgia slate of the northern part of the state. These rocks are known to overlie the quartz rock, farther north. That they do not appear here is probably because they are covered by the clays in Middlebury. These slates are the

same that underlie the red sandstone, as is easily seen further north.

It has been marked by Prof. Rogers in Pennsylvania, and elsewhere by other authorities, as at Chazy, N. Y. that the close of the Primordial system, or the Primal system of Pennsylvania, is marked by a slight disturbance, preceding the formation of the Auroral limestones. That is, at the close of the Potsdam period, and before the commencement of the Quebec formation, which consists of the Calciferous sandrock and the Chazy limestone.

This disturbance, which was very general, amply accounts for the want of conformity between the red sandstone and the underlying slates.

The second general disturbance took place at the close of the Hudson R. period. This is very evident in Pennsylvania, and is marked by the existance of extensive faults. And it is this disturbance which has caused the trouble in Vermont.

That there has been a fault here is evident, from the face of the country. The relative positions of Snake and Buck mountains, out of line, one thrown up here, another a little further west. The anticlinal, between the mountain and the lake, was made at the close of the Hudson R. period, else we should have some more recent rock, on the west, at least. Moreover a cleft, the line of the fault, is traceable says Prof. Emmons all the way from Bridport to Vergennes. Although I did not trace this cleft, I saw it in several places. I think then there is no doubt of the existance of a fault between the Hudson R. formation and the red sandstone on the east. And this is the opinion now held by the Canada Survey.

Mr. Perry, of Cambridge has recently published an article containing five "Queries on the Red sandstone of Vermont, and its relation to other rocks." The first is, "What is the Red sandstone of Vermont"? Dr Emmons, he says, long ago maintained

that it was Potsdam sandstone. And although other geologists have placed it in the Medina formation, the discoveries of fossils have led geologists very generally since 1861, to believe the rock to belong to the horizon of the Potsdam formation.

The second query is, "whether the sandstone is succeeded on the east by newer formations, that have been disguised, as to their age, by metamorphic action?"

Mr. Perry claims that the sandstone does not dip under the rocks on the east, but overlies them unconformably. That this is true in the case of the Georgia slates, which lie east of the sandstone in the northern part of the state, I do not doubt. But he has brought no evidence that the so-called Eolian limestone is not a newer rock than either the sandstone or slate.

The third question is, "if the sedimentary beds, which underlie the sandstone, are an extension of the Potsdam downwards?"

He notices the want of conformity in dip and strike, and the difference in fossils, and concludes, from this three-fold want of conformity, that the beds underlying the sandstone are distinct from it, and cannot be referred to the Potsdam period, or regarded as belonging to that formation. He accepts the Taconic theory of Prof. Emmons, and regards this rock as belonging to that formation.

Here I think he is mistaken. These slates are above the quartz rock, which is acknowledged Potsdam. The mistake is in placing the sandstone in the Potsdam age, without being first satisfied as to these lower rocks. The fact should not be overlooked that the Potsdam formation does not consist of a single sandstone, but where fully developed is a series, the upper member of which is a slate. Over this the Calciferous sandrock should lie unconformably, as here. And the Red sandstone of Vermont must be put in the

horizon of the Calciferous sandrock, and not of the Potsdam sandstone.

Mr. Perry asks as a fourth question, "What relation then, does the Red sandstone sustain to the underlying formation?"

He concludes that the rocks are so nearly related, that although not belonging to the same group, they should be contemplated as belonging to the same great zone of existance. And consequently that the Red sandstone must be regarded as an upper division of the Taconic system of rocks, that it follows the other group after a short interlude, forming a cap to the system. Thus violating the general law, that rocks in the upper part of a system are finer than those beneath, he would have this coarse sandstone, eminently the beginning of a series, follow as the upper member of a slate formation.

Fifthly, "as a final question, can the Red sandrock be referred to the Lower Silurian system of rocks?"

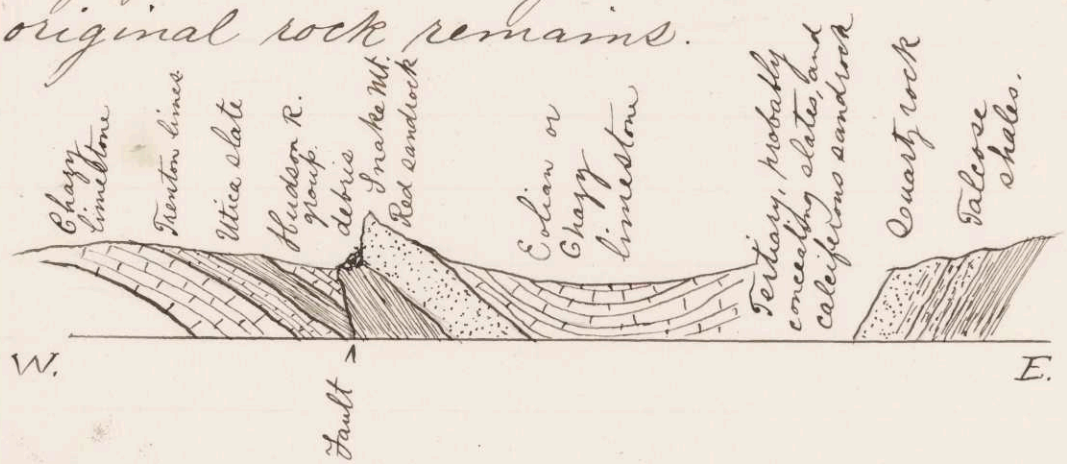
Noticing the want of conformity which usually exists between the Potsdam and Calciferous formations, and the change of fossils, he concludes that the Potsdam, or Red sandrock, should be regarded as an upper member of the Taconic system. And the Calciferous sandrock as the true base of the Champlain system.

I agree that the Calciferous sandrock should be the first of the series which ends with the Hudson R. group. That the Potsdam formation is distinct from it. But most of the rocks called Taconic belong to the Potsdam group, which may be called Lower Silurian or not. There certainly is a new period started with the Calciferous.

I shall then name the Red sandstone, Calciferous sandrock. The underlying slates, upper members of the Potsdam group. And the Eolian limestone, Chazy limestone.

I understand a disturbance to have taken place at the close of the Hudson R.

period. The great force of this disturbance was in the centre of the state, causing a westward pressure. This pressure caused the synclinal axis in the Eolian limestone and the anticlinal farther west. The fault between them was caused at the same time. The pressure being sufficient to throw up the mountains, bringing to the surface the Calciferous sandrock and the underlying slates. The denudation has since been very great, and only a small part of the original rock remains.



This section extends east farther than the map, going to E. Middlebury.