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GEOLOGICAL HORIZON OF THE KANAWHA BLACK FLINT

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RESULTS OF ROGERS' INVESTIGATIONS

To one of the nestors of American geology, the immortal William B. Rogers, we owe the first description of the Kanawha black flint of West Virginia. In his "Fourth Annual Report of Progress" of the Geological Survey of Virginia for the year 1839 he gives such a full and minute description of this remarkable stratum that little has been added by any subsequent observer. He did not define its exact place in the stratigraphic column, but by making it the dividing line between what he called his "Upper and Lower Coal Series," there can be very little doubt that he correctly divined its proper horizon.

VALUE OF THE FLINT AS A KEY ROCK

Unique in physical aspect, easily discerned, and almost constantly present in the section, it constitutes a most valuable key rock in the greatly thickened deposits of the region. Hence with proper care on

the part of the observer in keeping hold of the other members of the section below, as well as above this flint stratum, it readily leads to correct and accurate knowledge concerning the stratigraphic horizons of the principal Kanawha coal beds. For this reason it becomes a very important matter that such a conspicuous and valuable member of the Coal Measures should have its exact place in the geologic column determined beyond question.

Results of the first Investigations by the Writer

In 1884 the writer spent several months in the study of the Kanawha Coal Measures, collecting data for Bulletin No. 65 of the U. S. Geological Survey. In this work every stratum in the series from the Pittsburg coal near Charleston down to this black flint, as well as below it through the Pottsville series, was passed in review many times. As the result of this field study, the conclusion was reached that the Kanawha black flint marked a zone just above the Upper Freeport coal of the Allegheny formation, and I so published and described it in 1885 in volume VI of "The Virginias." This conclusion was deduced from purely stratigraphic evidence, based on a wide comparative study of the entire coal series of western Pennsylvania, northern West Virginia, eastern and southern Ohio, and the adjoining regions of Kentucky.

Investigations by Campbell and Mendenhall

In 1895 Messrs M. R. Campbell and W. C. Mendenhall, of the U. S. Geological Survey, undertook the task of classifying the Coal Measures on the New and Kanawha rivers. Their report was published in the Seventeenth Annual Report (part II, pages 479–511) of the U. S. Geological Survey. It contains many beautiful pictures, some observations on physiography, baselevels, and peneplains and some remarkable errors, but no detailed sections. Their net result in stratigraphy was to confirm in a general way what the writer had done ten years previously, and although dissenting from some of his identifications, they furnished no evidence against them. When they came to the problem of identifying and classifying the Kanawha series anew, they frankly gave it up in these words:

"Stratigraphically they can not be accurately subdivided without an amount of detailed work altogether out of proportion to the value of the results obtained."*

The writer will agree that it required an immense amount of detailed

* Page 499, loc. cit.

work to solve the Kanawha problems, and this work he performed in 1884.

Investigations by David White

After this complete surrender by Messrs Campbell and Mendenhall, they evidently turned the puzzle which proved too thorny for them over to Dr David White, the eminent palæobotanist of the National Museum and of the U. S. Geological Survey, who at the Washington meeting of our Society in 1899 read his paper, "Relative ages of the Kanawha and Allegheny series as indicated by the fossil plants,"* in which the problem of the black flint and of the Kanawha coals was attacked with the aid of palæobotany alone. His conclusions are in entire disagreement with mine. The stratigrapher and palæobotanist, each striving to discover the truth, have attained results diametrically opposed. David White places the black flint near the *base* of the Allegheny formation. The writer places it just above the *top* of the same. Hence the disagreement is vital, and one conclusion or the other is completely in error. It is a self-evident corollary that one or the other of us should revise his published statements, since it is not creditable to our science that its votaries attacking the same problem by two different paths should find themselves so widely apart in their conclusions that one of them has evidently missed the road entirely.

Concerning one of these warriors in behalf of science, I will gladly testify that he is brave, untiring, and honest, but in this case not sufficiently vigilant, since he was invading a new country characterized by exceptional conditions and environment (rapid subsidence and greatly thickened deposits), with which his old and trusty guides (fossil plants) were unfamiliar, and hence they piloted their general in the wrong direction—into confusion instead of order, into error instead of truth.

I do not call into question any of Dr David White's facts or plant identifications, for his skill and knowledge in palæobotany are beyond criticism, but only the interpretation of his facts in dealing with the problems of stratigraphy.

Recent Investigations by the Writer

METHOD EMPLOYED AND AREA COVERED

As already stated, my original conclusions concerning the place of the black flint were founded on the complete harmony of the stratigraphic column with the widely studied series in Pennsylvania, Ohio, Kentucky,

*Published in Bulletin of the Geological Society of America, vol. xi, pages 145–178.

and other portions of West Virginia, and not on the tracing of any particular coal bed or any other one member of the Allegheny formation across West Virginia from Pennsylvania to the Kanawha region. During the present year I have attacked the problem in question by direct tracing of the Upper Freeport coal and its associated strata from the Pennsylvania line along their eastern outcrops across to the Kanawha valley. In this I was entirely successful, and the result is a complete confirmation of my original conclusion with reference to the horizon of the Upper Freeport coal on the Great Kanawha, namely, that it is the first one below the black flint stratum, and hence this latter member belongs near the *base of the Conemaugh formation*, or just above the *top* of the Allegheny, where my studies in 1884 first placed it, instead of near the *base of the Allegheny*, to which position Dr David White has assigned it on the basis of fossil plants.

CHARACTERISTICS OF THE UPPER FREEPORT COAL

In this direct tracing the following elements enabled me to keep hold of the Upper Freeport coal:

First. The facies of the bed itself. It is always a multiple seam, with two or more divisions of slate or bone, the whole being characteristic to one who has learned to know a coal bed as one learns to recognize an individual from his physiognomy. This is an acquired faculty, and some people may reside on the Coal Measures all their lives and never attain it, just as some persons have difficulty in remembering human faces.

Second. The Mahoning sandstone series as a whole, which is easily followed from hill to hill in the topographic features it makes, even without recourse to its detailed lithologic structure, in which it possesses a peculiarity of its own very marked to the practiced eye.

Third. The Mahoning coal, a rather persistent member of the Conemaugh, occurring between the two members of the Mahoning sandstone at an interval above the Upper Freeport, varying from 40 to 80 feet.

Fourth. The Masontown coal, coming 10 to 20 feet above the top of the Upper Mahoning sandstone, its roof shales very rich in fossil animal remains at the north and in fossil plants at the south, and the coal itself always bright and pure, whether 1 foot or 4 feet in thickness, and nearly always present in the series at an interval of 120 to 200 feet above the Upper Freeport.

Fifth. A characteristic sandstone, 30 to 50 feet thick, overlying the Masontown coal and capping the highest summits along the outcrop of the Mahoning sandstone.

Sixth. The great "red bed horizon," which makes its appearance im-

mediately above the sandstone group and extends in a bright red band, as plain as a chalk mark on the floor, clear across the state, as well as through Pennsylvania, Ohio, and Kentucky, thus making a complete circle of red deposits, occupying always the same relative position in the center of the Conemaugh, midway between two important coal beds, the Pittsburg and Upper Freeport. In this red shale belt there also occurs an important fossiliferous limestone horizon, the "green crinoidal limestone" of the Pennsylvania series, which has been traced from central West Virginia northward to the Pennsylvania line and through southwestern Pennsylvania into Ohio and across that state without a break to where it reënters West Virginia again at Huntington. In addition to this, the oil-drillers have traced this red horizon underground across the state, since it caves readily and gives them much trouble. They term it the "Big red cave," and never fail to find it at the proper geological level.

STRATIGRAPHIC RELATIONS OF THE FLINT

Hence with all of this evidence from stratigraphy, there can remain no doubt as to the place of this flint at the base of the Conemaugh, and that the Allegheny series of Pennsylvania and northern West Virginia must be found *below* it in the Kanawha region instead of *above*, as concluded by Dr David White from his study of the fossil plants.

Analysis of David White's Conclusions

In the paper referred to, David White concludes that most of the Kanawha coals below this black flint are older than the Allegheny coals and intermediate between them and the Pottsville series, and that hence my correlations of them with the several members of the Allegheny must be completely erroneous.

In order to sustain this conclusion Dr David White was compelled to find a place for the Allegheny coals somewhere, so he cut off the lower half of the Conemaugh and said, here they are. It is not my intention to deal with the question of the equivalency of the Allegheny and Kanawha coals in the present paper, since this whole subject will be treated in detail in my forthcoming report on the coals of West Virginia now in preparation, and to be published during 1902 as volume II of the West Virginia Geological Survey, but it is proper here to show the inherent improbability of David White's conclusions with reference to this branch of the subject.

He will agree with me that the Lower Carboniferous beds, the Greenbrier limestone, and Mauch Chunk red shale thicken from 800 feet at

the northern line of the state to more than 2,500 feet on the Kanawha and New rivers; that the Pottsville conglomerate thickens from 450 feet to 1,400 feet in the same distance. He also agrees with me that the Allegheny series is 300 feet thick at the north, and that the Kanawha series is over 1,000 feet thick at the south. Why should the *expansion* of these sediments cease with the deposition of the Pottsville? Is it not more logical, aside from any evidence, to expect this thickening to affect the other formations above the Pottsville? In other words, that the 300 feet of Allegheny sediments and six coals at the north should merge into the 1,000 feet of similar sediments and the same number of coals at the southwest. Why should the analogy be interrupted and the Allegheny sediments *shrivel up* 150 feet when it is admitted that everything else below them has *expanded* more than threefold? Why should the Conemaugh decrease 200 feet in this direction instead of increasing by that amount, as my Charleston section shows on page 85 of Bulletin No. 65 of the United States Geological Survey? In this section there is given a measurement from the Pittsburg coal down to and including the black flint. This interval is practically a vertical measurement, since the Pittsburg coal is found in the summits of the hills only 2 miles north from Charleston, and the black flint passes below water level within the city limits. With due allowance for northward rise of the strata, the section foots up only 800 feet. The Conemaugh formation is seldom less than 600 feet in thickness at the northern line of the state, and frequently 650 to 700, and yet if we accept David White's correlation of the black flint as representing the Ferriferous limestone near the base of the Allegheny formation we are forced to believe that this 800 feet of strata at Charleston contains not only *all of the Conemaugh*, but also *nearly all of the Allegheny*, or, in other words, that in passing from the northern line of the state to the Kanawha, while the three other formations (Greenbrier, Mauch Chunk, Pottsville) have each *thickened up three or four fold*, and an intermediate formation (Kanawha) has *thickened* from 0 to 1,000 feet, the Conemaugh and Allegheny, which have a combined thickness of 900 to 1,000 feet even at the northern line of the state, have *shriveled up* to only 800 at Charleston. The mere statement of such a proposition is sufficient to raise very serious doubts of its truth, as well as to show the stratigraphic fallacies involved in Dr David White's conclusions from the standpoint of sedimentation alone.

But as my field studies on the question of tracing the coals below the Upper Freeport, southwestward from the Pennsylvania line to the Kanawha region, are not yet complete, I shall postpone the consideration of their equivalency in the two sections until another time.

The Masontown coal of the Conemaugh formation has proven a very

persistent member. Although frequently only 18 to 24 inches thick, it retains its characteristics as a bright, clean coal, and will furnish much fuel in commercial quantity between the northern line of the state and the Great Kanawha river.

It is mined frequently in Preston, Barbour, and Upshur counties by the farmers, and is always preferred by them to the Upper Freeport below.

In the vicinity of Sutton, Braxton county, this coal has long been mined and has furnished the principal fuel supply for the town, although only 2½ feet thick.

Through Webster and Clay counties it appears to be universally present at the proper geological horizon, and frequent openings have been made on it by the farmers.

At Clay Court House it comes just above the great cliffs of Mahoning sandstone, at about 375 feet above Elk river, and is between 2 and 3 feet in thickness, though a few miles below, on the lands of Mr Thompson, it has thickened up to 40 inches.

At Queen Shoals, near the Clay-Kanawha county line, on Elk river, this coal is mined on a commercial scale and shipped by rail to western markets. It is so highly prized that orders for it cannot all be filled. It lies here about 175 feet above the black flint which in emerging from the bed of Elk river makes the "shoals."

The same coal is mined near Clendennin, and also at the Graham and Mason mines, in Kanawha county, and is the horizon from which Dr David White obtained the plants listed on pages 170, 171, etcetera, loc. cit.

At North Coalburg, on the Kanawha river, this coal is termed the "Big bed," and is extensively mined. Its interval there is 175 feet above the black flint by accurate measurement, according to the levels of Mr C. C. Lewis, of Charleston, West Virginia.

This Masontown Coal horizon is unquestionably in the Conemaugh formation, entirely above the Mahoning Sandstone group, and yet on pages 172–173, loc. cit., its flora is referred by Dr David White to the Kittanning horizon, while the flora of the same coal at Clay Court House is referred to the Freeport group. It is needless to say that such results discredit the use of fossil plants for refined stratigraphical determinations, and must continue so to do until the coal flora and its geographical diversity are more completely known.

Stratigraphic Corollaries

In concluding this discussion the following important corollaries should be noted by every geologist interested in problems of stratigraphy:

1. Some individual coal beds, limestones, and sandstones can be followed and identified for hundreds of miles, in the Appalachian basin at least, and hence the doctrine that no coal bed can be certainly identified by stratigraphic methods beyond the limits of a small, circumscribed area is both erroneous and mischievous, leading to confusion and useless duplication in nomenclature instead of to order and simplicity.

2. When stratigraphy and palæobotany disagree, the latter must yield, since the few fossil plants we know can be only a tithe of those which must have existed, and hence we cannot reason with absolute safety upon such incomplete data.

3. Until we can know the Coal Measure flora more fully, and can work out its geographic distribution with more accuracy than is now possible, it must prove an uncertain and misleading guide to the correlation of distinct coal seams and horizons when widely separated, unless checked and controlled by stratigraphy. In other words, owing to the imperfection of our knowledge, palæobotany should be used only as an aid in supplementing the work of stratigraphy when we come to the detailed identification of individual coal seams or even groups of these beds.