

A PROBABLE FAULT NEAR BRETZVILLE, DUBOIS COUNTY, INDIANA

GEORGE WHITLATCH, Indiana University

During the past summer (1930), while engaged in the investigation of the clay resources of Indiana, the writer found a structure just north of Bretzville, southern Dubois county, that exhibits very peculiar relations. At the moment, believing that the structure was probably well known in geologic literature, only casual interest was aroused. Later, however, on finding that the literature contains only a single meager description of the structure, and that at variance with the writer's observations, it was felt that further consideration should be accorded this abnormality. Consequently, a second visit to Bretzville was made in order to study the structure in greater detail. This additional study has further emphasized the very peculiar structural conditions existing at this place and has added much valuable evidence for the view that the structure is a result of faulting.

Review of Literature. The railroad cut just north of Bretzville, in which the above structure is exposed, has been described by J. A. Price in the report on the coals of Dubois county. He describes it as follows: "In the cut north of Bretzville, the coal measured 32-34', with 2-4" of discontinuous shale above, 6-8" of light reddish shale to shaly sandstone above the shale and shaly sandstone, and above this last mentioned shaly sandstone occurs 6-8' of shale. The coal has a decided dip to the west at this point, dipping probably 4-5' in 50 or 60 yards. At the west end of the cut the strata are somewhat distorted. Coal II has dipped beneath the surface and 7' above the railroad track is an exposure of a broken ledge of whitish sandstone, 12-15" thick. In this sandstone ledge occur streaks of coal sometimes 2 inches thick. This coal outcrop is best seen along the south side of the cut where it is exposed for 40' or more with a dip to the east, 3 feet or more in 15 feet. Above the coal at one place is a broken ledge of whitish sandstone, 1-3' thick and 20' long. Below the coal is an outcrop of 6' of shale to shaly sandstone. Just east of the center of the cut the rocks form a trough, as seen on the south side, and on the west side of the trough, near the top of the cut, are two large impure limestone boulders.¹"

Location. The above structure is located in a cut on the Southern Railway just north of Bretzville, a railroad station 3 miles east of Huntingburg, southern Dubois county. The railroad runs practically due east and west at this point and is crossed at right angles, by means of a wooden overhead bridge, by the north-south road to Ferdinand and Jasper. The cut in question is directly below this bridge. As the railroad passes approximately one-eighth of a mile north of the cross-roads known as Bretzville, the cut is thus located in the southwest quarter of the northeast quarter of Section 32, Township 2 South, Range 4 West.

Topography and Geology. The topography of southern Dubois county is fairly rugged with hills rising in places to heights of 75 to 150 feet or more. In passing through this area, the Southern Railway has been forced to make numer-

Proc. Ind. Acad. Sci. 40: 251-257. (1930) 1931.

¹23rd Ann. Report, Ind. Dept. Geol. Nat. Resources, 1898. (Geo. H. Ashley), pp. 1123-24.

ous cuts, some of considerable depth. Most of the more rugged portions of the area are characterized by long ridges of fairly uniform slope, as would be expected in a region of sandstones and shales. Southern Dubois county has not been glaciated and outcrops of Pennsylvanian (Pottsville) rocks, which underlie the area, are numerous. The normal dip of this region is to the west.

Description of Cut. The north-south road to Ferdinand and Jasper follows the crest of a long ridge in the vicinity of Bretzville. The top of this ridge is slightly flattened, with the west side somewhat the higher. The slopes of the ridge are fairly uniform. The Southern Railway passes through this ridge, by means of a cut, in an east-west direction for a distance of approximately 675 feet. The cut is about 30 feet deep at the point of maximum depth.

Of the two sides of the cut, the north side is freest of debris and the position of the strata is plainly visible. The structural conditions exhibited on the north

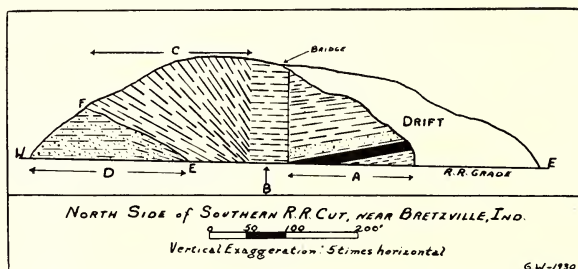


Fig. 1.

side are almost startling. The eastern half of the cut (Section A—Figure 1), measured from the eastern end of the cut to the bridge, is about 320 feet in length. For practically half of this distance westward from the eastern extremity of the



Fig. 2.

Fig. 2. View of east end of Southern Railway cut near Bretzville, showing steep dip of coal bed. Top of coal indicated by man's hand—coal disappears at overhead bridge due to faulting.

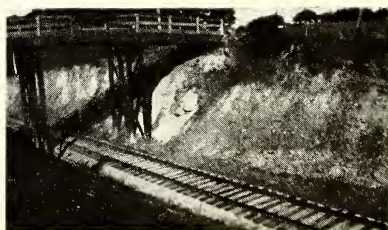


Fig. 3.

Fig. 3. View of north side of cut at overhead bridge, showing fault relations of "block" and eastern half of cut. Light portion directly beneath bridge is horizontal strata of "block." West dipping coal bed and its associated strata are to the right of "block."

cut, the strata are obscured by heavy drift. At a point about 150 feet east of the bridge, a coal, 32-34 inches thick, and 2-3 feet of associated dark gray underlay are exposed and are unobscured for the remaining 160 feet to the bridge where they disappear. This vein of coal has a west dip of 4-5 feet in 160 feet. Above the coal,

and conforming to the west dip of the coal is a succession of thin sandstones and shales. Six to eight inches of gray shale lie directly over the coal; above the shale is three feet of decidedly disconformable sandstone; overlying this sandstone is 15-20 feet of brown, sandy shale. The three feet of thin sandstones of the above section become more shaly in character as the bridge is approached. The south side of the eastern half of the cut is practically identical with the north side in dip and sequence of strata.

The above succession of west dipping strata end abruptly against a "block," some 50 feet in width in which *the strata lie practically horizontal*. Except for a small mass of thin sandstones directly under the bridge, at a height of six feet above the railroad bed, this block of horizontal strata is composed of shales similar to those in the eastern half of the cut, i.e., the shales are sandy and brown in color. The strata of this "block" meet the west dipping strata of the eastern portion of the cut in a very definite vertical line. (See Section B—Figure 1).

The west side of this "block" ends in a more or less well defined line, bringing up suddenly against 25 feet of similar shales *that dip to the east at an estimated*



Fig. 4.

Fig. 4. Highly inclined shales as exposed on north side, west end of Southern Railway cut near Bretzville. Dip is to the east.

dip of 20-25 degrees. The highly inclined strata of this western portion of the cut do not meet the strata of the "block" abruptly but seem to have a lessening dip over a distance of 4-5 feet as the horizontal strata of the "block" are approached. This flattening of dip ("E"—Figure 1) resembles a drag zone along the plane of movement of a fault. The ends of the strata of the block appear to have been dragged upward in this zone "E", and if such is actually the case, this drag would account for the apparent flattening of dip of the highly inclined strata to the west. A second factor which lends strength to the theory that this zone has been subjected to faulting is seen in the large number of vertical joints in the highly inclined shales. The vertical jointing has divided the shales into blocks, the effect of jointing being more pronounced towards the zone of junction of Sections C and B.

These highly inclined strata of Section C appear to lie upon a semi-triangular shaped mass of sandstones and shales. The base of this mass extends from the extreme west end of the cut to a point some 150 feet east where the sandstone grades into the highly inclined shales. The lower three feet of this mass consists of fairly massive, gray sandstone, highly crossbedded. The crossbedding of this lower three feet of the sandstone makes it difficult to determine the point at which the shale and sandstone meet. The upper portion of this triangular mass is composed of 5-10 feet of thin bedded, nearly horizontal, yellow sandstones and some

shales. The entire mass of shales and sandstones of this extreme western part of the cut seem to dip slightly to the east as the highly inclined strata are approached, although the junction of Sections C and D is rather indefinite. The line EF (Figure 1), however, does have some appearance of being a shear plane, i.e., that Section C might have sheared towards the east over the triangular mass D.

The stratigraphical relations on the south side of the cut are not so well exposed as those of the north side. (Figure 5). As noted above, the eastern half of the south side has practically the same relations as found on the north side, i.e., the coal and the overlying sandstones and shales dip to the west. At the bridge on the south side, opposite the "block" of the north side, the relations are much masked by drift, but there is apparently a block of nearly horizontal shales which abruptly meets the west dipping beds of the eastern half of the cut. This "block" of the south side is of considerably less width than the "block" on the north side; its width probably does not exceed 10 feet, whereas the north side "block" had a width of some 60 feet. The west side of this smaller block, similar to the conditions on the opposite side of the cut, meets a mass of shales, highly inclined to the east, which extends west for about 30 feet. The true conditions are so masked

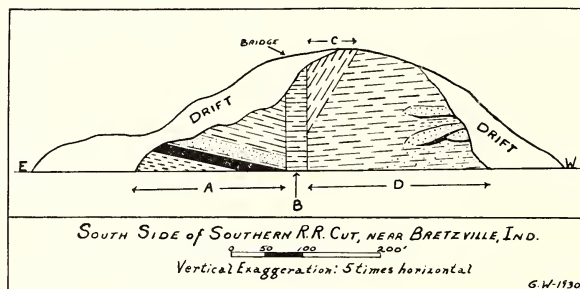


Fig. 5.

by drift that it is impossible to determine whether there is a drag zone at the point of contact of the "block" and the highly inclined strata. A small ravine has cut down through the steeply dipping strata and exposed the shale along its course. Shear planes are evident in the shale at that point. The planes dip steeply toward the southeast indicating some movement in that direction. The jointing noted in the highly inclined shales of the north side is equally well developed on this south side. Fifty feet west of the bridge the relations are less obscured. From this point west to the western end of the cut, the entire section is revealed as brown sandy shale, except for two lenses of sandstone and three small veins of coal at the extreme west end. The shale has a fairly uniform dip of approximately 10 degrees to the east.

The sandstone lenses mentioned above are about 100 feet from the west end of the cut. The lower lense lies about 8 feet above the railroad bed; it is composed of whitish sandstone, two feet thick in its eastern extension, and is underlain with 3-4 inches of coal and 5 to 6 feet of shale. The lense has a dip to the east, conforming to the dip of the shale that encompasses it. This lower lense is exposed for a distance of 30-40 feet, and as it is traced to the west, the sandstone splits into two small lenses which are separated by streaks of coal, 1-2 inches thick. This

portion of the lower lense is overlain by 2 feet of gray underclay, 1 inch of coal, and a second lense of whitish sandstone, 2-3 feet thick, that has a slight dip towards the west. These sandstones and coals lense out to the east, and although it is impossible to trace their westward extensions to the end of the cut due to the thickness of drift, they apparently pinch out in that direction also.

Discussion and Conclusions. It would be unwise to attempt to draw any final conclusions in regard to the above feature at Bretzville, since the present data are too meager and insufficient to justify such procedure. Practically anyone who has had occasion to make correlations based upon data from the Pennsylvanian strata will realize the danger of drawing conclusions based upon the study of small areas. The same is true in a measure for all conclusions, as generalizations require study of a structure both as an isolated unit and as a unit of the regional structure; but the rule is particularly applicable to Pennsylvanian structures. Change of character of sediments due to depositional factors is, at times, bewildering in the Coal Measures. It is not unusual to find shales changing into sandstone along the same horizon within incredibly short distances. Much of the coal of this period was laid down in small basins, many of which were steep sided, the result being that often the strata of these basins have steep dips. Again, horizons are not continuous over wide areas but are often interrupted, due to erosion periods during times of emergence. Consequently, it is evident that any conclusions regarding the structure at Bretzville must necessarily involve further investigation of the surrounding area adjacent to the structure.

Despite the inadequate nature of the present data, the writer does feel that certain assumptions based upon the observed facts are justifiable. In making such assumptions in an attempt to give a possible explanation of the origin of the Bretzville feature, the writer wishes it to be clearly understood that both the assumptions and the suggested explanation given below are not necessarily true. They are merely an attempt to explain the structure on the basis of present knowledge; future study may reveal facts out of harmony with the following explanation.

In the first place, the conditions existing in the cut at Bretzville may be ascribed, at least in part, to the presence of a small coal basin and its attendant depositional features. The high dip of the coal and its associated strata in the eastern end of the cut may be due to the original dip of the basin in which these sediments were laid down. The east dip of the western half of the cut may also be partially explained in this manner, particularly D of Figure 5 of the south side. Possible supporting evidence for this assumption is seen in the thin veins of coal at the west end of the cut. The basin may have been very steep sided on the western side since some known coal basins of Indiana are of this type. However, the idea of a coal basin does not explain the "block" of horizontal strata found at B on both sides of the cut, the drag of this block on the north side and the shear planes on the south side, the vertical jointing of the shales just west of the "blocks," and the portions of highly inclined shales. Were the structure due to deposition alone, one would expect more or less uniformity of relations between the north and south sides of the cut—relations that are conspicuous by their absence.

We are thus forced to seek for other factors that may have aided in producing the present features. The cut, when viewed in its entirety, presents the appearance of having been subjected to faulting. It is, therefore, a logical assumption to ascribe the present abnormalities to faulting within a coal basin. The block

diagram, Figure 6, is a hypothetical attempt to illustrate the probable faulting within a portion of this coal basin and the relation of the form of the basin to the present features now exposed in the railroad cut near Bretzville. This diagram is based upon the structural relations of the north side of the cut.

The coal basin depicted in Figure 6 is assumed to have a fairly uniform but rather high dip to the west in its eastern extension, but to rise sharply to the west. This assumption is based upon the presence of the nearly horizontal sandstone mass, D, that is exposed at the west end of the cut, the mass being considered a part of the steep side of a coal basin. A further assumption is made that this steep side, being a part of an irregular basin, does not extend north and south but runs northeast-southwest at this point; hence the absence of a similar mass on the opposite (south) side of the cut. The influence of this steep side in developing the present relations of the cut is important. The sediments deposited in the northwest part of the basin were laid down over a steeply inclined surface. As a consequence of such deposition, the strata of shales at this point, previous to the faulting, were already dipping strongly to the east. (C—Fig. 6). The shales

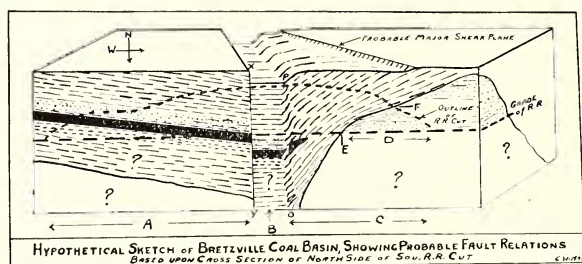


Fig. 6.

a short distance to the south (those exposed at D—Fig. 5), being deposited on a more gentle slope of the west side of the basin, possessed a lower dip to the east than the corresponding strata to the north. These differences of dip due to original deposition upon high and lower portions of the basin floor would seem also to account for the coal streaks found at the west end of the cut on the south side and the absence of such on the north side. To the north and west the coal probably pinched out rapidly, due to the steep dip of the basin, whereas the coal deposit thickened to the south, although even there one sees the rapid thinning of the coal to the west.

The initiation of stresses which resulted in the faulting of this area is not pertinent to our problem; it is sufficient to say that movement likely began along the plane of X-Y, Fig. 6, and a little later, along the plane of O-P. The plane of X-Y is sharp, with no notable evidence of excessive drag. We can assume from such criteria that this eastern side (X-Y) of the "block," B, suffered a sharp fracture along its entire vertical plane of movement. The result of such a clean break would be more rapid displacement of the east side of the block than along the west side (O-P) in which the displacement was retarded by excessive drag. The drag zone along O-P indicates such a relation attending the down-faulting of B. The ultimate effect of this differential movement of the two sides of the block was

a slight up-tilting of the west side of the block until the strata were practically horizontal as now exposed.

The displacement of B and the consequent drag of the strata along O-P set up definite stresses, principally of tensional character, the components of which were downward and horizontal (eastward). The effect of this tension is well exhibited by the vertical jointing of the shales in the portion of the cut marked "C." The strata of C, being already highly inclined, were easily affected by these stresses and sheared eastward as well as downward along the plane of E-F. The net result of this shearing was an increase of the high dip of these strata in the northwest portion of the basin. The strata to the south, not possessing an original high dip like those to the north, did not shear so readily and were not disturbed over so great a lateral distance. An additional reason for the shales being inclined over a zone of less width on the south side is seen in the fact that the fault block, B, narrows to the south. The cause of this narrowing of the fault block to the south is not known.

Such are the probable conditions that prevailed during the faulting of the Bretzville coal basin. The above hypothesis of the origin of the present structural features of the cut near Bretzville will explain most of the features of the structure, but there are some factors still unknown that no doubt would throw much light upon the problem. The amount of displacement of B, the true direction of the faults, and their extent are among the factors which might be determined by study of the surrounding areas. The foregoing theory of the development of the structure is confined to the consideration of the structure itself. No consideration has been given the regional structure. This should be done and no theory of the above structure should be considered as final without such a study. For instance, the Bretzville feature may be a fault as suggested but may also be related to a major regional fault. The suggestions of certain oil geologists, who have worked in this territory, that "there is something wrong in the vicinity of Bretzville," would seem to support the possibility of major faulting in southern Dubois county. It is hoped that future study may be made of this region and that the true relations of the feature at Bretzville may be solved.

