

# THE NORTH CRAVEN FAULT: GEOLOGICAL STRUCTURES OF COWSIDE BECK (BLACK HILL), YORKSHIRE

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## INTRODUCTION

THE area of study is the upper section of Cowside Beck east of Cowside Farm (SD 843 666). Fig. 1 provides the geological setting and O'Connor (1964) describes in detail the area around Malham Tarn. From the Settle-Malham Tarn road the Beck appears merely to channel the surface of a thick cover of glacial drift, which partly conceals a wealth of major and minor structures in the bed and banks of the stream. Some are well known but most recorded in this paper have not previously been described. The work centres around the major structure, the North Craven Fault, the northernmost member of the Craven Fault System bounding the southern edge of the Askrigg Block (The Pre-Carboniferous basement). The fault crosses the stream at three places, bringing into juxtaposition Carboniferous and Silurian strata. The latter consist of cleaved sandstones and siltstones of Wenlock age, while the former are dark limestones and shales from the cyclothemic Yoredale series.

Since no rock is exposed in much of the stream bed and the area close by, no correlations have been attempted. Because we are mainly concerned to record the various structures exposed, fossils are only briefly considered.

## FIELD DESCRIPTION

The tree lined section immediately to the east of the road bridge (845667) has no exposures, but between the coppice and the first major bend in the stream thinly bedded Yoredale limestones gradually change their dip upstream, curving round from a northerly to a north-easterly direction. Interestingly, the curve of the stream bank follows exactly the change in strike (Loc. 1; Figs. 2 and 3). The limestones vary from fine to coarse grained, are crinoidal in places and weather white. The swinging around of the beds appears to be a drag effect caused by a fault easily located by an abrupt change in dip (Loc. 2) and by an increase in the intensity of the calcite veins that affect the whole locality. The position of the fault on the north bank is marked by brecciated limestone, heavily veined with calcite, slicken-sided and mineralized with pyrite. On the south bank, the line of the fault is hard to see, because of a zone of large limestone blocks, but a low unusual slumped area in the bankside suggests that it runs south-south-easterly. Further bank evidence suggests that this is one of two branches, the other striking south-south-east, with the block zone enclosed in the wedge between.

There is no further exposure until Loc. 3 (Table 1), above which a straight pool section of 24 m. ends at Locality 4 in a shallow synclinal flexure of Yoredale limestones with an axial strike of  $151^\circ$  and a plunge of  $10^\circ$  in the same direction; a

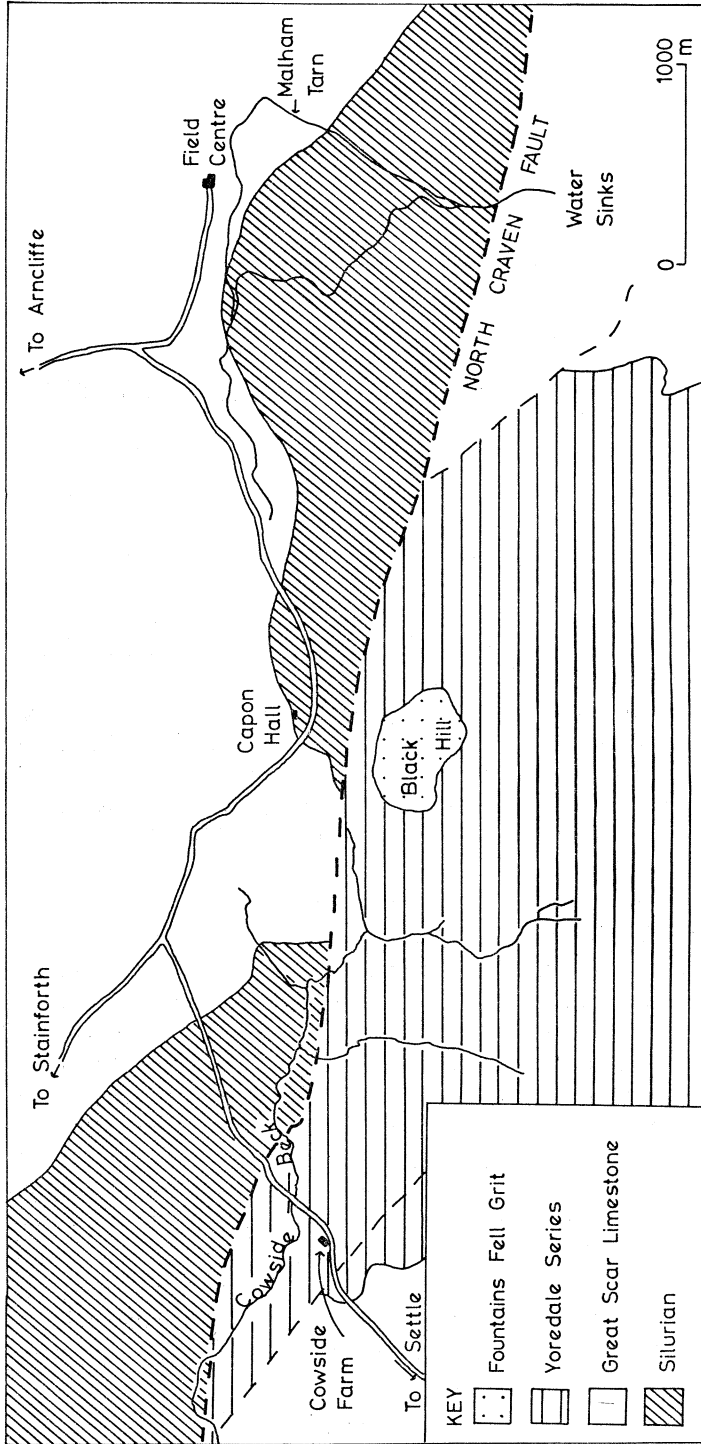


FIG. 1.  
Geological setting (after O'Connor, 1964).

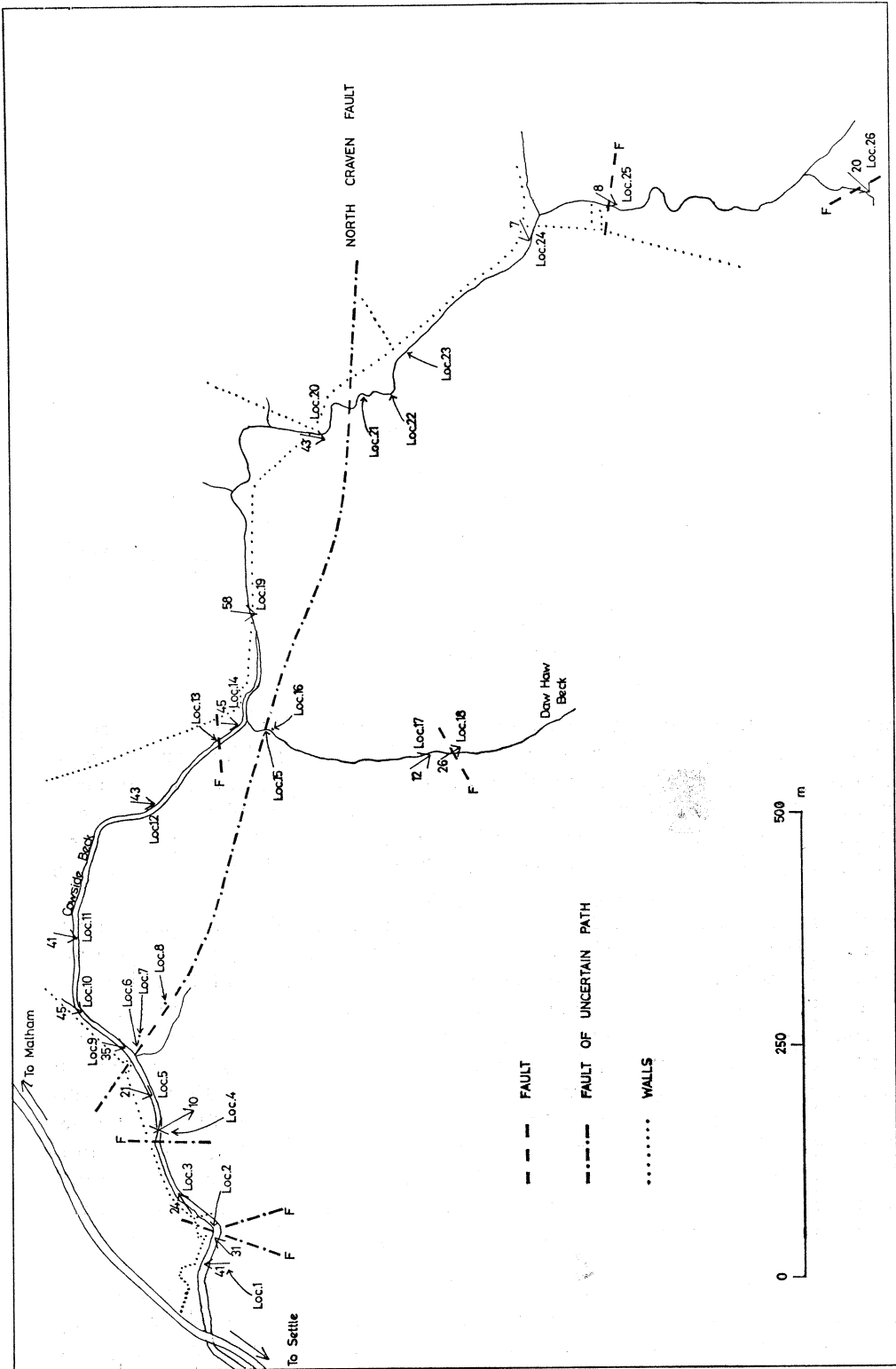


FIG. 2.  
Details of localities mentioned in text. Based upon the Ordnance Survey Map with the sanction of the Controller of Her Majesty's Stationery Office.  
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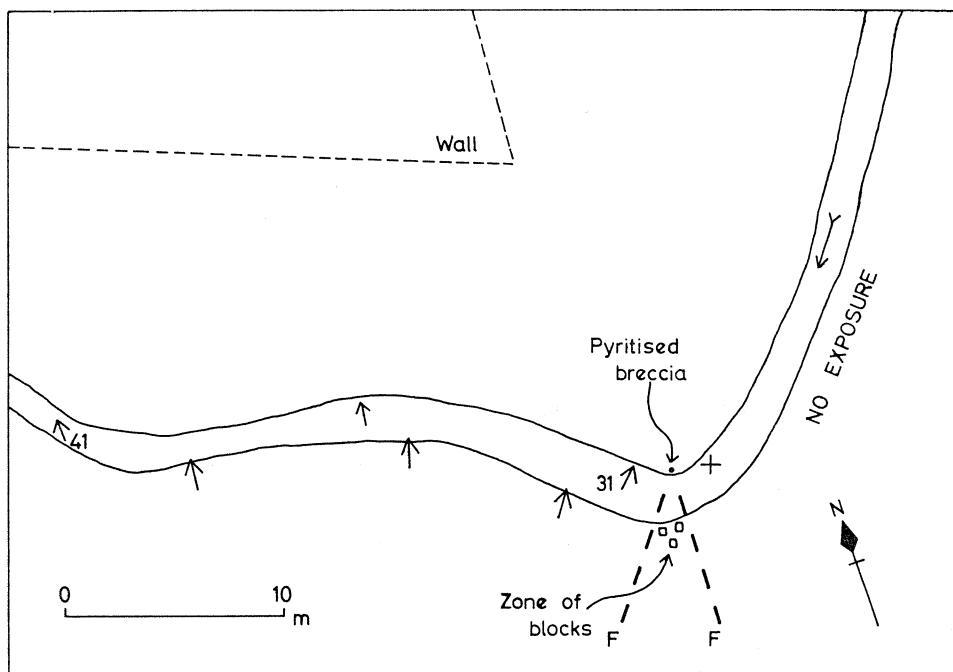


FIG. 3.  
Field evidence at Location 1.

dominant joint system trends at  $169^\circ$ . The downstream edge of this outcrop forms a low cascade in the stream and the face displays oblique slickensiding, suggesting a fault, as does the sudden appearance of the synclinal flexure itself and, in the south bank just downstream, a 6 m. wide zone of dolomitized limestone blocks with calcite veining. A fine weathered compound coral is exposed in a small gully just here. Upstream, the last limestone outcrop before the North Craven Fault, seen at Loc. 5 (Table 1) is part of the easterly limb of the synclinal flexure.

Opposite the derelict sheep fold a dolomitized, cemented, fault breccia of large blocks associated with the North Craven Fault forms a striking rib-like feature running north-eastwards up the valley side (Loc. 6 and Figs. 2 and 4) and has its steeply inclined westerly face smoothed by strong oblique slickensiding. This breccia zone is more extensive than previous workers indicated. On the western side of the rib a tributary rivulet trickles through a jumble of breccia blocks which increases in width up the gully and eventually disappears beneath thick rush-covered drift. The course of this rivulet may follow the original line of the fault zone. The maximum width of the brecciated zone is 14.5 m. Weathered Silurian sandstone outcrops 5.8 m. east of the rib (Loc. 7) so that the North Craven Fault must run through the intervening gap although the junction is hidden. The same weathered Silurian material close to the fault can be found up the valley side 16 m. away (Loc. 8).

Fine exposures of the Silurian start in Cowside Beck 24.5 m. upstream from the rib (Loc. 9). Blue-black cleaved siltstones with bedding indicated by colour banding are veined with calcite. In a true slate, large surfaces are cleavage planes, but here

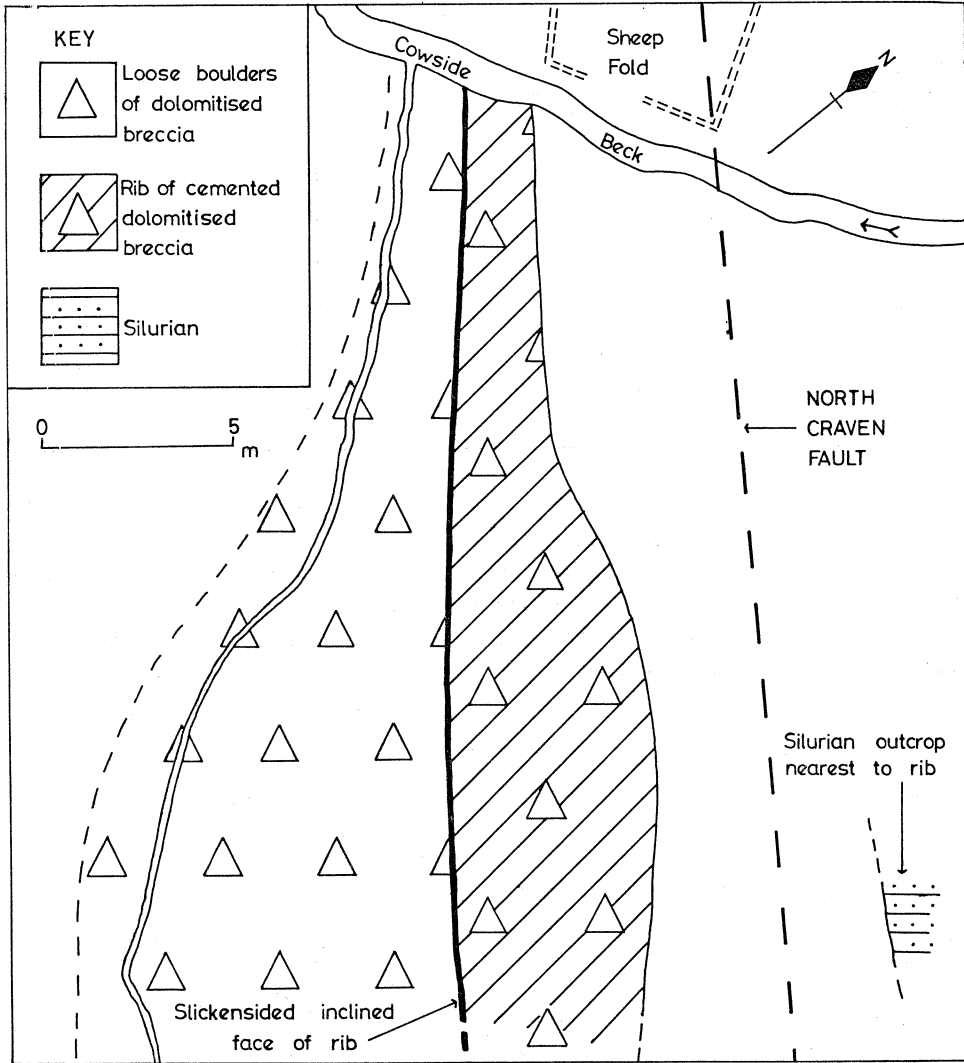


FIG. 4.

Details of Locality 6 North Craven Fault and rib of dolomitized fault breccia.

the large surfaces are bedding planes with a “ripple” effect produced by the intersection of cleavage ( $52^\circ$  dip) and bedding ( $35^\circ$ ), both dipping towards  $193^\circ$  (Fig. 5). Upstream, the structures in the Silurian remain essentially the same up to Loc. 13 (Table 1).

The lithology changes suddenly 34 m. downstream of the junction of Cowside Beck and its tributary Daw Haw Beck (Loc. 13). In the north bank, the cleaved siltstones are replaced by a medium-grained greywacke sandstone. The junction is faulted and marked by a bed of brecciated sandstone 0.6 m. wide at stream level, thinning to 8 cm. up the bank. Immediately adjacent, the cleaved siltstones have a phyllitic character and are veined with quartz. The fault has a strike of  $85^\circ$ . Upstream, the sandstones are well exposed (Loc. 14; Table 1).

Table 1. *Details of exposures not given in text*

Locality	Formation	Amount of Dip	Direction of Dip
1	Yoredale limestones	41°-31°	0°-40°
3	Yoredale limestones	24°	58°
5	Yoredale limestones	21°	197°
9	Silurian cleaved siltstones	35°	193°
10	Silurian cleaved siltstones	45°	212°
11	Silurian cleaved siltstones	41°	192°
12	Silurian cleaved siltstones	43°	183°
14	Silurian sandstones	45°	184°
17	Yoredale shales	12°	148°
18	Yoredale limestone	26°	152°
19	Silurian sandstones	58°	186°
20	Silurian sandstones	43°	189°
24	Yoredale shales	7°	246°
25	Yoredale shales	8°	209°
26	Yoredale limestone	20°	222°

The second outcrop of the North Craven Fault is in Daw Haw Beck, 47 m. from its junction with Cowside Beck (Loc. 15). A 7.5 m. wide zone of dolomitized fault breccia interbedded with unbrecciated slightly-veined sandstone is quite different in character and extent to the breccia zone associated with the North Craven Fault at the rib (Loc. 6). The strike (113°) too does not line up, so that either the fault curves round or it is displaced by cross faulting (O'Connor, 1964). After 4.5 m.

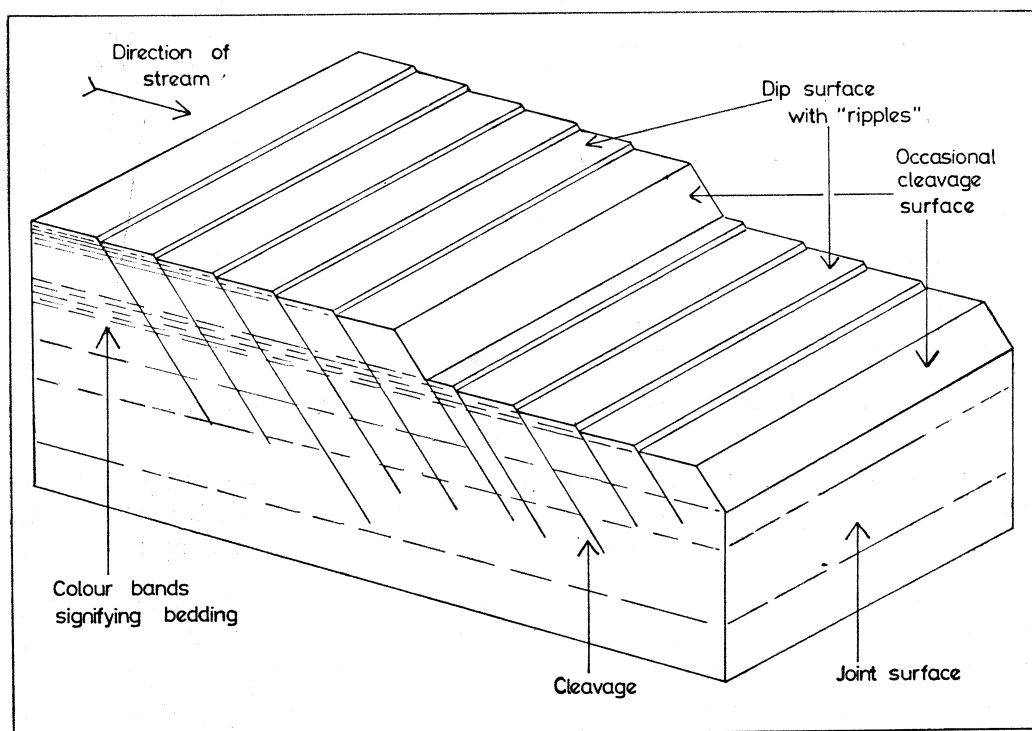


FIG. 5.

Block diagram illustrating relationship between dip and cleavage in Silurian siltstones at Locality 9.

of no exposure, a block of dark crinoidal Yoredale limestone forms a low cascade (Loc. 16). Next upstream, a long stretch of no exposure probably represents an extensive area of weathered shale, which outcrops south of the North Craven Fault between Locs. 22 and 25 and so would naturally be expected in this stretch of Daw Haw Beck. On the western bank at Loc. 17 black, fissile, calcite-veined shales outcrop with shallow dip which have yielded *Goniatites spiralis* giving them a  $P_1 (= D_2)$  age (Hudson and Jackson, 1929). After 35.5 m. the shales end at a fault where they are thrown against dark crinoidal limestones (Loc. 18). The fault plane, seen under the water, is a sloping junction where contorted shales are banked against the limestone. Upstream the limestone beds form a ladder of small cascades starting with a dip of  $26^\circ$  next to the fault but flattening out quickly (Table 1). The last exposure in Daw Haw Beck is a thin shale with a coral-brachiopod fauna, exposed beneath the highest cascade; the limestone below the shale contains the largest known species of brachiopod fossils (giganto-productids).

The Silurian sandstones well exposed at Locs. 19 and 20 (Table 1) are followed by a short stretch of no exposure somewhere in which the North Craven Fault must cross the stream because the next outcrop is in the Yoredale limestone (Fig. 6), 4.5 m. wide, partly brecciated and dolomitized and very heavily veined with calcite, occurring first as boulders, then as continuous outcrop, but with no clear indication of strike or dip (Loc. 21).

Boulders of breccia are seen again 25 m. upstream, where black, ferruginous, fissile shales first outcrop low down in the western bank, and they are well exposed in a 6 m. high cliff at a large bend (Loc. 22). From here to Loc. 25 Cowside Beck

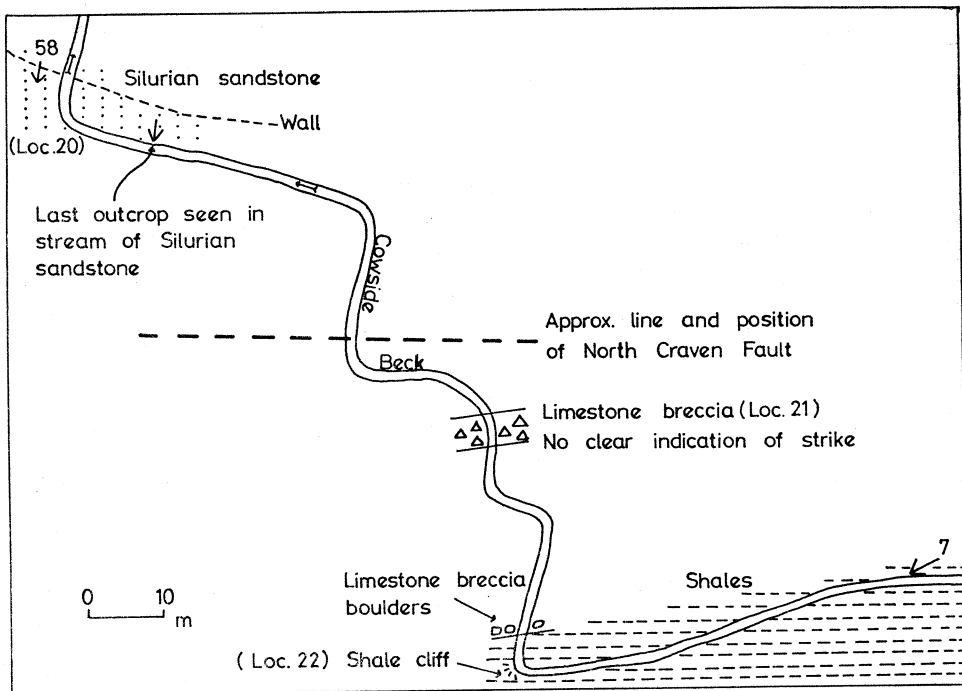


FIG. 6.

Field evidence in the vicinity of the third outcrop of the North Craven Fault.

roughly follows the strike across the most extensive exposure of shales in the whole study area. At Loc. 23 nodules are common in which fish remains, coprolites and goniatites have been found (O'Connor, 1964). Broad bedding surfaces of shale with a low dip are exposed up to Loc. 25 where, becoming almost vertical, they are faulted against limestones.

Upstream dark limestones are interbedded with shales (Table 1) and then a long stretch without exposure suggests, as in Daw Haw Beck, an extensive area of weathered shale.

A cascade caused by a bed of brecciated and dolomitized limestone dipping initially at 20° towards 222° marks the site of another fault (Loc. 26). For 45 m. below the cascade, the dip of limestones lying flat in the stream bed swings round from north-west to south-east upstream towards the fault.

#### CONCLUSION

Faults are known to be common south of the North Craven Fault (Garwood and Goodyear, 1924; O'Connor, 1964); some more are recorded here for the first time which have small throws and all apparently affect the same series of Yoredale limestones and shales. Their extent and continuity is made uncertain by extensive drift cover. The shales which outcrop south of the North Craven Fault in the upper reaches of Cowside Beck (Loc. 22 to 25) probably underlie Daw Haw Beck as well but they do not appear west of the rib of dolomitized breccia (Loc. 6). A cross fault may cut them out.

It is unusual to be able to trace such a major feature as the North Craven Fault along a series of sections as well exposed as those in Cowside Beck. No major fractures north of the North Craven Fault have been previously recorded. The fault at Loc. 13 may therefore be significant because it brings into contact two very different Silurian lithologies.

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### GLOSSARY

- Cyclothemic*: resulting from rhythmic or cyclic sedimentation.
- Slickensides*: smoothed striated surface resulting from movement along a fault plane.
- Dolomitization*: replacement of some of the calcium in the limestone by magnesium to give dolomite  $\text{CaMg}(\text{CO}_3)_2$ .
- Greywacke*: illsorted rock fragments in a matrix of fine detrital material—the result of deposition by turbidity currents.
- Phyllitic*: a fissile rock with a soapy feel due to the presence of small crystals of mica.
- $P_1 (= D_2)$ : One of the goniatite/lamellibranch zones of the Lower Carboniferous characterized by the presence of the lamellibranch *Posidonia*. This is correlated with other strata which contain the coral *Dibunophyllum* and are zoned by their coral/brachiopod fauna.

