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### Post-Carboniferous and Post-Triassic Structures in Southern New Brunswick

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TRIP A-10 and B-8, by P. Stringer and R. J. Wardle, University of New Brunswick.

## POST-CARBONIFEROUS AND POST-TRIASSIC STRUCTURES IN SOUTHERN NEW BRUNSWICK

### INTRODUCTION

The field trip is designed to draw attention to structures in Carboniferous and Triassic rocks of the Maritime Appalachians. Post-Carboniferous and Post-Triassic deformations are distinguished. The style and intensity of deformation of Post-Carboniferous (Pre-Triassic) structures differ between the Mississippian (or Pennsylvanian) Mispék Group and the Pennsylvanian Lancaster Formation, and also vary from place to place within each formation. Folds of varying magnitude are present in the Triassic rocks.

At Lepreau Falls (Stop 1) bedding attitudes in the Triassic Lepreau Formation indicate a minor NE-SW syncline. The fold

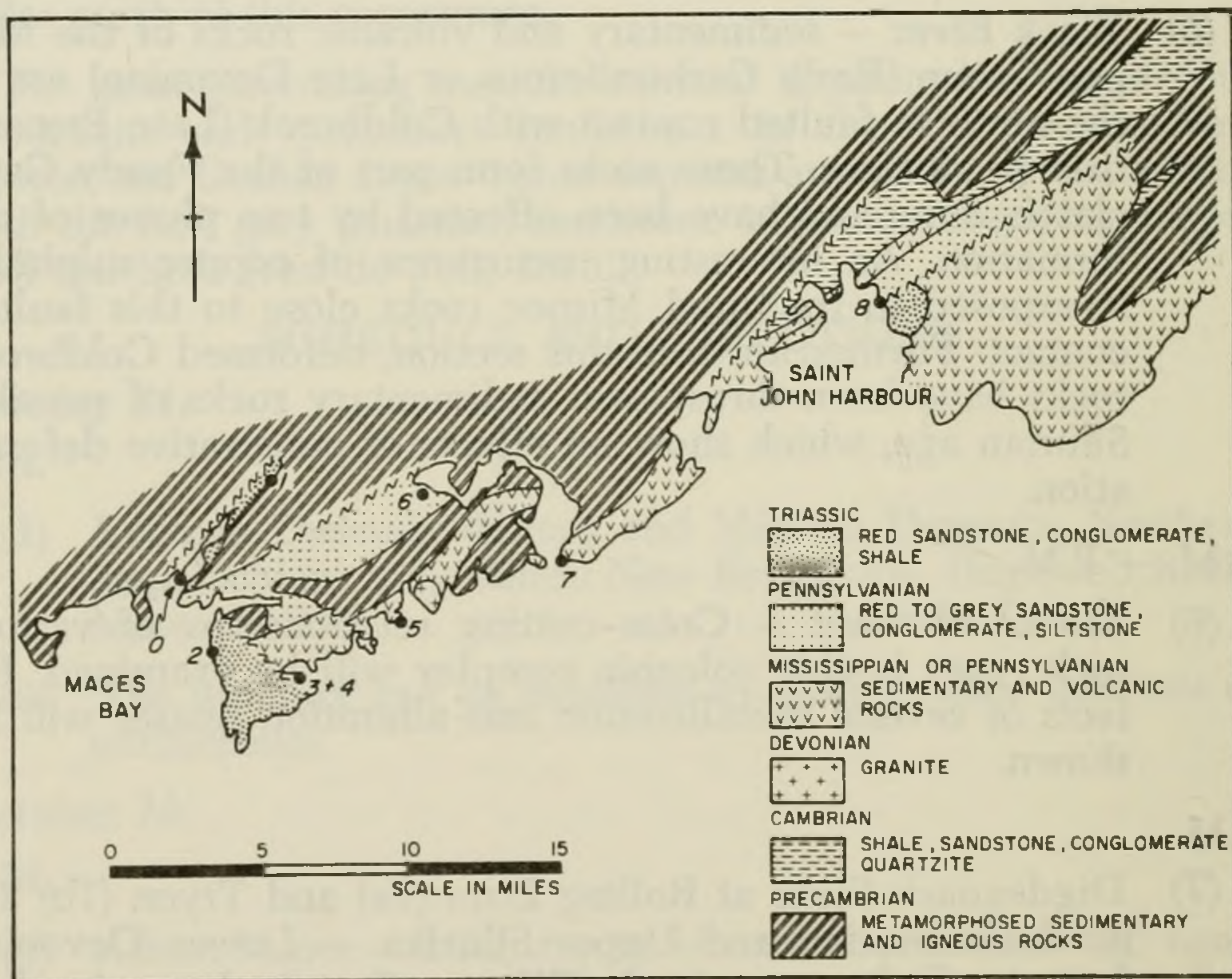
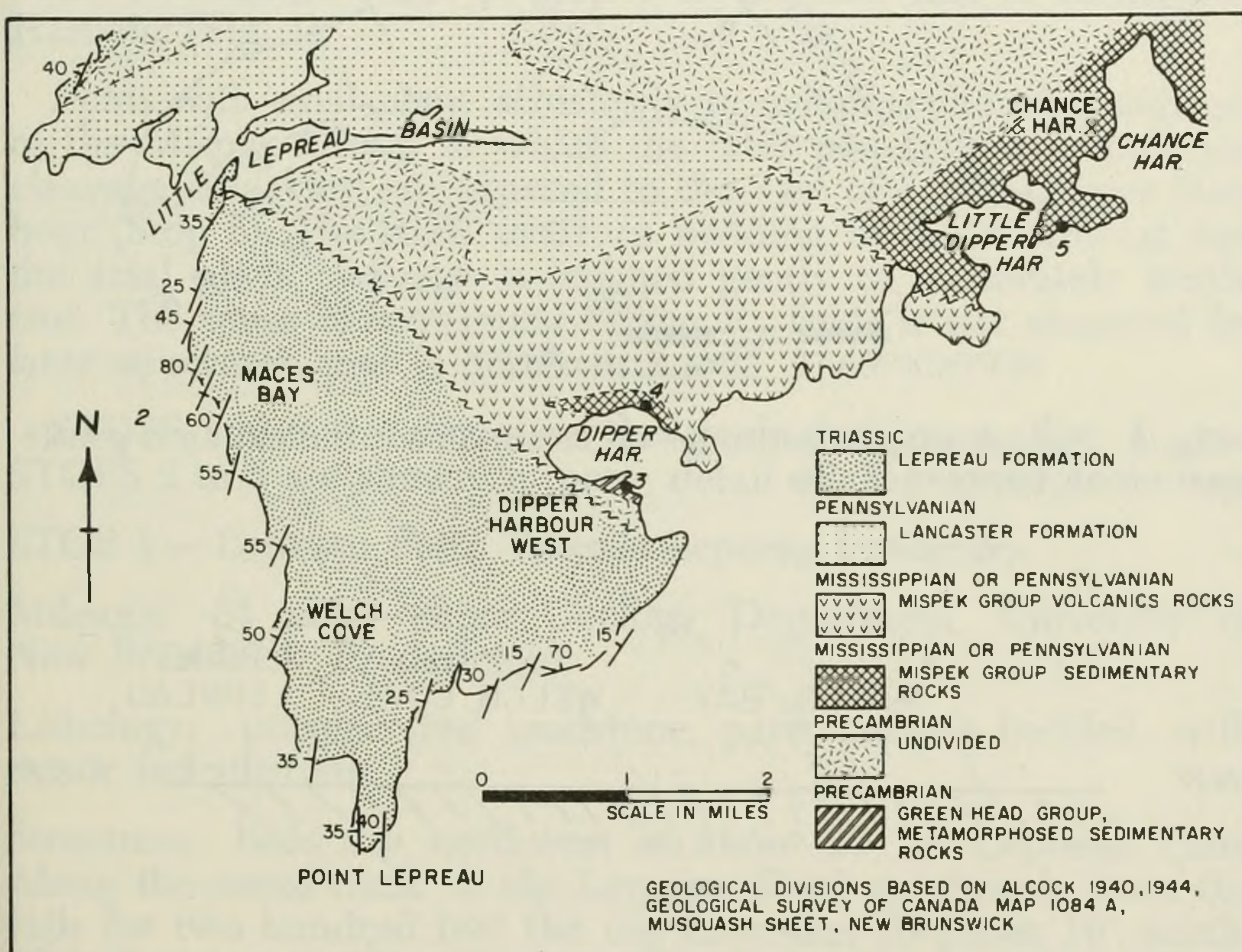


Fig. 1 Geological Map of Saint John Area, New Brunswick. Based on compilation by R. R. Potter, 1968.

trends parallel to the faulted contact between the Triassic beds and Precambrian rocks to the northwest (Fig. 1). The fold may be related in origin to the faulting. On the west side of the Lepreau Peninsula (Stop 2) attitudes of strata indicate a major monoclinial fold which trends NNE-SSW within the Triassic Lepreau Formation (Figs. 2, 3, 4). The trend of this structure differs from the trend of pre-Triassic structures, predominantly NE-SW, in the area. The monocline may be related to post-Triassic normal faulting in the underlying metamorphic basement of Carboniferous and older rocks but there is no obvious continuation of the NNE-SSW trending structure either as a fault or a monocline in the older rocks north of the Lepreau Peninsula.

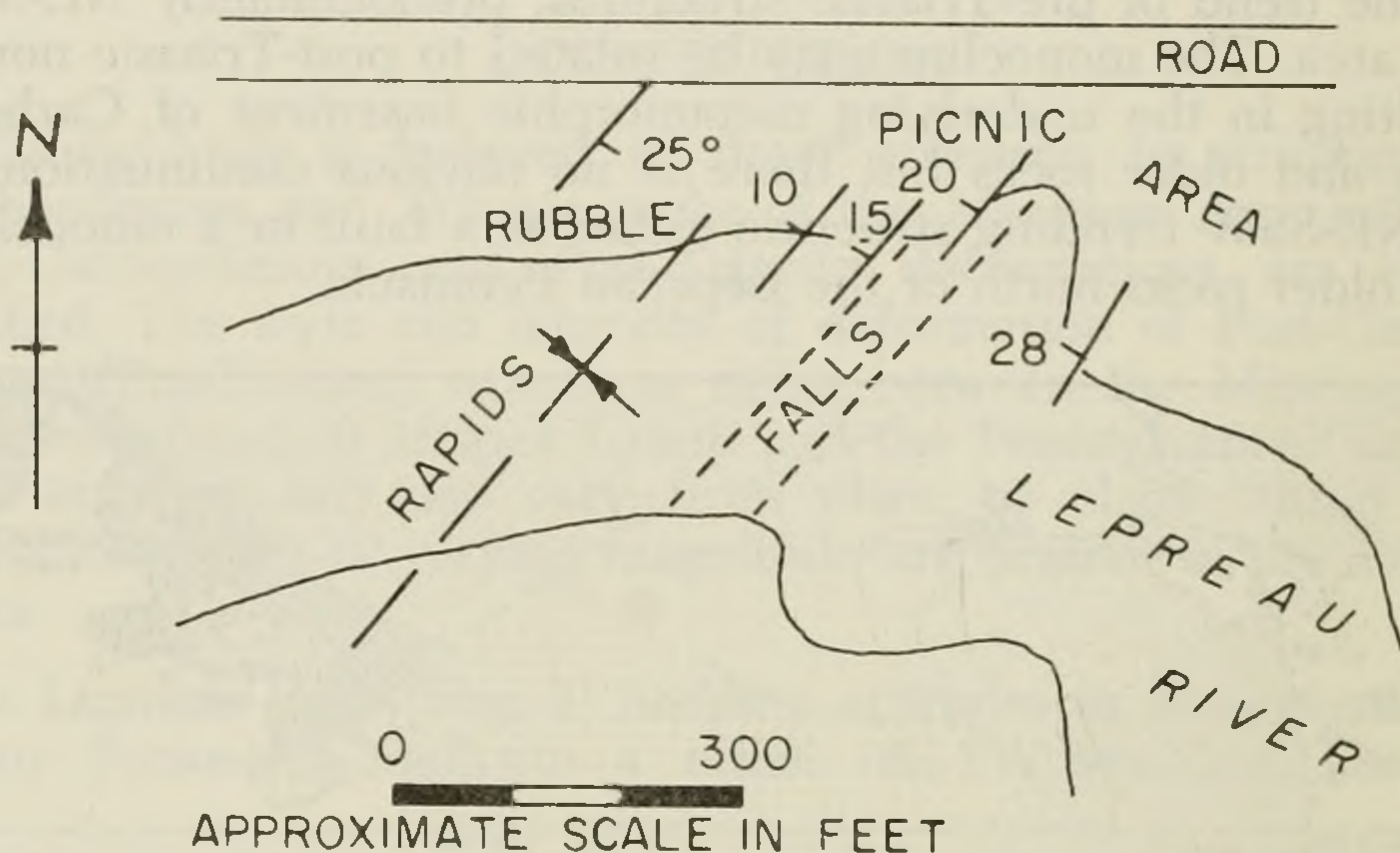


**Fig. 2** Geological Map of Lepreau Peninsula.

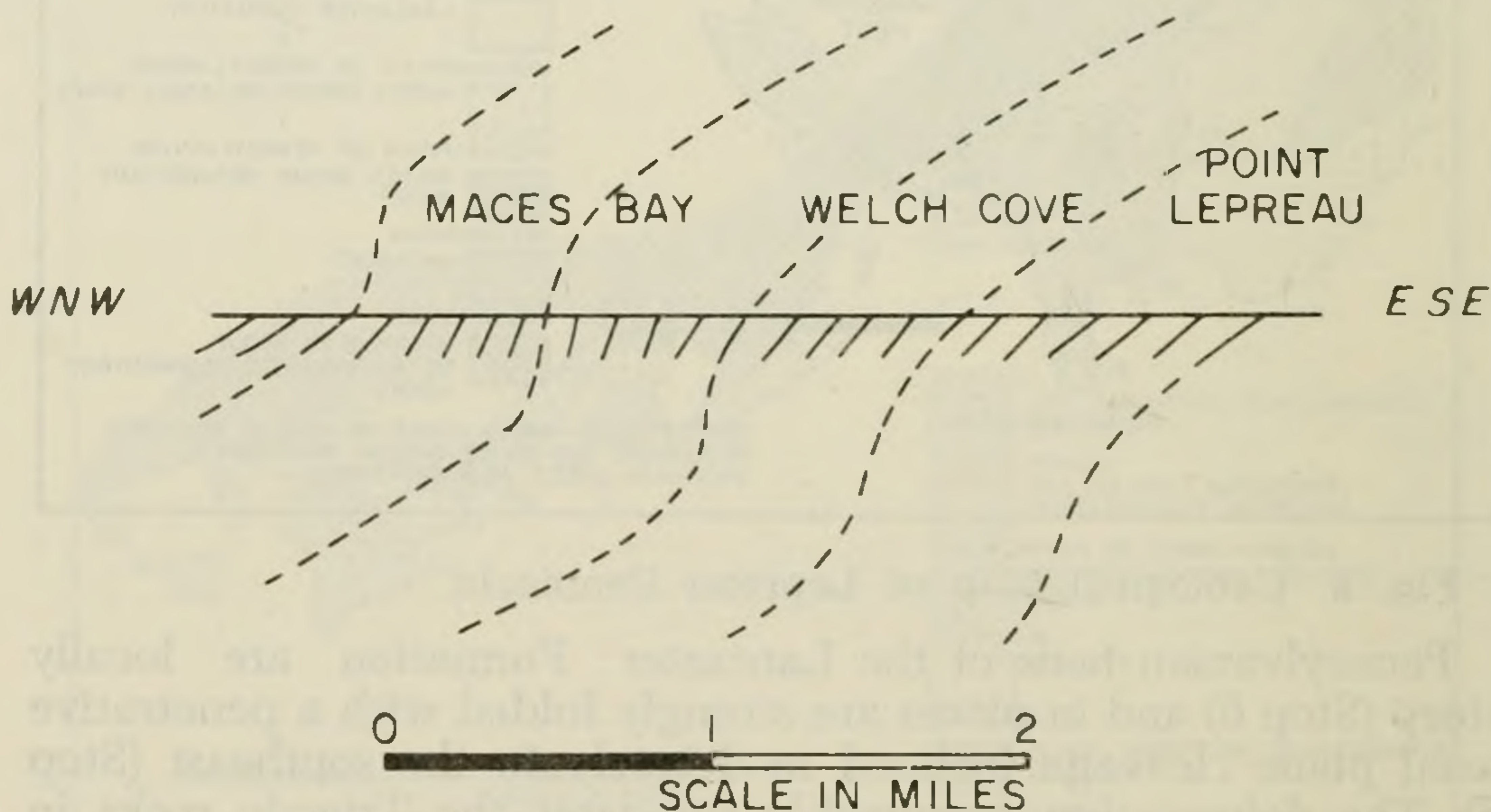
Pennsylvanian beds of the Lancaster Formation are locally steep (Stop 6) and in places are strongly folded with a penetrative axial plane cleavage inclined moderately to the southeast (Stop 8). The deformation presumably pre-dates the Triassic rocks in which cleavage is absent. The cleavage in the Pennsylvanian is most intense approaching the Variscan 'front' southeast of which Carboniferous and older rocks are intensely deformed by predominantly recumbent structures (Rast and Grant, 1973). The

deformation of the Pennsylvanian rocks is related to the Variscan Orogeny in southern New Brunswick, but lacks the polyphase deformation characteristic of Carboniferous rocks southeast of the 'front'.

Structures produced by two phases of deformation are present in metamorphosed sediments on the north side of Dipper Harbour



**Fig. 3** Sketch map of attitudes of Triassic beds indicating a gentle syncline at Lepreau Falls.



**Fig. 4** WNW-ESE section across the west side of Lepreau Peninsula projected from bedding attitudes exposed along the coast indicates a major WNW-facing monocline within the Triassic Lepreau Formation.

(Stop 4) mapped as Carboniferous Mispék Group (Alcock, 1940, 1944). An intense flat-lying schistosity is associated with hinges of recumbent folds of bedding which trend around  $055^\circ$ . The schistosity is deformed by a penetrative crenulation cleavage inclined gently to moderately northwest. The sense of overturning of the schistosity is southeastward. Rocks on the south side of Dipper Harbour (Stop 3), mapped as Precambrian Green Head Group by Alcock, are similar in lithology and structural style to the Carboniferous rocks at Stop 4. Metamorphosed sediments of the Mispék Group with an intense recumbent schistosity deformed by crenulation cleavage inclined gently to moderately northwest are also exposed for a mile north along the coast from Black Point three miles south of Stop 8 on the east side of Saint John Harbour (Fig. 1).

Folds with axial plane schistosity in metamorphosed sediments of the Mispék Group in which the later penetrative crenulation cleavage is lacking are exposed to the east of Little Dipper Harbour (Stop 5). The folds overturn bedding to the northwest and the axial plane cleavage is inclined gently to moderately southeast. The sense of movement of the  $F_1$  folds is not obscured by later structures, and is northwestward.

STOPS 1 to 8 are shown on the geological map, Fig. 1, and STOPS 2 to 5 are shown in more detail on the geological map,

STOP 1 – Lepreau Falls. Triassic Lepreau formation.

Mileage: 84 miles (from Geology Department, University of New Brunswick, Fredericton).

Lithology: purplish red sandstone, parts current bedded, with minor red siltstone.

Structure: beds dip northwest at about  $20^\circ$  in Lepreau Falls. Along the north bank of the Lepreau River westwards from the falls for two hundred feet the dip decreases to about  $10^\circ$  northwest. One hundred feet further west at the top of the bank beds dip southeast at  $25^\circ$ . The changes in dip indicate the hinge of a gentle NE-SW trending syncline of Triassic beds.

Close-spaced (one quarter of an inch) anastomosing joints occur in the red siltstone beds. The joints are sub-vertical and strike NE-SW, simulating an axial plane fracture cleavage.

STOP 2 – Lepreau Peninsula, west side. Triassic Lepreau Formation.

Mileage: 88 miles

Lithology: purplish red sandstone and conglomerate, parts current bedded.

Structure: Along the west side of the Lepreau Peninsula progressive changes in the attitude of bedding indicate a major monocline with NNE-SSW trend within the Triassic Lepreau Formation (Fig. 2 and Fig. 4). At Point Lepreau the dip is about  $35^\circ$ , and the dip increases northwards through  $50^\circ$  at Welch Cove to very steep at Maces Bay, in places vertical. Northwards from the steep zone the WNW dip decreases to about  $25^\circ$ . Several thousand feet of Lepreau Formation are involved.

A half mile traverse from SSE to NNW along the coast at STOP 2 crosses the steep limb of the monocline. The steep beds, predominantly conglomerate, form a prominent feature which extends SSW for two miles out to sea as strike ridges and ledges exposed at low tide.

STOP 3 – Dipper Harbour, south side. Precambrian Green Head Group (?).

Mileage: 92 miles

Lithology: metamorphosed pale grey calcareous siltstones with minor limestone pebble bands.

Structure: Semi-recumbent minor structures formed by two intense phases of deformation are present. A prominent crenulation cleavage produced by the later phase of deformation dips  $5^\circ$  to  $20^\circ$  between west and southwest, and is axial planar to tight minor folds which plunge gently southwards.

The crenulation cleavage and associated minor folds deform a penetrative fine-grained schistosity, overturning it eastwards. The overall attitude of the deformed schistosity is semi-recumbent, dipping southeastwards at about  $25^\circ$ . Limestone pebbles are flattened within the schistosity.

Bedding can be discerned at the north end of the exposure where sub-vertical pebble bands trend  $050^\circ$  across the flat outcrop surfaces.

The rocks are shown as Precambrian Green Head group on the geological map (Alcock, 1940, 1944), but the lithology and poly-phase structure can be matched with rocks on the north side of Dipper Harbour (STOP 4) shown as Mississippian or Pennsylvanian Mispick Group on Alcock's map (see also Fig. 2). It is proposed that the rocks at STOP 3 are Carboniferous and that both phases

of deformation are post-Carboniferous. The deformation is considered to be pre-Triassic, since Triassic rocks in the area lack cleavage.

STOP 4 – Dipper Harbour, north side. Mississippian or Pennsylvanian Mispick Group.

Mileage: 93 miles

Lithology: metamorphosed pale grey and purplish calcareous siltstones with limestone pebble bands.

Structure: Two phases of semi-recumbent minor structures similar to those at STOP 3 are present. A flat-lying earlier schistosity is associated with hinge remnants of recumbent folds of bedding which trend around  $055^{\circ}$  and plunge gently southwestwards. Limestone pebbles are flattened within the schistosity.

A crenulation cleavage which dips between west and northwest at  $15^{\circ}$  to  $35^{\circ}$  deforms the schistosity. Where strongly deformed between crenulation cleavage planes, the schistosity is overturned southeastwards.

STOP 5 – Little Dipper Harbour, east side, Mississippian or Pennsylvanian Mispick Group.

Mileage: 98 miles

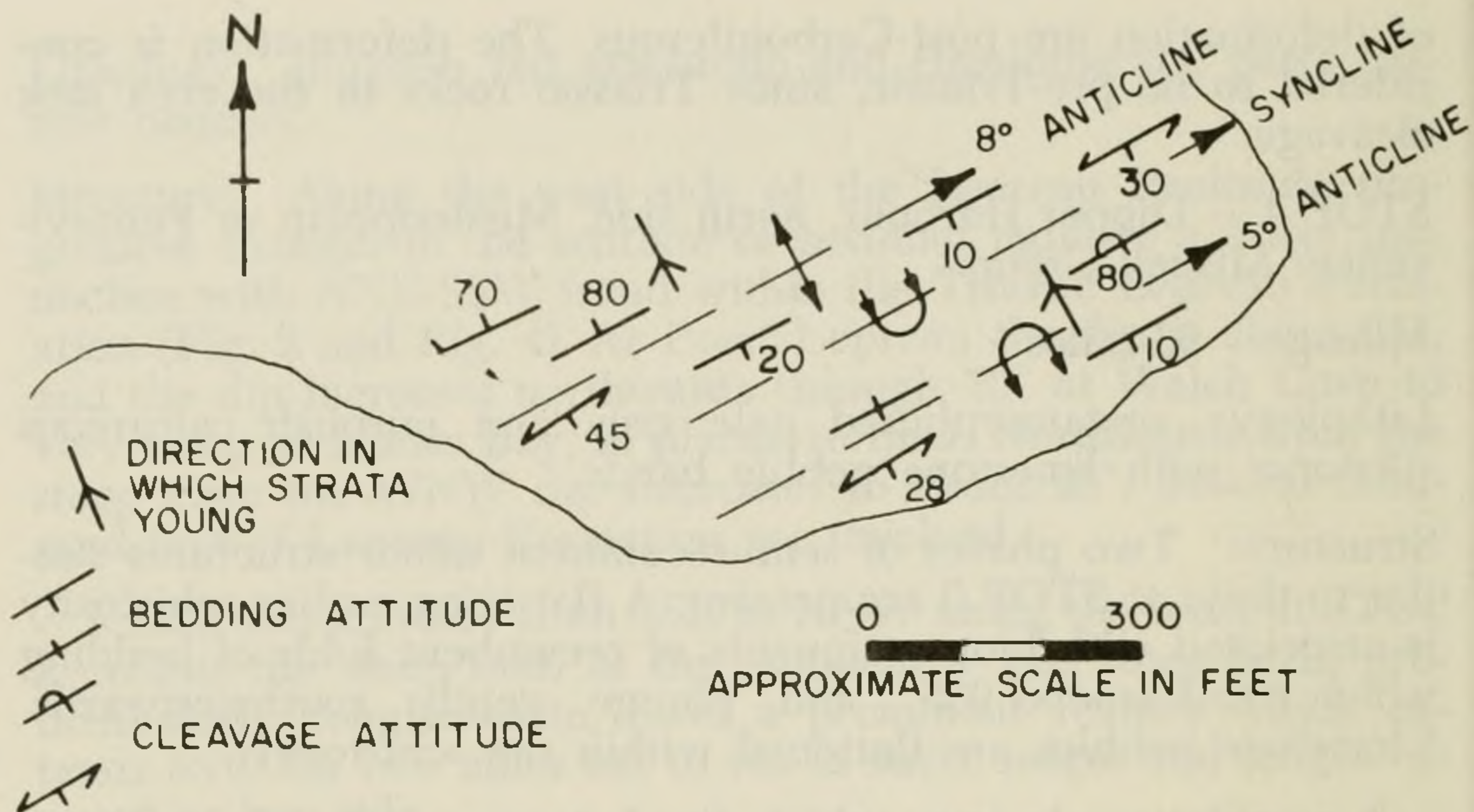
Lithology: purplish-red sandstone, siltstone, pale grey calcareous siltstone, and thin conglomerate bands including limestone pebbles.

Structure: Varying attitudes of bedding mapped on the tidal platform (Fig. 5) define folds asymmetric to the northwest which plunge gently towards  $055^{\circ}$ . On the gently inclined limbs bedding dips southeast at  $10^{\circ}$  to  $30^{\circ}$ , and in the steep limbs bedding is vertical or slightly overturned, dipping steeply southeast. The folded surface of a bed in the hinge of an anticline is well exposed for over two hundred feet at the west end of the tidal platform.

An axial plane schistosity dipping southeast between  $20^{\circ}$  and  $50^{\circ}$  forms a prominent cleavage. Limestone pebbles are flattened within the schistosity.

The rocks may be matched in lithology and structure with those at STOPS 3 and 4, except crenulation appears to be absent.

STOP 6 – West Musquash River. Pennsylvanian Lancaster Formation.



**Fig. 5** Sketch map of bedding and cleavage attitudes in folds exposed on the tidal platform on the east side of Little Dipper Harbour.

Mileage: 104 miles

Lithology: thick bedded grey sandstone.

Structure: beds dip south at 50° and strike 095°.

STOP 7 – Musquash Head. Mississippian or Pennsylvanian Misspek Group.

Mileage: 119 miles

Lithology: metamorphosed pale grey siltstone.

Structure: Two phases of deformation are present. Minor folds plunging gently SSE overturn an earlier schistosity westwards. The folded schistosity has an approximate overall dip of about 50° westwards. In places the minor folds have axial plane crenulation cleavage which dips gently southwards.

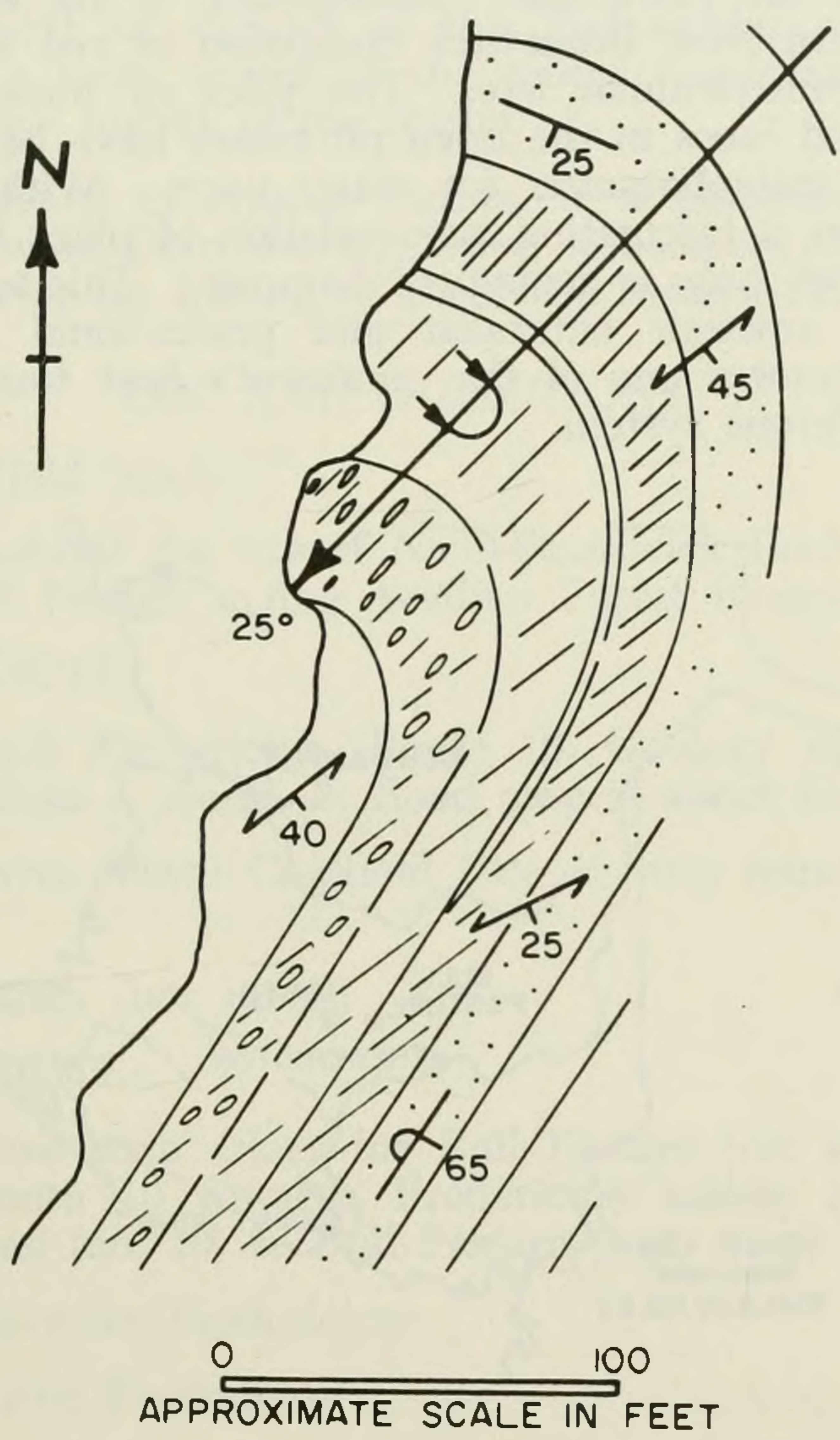
STOP 8 – Midwood, East Saint John. Pennsylvanian Lancaster Formation.

Lithology: grey and red sandstone and siltstone, with minor conglomerate bands and dark shales. Plant remains are present.

Structure: The hinge of an asymmetric syncline with intense axial plane cleavage is exposed on the tidal platform (Fig. 6). The



fold plunges southwest at  $25^\circ$ , and bedding is overturned towards the northwest. The axial plane cleavage is a fine-grained schistosity which dips southeast between  $25^\circ$  and  $45^\circ$ . Pebbles in conglomerate bands are flattened within the schistosity.



**Fig. 6** Diagrammatic plan view of the north end of the tidal platform at Midwood, East Saint John showing the hinge of an asymmetric and plunging syncline with axial plane schistosity in the Pennsylvanian Lancaster Formation.