THE GOLD DEPOSITS

O F

FIFTEEN MILE STREAM

NOVA SCOTIA

by

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C O N T E N T S

L I S T O F I L L U S T R A T I O N S

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A C K N O W L E D G E M E N T S

The writer wishes to acknowledge his indebtedness to Professor G. V. Douglas, without whose initial encouragement this thesis would not have been written. I am also indebted to Professor J. E. Gill of McGill University, who supervised the writer's work and offered many helpful suggestions and criticisms. Thanks are also due to Professor F. F. Osbourne, under whose supervision the microscopic work was done.

The writer wishes to thank the Nova Scotia Departments of Mines and Labour for permission to publish the data on Fifteen Mile Stream, and to especially thank Mr. Lauchlan Currie, Minister of Mines; Dr. Alan E. Cameron, Deputy Minister of Mines, and Mr. A. R. Lawrence, Director of the Rehabilitation Project, for their encouragement and assistance.

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A B S T R A C T

Fifteen Mile Stream gold district, Nova Scotia, is situated on a composite anticlinal dome. The folded rocks are the Goldenville formation of quartzites with interbedded slates, believed to be Pre-Cambrian in age. Interbedded quartz veins of saddle vein type occur in slates, along slate-quartzite contacts and rarely in the quartzites. Sections of these veins contain sufficient gold to constitute ore bodies. The dome has been truncated by erosion.

The district has been sheared regionally and shows a well defined fracture pattern consisting of two sets of main shears with their accompanying fractures. The local fold structure did not control the direction of shearing. Both sets of shears acted as channels for quartz-forming solutions later than the interbedded quartz veins. Bodies of commercial ore were formed along the lines of intersection of such channel fractures with interbedded quartz veins, or favourable slate belts. Ore also occurs in the shears at changes of strike and dip. Two good examples of the intersection type are given and a third inferred on the basis of the intersection theory. Similar bodies have been mined elsewhere in Nova Scotia. The small size of the local anticlinal structure makes Fifteen Mile Stream an ideal place to study the effect of shear zones on opposite sides of an anticlinal structure. The conclusions reached on the basis of this study, may prove very important in developing other districts.

THE GOLD DEPOSITS OF FIFTEEN MILE STREAM NOVA SCOTIA

INTRODUCTION -

Location and Accessibility -

Fifteen Mile Stream gold district is situated in the northeast corner of Halifax County, Nova Scotia. It is 112 miles from Halifax by road (Fig. 1) and is accessible by truck or automobile during all seasons of the year. An electric power line passes close to the district and a branch line supplies light and power to the mines.

Present Operations -

The present operations in the district are being carried on jointly by the Dominion and Provincial Departments of Labour as a rehabilitation project for unemployed miners of the province. Communications are maintained by radio with the Provincial Departments of Labour and Mines in Halifax.

History of Mining Operations -

Gold was first reported in 1867, but owing to its inaccessibility, the district has not been worked as extensively as

History of Mining Operations (Cont'd)

others in the Province.

The period from 1867 to 1885 was one of prospecting and small mining operations by individuals. In 1885 the mine, later known as the Old Edgerton, was opened (Fig. 2) and the period of real production began. From 1885 to 1890 the Edgerton Company continued operations in this mine and in the immediate vicinity, including the McLean and Serpent workings (Fig. 2). Reorganized as the New Edgerton, this company continued work from 1890 to 1893, and in that year amalgamated with the Stanley Company, which had begun operations in 1890. The Mother Seigel Mine (Fig. 2) was opened in 1896 and in 1897 operations ceased in the Old Edgerton. A cave-in closed the Mother Seigel workings in 1898, and, after an unsuccessful attempt at open-cut work, major operations ceased in the summer of the following year. The Mother Seigel workings were opened in 1901 by sinking a vertical shaft (known as the Borlace Shaft; Fig. 2) to the north of the old crush, and cross-cutting on the 170-foot level. This attempt at re-opening failed, apparently through lack of knowledge of where ore might be found in the old workings. The workings were pumped out and sampled in 1934, but no development was attempted. ⁂

⁂ Data from Memoir 156, C.G.S., 1929, p.p. 82-85; and personal communication from Mr. D. Fraser, former Assistant Manager, New Edgerton Company. 1934 - Report by Dr. J.E. Gill on Fifteen Mile Stream.

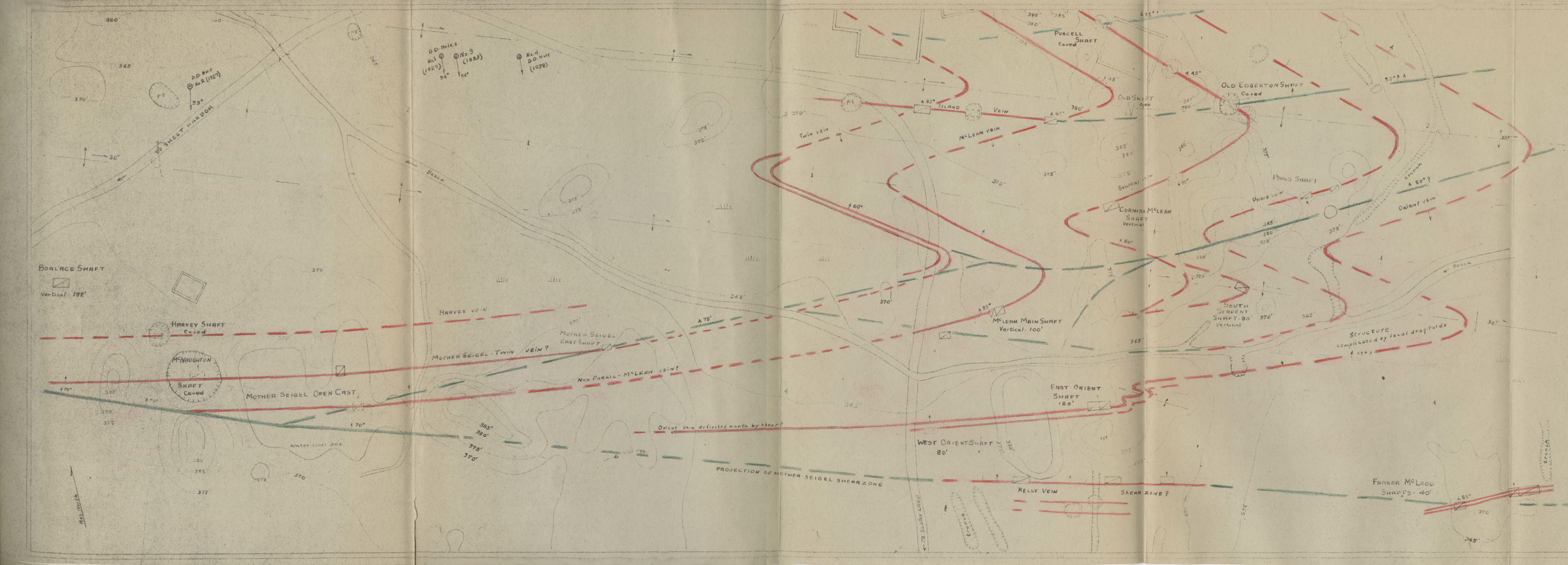

Fig. 2

SURFACE PLAN OF PART OF FIFTEEN MILE STREAM GOLD DISTRICT NOVA SCOTIA

SCALE 1" = 40'

LEGEND

- OUTCROP OF QUARTZ VEIN (traced)
- OUTCROP OF QUARTZ VEIN (inferred)
- OUTCROP OF FAULT OR SHEAR ZONE (traced)
- OUTCROP OF FAULT OR SHEAR ZONE (inferred)
- SHAFT - If caved-in they are so noted on map
- CONTOURS - chiefly on dumps - area is flat and swampy
- ANTICLINAL AXIS - approximate position
- OLD FOUNDATIONS

History of Mining Operations (Cont'd)

From the foregoing brief resume, it becomes clear that the history of real mining at Fifteen Mile Stream is largely that of the Old Edgerton and Mother Seigel Mines. Small bodies of ore were found elsewhere in the immediate vicinity, but these two mines supplied the major part of the production of the district. The present operations were, therefore, directed to testing the section in which these mines are situated.

Area -

The area covered by the present work is located in the eastern end of the district and comprises an oblong 1,200 feet E-W by 425 feet N-S (Fig. 2) which includes the Mother Seigel, Old Edgerton and McLean Shaft sections.

Previous Work -

The district and area were topographically and geologically surveyed by Dr. E. R. Faribault in 1888. The areal geology is shown on the C.G.S. Map No. 607 (Scale 1 inch - 1 mile) and the district geology on District Plan No. 650 (Scale 1 inch - 500 feet). In his 1902 report for the Edgerton Syndicate, Dr. Faribault reproduced this district plan on a 1 inch - 100 feet scale, which added greatly to its detail and usefulness. With this report was also a plan and section of the McLean and Old Edgerton sections

Previous Work (Cont'd)

(Scale 1 inch - 40 feet).

Pellew Harvey, M.E., made a report on the Mother Seigel Mine in 1897, but as far as can be learned, no plans accompanied it.

Four diamond drill holes were put down in 1927-28 under the direction of Sir Stopford Brunton (Fig. 2). The results were inconclusive.

Dr. J. E. Gill geologically surveyed the Mother Seigel Mine in 1934 and made a report accompanied by a plan of the accessible workings.

Just prior to the start of the present operations in the summer of 1938, the area shown in Fig. 2 was topographically surveyed by a plane table party under the direction of Professor G. V. Douglas. Because of lack of outcrops, the geology shown was limited to vein outcrops indicated by old shafts. The vein outcrops shown in Fig. 2 are based on underground work in the McLean and Mother Seigel sections as mapped by Dr. Gill and the writer.

Present Work -

The McLean Shaft section (Figs. 2, 4 and 5) was geologically surveyed by the writer, and the structure worked out as development progressed. Cross sections of the workings were made and a model constructed to illustrate and elucidate the structure

Present Work (Cont'd)

(Fig. 5). An analysis of the fault and fracture systems was made and the theoretical relations of these structures to ore bodies worked out. The theory of ore body formation given later is based, not only on facts observed at Fifteen Mile Stream, but on similar structures seen in other Nova Scotia gold districts. One such occurrence was used as the basis of mining development at Oldham, and in that instance the theory gave positive results. Other examples are quoted in the section on ore body formation.

TOPOGRAPHY :

Relief -

The Fifteen Mile Stream district is one of very low relief. It is situated on a partly dissected peneplane of Mid-Tertiary age, which has been glaciated. The present surface is gently rolling with many swamps and low drumlinoid hills of glacial drift. [*] Outcrops are usually numerous, but Fifteen Mile Stream is

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[*] Memoir 146, C.G.S., Physiography of Nova Scotia, J.W. Goldthwait
Memoir 156, C.G.S., p.p.15-19.

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remarkable for the lack of outcrops in the immediate vicinity of the mines. Our knowledge of the geology of the area is based on prospect trenches and mine workings. The heavy drift has made prospect-

Relief (Cont'd)

ing difficult and accounts for the comparatively few veins discovered.

Drainage -

The east branch of Sloan Brook, with a few small tributary brooks, drains the area (Refer to C.G.S., Map No. 607). In times of high water, this brook overflowed into the swamp just east of the Old Edgerton-McLean section, and great difficulty was experienced in keeping the McLean workings from flooding. A dam of mine rock grouted with tailings sand has been built from the high ground east of the Fraser-McLeod shafts to the high ground east of the Old Edgerton shaft and no further trouble has been experienced. A dense scrub of tamarack and second growth spruce is found in the vicinity of the mines, all the original heavy timber having been used as boiler fuel by the early miners. However, lumbering operations are being carried on within seven miles of camp and a sawmill provides a convenient source of timber for constructional and mining purposes.

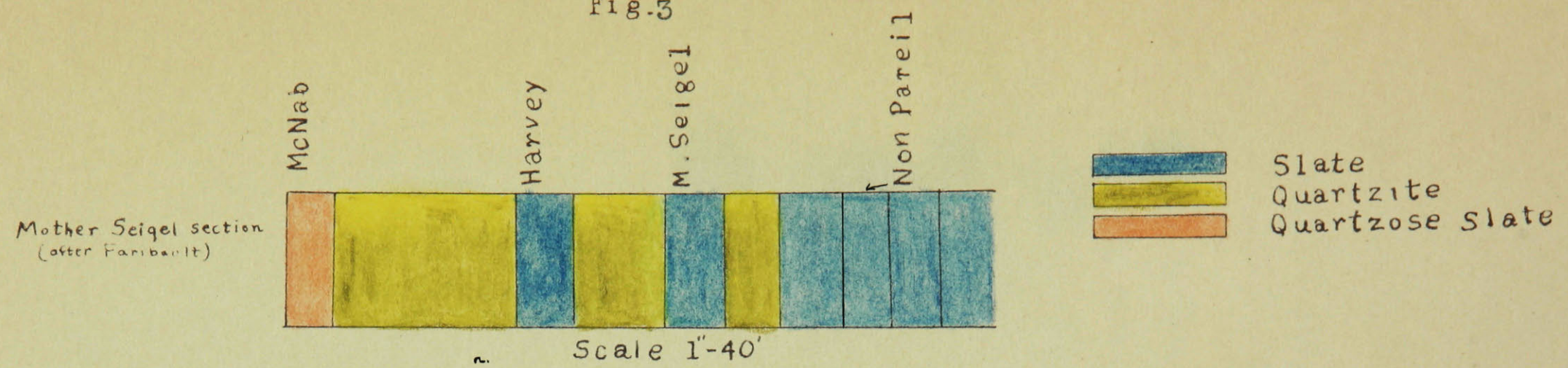
GEOLOGY :

Rock Formations -

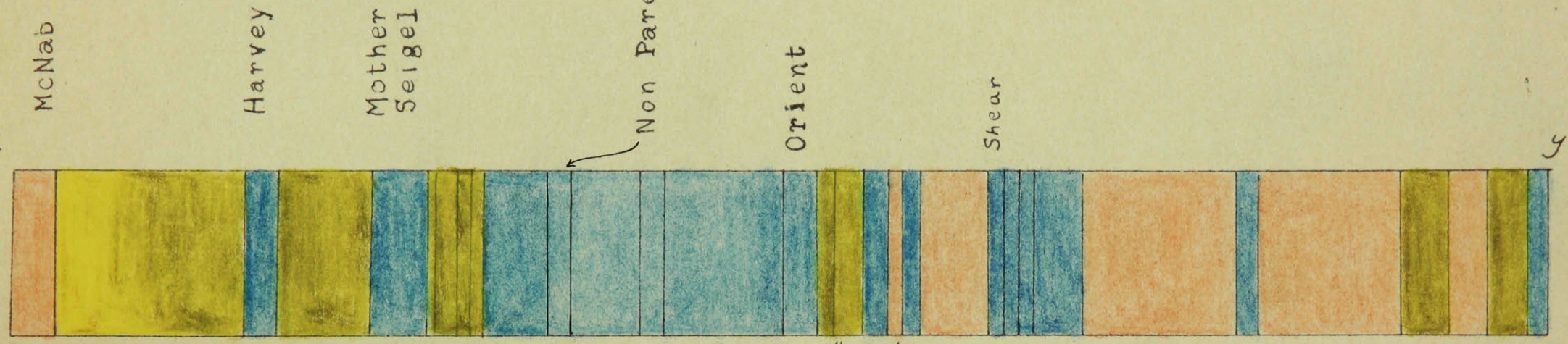
The Goldenville Formation of Pre-Cambrian age underlies the Fifteen Mile Stream gold district. This formation outcrops

Fig.3

A



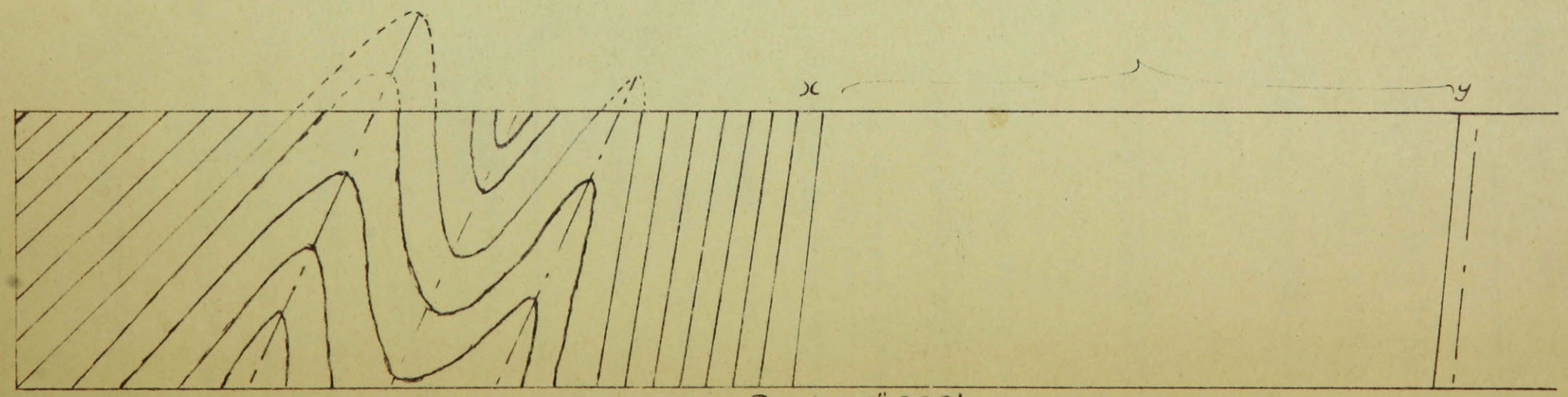
B



Mother Seigel section (after Gill)

Scale 1"-40'

C



Scale 1"-100'

Rock Formations (Cont'd)

over large areas in the southeast part of the Province. It is predominantly quartzite with interbedded slate bands which usually make up less than three percent of the total thickness. * How-

* Memoir 156, C.G.S., p.p. 20-21. This general matter is not recapitulated here.

ever, some districts show a higher percentage of slate outcrop than others. The known section of Fifteen Mile Stream (Fig. 3) shows an unusual amount of slate outcrop, but in this case there may be repetition by folding. It is of interest to note that the Moose River district, west of Fifteen Mile Stream, also shows a large amount of slate outcrop. These districts are mapped by Faribault as being on the same major anticlinal fold.

Stratigraphic Section -

The stratigraphic column shown in Fig. 3 was worked out from the following data - (1) Diamond drill holes Nos. 1, 2, 3 and 4 (Fig. 2) which are known to show repetition of beds in the first 100 feet * ; (2) the Mother Seigel workings, north and south

* Nos. 1 and 2 from the N.S. Mines Report, 1928; 3 and 4 from a private report by Sir Stopford Brunton, 1928.

Stratigraphic Section -(Cont'd)

crosscuts; (3) the McLean Shaft workings; the twin drift and south crosscut. The relation of the known section to the regional structure is shown in Fig. 3-G. Some difficulty was found in naming the rock types. The compact quartzite and the soft slate are distinctive, but the gradational types between them are difficult to name. The name "quartzose slate" has been given to the most plentiful intermediate type because of its cleavage and general appearance. The quartzites show a distinct flow cleavage in places, but are generally massive. The slates show a highly developed flow cleavage with a distinct fracture cleavage. The quartzites and slates show a less well developed flow cleavage and less distinct fracture cleavage. The flow cleavage is approximately parallel to the axial planes of the folds, while the fracture cleavage is believed to have developed as a result of the regional shearing.

Rock Structure -

The Major anticlinal fold which passes through Moose River, 25 miles west of Fifteen Mile Stream, is inferred by Faribault to pass through the latter district. * The correlation is based on

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* Memoir 156, C.G.S., P.82; and Map No. 53A (Southeast Nova Scotia)

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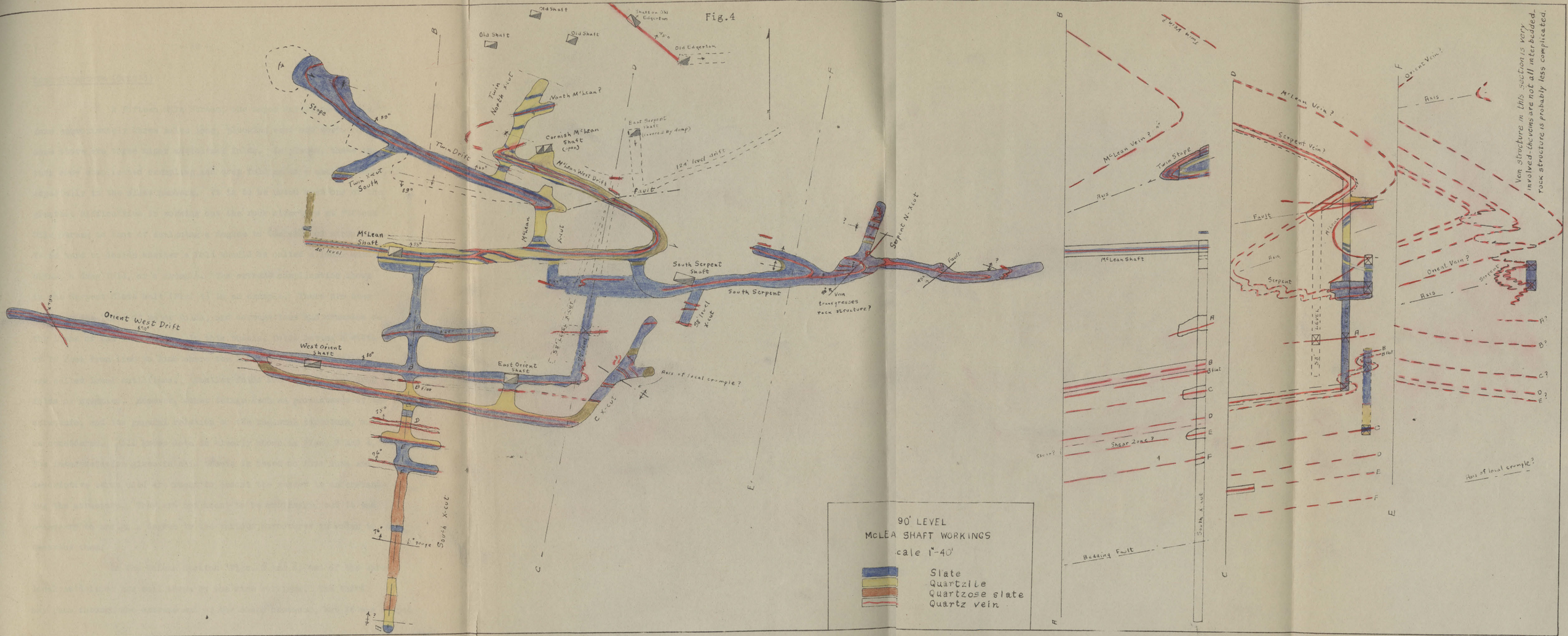
areal mapping and is supported by the lithological character of the two districts as noted under "Rock Formations".

Fig. 4


Old Shaft
Old Shaft
Old Shaft
Shaft on Old Edgerton
Old Edgerton
Twin North X-cut
North McLean?
Cornish McLean Shaft (open)
East Serpent shaft (covered by dump)
124' level drift
McLean West Drift
Fault
Twin Stope
Twin Drift
Twin X-cut South
McLean Shaft
40' level
McLean X-cut
South Serpent Shaft
South Serpent
Sag in N. X-cut
Fault
Vein transgresses rock structure?
Orient West Drift
West Orient Shaft
East Orient Shaft
B Floor
C X-cut
Axis of local crumple?
D
E
F
South X-cut
Stope
A
B
C
D
E
F
McLean Vein?
Twin Stope
Axis
McLean Shaft
Shear Zone?
Bedding Fault
South X-cut
McLean Vein?
Serpent Vein?
Fault
McLean
Axis
Serpent
Orient Vein?
Axis
Orient Vein?
Axis
Axis of local crumple?
Vein structure in this section is very involved - the veins are not all interbudded. The rock structure is probably less complicated.
90' LEVEL
McLEA SHAFT WORKINGS
cale 1"-40'
Slate
Quartzite
Quartzose slate
Quartz vein

Rock Structure (Cont'd)

A Fifteen Mile Stream, the major anticline forms a dome approximately three miles long, plunging east and west. On the dome there are three minor anticlinal folds. In places, these in turn show complicated crumpling and drag folding on a smaller scale, especially in the slate members. It is to be noted that one of the greatest difficulties in working out the rock structure at Fifteen Mile Stream is that of assigning a degree to the size of structures. It is hard to decide whether a fold should be called a local anticline, a drag fold, or a crumple. The extreme complication shown in the Serpent Slate belt (Fig. 4) is an example. There are drag folds on the limbs of major folds, and corrugations and crumples on the limbs of the drag folds. In this thesis, folds having a width of 30 feet from limb to limb where the limbs are nearly parallel, are called local anticlines. Smaller folds are called local drag folds or crumples. However, other things such as persistence of the structure, and its general relation to the regional structure, must be considered. All known data is clearly shown in Figs. 2 and 4. The interpretation given in this thesis is based on this data and the descriptive terms used are meant to assist the reader in understanding the structure. They are not meant to be arbitrary, but it was necessary to assign a degree to the various structures in order to describe them.

In the McLean Section 'Figs. 2 and 4) two of the three local anticlines are well shown by the mine workings. The third may pass through the extreme end of the south crosscut, but it was mapped

Rock Structure (Cont'd)

by Faribault as farther to the south, and the fold axis shown in the crosscut is probably a local drag fold. The two well-defined folds are known as the north and south anticlines. The general fold structure is shown by cross sections in Fig. 3 and by the mine model Fig. 5. The fold structure cannot be defined positively because of the difficulty in tracing any particular bed around the anticlinal noses. This is well illustrated by the band of quartzite between the Twin and McLean slate belts in the McLean shaft workings (Fig. 4). The variation in thickness shown in the twin crosscut and the north crosscut is difficult to account for. A possible explanation is that the fault in the north McLean drift has brought a vein and quartzite band close to the cut off end of the McLean vein. This cannot be proved and the correlation given in Fig. 4 is based on the repetition in the north crosscut of a slate band similar to that underlying the McLean belt in the Twin crosscut. This would make the vein west of the fault the continuation of the McLean vein. Quartz veins were followed by the former operators and were believed to define the rock structure, but some of the veins in the north McLean drift and the south Serpent drift transgress the bedding, and so cast doubts on all veins as means of tracing structure. The interpretation presented here is based primarily on stratigraphic correlation and subordinately on a limited number of vein sections where the interbedded character is certain. The most important correlation was that of the McLean and Mother Seigel sections. It will be seen from Figs. 2, 3 and 4

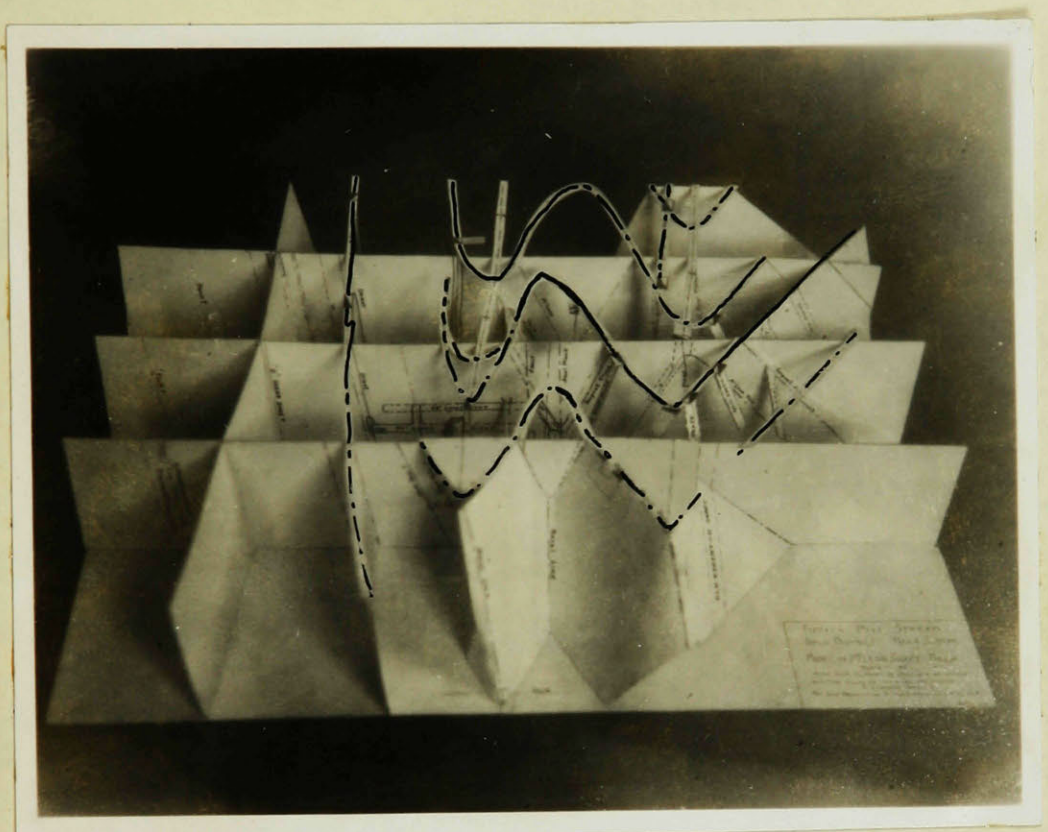
Rock Structure (Cont'd)

that the only well defined bed in the two sections is the massive quartzite band which forms the footwall of the Mother Seigel slate belt, and the hanging wall of the Twin slate belt. The complete correlation of the two sections is given in Fig. 2. It has been well substantiated by the Orient west drift and the strike of the vein system in the Mother Seigel.

In the 1902 report, mentioned previously, Faribault stated that a third anticlinal nose exists between the north and south anticlines. This statement was based on a vein intersected in an 18-foot crosscut driven north from the Serpent vein, midway between the Cornish McLean and the East Serpent shafts (Fig. 2). The vein showed an anticlinal nose and was believed to be on a third anticline of approximately the same size, between the two folds referred to as the north and south anticlines. The present work suggests that the structure consists of only two large folds and that Faribault's third anticline is only a local drag fold, of which there are numerous examples in the McLean workings. The contention that only two major anticlines are present is based on the following evidence - (1) The strike of the Twin belt west from the Twin nose and northeast from the Twin syncline, parallel to the vein in the north crosscut believed to be the McLean. (2) The drift on the 124 foot level from the east Serpent shaft toward the Old Edgerton nose. (Figs. 2 & 4) This drift and the accessible portion of the stope between the Cornish McLean and the east Serpent shafts, trace the strike of the bedding from the syncline to within a short distance

Fig.5

South



North

Photograph of model, McLean Shaft Section

Rock Structure (Cont'd)

of the nose of the north anticline. The space remaining unproved is too small to admit of an anticlinal fold as large as the north or south anticlines. This fact is very apparent from the model (Fig. 5). The Island vein between the Old Edgerton and the McLean Shaft (Fig. 2) is believed to be a fissure vein in the continuation of the Old Edgerton shear zone. From a mining standpoint, the limited size of the stopes possible on the small fold structure and the complication of workings, would prove serious drawbacks, even if ore is found there.

The Mother Seigel section shows a simple structure. The slightly curved strata dip steeply north, having been overturned. They are on the south limb of the south anticline.

Rock Types -

The rocks of the area are slates, quartzites and quartzose slates. The sequence and relative amounts of each type are shown in Figs. 3 and 4. A more detailed description is given based on a study of hand specimens and a number of thin sections cut from what are considered to be typical examples of the different rock types.

Quartzite -

A compact bluish gray rock, fine grained, dense and showing a conchoidal fracture in the wider beds and a distinct flow

Quartzite (Cont'd)

cleavage in the thinner beds. The bedding is obscured and accurate dips and strikes can only be taken at slate-quartzite contacts. The rock consists chiefly of quartz with some feldspar. Biotite and muscovite are present, and the sulphides, arsenopyrite, pyrite and pyrrhotite occur in well defined crystals. The best exposure of quartzite at Fifteen Mile Stream is the foot-wall band of the Mc-Lean belt in the Twin crosscut (Fig. 4).

Slate -

A soft greenish black chloritic rock, with a highly developed flow cleavage and a well defined fracture cleavage. Bedding is often obscured and reliable dips and strikes can only be taken at slate-quartzite contacts. In places lenticular zones in the slates show extreme cleavage. These zones cut across slate-quartzose-slate contacts with no observable change in character. So far, no explanation has been found for these structures.

Under the microscope the rock is seen to consist of medium grained flakes of chlorite and feldspar, with biotite and some muscovite. Post kinematic pyrite and magnetite are present. The bedding can be identified in thin section by the difference in optical character of the beds. Numerous biotite flakes occur along the lines of fracture cleavage and show up clearly by their simultaneous extinction.

Slate (Cont'd)

The best exposure of slate in the McLean workings is in the Twin south crosscut (Fig. 4), the core of the Twin anticline being entirely slate.

Quartzose-Slate -

These rocks include all gradations from compact quartzite to dark green slate. The intermediate type is a hard quartzose rock with a distinct flow cleavage, and in places a fracture cleavage. It is softer than the quartzites but resembles them in appearance. Porphyroblasts occur on cleavage surfaces, giving a mottled effect.

Under the microscope these rocks show the general characteristics of the slates, but contain considerable quartz.

The best exposure of quartzose-slate in the McLean workings is in the south crosscut.

Quartz Veins -

Age: Two ages of quartz veins are found in the district. There may be others, but they have not been definitely identified as yet. The earlier type is represented by the interbedded veins which have the form of saddle veins on the anticlinal structures; the later type by the non-interbedded veins, which offset the interbedded veins. With these are classed the cross veins which occur in

Quartz Veins (Cont'd)
Age -

the McLean workings, and which also displace the interbedded veins. The source of the quartz forming solutions has not been worked out but may be identified later when sufficient data have been collected.

Interbedded Veins - The interbedded veins occur in the slate belts, along slate-quartzite contacts, and occasionally in the quartzites. They occupy fractures caused by the slippage of the beds over each other during the folding. The incompetent slate was sheared, drag folded, and crumpled between the competent quartzite beds. The quartz veins formed in these channels have the same drag folded form as the enclosing rocks. This is very useful in tracing structure. Vein widths vary from two inches to twenty-four inches. The quartz is usually dark and oily with many dark platy inclusion which parallel the sides of the veins through the most intricate crumplings. These inclusions are usually chloritic but occasionally an inclusion of slate can be identified. They appear to be thin bands forced off the walls of the openings by the quartz-forming solutions. In addition to the inclusions, definite bands appear in the veins, which indicate separate injections of quartz solutions. Usually the quartz of the different bands is of the same general character, but in a number of places a band of white glassy quartz is in contact with dark oily chlorite bearing quartz. In the first case the quartz of the different bands is of approximately the same age, but in the second case, it is believed

Quartz Veins (Cont'd)
Interbedded Veins

that there was a considerable time between the injections. All the interbedded veins show evidence of movement subsequent to their formation. They are much fractured and in places are shattered, with slickensides showing on faces coated with pyrite. Sulphides present are massive arsenopyrite, sphalerite, pyrite, chalchopyrite and pyrrhotite. The veins are remarkable for the preponderance of pyrrhotite over arsenopyrite, a reversal of the usual relationship of these two sulphides in most Nova Scotia gold districts. The gold content of the interbedded veins tends to be low, except in zones where enrichment by later solutions has taken place. The known interbedded veins are shown in Figs. 2 and 4.

Non-Interbedded Veins - The non-interbedded veins are believed to be of later age than the interbedded veins because of the off-setting and cross-cutting relationships shown by a number of cross veins. The following evidence is cited in support of this belief - (1) In the south crosscut in the "C" vein drift, two small cross veins offset the bedded veins $1\frac{1}{2}$". (2) A cross vein in the north McLean drift, ten feet west of the fault, can be traced through the bedded vein (Fig. 4). The contacts are distinct and the white quartz of the cross vein contrasts distinctly with the dark quartz of the interbedded vein. This cross vein passes into the north wall of the drift with no deminuation of width. The same vein has been traced south into and across the Twin belt, but the old stope

Fig.6

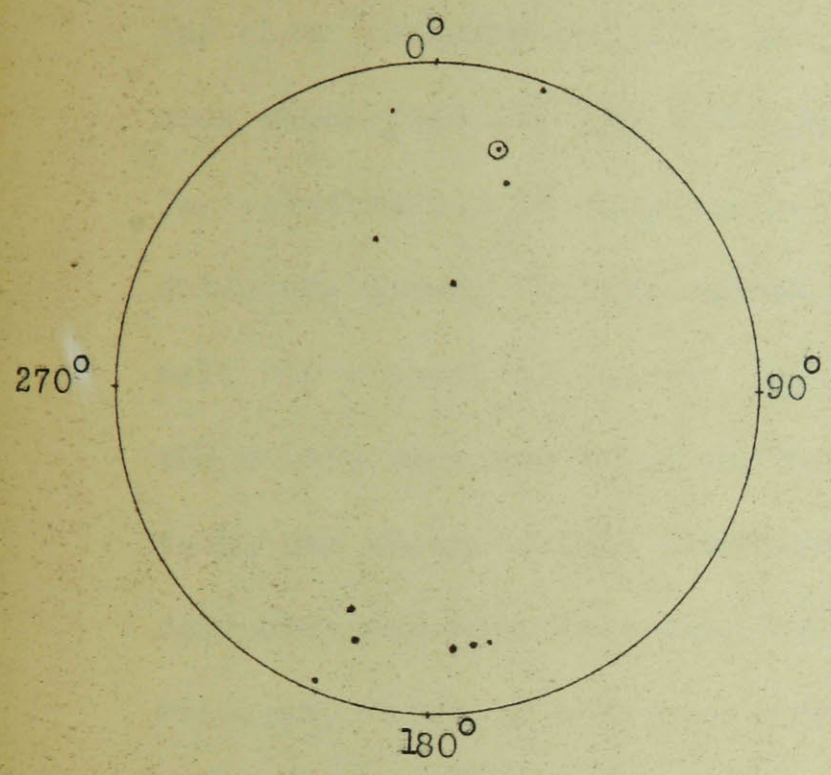
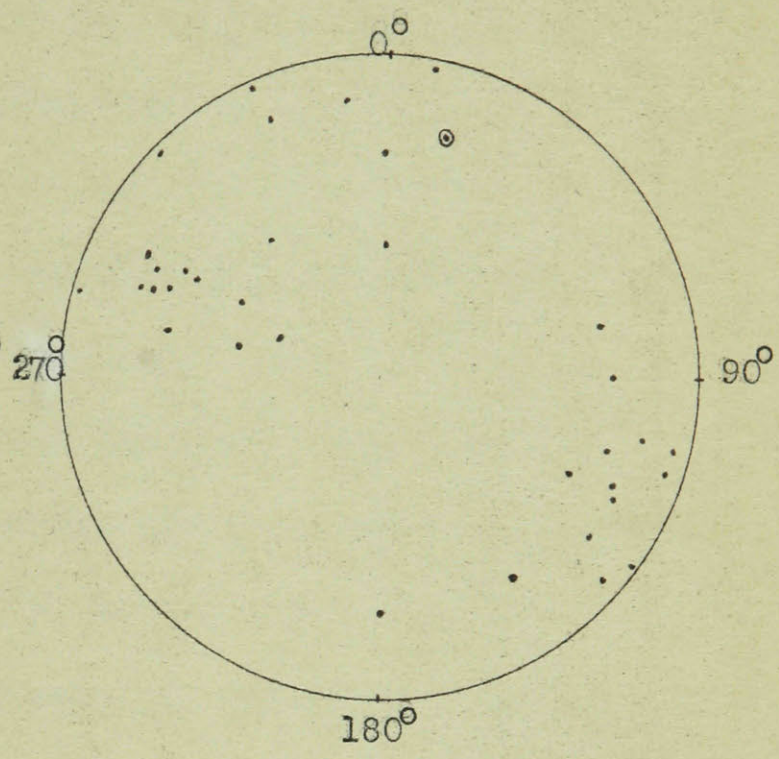


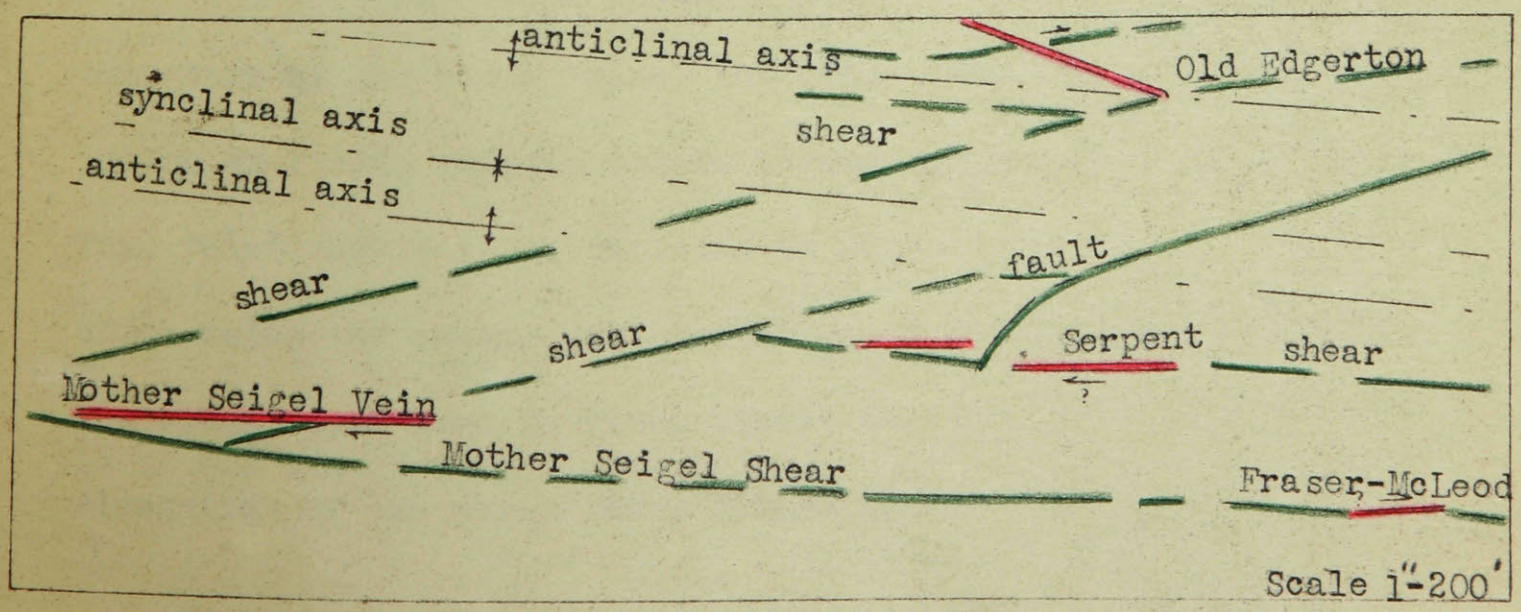
Fig.7



Faults and Shears

Cross Veins

Fig. 8



(Section covered by Fig.2)

Relation of shear zones to known ore bodies.

Quartz Veins (Cont'd)
Non-Interbedded Veins

prevented study of the actual vein intersections. (3) The veins in the shear striking S-E from the Mother Seigel Mine are in a shear zone which cuts off the interbedded Mother Seigel vein to the west. The relationship is complicated by the fact that some of the later solutions appear to have spread out into the Mother Seigel slate belt for a short distance. (4) The quartz lens in the fault in the McLean workings is of different character than the interbedded veins and though actual cross-cutting cannot be seen, it closely resembles the vein described in (2) above. In addition to this evidence, there is a marked difference in appearance between the cross veins and the interbedded veins. As described before, the interbedded veins are predominantly dark and highly contorted, while the cross veins are white, less contorted or not deformed at all. The smaller cross veins have very little massive sulphide and the larger ones only minor amounts, while the interbedded veins show a medium amount with high concentrations in some places.

The veins which occur in the shear zones are the most important of the cross veins, the other cross veins having the relation of filled tension cracks formed by the major shear stresses. This relationship is illustrated in Figs. 6 and 7, in which the cross veins and shears are plotted on an equal area projection. The cross veins tend to group almost at right angles to the axis of elongation of the shear rhomb formed by the two sets of major shears.

Quartz Veins (Cont'd)
Non-Interbedded Veins

The larger cross veins show crumple structures which plunge against the anticlinal structure. This helps to distinguish these veins from the interbedded type in sections where the two are parallel, such as in the north McLean drift and the south Serpent drift (Fig.4). Both these veins have chloritic inclusion similar to the interbedded type.

The gold content of the cross veins has not been definitely established. Gill reports gold in one of the veins in the Mother Seigel S-E shear [*], and the "E" vein in the McLean south

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[*] Private Report, 1934 - Dr. J. E. Gill

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crosscut showed low values. On the other hand, the North McLean and south Serpent non-interbedded veins did not appear to carry any values, at least not in the sections explored to date.

Accessory Minerals -

Pyrrhotite and arsenopyrite are the most abundant massive sulphides which occur in the quartz veins. In addition, sphalerite, galena, chalchopyrite and pyrite are found. Pyrite is ubiquitous, occurring as a massive sulphide, as drusy crystals in cavities, and as a plating in almost every crack in the veins. Chalchopyrite is seen only occasionally. Galena is the only "in-

Accessory Minerals (Cont'd)

dicator" sulphide noted at Fifteen Mile Stream. It is almost invariably found near free gold. In other Nova Scotia districts, galena and sphalerite have been noted as indicators, and it is likely that in or near major ore zones at Fifteen Mile Stream, sphalerite will also be found.

Faults and Shear Zones *

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* Shear Zones are here defined as multiple parallel or sub-parallel breaks, which form a zone of fracture which may show a large or small displacement. A fault is defined as a single well defined shear plane.

Two well defined shear sets have been observed in the area. One strikes approximately north 75° east and dips 75°-80° north, the other S 80° E and dips 70°-85° north. Both show local changes of strike and dip. The known and inferred sections of these shear zones are shown in Fig. 2. The displacements are not known, but they are believed to be greater on the southeast system. This belief is based on the fact that while shears of both sets intersect the Mother Seigel slate belt, those of the N-E one do not appreciably displace while a S-E zone cuts it off to the west.

It is inferred from the general relationships that the shearing was the result of forces regionally active and that the mass of folded strata had little effect on the direction of shearing. This is shown by the very local control observed at the very acute

Faults and Shear Zones (Cont'd)

angles between strong shear zones and soft slate belts. Similar shears observed at Oldham, Country Harbor, and South Uniacke, have the same relation to local structure.

The only two shears of any size which have been traced are the fault, which cuts the north McLean drift (Figs. 2 and 4) and the shear zone passing S-E from the Mother Seigel and identified as the "E" belt in the McLean south crosscut (Fig. 4).

The first has an apparent strike separation of six feet, but shows evidence of a diagonal movement of greater extent. The second has not been worked out, but in the "E" belt it does not show evidence of great horizontal movement. In the Mother Seigel, it is known to cut off the belt at the 134-foot level in the west shaft, and shows every evidence of a large displacement . This shear-zone is of importance because it may be of pre-ore age. Quartz veins occur in it and in the drag fractures curving out from it. One of these veins carries gold in the Mother Seigel Mine, and there is some gold in the "E" vein which follows the south side of the fault zone. The shear is believed to be pre-ore and may be the channel along which the ore solutions came up. If it is post ore, it indicates another mineralization episode after the ore forming solutions came up. In either case, it will be logical to look for ore to the west of the break.

In addition to these well defined shears, there are numerous small faults of a few inches displacement. These are of

Faults and Shear Zones (Cont'd)

little importance, but prove bothersome in stoping operations. The present workings in the McLean section are still in the disturbed surface zone and firmer ground is expected on the deeper levels.

Ore Body Formation -

Direct evidence exists in the veins of the Mother Seigel shear, the lens in the north McLean fault, and the cross veins which cut through this McLean Vein, that these fractures acted as channels for quartz-forming solutions of a different age than that of the interbedded quartz veins. Indirect evidence by inference from similar structures in other districts suggests that a large number of similar fractures did not act as channels, or, if they did, little or no mineralization occurred along their walls. Where such channel fractures intersect interbedded veins or favourable slate belts, later quartz solutions formed ore bodies of commercial size. The attitude of the ore body is defined within limits by the line of intersection of the shear zone and the interbedded vein or slate belt. The size of the ore body is often directly related to the rock type cut by the shear. If it is a narrow vein in a small hard slate belt, the width of the zone of enrichment will be narrow and very high grade; conversely, a wide soft slate belt may result in a wider and usually more patchy enrichment. In some places the shears themselves carry ore, which is localized by changes in strike and dip

Ore Body Formation (Cont'd)

of the zone. "E" vein in the south crosscut is an example of this type, the low grade enrichment occurring at a change of strike of the Mother Seigel southeast shear.

Known Ore Bodies -

(1) The Old Edgerton ore body lay along the line of intersection of a shear zone and the Serpent vein. The strike and dip of the two structures are shown in Fig. 2. The known extent of the shear zone is from the outcrop of the vein to the bottom of the inclined shaft 240 feet in depth , but it is very likely that it extends much further. The pitch of the ore is east approximately parallel to the axial line of the fold. The ore was mined to a depth of 240 feet on an incline, work being finally abandoned owing to the very wet condition of the mine, which made it practically impossible to keep a candle lit. The opening of the Mother Seigel resulted in the closing of the Old Edgerton because of the great improvement of working conditions in the new mine. ⁂

⁂ Statement of Mr. D. Fraser, Asst. Mgr., New Edgerton Company

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The lateral dimensions of the ore are not known, but it was not over thirty feet in width by ten inches in thickness. In the stopes, a large amount of vein on the margin of the enriched section was also mined, which makes a true estimate of the dimensions

Known Ore Bodies (Cont 'd)

of the shoot difficult. There is reason to believe that the ore was not exhausted and will be found to continue downward. The shaft is caved at the surface but approach can be made from the McLean workings if such development is undertaken.

(2) The Purcell Roll was an ore body similar to the Old Edgerton and paralleling it to the northwest in the same vein. The ore body was smaller and the history of the mine is obscure. The workings are at present inaccessible, the shaft having caved at the surface (See Fig. 2).

(3) The Island vein workings are believed to be on a spur of the Old Edgerton shear zone. They were spotty in character and did not contribute much to the production of the district. Two of the shafts are still open, but are filled with water. These old workings constitute a menace to the McLean Shaft and will eventually have to be drained, at which time they will be examined.

(4) The Mother Seigel discovery was made in the crosscut near the east shaft (Fig. 2). The ore was found to pitch flatly west in a well defined "roll" or thickening of the vein, which occurred at the intersection of a shear zone and a small interbedded vein * (Fig. 9). The dimensions of the shoot were 20 inches average

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* Memoir 156, C.G.S., P.82 - For strike of shear zone, See P.85

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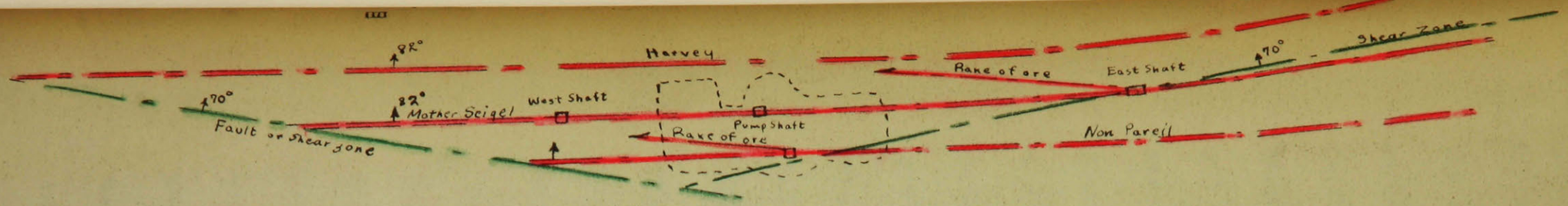
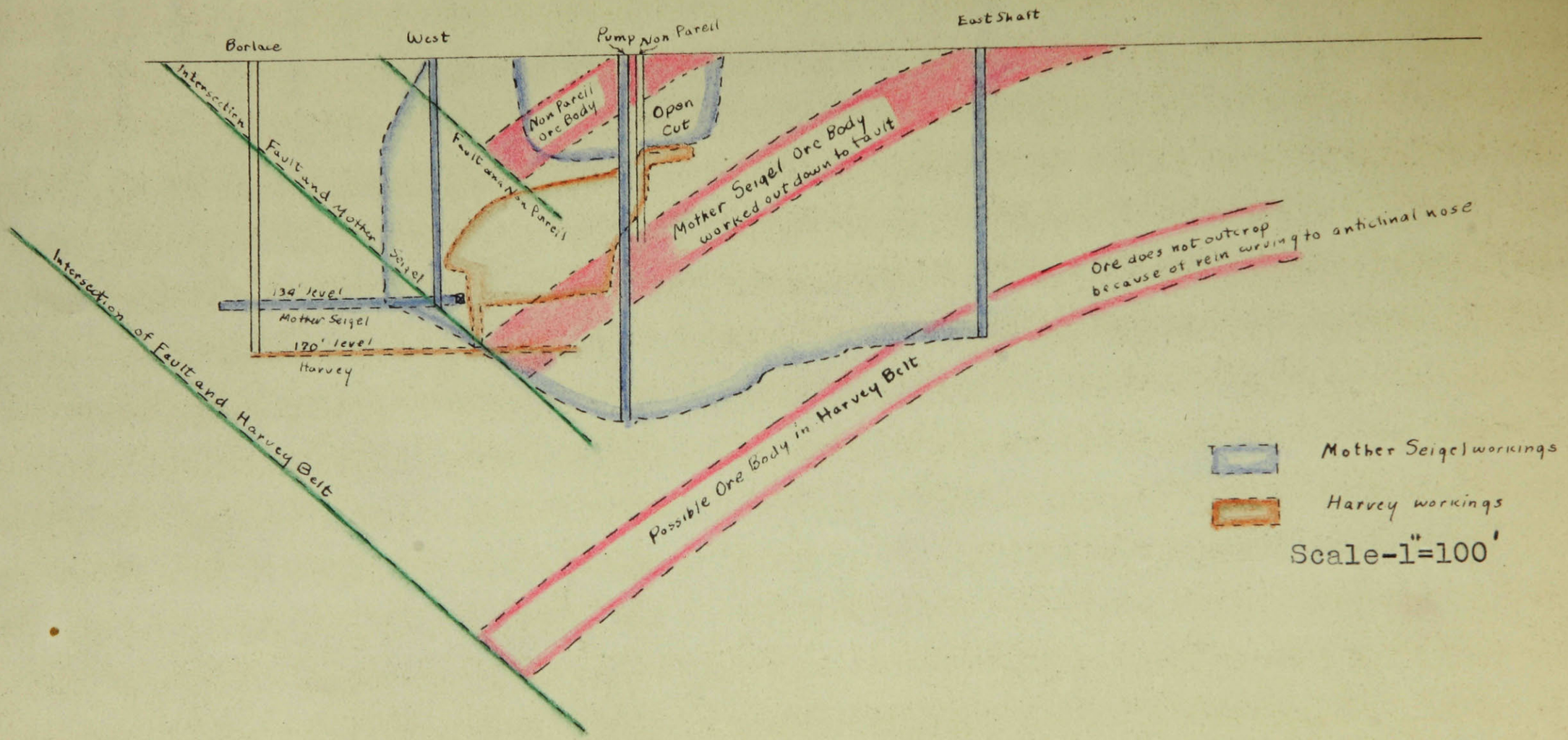
thickness by 20 to 35 feet in width. If a dip of 85° north is assumed



PLAN

Showing intersection of shears and faults
With Non Pareil, Mother Seigel, and Harvey veins.



LONGITUDINAL SECTION

Showing known ore bodies and a possible ore body in the Harvey vein.

6.11.9

Known Ore Bodies (Cont'd)

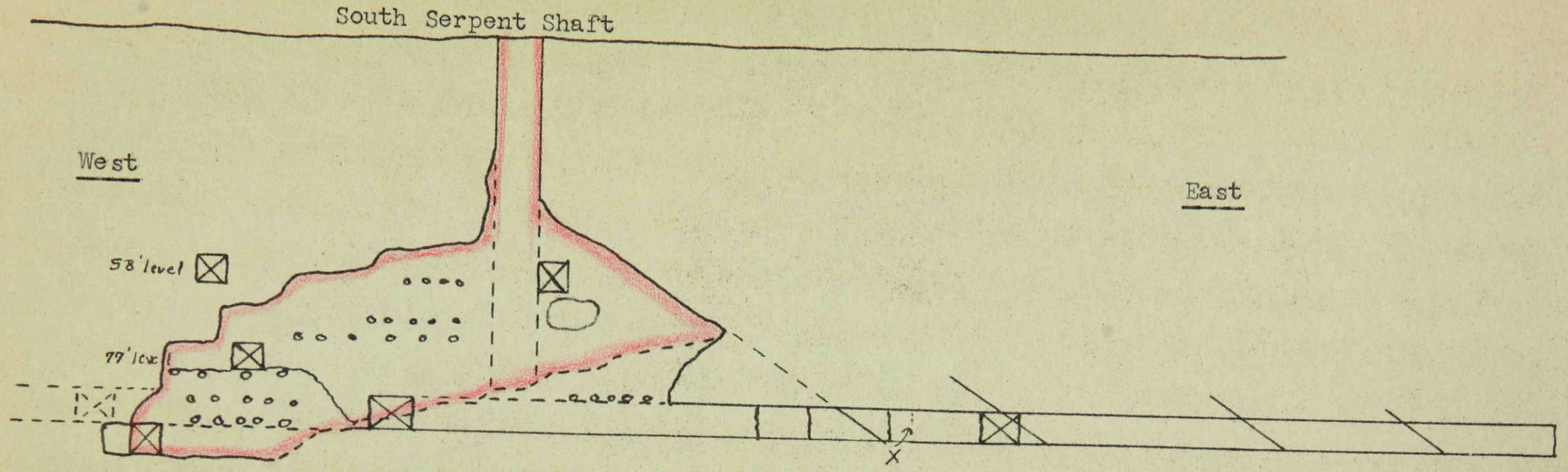
for the Mother Seigel vein and a 70° north dip for the shear zone, the line of intersection will pitch approximately 38° west. This accords roughly with the known pitch of the old workings, but other factors enter into the problem. At the east shaft, the vein is beginning to curve toward the anticlinal nose and the dip is closer to 90° than to 85°. In addition, the curve of the vein makes the strike intersection angle smaller. Both factors tend to give a very flat pitch at the east shaft with a gradual steepening to the west. A similar relationship holds for the shear which comes in from the southeast to intersect the Mother Seigel belt at a point west of the Borlace Shaft, but in this case the intersection pitches east and would not begin to steepen until some depth was reached. The general relationships are shown somewhat diagramatically in Fig. 9. A very important point is brought out here - in that ore bodies may be expected along the line of intersection of a shear zone and any favourable slate belt or quartz vein. It is known that a small body of ore was worked in the Non Pareil and a large one in the Mother Seigel. The possibility of a similar body in the Harvey belt is indicated by the plot of the shear vein intersections and is also indicated by diamond drill hole No. 4, which shows free gold in this section. If at all possible, this zone will be tested either by drill or by drift from the 200-foot level of the McLean shaft, which is now being sunk to that level. The importance of this work cannot be overestimated, because, if the ore is found as indicated, the theory will have proved of practical value to the mining industry.

Known Ore Bodies (Cont'd)
McLean Shaft Workings -

Though the most is known of the geology and present values in this mine by test, little could be learned about the ore bodies worked by the original operators. Mill tests were made from the Twin, South Serpent, "A" Vein, "B" (Orient) Vein, "C" Vein, and "E" Vein - all of which showed gold, but none in commercial quantities. The ore bodies worked previously are indicated by the old stopes. These were (a) the McLean vein at the McLean shaft; (b) the Twin on the crest of the south anticline; (c) the Serpent on the south limb of the south anticline; (d) the Serpent on both limbs of the syncline as far east as the fault; (e) the Orient vein between the two shafts.

The ore body worked in the McLean extended a short distance east and west of the shaft and is supposed to have pitched east. It is believed that it was located at the intersection of a shear zone and the McLean vein. The same shear intersects the Serpent farther east to form the ore body worked from the South Serpent shaft. Both these ore bodies were irregular patches which appear to have been partly due to a change in strike of the shear in addition to the vein-shear intersection. The shape of the Serpent stope (Fig. 10) suggests a west pitch, but the approximate end of the ore in the east drift gives an irregular shape to the body. It does not pitch east as the new drift did not show gold and the first nose was very low in grade. An isolated pocket was found at the second nose (Figs. 4 and 10), but it was not part of a plunging zone. The Serpent vein

Fig.10



Longitudinal Section of Serpent Vein Workings
Scale 1"-40'

Known Ore Bodies (Cont'd)
McLean Shaft Workings -

is much drag folded and a series of veins connect it to the next three veins overlying it to the east. The structure in this section is very complicated, but it is not of vital importance because of the lack of ore. The Serpent was also worked from the synclinal axis as far east as the fault in the North McLean drift (Fig. 4). Faribault reports that "the Serpent was small but very rich in the south syncline". * The fault contains a large lens of quartz on the

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* Memoir 156 - C.G.S., P.83.

77-foot level just south of the north McLean drift. This lens plunges east and does not show on the 90-foot level. It is probable that the fault was the channel along which the ore-forming solutions came up. Unfortunately, development work in this section was curtailed because of the old water filled workings to the north. It is planned to diamond drill here for the double purpose of draining the old workings and testing the structure.

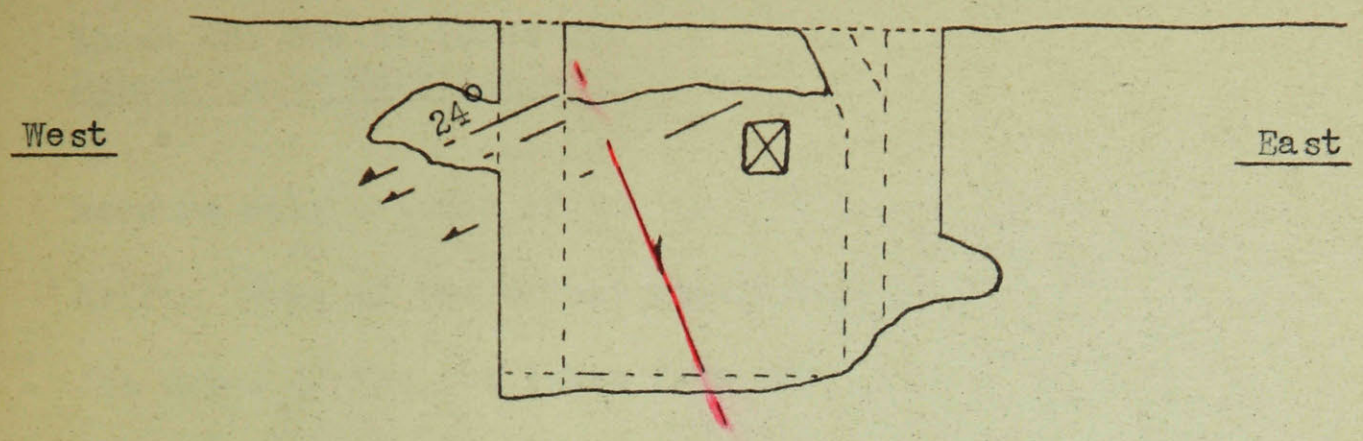
The Twin belt ore was on the crest and north limb of the south anticline. It was mined by the bench method from below the 100-foot level to approximately 45 feet above it. The old stope outline indicated the approximate bottom of the high-grade ore, which fact was closely checked in the new drift by daily examinations of the face and back. A mill test was taken from the veins at the axis of the syncline and the ore proved to be the best average grade milled.

Known Ore Bodies (Cont'd)
McLean Shaft Workings -

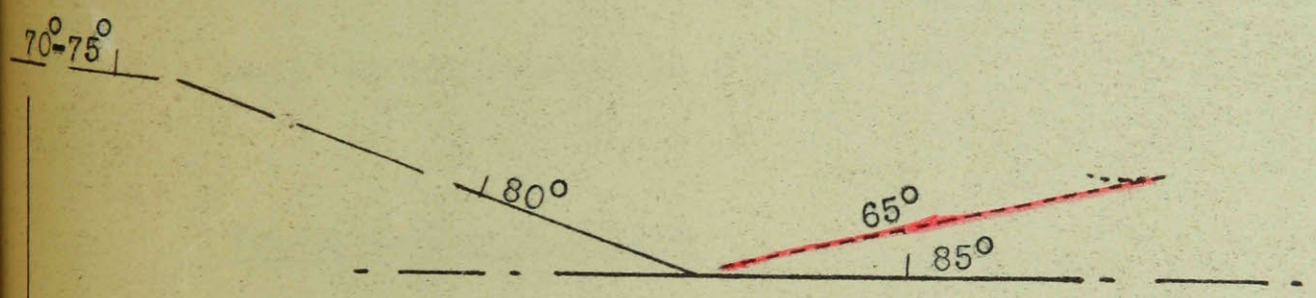
The fault in the north McLean drift turns into the Twin belt and follows it to the synclinal axis. It was probably the channel for the ore forming solutions.

The Orient workings were reached and drained by the south cross-cut. These are the largest workings in the section, but were not very successful according to all the information which could be obtained about them. They are 120 feet deep at the east shaft and 90 feet deep at the west, with stopes sloping up from the shafts. The ore was supposed to pitch east, but this cannot be verified. As it was impossible to go through the old stopes, the "C" vein was drifted on and a cross-cut driven north to the Orient at the west end of the old workings. A 200-foot drift was driven west on the Orient and the development rock stock piled. The vein was smaller than in the east and showed a tendency to offset to the south in shears and fractures in the belt. The "C" drift east was continued and a cross-cut driven to the east Orient shaft for the purpose of ascertaining the depth of this shaft. It was hoped that it was the 220-foot shaft referred to in the literature, in which case it was to have been used to develop a new level. Unfortunately, it proved to be only 120 feet deep. The "C" drift east was continued and a crosscut driven north as shown in Fig. 4. The Orient and the "B Flat" vein were found to curve back in a local drag fold as shown in Figs. 2 and 4. This is of interest in illustrating how quickly such local crumples can die out,

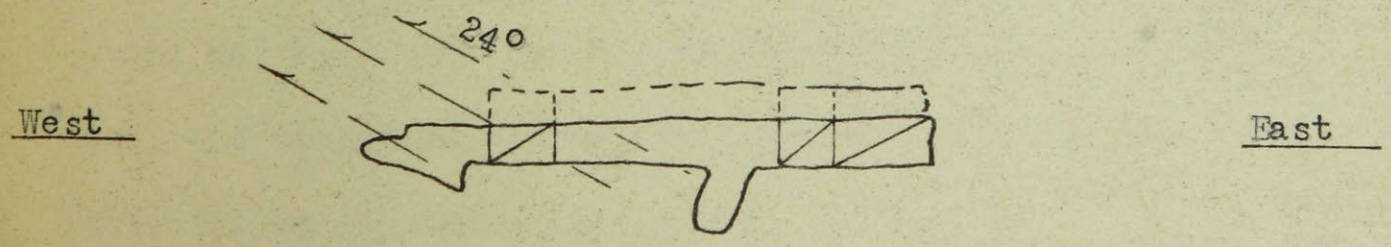
Fig.11



Longitudinal Section



Plan of theoretical intersection of shear zone and McLeod Veins showing inferred rake of ore.



Plan

FRASER McLEOD WORKINGS

FIFTEEN MILE STREAM, N.S.

Scale-1"-40'

Known Ore Bodies (Cont'd)
McLean Shaft Workings -

because only a trace of the drag fold can be identified in the McLean drift. None of the Orient development showed any commercial ore and the grade of the ore taken from the old workings is reported to have been low. It must be stressed that ore developed from the margin of previous stopes represents the transition from what was uncommercial ore in the past to barren ground. A true valuation of the ore bodies will not be attained until their downward extensions have been developed on a lower level.

Fraser-McLeod Workings -

A very interesting ore body was worked in the Fraser-McLeod mine to the southeast of the Orient. Two 40-foot shafts were sunk on a rich spot, which is thought to be the junction of the Mother Seigel southeast shear and a fissure vein. Three quartz veins averaging 6 inches to 12 inches almost completely fill the back of the stope and show very large drag folds plunging west. It is probable that the extension of the ore plunges steeply east. The general relationships are shown in Fig. 11. A change of strike of the shear zone also may have influenced the formation of this ore body.

SUMMARY AND CONCLUSIONS -

Fifteen Mile Stream gold district is situated on a composite anticlinal dome. The folded rocks are the Goldenville formation of quartzites with interbedded slates, believed to be Pre-Cambrian in age. Interbedded quartz veins of saddle-vein type occur in the slates, along slate-quartzite contacts, and rarely in the quartzites. Sections of these veins carry sufficient gold values to constitute ore bodies. The folded rocks have been deeply truncated by erosion.

The district has been sheared regionally and shows a well defined fracture pattern consisting of two sets of main shears with their accompanying fractures. The NE-SW set appears to be younger than the NW-SE set of shears. The local rock structure did not control the direction of shearing to any extent, for very acute angles are found between soft slate beds and strong shears. Both sets of shears acted as channels for later gold bearing quartz solutions. Bodies of commercial ore were formed along the lines of intersection of such channel fractures with interbedded quartz veins, or favourable slate belts. In some of the stronger shears, ore bodies occur in favourable places formed by changes in strike and dip of the shear zones. The intersection type tends to be high grade, while the second type tends to be lower, though still of higher grade than the bulk of the interbedded quartz veins. The two best examples of the intersection type are the Old Edgerton and the Mother Seigel,

Summary and Conclusions (Cont'd)

both of which were worked for a number of years. It is stressed that these types of ore bodies are not unique. Similar bodies have been mined in Nova Scotia at (1) South Uniacke (2) Oldham (3) South Brookfield (4) Central Rawdon (5) Tangier, and many other districts.*

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* Memoir 156, C.G.S. - See description of districts.

It is concluded that Fifteen Mile Stream is very favourable for studying the structures which controlled ore formation. The well defined shear zones cutting the small local anticlines, will make it possible to trace the effect of shear structures on opposite limbs of an anticlinal fold. This is impossible in the majority of gold districts in Nova Scotia, because of the large size of the folds. In addition, the effect of shears passing through a number of interbedded veins which overlie one another stratigraphically, can be investigated. Both of these factors are of vital importance to the mining industry. If the ore could be located on the basis of shear-vein intersections, the development of overlying and underlying veins could be carried out systematically with a minimum amount of dead work. Development on such a basis has been carried out at Oldham with positive results, but long distances between the veins and other factors prevented conclusive proof of the theory. If the possible ore body in the Harvey belt (Fig. 9) is found to exist, the theory may be considered proved to the extent of forming a working theory on which to base mine

Summary and Conclusions (Cont'd)

development. From this standpoint, the work now going on at Fifteen Mile Stream is extremely important to the mining industry of the Province, even if it does not result in the development of an operating mine.

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