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CLAY PRODUCTS FROM PRINCE EDWARD ISLAND CLAYS AND SHALES

by

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SUMMARY

Comments are made on the Clays and Shales of Prince Edward Island from information contained in published reports and from recent observations made by V.K. Prest of the Geological Survey of Canada.

An evaluation of samples taken in 1958 from Howard's Cove, Bacon Point, and Prim Point indicates that they are suitable for the production of building tile, drain tile and face brick. The firing ranges of all samples tested are inclined to be short for face brick manufacture.

The Prim Point area is not considered suitable for development because of a high proportion of sandstone.

The Howard's Cove and Bacon Point areas appear to contain fairly extensive quantities of good quality shale. The Bacon Point location is probably the most favourable one of the two. The quantity and quality of shale here appears to be better than at the majority of locations reported on in previous years.

It is recommended that core samples at locations back from the Bacon Point Cliffs be evaluated. The drilling will indicate the quality and extent of the shale deposit. In addition it is recommended that a survey should be made to determine the market potential for clay products in Prince Edward Island.

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INTRODUCTION

The Prince Edward Island samples evaluated in this report were collected by the author, G.H. Crowl of the Geological Survey of Canada (G.S.C.), and B. Graham Rogers of the P.E.I. Department of Industry and Natural Resources during July 1958. Representative shale samples were obtained from the cliffs at Howard's Cove, Bacon Point, and Prim Point. In 1955 samples from the first two localities were submitted by V.K. Prest of the Geological Survey of Canada who is in charge of the geological mapping work being undertaken by the Department of Mines and Technical Surveys on the Island. He had found from his observations that these points appeared to contain the largest and most suitable shale deposits of any he had seen on the Island. Preliminary evaluation of the samples indicated that these materials could probably be employed for production of red burning clay products and that further work to confirm the results would be desirable.

There were a few small and unsuccessful clay products plants on the Island which ceased operations many years ago. The principal difficulties appeared to be unsuitable raw material and improper operating techniques. The Prince Edward Island government is interested in finding a clay or shale deposit suitable for the manufacture of clay products and in the development of a small clay products industry. The demand for brick and tile on the Island is small and there are many factors which could make exporting of the products

uneconomical. Consequently, it appears likely that only a small capacity plant, geared mainly to the Island's demand, should be considered. The principal market would likely be in agricultural drain tile. A very small quantity of building tile and face brick is used. The stiff mud or extrusion method of manufacture, which is the most commonly used for production of clay products, must be employed for drain tile forming.

SUMMARY OF PREVIOUS WORK ON CLAYS AND SHALES

A brief report by Howells Fréchette and J.F. McMahon (1) dealt with the general situation in regard to clays and shale on Prince Edward Island. Samples were collected by Frechette and the laboratory work was carried out under the direction of J.F. McMahon in the ceramic laboratories of the Mines Branch. The results of this work were compiled by A.R. MacPherson (2). All samples were found to be red burning common clays or shales.

Frechette concluded that in general the Prince Edward Island clays did not offer as suitable a source of raw material for clay products as some of the shales. He found that the clay beds were often not more than 2 or 3 ft thick and were contaminated with a variable amount of sand. In some localities the clays contained fragments of sandstone and occasionally lime pebbles. He reported that a considerable quantity of the shale was very sandy, was interbedded with sandstone, or that visible outcrops of shale did not

extend laterally for any distance because of the structure of the formation.

The location of several deposits and a summary of MacPherson's publication appear in a report by G.C. Milligan (3). No properties of the samples Milligan collected are shown in his report.

According to MacPherson's conclusions, of the 25 deposits considered by Fréchette to be worth while testing, the following appeared to hold the greatest promise:

1. At Tignish, Prince County, ½ mile from where the road from Tignish to the Gulf of St. Lawrence arrives at the coast, a 10 to 15 ft bed of soft shale or keel occurrs under shallow overburden.

2. In the West Point area, Prince County, north along the sea coast, 1¼ to 3 miles from the West Point lighthouse, a stratum of soft shale (keel) occurrs in the upper section of the cliffs. This material was stated to be plentiful but a sample was not taken for evaluation.

3. At Richmond, Prince County, a 2 ft bed of non-uniform glacial till occurring in a swampy area was used by a plant which was destroyed by fire in 1927. Soft shale was stated to occur below the clay. The plant manufactured drain tile and face brick.

4. At Richmond, Prince County, a second deposit 1½ miles north of town was sampled. This is a 3 ft bed of surface sandy clay.

5. At Devil's Punch Bowl, Queens County, in the area northeast of the junction of the old Princeton road and the

road running south from Stanley Bridge to Springfield, a 10 ft seam of unlaminated soft shale was exposed in the side of the hill. The shale is overlain by sandstone and boulder clay. The sampled area was stated to be unsuitable for development.

6. Gallows Point (or Gallas Point), Queens County, east of Gallows Point, on the east side of Hillsborough Bay, approximately 20 ft of partly weathered shale outcrops in low cliffs. The overburden apparently is thin.

7. Near Bridgetown, Kings County, south of Bridgetown, on the west bank of the Grand River (now Boughton River on topographic maps), on the farm of Edwin Clay, there is a surface clay deposit of approximately 5 ft in depth and covering about 1½ acres. There is very little overburden and no stones.

8. At Bothwell, Kings County, there is an outcrop of soft shale in the face of the cliff on the coast side of Talbot Stewart's farm. There is up to 15 ft of sandstone overburden.

Considering the properties of these clays and shales as listed by MacPherson (2) and the information gained from recent extensive geological work carried out by the Geological Survey, some comment should be made on the eight selected deposits.

The Tignish material (No. 1) has a very high drying shrinkage (7.5%). At cone 06 (1816°F), which is in the range for face brick, the fired shrinkage is excessive (7%). Thus for face brick manufacture the combined drying and

fired shrinkage is too high for good results. The shale has a short firing range. Furthermore, according to V.K. Prest of G.S.C. there is little likelihood of a large uniform deposit being available in this region. Consequently, it appears that this area does not offer any promise for a long term clay products industry.

The West Point soft shale (No. 2) was not sampled and so it is of unknown quality. Prest states that shale comes in at sea level at a point two miles north of West Point, and that from here northwards shale is intercalated with sandstone for many miles. The first significant deposit of shale at the surface is in the vicinity of Greenhill, but here the beds are rather lenticular. Two miles further north, according to Prest, 15 to 20 ft of shale occurs within 10 ft of the surface, but the most favourable location in this area is at Howard's Cove.

The clays of the Richmond area are shallow surface materials. The deposits are 2 to 3 ft thick, with beds of sand or gravel occurring above the clay, according to Frechette. The reported drying shrinkage varies from 4.5% to 7.5%. The latter figure is too high for satisfactory drying. Some of the samples from this locality had short firing ranges and consequently it would be likely difficult to obtain a hard, dense, uniformly sized product. Sample No. 3 was taken from a low swampy area. It is here that the soft shale was stated to occur below the clay. This deposit would probably be wet and working a pit would be difficult in wet weather. The clay would likely be

contaminated with gravel.

The area in which No. 5 deposit (Devil's Punch Bowl) occurs was stated to be unsuitable for development. MacPherson also stated that the shale has one of the best vitrification ranges of the materials sampled. However, from examination of the test results, this range is fairly short for face brick manufacture. The fired shrinkage at cone 03 (1987°F) is on the high side (6.5%). Beyond this point the shrinkage increases rapidly to 9.5% and the product becomes vitrified (close to zero absorption). This sample should be suitable for building tile and drain tile but care is needed in firing face brick.

The Gallows Point shale (6) has a moderate drying shrinkage of 4.5%. The firing range is inclined to be short for the manufacture of face brick, and so care would be necessary in firing this product. The test results indicate that building tile and drain tile could be produced satisfactorily. According to V.K. Prest, however, there is only a very limited supply of shale on Gallows Point. He states that the surface trace of the shale layer extends northward for 1½ miles to Pownal Bay along a small draw at less than 25 ft above sea level. The site therefore does not appear favourable for commercial development of the shale. Prest states that there is a somewhat thicker and more uniform shale horizon in Orwell Point one half mile east of Gallows Point. Again, the quantity of shale available on this Point is too small for development. Northward towards Pownal Bay the small draw marking the trace of the shale does

rise above 25 ft and he believes sufficient quantities of shale should be readily available here. The quality of this material is unknown but it is probably somewhat similar in properties to the Gallows Point sample.

The Bridgetown sample (7) is a surface clay from an apparently limited area. The firing range is inclined to be short and so care would be required in face brick manufacturing. The properties indicate that it would be suitable for drain tile and building tile.

The shale from Bothwell (No. 8) cannot be worked economically and should not be considered unless a deposit with less overburden and greater thickness can be located in the same general area. The firing range is inclined to be short and at temperatures greater than cone 06 the shrinkage becomes excessive. Production of drain tile and building tile could be accomplished readily. Care might be required in drying a de-aired extruded product since the drying shrinkage is on the high side (6%).

Thus, in summarizing, samples of surface clays from Richmond and Bridgetown have the disadvantages common to surface clays. The material from West Point was not sampled and so is of unknown quality. The deposits sampled at Bothwell and Devil's Punch Bowl are unsuitable for development according to MacPherson (2). The soft shale (keel) at Tignish and weathered shale at Gallows Point appear to hold the greatest promise when Frechette's samples are considered. However, the extent of the Tignish material is very limited and consequently this area probably should

not be considered. In any event the Gallows Point shale has less drying shrinkage and fires to a given absorption with less shrinkage than the Tignish shale. Consequently the Gallows Point - Orwell Point - Pownal Bay area appears to offer the best possibilities of the eight locations.

LOCATION OF FORMER CLAY PRODUCTS PLANTS

No exact record is available to the author on the locations of former plants on Prince Edward Island. The following locations of plants were compiled from the references mentioned earlier in this report:-

1. Richmond, Prince County:- surface clay.

2. Lower Bedeque, Prince County:- clay from the beach below high tide level.

3. Old Georgetown Road, near Charlottetown, ½ mile east of the junction of Old Georgetown road and the road to Battery Point, about 1 mile east of the Hillsborough River- surface clay.

4. Lake Verde, Queens County, ½ mile north of Lake Verde Station and ½ mile east of the Lake Verde - Auburn Road:- sandy surface clay in a swampy area.

It should be noted that in MacPherson's report (2) only the surface clay in the Richmond area was considered suitable for clay products.

GENERAL COMMENTS ON CLAYS, SHALES AND CLAY PRODUCTS

Generally speaking a surface clay deposit is more difficult to work than a shale deposit. Usually the physical properties of the clay in a surface deposit are variable. Frequently the deposits are shallow and contain hard stones or lime pebbles which are difficult to grind and cause trouble in cutting and in the finished ware. Surface clays take up moisture readily and are often impossible to work in wet weather. Frequently these clays are very plastic and are difficult to dry.

Shales are generally harder and less plastic than surface clays. When used by themselves the shales should have sufficient plasticity for extrusion if stiff mud products are being made. If the material is very hard then crushing, grinding and the plasticity when tempered sometimes become a problem. Usually shales have a lower drying shrinkage than clays and dry more readily. Then can be worked ordinarily in wet weather because they do not get soft and sticky. Soft shales, such as the so called keel, may behave in a similar manner to a clay so far as moisture is concerned.

Clay products such as drain tile, building tile, and common or back-up brick are usually fired only to a fairly hard condition where ordinarily the absorption is 12 to 20% and the fired shrinkage is small. The product should be reasonably hard and strong and the sizing fairly uniform.

Colour is not important. Usually these conditions are reached in the red-firing clays at temperatures lower than those necessary for bringing out a good red. The colour is usually salmon or light red. From Frechette's samples, recommended by MacPherson (2), suitable properties for drain tile, building tile and common brick could be obtained at a temperature of cone 06 (1816°F) or slightly lower. In this temperature range the shrinkage and absorption of the P.E.I. materials do not change enough to make firing difficult.

The requirements of face brick are more severe. In a moist climate where there is apt to be freezing and thawing conditions, an absorption of 8% or slightly less is considered to be desirable. The colour should be of a pleasing shade. The size must be uniform and the brick should be strong and very hard. These conditions appear to be met in Fréchette's samples usually between cones 06 and 03 (1987°F) and generally close to cone 03. In this temperature range the clays are shrinking rather rapidly and the absorption is decreasing rapidly. Clays or shales of this type are said to have a short firing range. Thus there is difficulty in producing a product of uniform size, colour, strength and absorption unless the kiln temperature is very uniform. In large periodic kilns a uniform temperature throughout the kiln is difficult to obtain. Even in tunnel kilns or small capacity periodic shuttle kilns, where a uniform temperature can usually be obtained, there may be difficulty if the raw material has a short

firing range.

Clay or shale for the manufacture of stiff mud products should withstand fairly severe drying conditions without cracking. The drying shrinkage should not be much above 5%, otherwise difficulty is apt to be encountered from drying cracks or warping. The fired shrinkage should not be much greater than 5%. High fired shrinkages cause undue movement and distortion of the ware during firing and sometimes make proper sizing difficult to achieve.

One of the most important considerations in planning a clay products plant is the selection of a suitable clay or shale deposit. There should be a sufficient quantity of material for approximately 30 to 40 years of production. The clay or shale should be uniform, free of stones or other unsuitable material, have little overburden, and be suitable for production of the desired products. If a preliminary evaluation shows the quality of a raw material is satisfactory then further work is required to prove up a sufficiently large area for the needs of the plant. It is important to arrive at an estimate of the market potential. This should govern the size of the plant.

1958 SAMPLES

Representative samples were taken from three locations in P.E.I. These appeared to have extensive outcrops of favourable shale formations on the shore cliffs. The locations and descriptions of the deposits are as follows:

1. Howard's Cove - Prince County

At Howard's Cove, approximately 2 miles north of Cape Wolfe on the west shore, four 10 lb samples from a continuous chip-channel were taken from the cliffs north of the Government wharf. There were 3 to 4 ft of overburden and 36 ft of red, friable shale down to the shore. There was very little evidence of sandstone. One small seam of it occurs approximately 14 ft from the top of the shale. The shale is continuous for approximately 100 yards north of the wharf. The extent of the shale back from the shore is unknown. The land immediately back of this deposit belongs to the Federal Government. Prest states that due to the dip of the beds relative to the trend of the shore, the shale passes beneath sandstone going southward, and passes below sea-level at a point ½ mile south of the Cove. Hence there is little chance of utilizing the shale in this direction. North of the Cove, Prest points out that harder sandstone occurring beneath the shale rises above the sea and forms the bulge in the coast-line known as Seal Point. Accordingly, he believes the shales should cross the high ground between the Point and the west coast main road, about 40 ft above sea-level. The shale layer has a thickness of approximately 30 ft and should be traceable, according to Prest, behind Seal Point for a distance of about ¾ of a mile. Sufficient shale would appear to be present north from Howard's Cove to make a commercial operation possible. The shale dips inland at about 8° to 10°, and as higher ground also comes in along the main road,

Prest reasons that a shale pit could probably not be located eastward beyond this point. The samples were identified from top to bottom as numbers 219 (top 10 ft), 220 (10 to 19 ft), 221 (19 to 27 ft), and 222 (27 to 36 ft).

2. Bacon Point on Hillsborough Bay

Bacon Point is on the west side of Hillsborough Bay, Queens County, approximately 1/3 mile south of the Cumberland church on the main road. The red friable shale at this point occurs below a few feet of overburden. A 36 ft section of the shale, from below the overburden down to a greenish sandstone layer approximately 0 to 10 ft above the beach, was sampled. Four separate 10 lb samples were obtained. The shale extends laterally for approximately 100 yards and due to the general structure along the shore, gives way to sandstone on either side as at Howard's Cove. The land rises from the cliffs back to the highway. At points along the highway close to the church and near an adjacent farmhouse, red shale of unknown thickness occurs below approximately 4 ft of overburden. This shale belongs to a higher bed than that sampled at the cliffs. It may be present elsewhere along the highway although Prest noticed only micaceous sandstone in shallow road cuts. He has also observed that the main Bacon Point Horizon, and others stratigraphically above and below it, also outcrop along the shore both east and west of Bacon Point. He found that shales are prevalent at Holand Cove 2 miles to the north east, but these were not sampled. Large quantities of shale would therefore appear to be

available for exploitation in this general area. There were a few small seams of soft sandstone in the shale at the Bacon Point Cliffs. The sandstone was included in the samples. The samples were identified from top to bottom as 223 (top 10 ft), 224 (10 to 18 ft), 225 (18 to 26 ft) and 226 (26 to 36 ft).

3. Prim Point, Hillsborough Bay

A road runs out to Prim Point which is on the southeast side of Hillsborough Bay, Queens County. One sample was taken on the Hillsborough Bay side. Two 10 lb samples were selected and combined into one. This represents 10 ft of the best shale in the upper portion of the 25 ft cliff. This location does not appear to be favourable because of the large amount of sandstone present. Some of the shale appears to be very sandy. The sample which did not contain the very sandy portion was identified as No. 227.

PROCEDURE

The samples were crushed to pass a 16 mesh laboratory Tyler screen. Trial specimens were hand molded in 4 by 1½ by 1¼ in. metal molds. The plasticity, workability and amount of water required for tempering (water of plasticity) were noted. The drying behavior of each sample was observed. One briquette from each sample was immediately subjected to severe drying conditions at 185°F and the balance was air dried and then dried finally at 185°F.

The drying shrinkage was measured. The briquettes were fired at cones 06 (1816°F), 04 (1922°F), 02 (2014°F) and some of them if necessary at cone 1 (2077°F). The fired shrinkage, colour, hardness, and water absorption after a 24 hr soak in cold water, were observed. The pyrometric cone equivalents (PCEs), or heat softening points, were obtained.

Differential thermal analysis (DTA) curves were obtained for samples 222, 223, 224, 225 and 226, principally to check on the amount of quartz in the shale. Since the Howard's Cove deposit appeared to be uniform, the quartz content of sample 222 only was determined.

RESULTS

The physical properties determined from the various tests are shown in Tables 1, 2 and 3.

The approximate percentage of quartz determined by DTA is shown in Table 4. The balance of each of the samples is made up mainly of an illitic or chloritic clay mineral.

TABLE 1

Physical Properties of Howard's Cove Shales

Clay No.	UNFIRED CHARACTERISTICS	P.C.E.	FIRED CHARACTERISTICS					REMARKS
			Cone No.	Fired Shrinkage %	Absorption %	Colour	Hardness	
Lab 219 top 10' shale	Red, non-calcareous shale, good plasticity, tough, works well, water of plasticity 23.0%, safe drying, drying shrinkage 4.1%	7½ (2238°F)	06	2.3	12.7	light red	hard	This section is plastic and dries safely. The firing range is inclined to be short. Indications are that it is satisfactory for red face brick, building tile and drain tile.
			04	5.0	7.5	" "	very hard	
			02	8.6	0.8	dark red	steel hard	
Lab 220 (10' to 19')	Red, non-calcareous shale, good plasticity and workability, water of plasticity 23.0%, safe drying, drying shrinkage 4.3%.	8 (2257°F)	06	2.0	13.3	light red	fairly hard	Same comments as sample 219
			04	5.0	7.9	" "	hard	
			02	8.0	0.7	dark red	steel hard	
Lab 221 (19' to 27')	Red, non-calcareous shale, good plasticity, works well, water of plasticity 24.4%, safe drying, drying shrinkage 5.0%.	8½ (2278°F)	06	2.5	9.6	light red	hard	Same comments as sample 219
			04	5.0	7.3	" "	very hard	
			02	8.5	0.5	dark red	steel hard	
Lab 222 (27' to 36')	Red, non-calcareous shale, good plasticity, works well, water of plasticity 21.7%, safe drying, drying shrinkage 4.8%.	8 (2257°F)	06	1.1	12.3	light red	fairly hard	Same comments as sample 219
			04	2.7	9.9	" "	hard	
			02	6.5	2.2	dark red	steel hard	

TABLE 2

Physical Properties of Bacon Point Shales

Clay No.	UNFIRED CHARACTERISTICS	P.C.E.	FIRED CHARACTERISTICS					REMARKS
			Cone No.	Fired Shrinkage %	Absorption %	Colour	Hardness	
Lab. 223 (top 10' shale below 10' overburden	Red, slightly calcareous shale, good plasticity, works well, water of plasticity 21.1%, very slight tendency to crack in rapid drying, drying shrinkage 5.3%.	7½ (2238°F)	06	0.3	11.9	dark salmon	fairly hard	This sample has good plasticity. It has a very slight tendency to crack in rapid drying. The fired characteristics are good. Should be suitable for red brick, building tile and drain tile.
			04	1.7	11.8	light red	hard	
			02	3.3	8.4	red	hard	
			1	5.5	3.9	dark red	steel hard	
Lab. 224 (10' to 18')	Red, calcareous shale, fair plasticity, works fairly well, water of plasticity 21.4%, safe drying, drying shrinkage 4.7%.	5½ (2172°F)	06	0	13.1	light red	fairly soft	The sample has enough plasticity to extrude. It dries safely. The fired characteristics are satisfactory. Should be suitable for red brick, building tile, and drain tile.
			04	0.3	13.0	light red	fairly hard	
			02	1.7	9.7	red	hard	
			1	4.7	3.7	dark red	very hard	
Lab. 225 (18' to 26')	Red, calcareous shale, good plasticity, works very well, water of plasticity 22.2%, safe drying, drying shrinkage 5.0%.	5½ (2172°F)	06	0	13.1	light red	fairly soft	The sample dries safely and has good plasticity. The fired characteristics are satisfactory It should be suitable for red brick, building tile and drain tile.
			04	1.0	12.8	light red	fairly hard	
			02	2.6	8.8	red	hard	
			1	6.2	2.1	red	steel hard	
Lab. 226 (26' to 36')	Red, non-calcareous shale, good plasticity, works very well, water of plasticity 23.0%, safe drying, drying shrinkage 5.0%.	5½ (2172°F)	06	1.7	12.1	light red	fairly hard	Same comments as for sample 225.
			04	4.3	7.9	medium red	hard	
			02	6.5	3.3	good red	very hard	

TABLE 3

Physical Properties of Prim Point Shale

Clay No.	UNFIRED CHARACTERISTICS	P.C.E.	FIRED CHARACTERISTICS					REMARKS
			Cone No.	Fired Shrinkage %	Absorption %	Colour	Hardness	
Lab 227 (best 10' section at Prim Point)	Red, non-calcareous shale, good plasticity, works well, water of plasticity 23.0%, very slight tendency to crack with rapid drying, drying shrinkage 5.2%.	8 (2257°F)	06	1.0	12.9	light red	fairly hard	This sample has good plasticity. It has a very slight tendency to crack in drying. The fired characteristics are satisfactory. Should be suitable for red brick, building tile and drain tile.
			04	3.3	8.7	light red	hard	
			02	7.2	2.4	red	steel hard	

TABLE 4

Quartz Content of Some P.E.I. Samples

Sample Number	Percent Quartz
222	12 to 17
223	20 to 25
224	18 to 23
225	17 to 20
226	10 to 15
227	10 to 15

DISCUSSION OF RESULTS

1. Howard's Cove Shale

The results of the tests on the samples from Howard's Cove show that the physical properties of the deposit are uniform from top to bottom and consequently similar comments apply to all samples. The material is safe drying and has a drying shrinkage of approximately 4 to 5%. The workability and plasticity are good and so the material should extrude readily. The samples fire to a fairly hard to hard condition at cone 06 (1816°F). At cone 04 (1922°F) the test pieces are generally hard to very hard and the absorption is approximately 8%. At cone 02 the test pieces are almost vitrified.

Indications are that this material is suitable for drain tile and building tile when fired to approximately cone 06. The firing range for face brick is inclined to be

short. However, with care in firing, it is likely that red face brick could be obtained at approximately cone 04.

2. Bacon Point Shale

In general the four samples collected from the Bacon Point deposit are similar although there is more variation in this deposit than in the one at Howard's Cove. They are fairly plastic to plastic and work well which indicates this material should extrude unless the plasticity becomes much less back from the cliffs. The drying shrinkage is approximately 5%. The upper portion of the deposit (sample 223) has a slight tendency to crack with rapid drying. Thus care will likely be required in drying if this portion is used alone.

Samples 223, 224 and 225 have similar fired properties. At cone 04 the test specimens are fairly hard to hard. The fired shrinkage at this temperature is approximately 0.5 to 1.5% and the absorption 12 to 13%. At cone 02 the briquettes are a good red colour and are hard. They have shrinkages of approximately 2 to 3% and absorptions of 8 to 9%. At cone 1 the briquettes have low absorptions of 2 to 4% and shrinkages of approximately 5 to 6%.

The test results of these three samples indicate that the shale is suitable for production of drain tile and building tile when it is fired to approximately cone 04. Face brick can probably be produced from it in the firing range of approximately cone 02 to cone 1. Close control of firing should be maintained for face brick production.

Sample 226 matures at a lower temperature than the

upper 3 samples from the deposit. This shale should produce a good quality drain tile and building tile when fired to approximately cone 06. The firing interval for face brick is approximately cone 04 to cone 02. Care is required in firing this material if a uniform face brick is desired.

Two narrow sandstone seams occur in the shale formation at Bacon Point. The sandstone was included in the samples and did not appear to affect the plasticity greatly. A higher proportion, unless eliminated, may reduce the plasticity and make grinding difficult.

The firing range for the Bacon Point samples is slightly longer than for the Howard's Cove shale and a slightly higher firing temperature for all products is necessary for this shale.

3. Prim Point Shale

The Prim Point sample has fired properties similar to those from Howard's Cove. Care would be required in drying this material. The high proportion of sandstone in the Prim Point area appears to make this an undesirable location for further work.

4. Quartz Content of Samples

Quartz usually occurs in a clay or shale up to approximately 20%. When the proportion of quartz becomes greater than approximately 30% then the plasticity will likely be reduced and some difficulty may be encountered from the fired ware cracking in cooling due to the inversion from beta to alpha quartz. Table 4 indicates the quartz content of the samples subjected to DTA was 10 to 25% which

should not be harmful.

CONCLUSIONS AND RECOMMENDATIONS

Indications are that the shales from Howard's Cove and Bacon Point are suitable for salmon to red stiff mud (extruded) products such as building tile, drain tile and face brick. Their firing ranges are inclined to be short, and consequently care would be required in firing hard, dense, uniformly sized products such as face brick. The results confirm the evaluation of samples obtained from these areas in 1955.

The test results show that the Howard's Cove and Bacon Point shales are equally as good or better than the Gallows Point shale for production of clay products. The shales from these localities have somewhat similar drying characteristics. The fired properties of the Howard's Cove samples are similar to those reported by MacPherson (2) for the shale from Gallows Point. The Bacon Point samples generally have slightly lower fired shrinkages than the materials from the other two localities.

The Bacon Point deposit is in a more central location on the Island than the Howard's Cove deposit. Preliminary evidence indicates that there is a substantial quantity of shale at either locality. There could possibly be a problem at Howard's Cove with regard to land owned by the Federal Government. Examination by V.K. Prest of the G.S.C. indicates that the Gallows Point shale is limited in extent although

there may be larger quantities of similar material nearby. Accordingly it appears that the Bacon Point site might be the most suitable location to carry out core drilling back of the cliffs. This is necessary to prove up the quantity and quality of the shale. Evaluation tests of the drill cores should be carried out and if these are encouraging them, if possible, a plant trial of the material should be arranged.

In the meantime, before too large a program is instigated a market survey should be carried out to determine the market potential of Prince Edward Island. This should show whether it would be practical to build a plant, or at least indicate the capacity necessary for a proposed plant.

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