



Report on the Possibilities of Pottery Manufacture in the Province of Bombay

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BOMBAY

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FOREWORD.

Pottery manufacture is one of the important rural industries of the Province of Bombay.

The village potter carries out his craft in a primitive manner and limits his manufacture principally to unglazed utility articles, such as, containers for cereals and liquids, and kitchenware. It is estimated that over 58 thousand persons are engaged in the village pottery industry as potters and makers of earthenware. There is also a substantial number of dependents who solely depend on these workers.

2. Although the import of household glazed wares into Bombay is large, there is, however, no factory in this Province which manufactures such articles as cups, saucers, plates, etc. In recent years there has come into existence a factory in the city of Bombay for the manufacture of sanitary glazed ware and tiles, etc. ; and similarly there are one or two other factories which make stone ware pipes and pickle jars. It will be correct to say that pottery industry on a factory scale practically does not exist in the Province.

3. Although no systematic survey had been made, yet it was known that most of the raw materials required for the industry were available in the Province. The requisite skilled labour can easily be trained from amongst the hereditary village potters. There is a good demand for the finished products both in the rural and urban areas. The three most important conditions for the successful establishment of the industry seemed thus to be fulfilled. A scheme was, therefore, prepared by this Department for investigating the prospects and possibilities of the manufacture of up-to-date pottery ware. The broad outlines of the scheme as sanctioned by Government in May 1938 are as under :—

(1) Survey of the areas in which suitable clays occur ; the sampling of clays for tests, and investigations of the approximate quantity available ;

(2) Manufacture of glazed and unglazed ware from collected samples of clay—

(a) Cheap household wares used in the Province which can be made by local potters,

(b) Cups and saucers, plates, etc., in a power factory located nearby in an urban area like the city of Bombay,

(c) The estimates for the commercial manufacture of (a) and (b) above and costings of manufacture.

(3) Experimental work in connection with the construction of a wood fired glazing furnace for the use of village potters,

(4) Preparation of detailed estimates for—

(a) Small central factory for mixing and grinding frits and glaze mixes for use by the village potters for the manufacture of the cheaper classes of glazed pottery ware,

(b) A factory in an urban area like the city of Bombay for the manufacture of glazed ware, e.g., cups, saucers, plates, etc.

4. In order to carry out the investigations and entertainment of some duly qualified temporary staff and provision of adequate workshop facilities were essential. The part-time services of Mr. C. P. Shah, Ceramic Expert of Bombay Potteries and Tiles Ltd., were secured on a suitable honorarium. Mr. P. M. Shah, B.Sc., with some experience in such work was appointed Assistant Chemist to assist the Pottery Expert in the analysis and tests of clays, etc. Mr. D. N. Mukerji, a graduate of the Calcutta University in Geology, was engaged to carry out a geological survey of clay beds in the different districts, under the guidance of Mr. C. P. Shah. It should be mentioned here that Mr. G. P. Ogale of the Ogale Glass Works, Ltd., voluntarily accompanied the geologist in certain investigations and rendered very useful service in the course of the survey for which the sincere thanks of this Department are due to him.

So far as the practical side of the scheme is concerned, the Bombay Potteries and Tiles Ltd. kindly agreed to co-operate with this Department by allowing their Mr. C. P. Shah to undertake the survey work and to conduct in their factory tests on clays and experiments for the manufacture of different types of glazed and unglazed wares. A wood fired furnace intended for village potters and designed by the Industrial Engineer of this Department, was also allowed to be put up in the factory and tested. A small grant was sanctioned by

Government to the Company for these facilities. It is gratifying to note that the Board of Directors of the Company co-operated fully with this Department and provided all the necessary facilities for the work. The very sincere thanks of the Department are due to the Company.

5. The report furnished by Mr. C. P. Shah, Pottery Expert, and the survey notes prepared by Mr. Mukerji (*vide* Appendix I to the Report) are both interesting and informative on the question of (1) the availability in adequate quantities of suitable raw materials in this Province, and (2) the possibility of the manufacture of glazed and unglazed wares from same, both on the village industry and factory scale. The report with detailed estimates for manufacturing units, photographs of articles made, places where raw materials are available, etc., is published in its original form. The views expressed are those of the Pottery Expert and the geologist. Both of these gentlemen have worked hard and put in their best in the production of the present report. It is hoped that the detailed information given by them will lead to the growth of the pottery industry—both village industry and factory scale—in this Province.

P. B. ADVANI,
Director of Industries.

Old Custom House Yard,
Bombay, 27th March 1940.

CONTENTS

REPORT ON THE POSSIBILITIES OF POTTERY MANUFACTURE IN THE PROVINCE OF BOMBAY

	Page
INTRODUCTION	1
PLACES VISITED	2
SAMPLES COLLECTED	3
STATE OF THE POTTERY INDUSTRY IN THE BOMBAY PROVINCE	4
SCOPE FOR THE INDUSTRY IN THE PROVINCE	6
RESOURCES IN RAW MATERIALS AND MEN	7
WHERE THE INDUSTRY CAN BE ADVANTAGEOUSLY ESTABLISHED	8
ON WHAT LINES AND BASIS THE INDUSTRY SHOULD BE ORGANISED.. .. .	11
SPECIFIC RECOMMENDATIONS	13
APPENDICES—	
Appendix I—Geological survey work on clay beds and other rocks in the Bombay Province	17
Appendix II—(A) Tests of clay samples collected during the geological survey	61
(B) Construction of a Furnace for the use of village potters for using wood fuel for firing cheap glazed ware.. .. .	80
Appendix III—Estimates—	
(1) Estimates for a small Central Factory which would provide to the village potters in the Province, ground prepared materials for body mixing and glaze mixes for the manufacture of cheaper quality of glazed pottery ware and unglazed pottery ware	87
(2) Estimates for the manufacture of cheap Red Glazed ware on the basis of a small-scale industry at Bassein in Thana District	91
(3) Estimates for the manufacture of Kujas, Drainage pipes, Garden pots, Fire-bricks and Fire-clays on the basis of a small-scale industry at Derol in Panch Mahals District	94
(4) Estimates for the manufacture of cheap glazed ware on the basis of a small-scale industry at Derol in Panch Mahals District	96
(5) Estimates for an up-to-date factory for the manufacture of Cups, Saucers, Plates and Dinner ware	99
Appendix IV—Photographs of articles produced from the samples of clays collected during the geological survey	115

REPORT ON THE POSSIBILITIES OF POTTERY MANUFACTURE IN THE PROVINCE OF BOMBAY.

INTRODUCTION.

The subject of the development of pottery industry was discussed with the Director of Industries and an outline of the scheme to develop the same was submitted to him in January, 1938.

The idea was to create small industrial units all over the Province where suitable clays were available with a view to manufacture modern household utility glazed articles by modern methods and also to develop large scale industries in future in urban areas.

To develop small industrial units on cottage industry basis, it is essential that a suitable wood fired furnace be evolved which would give sufficient heat to mature glazes which are used in manufacturing cheap glazed ware and which will at the same time be comparatively cheaper in fuel consumption than coal.

The possibility of manufacturing white ware by power driven machinery on a commercial scale, if raw materials to manufacture them are available in the Province, was also to be considered.

2. The following suggestions were put before the Director of Industries :—

- (1) Geological survey of the areas where suitable clays are available,
- (2) General tests of the clays,
- (3) Analysis of the selected clays,
- (4) Manufacture of cheap glazed ware from the selected clays of the selected localities,
- (5) Manufacture of white ware from the raw materials available from the selected places in the Bombay Province,
- (6) Evolving a suitable wood fired furnace for small scale and cottage industry,
- (7) Reports and details of the work done,
- (8) Recommendations.

3. The Director of Industries sanctioned the scheme of investigations on 26th May 1938 on the following lines :—

- (1) Survey of the areas in which suitable clays occur, investigations of the approximate quantities available and the drawing of samples for tests.

(2) Manufacture from the collected samples of clays of :—

(a) Cheap glazed household wares used in the Province which can be made by village potters,

(b) Cups and saucers, plates, etc., in a power factory located near an urban area like the city of Bombay,

(c) Costings and estimates with detailed samples for the commercial manufacture of (a) and (b) above.

(3) Experimental work in connection with the construction of a wood fired furnace for the use of village potters.

(4) Preparation of detailed estimates for :—

(a) Small central factory for mixing and grinding frits and glaze mixes for the use of the village potters for the manufacture of cheaper qualities glazed pottery ware,

(b) A factory in an urban area like the city of Bombay for the manufacture of glazed ware such as cups, saucers and plates, etc.

4. The work was begun on 15th June 1938 at the factory of Messrs. Bombay Potteries and Tiles Ltd., situated at Mazagaon, Bombay.

The Board of Directors of the Company kindly agreed to co-operate and provided the facilities to conduct experiments, to build up wood fired furnace in their premises and placed at the disposal of the Department of Industries all their resources and staff for the purpose.

The geologist was appointed on 1st October 1938 for the survey of selected clay beds and to ascertain the quantities of clays in the surveyed areas.

The assistant chemist was appointed on 1st October 1938 to analyse the selected clays.

The analysis work of clay samples was done at the Royal Institute of Science.

5. The raw materials required for manufacturing cheap glazed pottery ware and white ware are china clay, white plastic clay, fire clay, quartz, felspar and coloured laterite clays free from lime.

PLACES VISITED.

The following districts and places were visited for the purpose of collecting the samples of the abovementioned materials :—

District.	Taluka.	Place.	Raw material.
Panch Mahals	.. Derol	.. Rajpur	.. Fire clay.
Do.	.. Do.	.. Balatia	.. Do.
Do.	.. Sant Road	.. Natapur	.. Quartz.
Do.	.. Do.	.. Toova Road	.. Felspar.
Thana	.. Bassein	.. Gokhera	.. Red clay.
Do.	.. Do.	.. Achola	.. Do.
Do.	.. Do.	.. Bhoida	.. Do.

District.	Taluka.	Place.	Raw material.
Belgaum	.. Belgaum	.. Desur	.. Fire clay.
Do.	.. Do.	.. Do.	.. White clay.
Do.	.. Do.	.. Khanapur	.. China clay.
Do.	.. Do.	.. Gunji	.. Do.
Do.	.. Do.	.. Keerowlee	.. Do.
Do.	.. Do.	.. Kapoli	.. Do.
Do.	.. Do.	.. Londa	.. Moulding sand.
Do.	.. Do.	.. Castle Rock	.. White clay.
Do.	.. Do.	.. Ghatgoli	.. China clay.
Do.	.. Do.	.. Patoli	.. Do.
Do.	.. Do.	.. Shivthan	.. Do.
North Kanara	.. Honawar	.. Dhareshwar	.. Red clay.
Do.	.. Do.	.. Nagre	.. China clay.
Do.	.. Do.	.. Kulkod	.. Do.
Do.	.. Do.	.. Padkuli	.. Yellow clay.
Do.	.. Do.	.. Jalbali	.. Do.
Do.	.. Do.	.. Kaur	.. Black clay.
Do.	.. Do.	.. Haspatan	.. Quartz.
Ratnagiri	.. Dapoli	.. Jalgaon	.. Red clay.

SAMPLES COLLECTED.

6. The samples of suitable clays were collected on the spot after the geological survey work was completed and fifty-seven samples as described in Appendix II (A) and shown in Appendix IV, Photo No. 1, were collected and brought to Bombay for tests.

The samples are tabulated below according to districts :—

Panch Mahals District	..	..	8
Thana District	..	..	15
Belgaum District	..	..	21
North Kanara District	..	..	8
Ratnagiri District	..	..	5

7. The samples are tabulated further below to show the types of raw materials :—

China clay	..	..	..	17
White clay	..	..	..	1
Fire clay	..	..	..	6
Red clay	..	..	..	18
Yellow clay	..	..	..	4
Black clay	..	..	..	2
Quartz	..	..	..	1
Felspar	..	..	..	3
Felspar and Quartz	..	..	..	1
Sand stone	..	..	..	3
Moulding sand	..	..	..	1

These samples were first of all tested for lime and those containing lime were rejected.

Trial tiles were made from clay samples to see their behaviour at 1080°C. Those found useful were taken for chemical analysis and samples of articles were made.

Results of tests taken are summarised in Appendix II (A).

STATE OF THE POTTERY INDUSTRY IN THE BOMBAY PROVINCE.

8. In the year 1909 pottery department was opened at the Sir J. J. School of Art, Bombay, to carry out investigations on clays in the Bombay Province and to conduct experiments to find out the suitability of the clays for pottery manufacture. The department was provided with (1) a chemical laboratory, (2) a physical laboratory with gas fired small experimental kilns, (3) a small unit of pottery machinery for demonstration and (4) coal fired furnaces to conduct the manufacture on semi-commercial scale.

Students were admitted in the institution for training in pottery.

One roofing tile factory at Khanapur was established in the year 1918 through the efforts of this department and later on another factory at the same place was put up by another gentleman.

A student trained up at the Sir J. J. School of Art was taken up by the Paisa Fund Glass Works at Talegaon and a pottery department was added to the institution which is now working on a factory scale.

In the year 1926 Government abolished this department and the Province was deprived of its only institution where students used to get training and the people interested in the industry could get advice.

In the year 1933 a public limited liability company was registered in Bombay for the purpose of manufacturing ceramic flooring tiles, glazed wall tiles, sanitary ware, etc. It took nearly three years before a small amount of capital just enough to put up the smallest unit of the factory was available. This company, the Bombay Potteries and Tiles Ltd., began manufacturing on commercial scale in the year 1936. On account of lack of capital, the factory is handicapped in its operations and has to content itself to restricted productions.

There are no other factories in the Province where any kind of modern pottery articles are manufactured.

Though there is a number of building bricks factories in the Thana District since many years, there is not a single factory where building bricks of a proper type and quality are manufactured which will satisfy the architects' specifications.

In Ahmedabad also there is a number of factories which manufacture red building bricks but these products are also not to the mark.

A factory has been put up in Ahmedabad, recently to manufacture drainage pipes. These are salt-glazed and it is a welcome addition to the industry.

9. In short, at present, the following is the list of factories manufacturing various types of pottery :—

(1) *Red Building Bricks*—

(a) A number of factories at Kalyan in Thana District.

(b) A number of factories at Ahmedabad.

(2) *Roofing Tile factories*—

Two factories at Khanapur.

(3) *Stone ware pipe factories*—

At Ahmedabad.

(4) *Pickle-jars factory*—

The Paisa Fund Glass Works at Talegaon.

(5) *Pottery factory*—

The Bombay Potteries and Tiles Ltd., Bombay.

The following articles are manufactured :—

(a) Ceramic flooring tiles of various colours such as red, yellow, blue, grey, white and mosaic,

(b) Wall glazed tiles, white and coloured,

(c) Sanitary ware and its fittings :—

Indian W. C. Pan with trap.

European type closets.

Urinals—wall and corner.

Wash basins.

Sinks.

White glazed channels and cups.

Soap boxes and toilet paper box.

(d) Acid proof tanks, mortars and pestles,

(e) Cotton and silk mills porcelain requisites such as Pot eyes, Ball thread guides, Bobbins and acid proof white tiles,

(f) Porcelain insulators of special shape and size,

(g) Plumbago Crucibles.

It will be seen from the above that the industry is almost a new one and not at all developed.

There are no facilities in the Province where any investigations can be carried out for the development of the industry.

There is also no record of work done on the clays of the Province available to the public to create an interest in this nascent and indigenous industry. Practically the whole field is unexplored.

SCOPE FOR THE INDUSTRY IN THE PROVINCE.

10. In the Province there are various industries in relation to which articles made from clays are used. The following is the list of industries showing the type of articles used :—

Name of Industry.	Name of articles used.
(1) Building trade	.. (1) Red bricks. (2) Roofing tiles. (3) Salt-glazed drainage pipes. (4) Ceramic flooring tiles. (5) White glazed tiles for bathrooms on walls. (6) Vitreous white non-slip tiles for floor of the bath rooms. (7) Sanitary fittings such as W. C. Pans, Urinals and Wash basins.
(2) Cotton Mills	.. (1) Fire bricks and refractories for boilers. (2) Porcelain pot eyes and pegs for Bleaching department. (3) Ball thread guides for Spinning department. (4) Acid proof tanks and tiles for Bleaching department.
(3) Artificial Silk Mills	.. Porcelain thread guides of various shapes and sizes.
(4) Glass industry	.. (1) Special refractories for building the furnace. (2) Glass pots and muffles.
(5) Iron and Brass Casting furnaces.	(1) Cupola blocks for furnaces. (2) Plumbago crucibles. (3) Refractory crucibles.
(6) Electric Supply Companies .	(1) Electric insulators. (2) Porcelain articles for electric fittings.

All the above industries require articles made from clays in one form or the other and most of their requirements are met with by imported articles.

It will not be out of place to point out here that a large quantity of white ware such as cups, saucers, etc., is imported every year into the Bombay Province. The supply from other provinces in India is very meagre.

11. The following is the table showing for the last five years ending 1937-38 the value of different types of goods imported into Bombay only :—

	1933-34	1934-35	1935-36	1936-37	1937-38
	Rs.	Rs.	Rs.	Rs.	Rs.
Sanitary ware ..	2,67,486	3,13,561	2,83,757	3,50,145	3,64,602
Other kinds ..	4,15,086	3,92,996	3,58,472	3,18,285	4,85,490
Porcelain Electrical ..	29,891	49,353	68,251	40,530	48,378
Porcelain other than electrical	10,66,197	11,61,213	8,89,660	7,93,970	12,53,416
Total ..	17,78,660	19,17,123	16,00,140	15,02,930	21,51,886

From the above figures it will be seen that there is an increase of nearly 25 per cent. of imports in the year 1937-38.

The production in this Province of the above articles is not worth more than Rs. 60,000 per year.

The scope for development of the industry is, therefore, evident from the above table.

RESOURCES IN RAW MATERIALS AND MEN.

12. The raw materials required for the manufacture of pottery are china clay, white burning plastic clay, fire clay, quartz and felspar. These raw materials, except the fine quality of china clay occur in abundance in this Province.

Only selected places in the Province were visited and samples of the raw materials were collected from them, and from the tests made, it has been found that ample raw materials are available and there is a probability of getting a better quality of china clay at one or two places if further investigations are made in those places which are recommended. There are many more places in the Province which are full of useful raw materials and these places should be geologically surveyed and the samples tested.

There are hundreds of potters in the Province who are born craftsmen and a little training in the use of modern machinery and methods will

make them adapt to the conditions. There are also many middle class trained mechanical and electrical engineers and fitters who can be usefully trained for the technical methods used in the pottery manufacture.

It will not be out of place to mention here that many of the pottery factories in India are run by the students trained at the Pottery department of the Sir J. J. School of Art, Bombay.* If opportunity is given to the local talent, there will be no dearth of trained labour required to man the modern pottery factories.

The scope of the present investigations was limited. It was not possible to visit each and every place where clays and other raw materials exist as the time was limited. The work had to be finished in six months and the results to be reported.

However, the investigations made of the raw materials available at some of the places reveal the fact that suitable raw materials are available in large quantities and pottery articles of various types can be manufactured of the quality as good as that of the articles which are imported from the foreign countries as can be seen from the photographs of the specimens made from the clays of the various districts (Appendix IV).

WHERE THE INDUSTRY CAN BE ADVANTAGEOUSLY ESTABLISHED.

13. From the results of the investigations made, it appears that small industrial units on the cottage industry basis may be established at the following places :—

(1) BASSEIN IN THANA DISTRICT.

To manufacture—

- (a) Cheap red glazed ware such as tea pots, sugar basins, milk jugs, vases and garden pots and,
- (b) Unglazed garden pots, Mangalore tiles, red facing bricks and terra cotta.

The quantity of suitable clay available at Bassein in Thana District is estimated by the geologist in his report (Appendix I-4) at 65,000 tons. This quantity is more than enough to last for a number of years. There are further similar deposits nearby to augment the supply of raw material if required in future.

The quality of articles which are manufactured from this clay, (Appendix IV Photographs Nos. 2, 3, 4) are quite good.

As for the cost of manufacture and the prospects for commercial development as a small industrial unit, the same have been given in detail in Appendix III-(2).

The wood fired furnace designed by the Industrial Engineer of the Department of Industries is quite suitable for burning the goods with wood fuel. This furnace is illustrated by photograph No. 21 under Appendix IV.

(2) DEROL IN PANCH MAHALS DISTRICT.

To manufacture—

- (a) Fire bricks and fire clay,
- (b) Pickle jars, mortars and pestles, and
- (c) Glazed tea pots, bowls, chutney pots, etc., white and coloured,

The part of the area of clay deposits suitable for the proposed manufacture has been surveyed and the approximate quantity available is estimated at 60,600 tons. (Appendix I-1).

The other raw material required is quartz available at Sant Road. The quantity available is estimated at 305,000 tons (Appendix I—3).

Felspar is also required and it is available at Toova Road. The geological survey work is not done in detail but the approximate quantity available is estimated at 75,000 tons (Appendix I—2).

The ratio of the above three materials for the mixture is approximately 6 : 2.5 : 1.5. There is an ample supply to last for years.

The wood fuel is available in a large quantity as there is a forest nearby.

The quality of articles produced from these materials is good (Appendix IV, photographs Nos. 5, 6, 7, 8, 9, 10, 11, 12 and 13).

The cost of manufacture and commercial prospects for a small industrial unit are worked out in detail [Appendix III—(3) and (4)].

(3) BELGAUM DISTRICT.

To manufacture—

Cheap red glazed ware at Belgaum from clays at Desur and Khanapur.

The clays at Desur are suitable for cheap glazed ware. The quantity available is sufficient for a small industrial unit. The samples made are also quite satisfactory (Appendix IV, photograph No. 14).

The clay at Khanapur is being used for the manufacture of roofing tiles. It can be used for the cheap glazed pottery.

The clay from Kapoli is also good for the cheap glazed ware as can be judged from samples of articles produced (Appendix IV, photograph No. 15).

No separate estimates are prepared in this connection as they will be similar to those made for Bassein clays in Thana District [Appendix III (2)].

(4) NORTH KANARA DISTRICT.

Utilisation of clays round about Honawar.

- (1) A china clay refinery may be set up to produce refined china clay for—
 - (a) The use of pottery industry,
 - (b) Sizing purposes in cotton mills,
 - (c) Serving as a filler for paper industry.
- (2) The clay may be used for the manufacture of—
 - (a) Red glazed ware,
 - (b) Garden pots and kunjias,
 - (c) Vitreous white articles.

There is a number of clays of different varieties available round about Honawar (Appendix I—7). A number of small industrial units can be set up. There is a sufficient quantity of clay, quartz, felspar and fuel available.

The china clay deposits near Honawar can be developed on scientific lines and there is a possibility of getting a good quality of china clay for white ware manufacture and for the use of cotton mills and paper manufacture. The present quality of china clay available contains iron and the goods manufactured with this clay are of yellowish tint, (Appendix IV, photograph No. 17).

It is necessary, therefore, to have a china clay free from iron if it is to be used for white ware.

(5) RATNAGIRI DISTRICT.

Clays from Jalgaon can be used—

- (1) For the manufacture of roofing tiles, and
- (2) Cheap red glazed ware.

The clays from Jalgaon have been geologically surveyed and the quantity available is approximately estimated at 1,000,000 tons (Appendix I—8).

The samples made from this clay are very good (Appendix IV, photograph No. 16).

The roofing tile factory, if one be organised, will have to be on a large scale with proper equipment and machinery because it will have a strong competition from Mangalore tile manufacturers.

The cheap glazed ware manufacture can be undertaken as a small industrial unit.

(6) WHITE WARE FACTORY IN BOMBAY.

Possibilities for a complete properly equipped factory to manufacture cups and saucers, plates, etc., on a large scale.

Having investigated various raw materials available in the Bombay Province it may be stated that it is possible to manufacture white ware on a large scale industry basis. At present a good quality of china clay is not available; it is, however, possible to get the same from some of the places visited. Further investigations are, however, necessary to make sure of the quality and quantity available. In the meantime imported china clay will have to be used if snow white wares are to be manufactured. About 30 per cent. of china clay is being used in the white ware manufacture.

Samples were made by using a part of English china clay, a part of Honawar china clay and other Bombay Province materials and it has been found that the articles made are slightly creamish (Appendix IV, photograph No. 18).

Articles made from English china clay and the other Bombay Province raw materials compare favourably in colour with those imported from foreign countries (Appendix IV, photograph No. 19).

With regard to quality they are as good as any of the foreign make available in the market.

A number of articles has been made from the different clays collected from the Bombay Province and there is absolutely no doubt that white ware can be manufactured in Bombay (Appendix IV, photograph No. 20).

As regards cost and commercial prospects of such a factory a detailed scheme has been given in Appendix III (5). This has been corroborated by British and German manufacturers of machinery with regard to its economic soundness as well as its being a commercial proposition.

ON WHAT LINES AND BASIS THE INDUSTRY SHOULD BE ORGANISED.

(1) COTTAGE INDUSTRY.

Production by village potters.

14. It is necessary to give training to village potters from the places where suitable clays are available in the use of modern methods and in the treatment of raw materials. This training can be given either in a pottery school or in a factory. As there is no institution of the former type, some arrangement must be made in a factory where a batch

of four to six potters can be trained at a time in the art of manufacturing various kinds of pottery articles. A period of six months is considered quite enough for such a training.

When these potters are trained up, they are to be provided with the necessary equipment for a small unit on the cottage industry basis. They should manufacture various articles from the indigenous clays which will have been used by them during the period of their training at the factory.

One potter thus trained must manufacture one kind of pottery articles in a selected district, while the other one in another district must manufacture another variety. There will thus be no competition among them and the quantity produced should be just enough to supply the needs of that particular district.

The equipment to be provided for for such units has been specified [Appendix III (2), (3) and (4)]. The cost of such equipment has to be borne by Government in the beginning and to be recovered in instalments. The sales of production of these units can be made locally and partly in any shops that Government may be organising for the sale of cottage industry products.

The working capital required for such units can be made available in the shape of loans by the Department of Industries, Bombay.

The detailed estimates for such typical units in selected districts are also attached. [Appendix III (2), (3) and (4).]

By organising such units, a real foundation to develop the manufacture of pottery articles on cottage industry basis can be laid. In a few years, a number of such units can be established to manufacture all kinds of pottery articles and an army of trained potters and craftsmen can be created.

Provision of wood fired furnace for village potters.

15. There has been a general impression among workers that a high temperature cannot be obtained with wood fuel and it is necessary to use coal. Village industry cannot be developed economically if coal has to be used for firing the furnace.

This problem has been thoroughly investigated by constructing a four feet diameter furnace with suitable chimney. A number of experiments in firing and in construction of the furnace has been made [Appendix II (B)]. The furnace was designed by the Industrial Engineer of the Department of Industries, Bombay, in consultation with the Pottery Expert (the writer). Pottery articles glazed and unglazed were fired from 1080°C to 1230°C and the results obtained were quite satisfactory as can be judged from the various photographs of articles manufactured given under Appendix IV.

After making final alteration in the construction of the furnace the temperature in the furnace from bottom to the top was obtained fairly

uniform and the results obtained were quite satisfactory. The final plan of the suitable furnace has been prepared by the Industrial Engineer [Appendix II (B)].

The cost of wood fuel has been found 25 per cent. cheaper than that of coal, and it is easier to obtain in the villages. The supply of wood fuel at the places recommended for the establishment of cottage industries has been plenty as these places are situated near forest areas.

Provision of prepared materials for village potters.

16. To manufacture pottery articles by modern methods, it is necessary to provide the village potters finely ground materials and glazes. It will not pay to do these processes of grinding and making frits and glazes at each centre. Each will require a small quantity and the provision of machinery for grinding and frit furnaces will be expensive and will not be a commercial and economic proposition.

A central factory in a city like Bombay may, therefore, be established whose function will be—

(1) To provide all mixing materials for bodies to the village potters to manufacture cheap unglazed and glazed pottery ware,

(2) To test the bodies and glazes for the use of village potters and teach them how to use them on commercial scale,

(3) To train up the village potters to manufacture pottery articles by modern methods from indigenous clays obtained from their villages,

(4) To solve the difficulties which village potters come across in the course of manufacture, and

(5) To supply glazes, colours and other necessities to village potters in order that they can carry on the manufacture without difficulty.

A complete scheme for such a central factory is furnished in Appendix III (1).

(2) FACTORY BASIS.

17. A typical scheme to manufacture white ware on mass production is attached [Appendix III (5)]. Such a factory will employ about 500 persons and will be an up-to-date mechanised factory. It will produce goods as good as the imported articles and will stand to competition in price.

SPECIFIC RECOMMENDATIONS.

18. The present investigations having been completed, prove that pottery industry can be developed in this Province. It can also be made commercially successful if a beginning is made in the right direction. To attain the above object the following recommendations are made.

I. (A) VILLAGE INDUSTRY.

19. (1) To appoint an assistant chemist trained in pottery work on the permanent establishment.

The duties of the assistant chemist will be—

(a) To teach modern methods of glazed ware manufacture to the village potter,

(b) To take demonstration parties in each district for the purpose of showing the improved methods of manufacturing unglazed and cheap glazed ware, to demonstrate the use of improved type of potter's wheel and to show the method of firing the new wood fired furnace,

(c) To solve the difficulties which are met with in the course of manufacture,

(d) To construct wood fired furnace for the village potters and teach them the methods of firing,

(e) To analyse clays from the different places in the Province and conduct tests for their suitability of pottery manufacture,

(f) To train up village potters for a period of six months with a view to organise small scale village industries for manufacturing different types of pottery articles at various places in the Province. These potters during the training period will manufacture articles of pottery from the indigenous clays and after the completion of the training, will begin to manufacture the same articles in their villages.

(2) To provide the necessary capital to the village potters to put up the small manufacturing units as outlined [Appendix III (2), (3) and (4)], and to advance loans to these small units for working capital.

(3) To make arrangements for selling the products of these small units.

I. (B) CENTRAL FACTORY.

20. To establish the central factory in Bombay for supply of ground and prepared materials to village units as outlined in the scheme [Appendix III (1)].

If the proposal to establish a central factory as outlined is considered at the moment not possible, arrangements can be made with the Bombay Potteries and Tiles Limited to carry out all the functions as detailed in the scheme.

The Bombay Potteries and Tiles Limited are fully equipped to carry out the work. They have co-operated with the Department of Industries, Bombay, to carry out these investigations and it is expected that they will accord their full co-operation in future.

II. LARGE SCALE MANUFACTURE.

21. The samples of cups, saucers, tea pots, sugar basins, milk jugs, plates, etc., made from the local materials are as good as those imported

from Japan in quality but slightly cream in shade as the china clay available at the moment is not as white as required. When the mixture of foreign china clay is made along with other materials, the samples made are as white as the colour of the imported articles.

It is necessary to manufacture white ware on mass production basis for a businesslike commercial proposition. It also requires a large amount of capital to the extent of Rs. 10 lakhs for an economic unit as outlined in the scheme in Appendix III (5).

It is difficult to get this capital for a new industry and, therefore, for a demonstration purpose it is suggested that a subsidy and a loan to the extent of Rs. 10,000 may be given to the Bombay Potteries and Tiles Limited to buy necessary equipment and machinery required to manufacture cups, saucers and plates. They should be asked to manufacture these articles on a commercial scale along with their usual production.

Steps may be taken to promote the manufacture of crockery ware on a large scale as proposed, after seeing the results obtained by the Bombay Potteries and Tiles Limited by getting the industrialists and financiers of Bombay to be interested in the industry. It will give employment to some 500 persons and the import to the extent of Rs. 7½ lakhs per year will be lessened.

III. FURTHER INVESTIGATIONS.

22. Although the survey and tests made show conclusively that adequate raw materials are available in the Province for a successful pottery industry, the time allowed was not sufficient to survey all the known resources of clay. It is suggested that in due course a further geological survey be carried out covering raw materials for pottery industry and specially covering the china clay deposits and felspar deposits found at Ghatgoli in the Belgaum District, and in the Panch Mahals District, respectively, in order to find out the extent and quality available at greater depth. The raw materials when found must also be tested and tried out by actual manufacture of various articles.

IV. CONSULTANT.

23. Finally, it is advisable to have a consulting expert in pottery industry on an honorarium basis who will help the Department of Industries in all the activities in pottery industry with technical advice.

Bombay, 3rd January 1940.

C. P. SHAH,
Pottery Expert.

APPENDIX I.

CONTENTS.

GEOLOGICAL SURVEY WORK ON CLAY BEDS AND OTHER ROCKS
IN THE BOMBAY PROVINCE.

	Page
1. Geological investigation on clay deposits in Rajpur (Pingli) and Balatia Mouzas in district Panch Mahals, Bombay Province—	
1. Introduction	21
2. Observations	21
3. Geology of the areas close to Pingli and Balatia Mouzas	21
4. Prospecting in the area in Pingli and Balatia Mouzas, where clay deposits occur	21
5. Quality of the clay and its use for pottery manufacture	22
6. Field Notes—	
(a) Pingli area	22
(b) Records of trial pits in Pingli area	24
(c) Balatia area	25
(d) Records of trial pit in Balatia area	25
(e) Records of trial pit in Toova area	25
7. Approximate volume and tonnage of greyish plastic clay deposit (10 feet thick) in Rajpur (Pingli) and Balatia Mouzas in area prospected	26
8. Approximate cost of raising and transport of the clay of prospected Rajpur (Pingli) and Balatia area, district Panch Mahals	26
9. Map showing clay deposit in Rajpur (Pingli) and Balatia Mouzas, district Panch Mahals (Facing)	26
2. Geological investigation on felspar rock in Toova area, district Panch Mahals, Bombay Province—	
1. Introduction	27
2. Occurrence	27
3. Prospecting in Toova area for felspar	27
4. Quality of the felspathic rock and its use for pottery manufacture	27
5. Approximate felspar reserve in prospected Toova area	28
6. Field Notes—	
Toova area	28
7. Cost of raising and transport of the felspathic rock of prospected Toova area, district Panch Mahals	29
8. Map showing occurrence of felspar in Toova area, district Panch Mahals. (Facing)	30
3. Geological investigation on quartz rock in Sant Road area, district Panch Mahals, Bombay Province—	
1. Introduction	31
2. Occurrence	31
3. Prospecting in Sant Road area for quartz rock	31
4. Quality and uses of the quartz rock	31
5. Field Notes—	
Sant Road area	31
6. Approximate volume and tonnage of main quartz cappings on quartz reefs in Sant Road, near Natapur Village, district Panch Mahals	33
7. Approximate cost of raising and transport of the quartz rock of prospected Sant Road area, district Panch Mahals to Bombay	33
8. Map showing quartz cappings in Sant Road area, district Panch Mahals (Facing)	34

CONTENTS

	Page
4. Geological investigation on clay deposits in-and about Gokhera Mouza, near Bassein Railway Station, district Thana, Bombay Province—	
1. Introduction	35
2. Geology of the areas round Gokhera Mouza—	
(i) Gokhera	35
(ii) Nala Sopara	35
(iii) Achola	35
3. Prospecting for clay deposits in Gokhera Mouza	35
4. Uses of clay deposits in Gokhera Mouza	36
5. Approximate volume and tonnage of clay reserve in Gokhera Mouza in area prospected	36
6. Field Notes—	
(a) Gokhera area	37
(b) Records of trial pits in Gokhera Mouza	39
7. Approximate cost of raising and transport of the clay of prospected Gokhera Mouza, district Thana to Bombay	39
8. Approximate cost of raising and transport of clay in prospected Achola area, district Thana	39
9. Map showing clay deposits in Gokhera Mouza, district Thana (Facing) ..	40
5. Geological investigation on clay sandstone deposits in Belgaum District, Bombay Province—	
1. Introduction	41
2. Geology of the different places in Belgaum District—	
(i) Desur	41
(ii) Khanapur	41
(iii) Gunji	42
(iv) Keerowlee	42
(v) Kapoli	42
(vi) Londa	42
(vii) Moeeshet	43
(viii) Castle Rock	43
3. Manganese ore deposits	43
4. Mode of formation of rocks in Belgaum District	43
5. Field Notes—	
(a) Records of Trial Pits in Keerowlee area	44
(b) Records of Trial Pits in Ghatgoli area	44
(c) Records of Trial Pits in Gunji area	44
6. Geological investigation on clay deposits in Kapoli Mouza, district Belgaum, Bombay Province—	
1. Introduction	45
2. Geology of the areas close to Kapoli Mouza—	
(i) Ghatgoli	45
(ii) Shivthan	45
(iii) Patoli	45
(iv) Railway cutting	45
3. Mode of formation of the clay beds	45
4. Prospecting for clay deposits in Kapoli Mouza	45
5. Approximate volume and tonnage of yellow-stained white clay reserve in Kapoli Mouza—(as far prospected)	46

CONTENTS

	Page
6. Field Notes—	
(a) Kapoli area	47
(b) Record of trial pits in Kapoli area	50
7. Approximate cost of raising and transport of clay in prospected Kapoli Mouza, district Belgaum	50
8. Map showing clay deposits in Kapoli Mouza, district Belgaum (Facing) ..	50
7. Geological investigation on clay deposits in Honawar area in district North Kanara, Bombay Province—	
1. Introduction	51
2. Geology of the area inspected and examined near Honawar, in district North Kanara—	
(i) Hadinbal	51
(ii) Nagare	51
(iii) Kulkod	51
(iv) & (v) Opani and Amboli	51
(vi) & (vii) Padukuli and Jalbali	52
(viii) Kaur	52
(ix) Hairungri	52
(x) Haspatan	52
(xi) & (xii) Dhareswar	52
3. Prospecting for china clay deposits near Honawar—	
(i) Hadinbal	52
(ii) Nagare	53
4. Approximate clay reserve of Hadinbal-Nagare deposit in area prospected	53
5. Field Notes—	
Honawar area	54
6. Approximate cost of raising, levigation, transport, establishment, etc., in respect of clay of Hadinbal area, district North Kanara	56
7. Map showing white china clay deposit in Hadinbal, Berolli and Nagare Mouzas, near Honawar, district North Kanara (Facing) ..	56
8. Geological investigation on clay beds in Jalgaon Mouza, taluka Dapoli, district Ratnagiri—	
1. Introduction	57
2. Geology of Jalgaon area	57
3. Quality of the clay	57
4. Prospecting on clay beds in Jalgaon area	57
5. Defects in the present working	58
6. Future aspect of the development of the working on clay bed in Jalgaon Mouza	58
7. Approximate clay reserve in Jalgaon Mouza in area prospected ..	58
8. Field Notes—	
(a) Jalgaon Mouza	59
(b) Records of Pit work in Jalgaon Mouza, taluka Dapoli, district Ratnagiri	60
9. Map showing clay deposit in Jalgaon Mouza, district Ratnagiri (Facing) ..	60

APPENDIX I.

1. GEOLOGICAL INVESTIGATION ON CLAY DEPOSITS IN RAJPUR (PINGLI) AND BALATIA MOUZAS IN DISTRICT PANCH MAHALS, BOMBAY PROVINCE.

1. INTRODUCTION.

I left Bombay on 12th October with Mr. C. P. Shah and arrived at Derol in Panch Mahals District the next morning. With him I visited the clay deposits in Rajpur (Pingli) and Balatia areas near Derol R. S., Quartz rock near Sant Road R. S. and Felspathic rocks near Toova R. S. in Panch Mahals District on 13th, 14th and 15th October 1938 respectively. After consultation with Mr. Shah I commenced my work in those places on 17th October and finished geological traverse work and pit work there on 3rd November 1938. Mr. Shah and myself jointly collected five bags of sample clay from the pits in Rajpur (Pingli), two from Balatia and two from Toova areas and sent them for proper tests in the factory of Bombay Potteries & Tiles Ltd. and returned to Bombay on 6th November 1938.

2. OBSERVATIONS.

Some people of the locality worked on a few outcrops only of clay beds in Rajpur (Pingli) area, which were shown to me. After proper geological traverse work and pit work I traced the clay beds about 2,000 feet and found out that the thickness of a big clay bed, free from lime, is 10 feet. There is a good cart road running from Derol railway station to the clay deposit, but a river, called Kuwach, has to be crossed to reach there.

3. GEOLOGY OF THE AREAS CLOSE TO PINGLI AND BALATIA MOUZAS.

In the areas round about Pingli and Balatia Mouzas no plastic clay of good quality and free from lime is observed. Coarse or fine grained white yellowish or pinkish sandstone with occasional thin layers of reddish or brownish clay and a heavy overburden of recent alluvium containing a large percentage of lime is noticed all round. By the percolation of lime water through the different layers of the thin clay beds, they are made unfit for pottery purposes.

4. PROSPECTING IN THE AREA IN PINGLI AND BALATIA MOUZAS, WHERE CLAY DEPOSITS OCCUR.

After proper prospecting operations, several clay beds are detected in Pingli and Balatia areas with intervening deposits of sandstone, either coarse or fine-grained and heavy overburden in some places of surface soil containing lime in large quantity. Due to water action the surface soil in most part of the clay bed areas is denuded forming a net work of channels. The sandstone beds being less denuded are exposed on higher levels. So the surface of the country is a very undulated one. The lime of the surface soil by water action enters into the bedding planes of the clay deposits here also and makes the upper 2 or 3 feet of the clay unfit for pottery manufacture. Of all the clay beds here, the main one is a fine-grained greyish plastic clay deposit, the lower ten feet of which is free from lime and the upper three feet or so is a mixture of lime and clay. This big clay bed has been traced about 2,000 feet from Kuwach river to Pit No. 7 with two faults breaking it into three distinct parts. The strike of the clay bed is north-westerly from Kuwach river, near its crossing with the Balatia-Satamna cart road; then the clay after having twice faulted, broken and highly bent runs at last almost in a northerly direction (*vide* Map). This thick big clay bed is well shown in trial pits No. 1 in Balatia area and Nos. 8, 3 and 7 in Pingli area. Though the clay bed is highly crushed and contorted due to faulting and earth movement, the general dip of the clay is very low, though in some places dip up to 53° is observed. Of the two said faults, the eastern one runs N. 35° E—S. 35° W and the western one runs N. 42° E—S. 42° W.

Pinkish coarse grained sandstone overlies the main big clay bed, as is well shown in the faulted zone. Above this pinkish sandstone pinkish plastic clay is observed. Four and a half feet of it towards the bottom is free from lime, though it is about 6 feet thick. This pinkish clay runs almost parallel to the above big clay deposit.

The main clay bed of 10 feet thick, stated above, overlies white sandstone, which again overlies brownish fine-grained sandstone. Though this brown sandstone looks like clay, it contains a large percentage of silica and it is more or less mixed with lime.

In the above clay bed areas, the main clay bed is almost free from iron. Only in a very few places in the clay iron stains are observed.

Besides the above clay deposits other clay beds of 1 to 3 feet thickness are noticed in Pit No. 1. These are small pocket deposits and do not run more than 50 feet. So they are not available in a large quantity.

The major portion of the big clay deposit, stated above lies in South-Western portions of Pingli Mouza and a minor part lies in Balatia Mouza.

Just south and east of plot No. 1001, which lies to the south-western corner of Pingli Mouza and also to the south of plot No. 1002, which is just east of Plot No. 1001, several trial pits were sunk. Ten of which are in Pingli and one in Balatia Mouza. The trial Pits Nos. 7, 5 and 3 (Pingli) which lie near the western border of plot No. 1002 and trial pit No. 8 (Pingli) and Pit No. 1 (Balatia) just south of the same plot No. 1002, show that the big clay bed of 10 feet thickness mentioned above passes through those pits and after having faulted in two places, as shown in Plot I, it runs to the northern bank of Kuwach river, where again the same type of clay appears. The trial Pit No. 9 exposes 4'-6" of reddish clay which runs almost parallel to the above big clay bed. The trial Pits Nos. 2 and 4 are dug on brownish shaly sandstone of about 10 feet thickness overlying brownish hard sandstone.

The general dip of the above clay deposits being low and the overburden surface soil in most places being denuded by water action, the above clay beds can be worked easily.

5. QUALITY OF THE CLAY AND ITS USE FOR POTTERY MANUFACTURE.

The clay which contains lime and iron even in small quantity is considered unfit for pottery manufacture. Hence the upper 2 or 3 feet of the clay deposits in Pingli and Balatia areas, which contain more or less percentage of lime should not be taken. The lower 10 feet of the big greyish plastic clay deposit and the lower 4'-6" of the reddish plastic clay bed are free from lime. Seven samples of the above clay beds were collected by Mr. C. P. Shah and sent to Bombay Potteries and Tiles Ltd. for chemical analysis and other tests for pottery manufacture.

6. FIELD NOTES.

(a) In Pingli area, district Panch Mahals.

Traverse along Khurhi from its mouth near the junction of Balatia-Satamna cart road and Kuwach river.

Observations.

- (1) Exposure near the junction and at the mouth of Khurhi of greyish and brownish sandstone containing a large percentage of lime. Highly contorted.
- (2) Exposure of white soft sandstone, containing lime, on the side of the Khurhi, which forms the southern boundary of Pingli Mouza.
- (3) Exposure on the side of the Khurhi, highly contorted greyish and whitish sandstone. No definite dip is indicated.
- (4) Exposure of highly contorted white soft sandstone on the side of the Khurhi.
- (5) Exposure of brownish sandstone containing lime. No definite dip.
- (6) Greyish sandstone is exposed along path almost free from lime. Dip 17° to $N. 52^{\circ} W.$
- (7) Exposure of highly contorted brownish sandstone along path. No definite dip is indicated, close to this place there is a fault, running $N. 35^{\circ} E-S. 35^{\circ} W.$
- (8) Exposure of white sandstone on the side of the Khurhi. Highly crushed and contorted.
- (9) Exposure of white sandstone on the bed of the Khurhi. Dip 64° to $N. 50^{\circ} W.$
- (10) Exposure of reddish and greyish highly contorted sandstone on the side of the Khurhi.
- (11) White sandstone is exposed. Highly contorted. Massive. No definite dip is indicated.

Traverse round the pits in Pingli area.

Observations.

- (12) Exposure in Khurhi of white sandstone deposit. No definite dip. A fault runs, near this place, $S. 42^{\circ} W-N. 42^{\circ} E.$

- (13) Exposure of white sandstone. No definite dip is indicated. Highly contorted.
- (14) Here the exposure of sandstone of observations (13) ends and the exposure of brownish clay deposit begins. Almost free from lime. Highly crushed.
- (15) Exposure of the same brownish clay of observations (14) above continues.
- (16) Exposure in Pit No. 4 of the same kind of brownish clay deposit as in observations (15). It is almost free from lime.
- (17) Exposure of the same kind of brownish and greyish clay of observations (16) ends here and towards the east and along the northern side of the Khurhi white sandstone begins. The clay beds are highly crushed and crumpled. Below the first 2 feet of the clay bed, the clay is almost free from lime.

Traverse in Pingli Mouza along Kuwach river.

Observations.

- (18) Exposure on Kuwach river of white coarse grained grit with round pebbles of white, red and pink quartz. Massive.
- (19) Seventy-four feet exposure of white massive sandstone on Kuwach river. No definite dip is indicated. Upper portion (about 3 feet) contains lime and the lower portion (about 5 feet) exposed is almost free from it.
- (20) Exposure on Kuwach river of black and brownish massive sandstone with a large quantity of lime, near the junction of Balatia-Satampa cart road. Thirty-four feet of it is exposed along the river. No definite dip is indicated.

Traverse in Pingli area along the clay deposits.

Observations.

- (21) Exposure of brownish clay with lime, highly crushed and contorted on the northern side of Khurhi.
- (22) Exposure of white sandstone and the above brownish clay bed ends here. No dip is indicated.
- (23) Exposure of white massive sandstone with lime overlying the greyish clay deposits in Pit No. 3.
- (24) Exposure of brownish crushed clay deposits with a large quantity of lime on the side of the Khurhi.
- (25) Exposure of white and pinkish sandstone underlying hard white massive sandstone. No dip.
- (26) Exposure of soft greyish and white sandstone underlying white sandstone. No definite dip is indicated.
- (27) Exposure in Khurhi of white soft sandstone, overlying the clay deposit of Pit No. 1. Dip 42° to N. 72° E.
- (28) In Pit No. 3, exposure of white sandstone. Dip 53° to S. 85° E.

Traverse round the trial pits in Pingli area.

Observations.

- (29) General dip of clay in Pit No. 7 is 9° to S. 3° E. Highly crushed. It underlies white sandstone, which is massive.
- (30) Small exposure, in water course of greyish clay underlying white sandstone which contains a large percentage of lime.
- (31) Greyish clay deposit in Pit No. 3. It overlies white sandstone and underlies surface soil containing a large percentage of lime. So the upper 2 feet or so of the clay deposit is mixed with lime.
- (32) Exposure of brownish clayey sandstone of Pit No. 2. Highly crushed and mixed with lime. Only 3 feet in the middle of the deposit is almost free from lime.
- (33) Exposure in Khurhi of white massive sandstone. No definite dip is indicated.

- (34) Exposure in Khurhi, near the tri-junction of Pingli, Balatia and Khandoli Mouzas of white massive soft sandstone without lime. No definite dip.
- (35) Exposure of reddish sandy clay overlying white sandstone. No dip. Highly crushed. It contains lime in a large quantity and it underlies brownish clay with a high percentage of lime.
- (36) Exposure in Pit No. 8 of greyish plastic clay. Highly crushed.
- (37) Exposure of greyish plastic clay in Pit No. 1. Highly crushed. The formation of the clay bed here is lenticular.
- (38) Exposure of reddish sandy clay with lime overlying white sandstone which overlies clay of Pit No. 8.

Traverse along Kuwach river from the junction of Balatia-Satamna cart road to Rajpur village.

Observations.

- (39) Exposure of greyish and pinkish clay below white sandstone of observations (19). No definite dip is indicated.
- (40) Exposure on the bed of Kuwach river pinkish sandstone overlying pinkish sandy shales. No definite dip.
- (41) Exposure on the northern bank of Kuwach river of pinkish sandstone mixed with white sandstone. Massive, no definite dip is indicated.
- (42) Exposure on the northern bank of the river of brownish clay, about 2 feet wide free from lime.
- (43) Exposure of white sandstone mixed with greyish sandstone. Massive.

(b) Records of trial pits in Pingli area.

<i>Pit No. 1.</i>		<i>Pit No. 4.</i>	
Greyish plastic clay (free from lime)	2'-9"	Brownish shaly sandstone (with lime)	2'-0"
White and grey sandstone	4'-2"	Brownish shaly sandstone (without lime)	4'-6"
Greyish plastic clay (free from lime)	0'-9"		
Greyish and white sandstone	1'-7"		
			6'-6"
	9'-3"		
<i>Pit No. 2.</i>		<i>Pit No. 5.</i>	
Brownish shaly sandstone (with lime)	1'-6"	Surface soil (mixed with lime)	4'-6"
Brownish shaly sandstone (without lime)	3'-0"	Soft Greyish clay (with lime), (as in Pit No. 3).. ..	0'-6"
Brownish shaly sandstone (with lime)	1'-6"		
Deep brown shaly sandstone (without lime)	2'-9"		
Deep brown shaly sandstone (with lime)	1'-0"		5'-0"
Brownish hard sandstone	0'-6"		
	10'-3"	<i>Pit No. 6.</i>	
<i>Pit No. 3.</i>		Surface soil	3'-6"
Surface soil	6'-0"	White hard sandstone	2'-0"
Soft greyish clay (with lime)	3'-8"	Soft pinkish sandstone	0'-8"
Greyish plastic clay (free from lime)	10'-0"	Pinkish shaly sandstone (free from lime)	1'-10"
White sandstone (with lime)	0'-6"	White sandstone	1'-6"
	20'-2"		9'-6"

<i>Pit No. 7.</i>			<i>Pit No. 9.</i>		
Surface soil	0'-10"		Surface soil	0'-2"	
Greyish plastic clay (with lime)	11'-0"		Pinkish clay (more or less sandy)	4'-6"	
(as in Pit No. 3).					
	11'-10"				4'-8"
<i>Pit No. 8.</i>			<i>Pit No. 10.</i>		
Surface soil	2'-4"		Surface soil	0'-2"	
Greyish plastic clay (free from lime)	3'-6"		Mixed greyish and pinkish shaly sandstone	2'-0"	
(as in Pit No. 3)			White sandstone	0'-6"	
	5'-10"				2'-8"

(c) In Balatia area.

Traverse along Kuwach river in Balatia Mouza from the junction of Balatia-Satamna cart road.

Observations.

- (1) Exposure of soft white sandstone on the northern bank of Kuwach river near its junction with Balatia cart road. Local people take soft white sandstone from here. The number of the plot, in which this exposure lies is 35 of Balatia Mouza and it belongs to Inamdar Himatlal Pransankar Jani of Kalol.
- (2) Exposure of hard white and pinkish sandstone on Kuwach river. Dip 42° to N. 88° W.
- (3) Exposure of brownish highly crushed brownish clayey sandstone containing a large quantity of lime on the bank of the river Kuwach.
- (4) Exposure of grit on the southern bank of Kuwach river, containing a large percentage of lime. Dip 15° to S38° E. This exposure is 230 feet east of the tri-junction of Kanatia, Khandoli and Balatia Mouzas.
- (5) Exposure Kuwach river of white coarse massive soft sandstone, quarried by the people of the locality. It is exposed 88 feet along the river, and it extends in Balatia Mouza up to its northern boundary line and then it extends further up in Pingli area.
- (6) Exposure on the northern bank of Kuwach river of hard coarse sandstone. Dip 42° to N. 88° W. It contains a large percentage of lime.

(d) Records of Trial pit in Balatia area (measurements on Northern wall).

<i>Pit No. 1.</i>					
Surface soil	0'-2"				
Greyish plastic clay (free from lime)	8'-0"				
					8'-2"

(e) Records of Trial pit in Toova area (measurements on Western wall).

<i>Pit No. 1.</i>					
Surface soil	3'-0"				
Felspathic rock	5'-0"				
					8'-0"

7. APPROXIMATE VOLUME AND TONNAGE OF GREYISH PLASTIC CLAY DEPOSIT (10 FEET THICK) IN RAJFUR (PINGLI) AND BALATIA MOUZAS IN AREA PROSPECTED.

In Rajpur (Pingli area).

(250' × 120' × 10') = 300,000 cubic feet = 15,000 tons at 5 tons per 100 cubic feet.

(80' × 120' × 10') = 96,000 " = 4,800 " " " "

(500' × 120' × 10') = 600,000 " = 30,000 " " " "

49,800 tons.

In Balatia area.

(180' × 120' × 10') = 216,000 cubic feet = 10,800 tons at 5 tons per 100 cubic feet.

Total .. 60,600 tons.

Say 60,000 tons, approximately.

(Sixty thousand tons only).

8. APPROXIMATE COST OF RAISING AND TRANSPORT OF THE CLAY OF PROSPECTED RAJFUR (PINGLI) AND BALATIA AREAS, DISTRICT PANCH MAHALS.

The wages of coolies are generally 6 annas per head per day and the distance of the clay deposit from Derol Railway Station is about 4 miles by cart road and Derol Railway Station is 275 miles from Bombay Central Station.

		Rs. a. p.
Hence, approximate cost of raising the clay	1	0 0 per ton.
Approximate cost of transport from clay deposit to Bombay Central—		
Carting	5	0 0 per ton.
Railway freight by goods train	10	3 0 " "
	15	3 0 " "
		say, 15 0 0 per ton.
Total ..	16	0 0 " "
		(Rupees sixteen per ton).

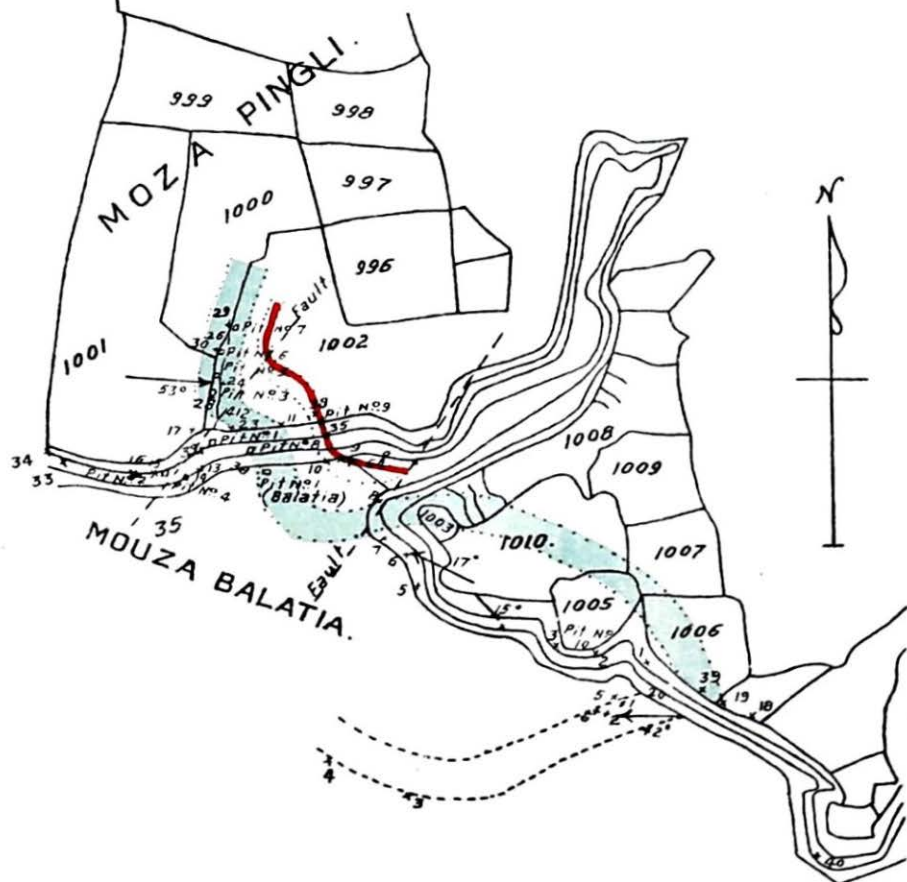
Market value—

Present market value of fire clay f. o. r. Bombay is Rs. 20 to Rs. 30 per ton.


MAP SHOWING CLAY DEPOSIT IN
RAJPUR (PINGLI) & BALATIA
MOUZAS

DIST. PANCH MAHALS

SCALE 8" = 1 MILE



REFERENCE:—

-  GREYISH PLASTIC CLAY
-  REDDISH PLASTIC CLAY

Drawn by—
D.N. Mukerji
Geologist

2. GEOLOGICAL INVESTIGATION ON FELSPAR ROCK IN TOOVA AREA, DISTRICT PANCH MAHALS, BOMBAY PROVINCE.

1. INTRODUCTION.

In the course of my survey work for clay beds in Rajpur and Balatia areas near Deroi in district Panch Mahals, I spent only a few days in doing geological investigation on felspathic rock in Toova area in the same district in the months of October and November 1938. After making preliminary survey work and pit work in Toova area I collected 2 samples with Mr. C. P. Shah of felspathic rock from that place and sent them to Bombay Potteries and Tiles Ltd. for proper tests and examinations.

2. OCCURENCE.

Somnath Temple lies about half a mile off from Toova Station. Close to that temple there are several hot springs, which are saline in taste and a smell of sulphur is also detected in the water. On the bed of Khari river, which flows close by the above temple, there are several good exposures of granite-rock. A large exposure of the same granite rock is also observed in the field, lying waste, situated to the South of the said river. There runs a good cart road from Toova Station to Somnath Temple. But Khari river has to be crossed to reach the granite rocks on the other side of it.

3. PROSPECTING IN TOOVA AREA FOR FELSPAR.

(22° 54' : 73° 39').

A large number of exposures of granite rock, with inclusions of pegmatite veins is noticed along the banks and the bed of Khari river from Somnath Temple Ghat to Toova railway bridge. The granite rock contains pink orthoclase felspar, white quartz and mica; this orthoclase felspar occurs in a large percentage and quartz and mica in a small quantity. The crystals of orthoclase felspars are generally small in size on the surface due to decomposition. The same type of orthoclase felspar is also observed in the granite in the waste land stated above and it extends over a vast area. About 1,000 ft. long and 900 ft. wide granite rock has been traced in the above waste land. Average width is about 500 ft. A detailed work in future and sinking of trial pits and boreholes in a large number are required in this area to find out its actual extent and the undecomposed portion of the granite rock. Big crystals of felspar were excavated under my supervision from a pit on granite rock and a bag full of them was sent to Bombay Potteries & Tiles Ltd. in the presence of Mr. C. P. Shah for proper tests. This goes to prove that there may be an undecomposed granite rock close by.

Besides the above pink granite rock, I find good exposures of hornblende granite containing a large percentage of felspar with quartz, hornblende and other minerals, close to this area. The presence of hornblende in the hornblende granite makes it unfit for pottery purposes, as hornblende contains iron besides other minerals.

Taking 1,000 ft. length and average 500 ft. width and 3 ft. thickness of the felspar deposit, we get the volume 1,500,000 cubic ft. which is 75,000 tons approximately at 100 cubic ft. = 5 tons.

4. QUALITY OF THE FELSPATHIC ROCK AND ITS USE FOR POTTERY MANUFACTURE.

As the felspathic rock in this area lies below the surface soil, the former is found more or less decomposed. Big crystals of orthoclase felspars of the rock are broken along their lines of cleavages and formed small crystals. The surface soil contains a large percentage of lime in some places. So by percolation of water from the surface to the rock underneath, the lime passes and settles into the bedding plane of the felspathic rock. Thereby the upper 2 or 3 ft. of it, is made unfit for pottery purposes. In spite of the above fact, I find that the lower 3 or 4 ft. of it is free from lime and big crystals of felspars are obtained from the rock in a large number. Further geological prospecting operations may reveal some more places where big crystals of pure big orthoclase felspars may be found.

5. APPROXIMATE FELSPAR RESERVE IN PROSPECTED TOOVA AREA.

In waste land South-west of Somnath Temple, in Toova area—75,000 tons, approximately. (Seventy-five thousand tons only).

6. FIELD NOTES.

In Toova Area, district Panch Mahals.

General traverse round about Somnath Temple, South-West of Toova Railway Station.

Observations.

- (1) Several hot springs are observed near the Somnath Temple and also on the bed of the nala, called Khari river. The water of the springs is saline in taste and it seems to contain sulphur.
- (2) Exposure of granite rock on the bed of the Khari river, S 40° W of Somnath Temple. The rock consists of pink orthoclase felspar in a large quantity and a small percentage of white quartz and muscovite mica. The strike of the rock is N 75° E—S 75° W at this point.
- (3) 48 feet N. W. of observations (2) above exposure of massive granite rock with orthoclase felspar, quartz and mica on the bed of the river. Felspar appears in large percentage in the rock.
- (4) Exposure in a small water course S 40° W of observations (2) above of the same type of granitic rock with bigger crystals of pink orthoclase felspars.
- (5) Exposure of black saline silt just above observations (2). It lies just below recent alluvium.
- (6) Poor exposure in a small water course, S 52° W of observations (4) above, of the same type of granitic rock. But the crystals of pink felspars are smaller in size on the surface.
- (7) Exposure in Khari river of massive granite rock with big crystals of pinkish orthoclase felspar with small crystals of mica and quartz.

*Traverse along Khari River.**Observations.*

- (8) Good exposure of granite rock on the bank of Khari river containing white quartz, pinkish orthoclase felspar and mica. The crystals of felspar are of small size.
- (9) Good exposure on the bank of Khari river of massive pinkish granite rock containing white quartz, pinkish felspar and a small quantity of mica. Some big crystals of felspar are found here. No definite dip is indicated. Felspar is contained in the rock in a large quantity.
- (10) Good exposure of massive hornblende granite consisting of white plagioclase felspar, quartz, hornblende and other minerals on the bed of Khari river near Railway bridge.

*Traverse along a water course, near railway line.**Observations.*

- (11) Exposure in a watercourse of pinkish massive granite rock containing pinkish orthoclase felspar in a large quantity.
- (12) Good exposure in the watercourse of massive hornblende granite containing white plagioclase felspar, white quartz, black hornblende besides other minerals.
Pinkish big and small crystals of orthoclase felspar also appear in a few places on the above rock.
- (13) Exposure in the watercourse of massive hornblende granite of the type mentioned in observations (12) above.
- (14) Exposure in a watercourse of massive decomposed pinkish granite rock containing a large percentage of orthoclase felspar.

7. COST OF RAISING AND TRANSPORT OF THE FELSPATHIC ROCK OF PROSPECTED TOOVA AREA, DISTRICT PANCH MAHALS.

Wages of coolies 6 annas per day per head.

The distance from the place of occurrence to Toova station is $1\frac{1}{2}$ miles and from Toova Railway Station to Bombay Central is 298 miles.

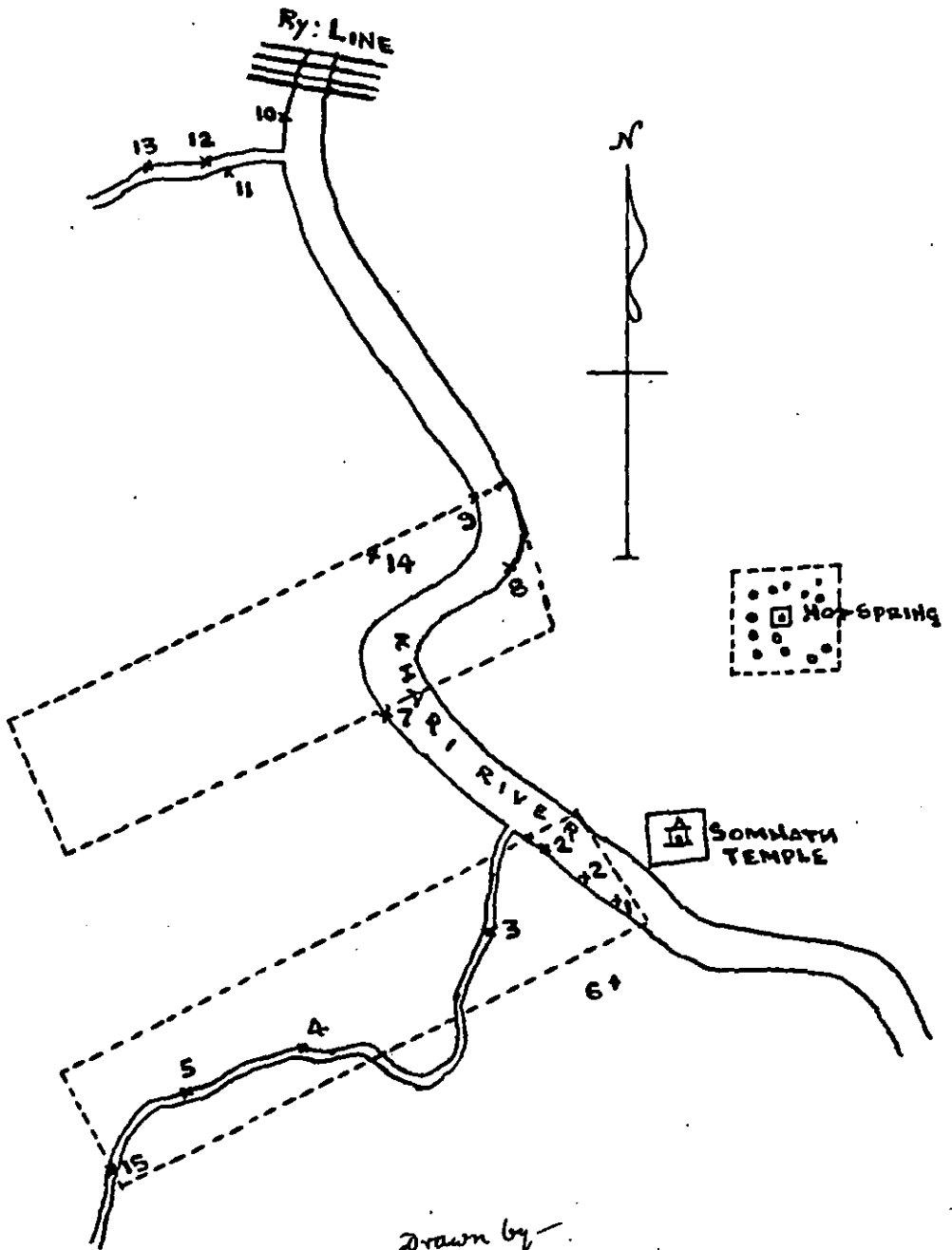
			Rs. a. p.
Cost of raising	.. ..	..	1 0 0
Cost of transport—			
Carting	..	Rs. 1-8-0 per ton.	
Railway freight	..	Rs. 10-8-0 per ton (by goods train).	
		<hr/>	12 0 0
		Total ..	<hr/> 13 0 0
			per ton (approximately).

Market Value—

Present market value of felspar f. o. r. Bombay is Rs. 18 per ton.

MAP SHOWING OCCURANCE OF FELSPAR
IN TUWA, DISTRICT PANCH-MAHALS.
(IN AREA PROSPECTED)

SCALE 16" = 1 MILE



Drawn by
D.N. Mukhop
Geologist

3. GEOLOGICAL INVESTIGATION ON QUARTZ ROCK IN SANT ROAD AREA, DISTRICT PANCH MAHALS, BOMBAY PROVINCE.

1. INTRODUCTION.

I devoted a few days in the month of October and November 1938 in doing geological investigations on quartz rock during the course of my survey work for clay beds in Rajpur and Balatia areas near Derol in district Panch Mahals. The above quartz rock was observed in Sant Road area, about $2\frac{1}{2}$ miles north of Sant Road station, on several quartz reefs running almost N 3° E—S 3° W. These reefs cross the main mortar road between 28th and 29th mile post from Santrampur. It is a good mortar road through which the quartz rock can be easily transported from the place of occurrence to the Sant Road Railway Station (B. B. & C. I. Rly.) in district Panch Mahals.

2. OCCURRENCE.

($22^{\circ} 49' : 73^{\circ} 51'$).

The above quartz reefs, on both sides of Santrampur Road, close to Natapur village, occur in reefs and small veins. Some of those reefs have been traced more than a mile. There are also minor quartz veins joining them in irregular lines. On the above quartz reefs I find quartz cappings in a large number on some parts of them. Of these quartz cappings, fourteen are much bigger in size and others are minor ones.

3. PROSPECTING IN SANT ROAD AREA FOR QUARTZ ROCK.

Molten magma of silicon dioxide in a pure state came out of the fissures of the earth and formed veins and reefs of pure white quartz from a few inches to several feet in thickness. The country rock of the area is phyllite and it is highly crushed and crumpled at the places where it is crossed by quartz reefs and veins. The reefs are from 2 to 8 feet wide and some of them run more than a mile. These quartz reefs are white, massive, hard and compact. Hard coarse or fine grained sandstones are formed on both sides of the quartz reefs. The quartz cappings which are observed on some parts of the quartz reefs, were formed by the flow of molten magma of quartz body. Due to weathering these quartz cappings in later years broke on the top and small blocks or nodules of quartz scattered all round the place. So we find that quartz rocks in small pebbles or large blocks are scattered all round the place. So we find that quartz rocks in small pebbles or large blocks are scattered over the surface soil in large area in this locality. The above cappings are found in some places 45 feet deep and about 200 feet wide lying over quartz reefs of about 8 feet thickness. There are also cappings of small size and depth resting on quartz veins, 4 to 8 feet thick. The quartz veins and reefs run to a very great depth. To prove the actual depth of the rock in quartz reefs blasting by dynamites and deep underground mining for a considerable period are required. However, the pure white quartz rock of the above cappings only are very large in quantity.

4. QUALITY AND USES OF THE QUARTZ ROCK.

The above quartz rock is pure white in colour, though red stains on the surface only are observed due to weathering. It contains pure silicon dioxide to a very large extent. To grind this rock is a difficult task, as it is very hard. It may be tested whether this quartz rock mixed with requisite proportion of clay be useful for pottery manufacture.

5. FIELD NOTES.

Sant Road Area, District Panch Mahals.

Traverse along Santrampur Road, north of Natapur Village.

Observations.

- (1) Exposure of greyish phyllite on the main road cutting. Dip 36° to N 82° W.
- (2) Exposure on the road cutting of phyllite, highly crushed and contorted at the junction of the exposure of quartzite on the main road.

- (3) Exposure of greyish very hard massive quartzite with capping of white quartz.
- (4) Exposures on the road cutting of phyllite. Dip 42° to N. 88° W.
- (5) Exposure of greyish hard massive quartzite.
- (6) Exposure on the cutting of phyllite. Highly contorted.
- (7) Exposure of quartzite. Massive. Greyish in colour. Highly crushed and crumpled.
- (8) In another road cutting on Santrampur Road, exposure of white massive quartz.
- (9) Exposure of phyllite in the road cutting. Highly contorted.

Traverse round quartz reefs near Santrampur Road, North of Natapur village.

Observations.

- (10) Exposure of a capping of quartz rock above a quartz vein. The quartz is pure and white in colour. Slightly weathered and stained red on the surface.
- (10A) to (23) Exposure of a capping of quartz rock above a quartz vein. The quartz is pure and white in colour. Slightly weathered and stained red on the surface.

The above exposures are of the same nature and pure and white in colour as in Observation (10) above. All the above cappings are close together and are situated on both sides of Santrampur Road.

In Sant Road area.

Traverse along a small water course from a bridge on Santrampur Road (Ambli 8 mile post) to Natapur village—(Crossing some of the quartz reefs).

Observations.

- (24) Exposure in the water course of greyish phyllite. Highly crushed and contorted. No definite dip is indicated. Near the surface it is mixed with hard sandstone, being close to a quartz reef.
- (25) Exposure of highly crushed greyish phyllite on the water-course. No definite dip is indicated.
- (26) Exposure of white quartz vein (3 feet wide), massive. It runs $N3^{\circ}E-S3^{\circ}W$.
- (27) Exposure of greyish sandstone, massive in the water course. No dip.
- (28) Exposure of hard greyish sandstone with a capping of quartz rock on it. Phyllite is turned here (metamorphosed) into hard sandstone.
- (29) Exposure of thin white quartz vein (2 feet wide), passing through the above sandstone of observations 28.
- (30) Exposure of hard greyish phyllite. Highly contorted. No definite dip is indicated.
- (31) Exposure of white quartz vein (4 feet wide) running $N3^{\circ}E-S3^{\circ}W$, through the country rock phyllite.
- (32) Exposure on the small water-course, of phyllite highly crushed and crumpled.
- (33) Exposure of thin quartz vein (2 feet wide), running $N5^{\circ}E-S5^{\circ}W$. It turns the country rock phyllite into a hard sandstone on its both sides.
- (34) Exposure of quartz vein, 50 feet $N-20^{\circ}W$ of Natapur village, on the bund of a field. It is 6 feet wide and runs $N3^{\circ}E-S3^{\circ}W$.

N.B.—The above quartz veins were traced close to the 29th mile stone on road (from Santrampur) from observations 13, i.e., more than a mile.

6. APPROXIMATE VOLUME AND TONNAGE OF MAIN QUARTZ CAPPINGS ON QUARTZ REEFS IN SANT ROAD, NEAR NATAPUR VILLAGE, DISTRICT PANCH MAHALS.

Quartz Capping C ₁	..	.. (60' × 240' × 36')	..	518,400	Cu. ft.
" " C ₂	..	.. (60' × 180' × 30')	..	324,000	" "
" " C ₃	..	.. (120' × 180' × 45')	..	972,000	" "
" " C ₄	..	.. (252' × 90' × 36')	..	816,480	" "
" " C ₅	..	.. (90' × 60' × 30')	..	162,000	" "
" " C ₆	..	.. (90' × 60' × 28')	..	151,200	" "
" " C ₇	..	.. (30' × 60' × 30')	..	54,000	" "
" " C ₈	..	.. (24' × 60' × 30')	..	43,200	" "
" " C ₉	..	.. (42' × 60' × 36')	..	90,720	" "
" " C ₁₀	..	.. (150' × 9' × 15')	..	20,250	" "
" " C ₁₁	..	.. (24' × 36' × 15')	..	12,960	" "
" " C ₁₂	..	.. (150' × 24' × 24')	..	86,400	" "
" " C ₁₃	..	.. (24' × 120' × 15')	..	43,200	" "
" " C ₁₄	..	.. (12' × 60' × 12')	..	8,640	" "

Total .. 3,303,450 " "

=165,172 tons at 5 tons
per 100 Cu.ft.

Say, 165,000 tons, approximately.

14 Quartz reefs—

$14 \times (5,000' \times 20' \times 2') = 2,800,000$ Cu. ft. = 140,000 tons at 5 tons per 100 cu. ft.

Total 305,000 tons, approximately.

7. APPROXIMATE COST OF RAISING AND TRANSPORT OF THE QUARTZ ROCK OF PROSPECTED SANT ROAD AREA DISTRICT PANCH MAHALS TO BOMBAY.

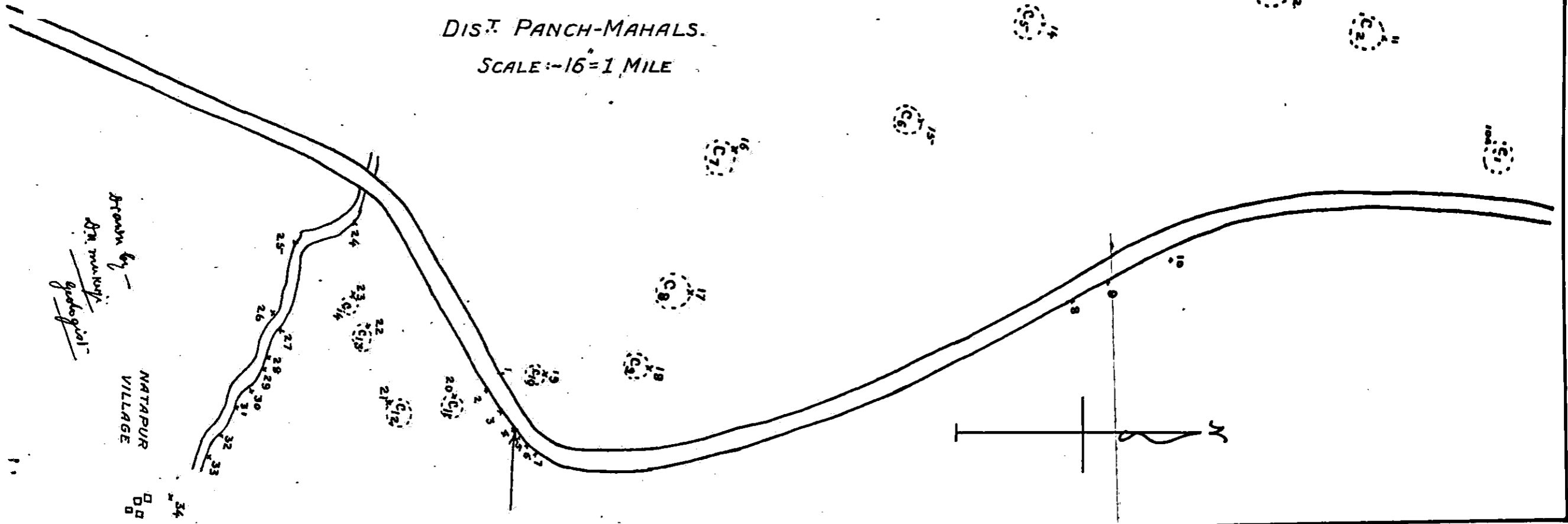
The distance between Sant Road Station and the place of occurrence of quartz rock is $2\frac{1}{2}$ miles and between Bombay Central and Sant Road Station is 302 miles. Blasting is required to take out the rock.

Approximate cost of raising (including cost of blasting)	..	..	..	Rs. a. p.	3 0 0	per ton.
Carting	..	..	Rs. a. p.	2 0 0	per ton.	
Railway freight (By goods train)	..	..	10 8 0	" "		
			12 8 0	" "		
∴ Approximate cost of transport to Bombay	..	..	12 8 0	" "		
			Total ..	15 8 0	" "	

Market Value—

Present Market value of Quartz rock f.o.r. Bombay is Rs. 11 per ton.

MAP OF SANT ROAD AREA
SHOWING QUARTZ CAPPINGS IN
AREA PROSPECTED.
DIST. PANCH-MAHALS.
SCALE :- 16" = 1 MILE



NATAPUR
VILLAGE

4. GEOLOGICAL INVESTIGATION ON CLAY DEPOSITS IN AND ABOUT GOKHERA MOUZA, NEAR BASSEIN ROAD STATION, DISTRICT THANA, BOMBAY PROVINCE.

1. INTRODUCTION.

I visited the clay deposit in Gokhera mouza on 9th November 1938, and returned to Bombay on the same day to make arrangements for prospecting operations in the said mouza. On 12th November I left Bombay and arrived Bassein Road the same morning. After preliminary arrangements I started traverse work and pit work on Gokhera clay deposit on 13th and finished geological operations on 24th November 1938. Forty-six bags of sample of clay weighing about 2 tons were collected by me as directed by Mr. C. P. Shah, and I sent them to Bombay Potteries & Tiles Ltd. for proper tests on 22nd November 1938. Returned to Bombay on 24th November evening.

2. GEOLOGY OF THE AREAS ROUND GOKHERA MOUZA.

(i) Gokhera.—On ranges of hillocks or dungries, lying just to the eastern portion of Gokhera mouza, I find laterite deposit which forms the main body of the hillocks, underlying white and pinkish coarse grained sandstone. More than 6 feet of such laterite deposit are noticed in the excavations on the hillocks and these deposits are used as murrum for road metalling. Below this laterite bed I observed more than 7 feet of soft mixed yellow and reddish clay beds. In some places on hillocks, north of Gokhera mouza, hard white and pinkish sandstones are exposed with underlying laterite bed.

In the area south-west of Gokhera mouza there is no hillock. It is a low country covered with black plastic clay on which sea water is carried, collected and salt is prepared under Government supervision. So the lime content of this black plastic clay is high, as the sea water percolated through it to a great depth.

(ii) Nala Sopara.—There is an isolated hill, about half a mile North-west of Nala Sopara Railway Station and it is mainly composed of greyish and yellowish coarse grained sandstone. To the north-western side of this hill, there is a good deposit of white plastic china clay free from lime. The land belongs to the Railway Board. They dug out, by their contractors, a large quantity of clay about 15 years back. Now that clay bed lies under water of about 5 feet deep and some portion of the clay runs below the hill. So if prospecting operations are required to be done in this area for the white china clay, then water is to be pumped out or the hill is to be blasted to expose the clay bed lying below.

(iii) Achola.—There is also a good deposit of yellowish clay on a hill in Achola mouza about $1\frac{1}{2}$ miles S60° W of Nala Sopara Railway Station. This deposit is well exposed on the cutting of the hill, more than 20 feet high on both sides of the path runs across it. About 150 feet wide yellow clay, almost free from lime, is observed along the said path lying at steep angle below hard greyish sandstone and granite rock about 300 feet wide above pinkish sandstone which forms the main ridge of the hill running N38° W—S38° E. So good yellow clay is available here in large quantity and it forms the major portion which is about a mile in length, of the hill running to a great distance. Thorough and detailed geological operations including trial pits, are required to estimate its actual extent. In a well of about 20 feet deep on the eastern slope of the above hill, the said yellow clay is observed all along from top to bottom. The overburden of the surface soil is about 3 feet on the average. So the yellow clay can be easily dug out and transported to Nala Sopara Railway Station, which is about a mile and a half off from the deposit. The approximate volume of the yellow clay free from lime in the prospected Achola area is about 45,000,000 Cu. ft. taking 5,000 ft. length (150' + 300') or 450 feet width and 20 feet thickness which makes the tonnage 2,250,000 at 5 tons per 100 cu. ft.

3. PROSPECTING FOR CLAY DEPOSITS IN GOKHERA MOUZA.

The clay deposits that are observed in Gokhera mouza are of five kinds—

- (1) Soft yellowish clay.
- (2) Hard deep yellow clay.
- (3) Soft reddish clay.
- (4) Black plastic clay.
- (5) Brownish clay.

(1) *Soft yellowish plastic clay.*—This is found in the middle of Gokhera mouza on both sides of the main mortar road. The average thickness of the deposit is $4\frac{1}{2}$ feet and it extends over a wide area. About 1,000 feet of it has been traced in a low valley, just east of a low hillock, North-east of Gokhera village. The main bulk of the clay lies in Government land in Plot No. 113 of Gokhera mouza; other portion lies in private lands adjacent to it. By sinking trial pits on both sides of the above hillock, which is composed of coarse grained white and pinkish sandstone, I find that there are two distinct beds of yellow clay. The clay on the eastern side is more pure and unmixed with reddish clay than that on the western side of the dungri. Both the clay beds are plastic and soft. This yellow clay is very soft and lies only 3 feet to 4 feet below the surface soil. Hence it can be taken out easily.

In Bhoida area poor exposures of yellow clay are observed south of Bhoida village. It does not seem to extend far and large quantity of this clay is not available from this place.

(2) *Hard deep yellow clay.*—The beds of this clay were observed in Gokhera Mouza in several places. The best portion of it lies just under the soft yellowish plastic clay near the main road. The deep yellow clay is so hard that it is very difficult to take out even by pickaxes. For deep underground mining, blasting is required on this clay bed. It is about 5 feet thick and is found in the above Government land in plot No. 113 in two distinct places on both sides of the hill. One is detected near main road in a cutting, South-east of the above hillock and the other in Pit No. 6 on the opposite side of it. Both the deposits extend over a wide area. General dip of the clay is 35° to $N68^\circ$ E.

(3) *Soft reddish clay.*—This is observed on hillocks lying on the eastern portion of Gokhera mouza. Good deposits of such clay are observed in Bhoida area near main mortar road. Trial pit was dug on this clay bed. The reddish clay of 4 feet thickness underlies reddish and pinkish sandstone and overlies mixed yellowish and reddish clay, about seven feet of which is detected in the above trial pit.

(4) *Black plastic clay.*—This is observed in the fields South-west of Gokhera mouza. As sea water covers this clay every year during rainy season, it contains salt.

(5) *Brownish clay.*—This is found in most of the places, above the yellow clay deposits, and contains lime in a high percentage. So this clay is not good for pottery manufacture.

4. USES OF CLAY DEPOSITS IN GOKHERA MOUZA.

The yellow clay is taken out from a few out crops in some places in Gokhera mouza by local people and some of them prepared red tiles out of this clay. The yellow clay, when burnt, becomes red. After proper tests of the clays, which are sent by me to Bombay Potteries & Tiles Ltd. from different places in Gokhera mouza, their qualities and uses may be ascertained. The quality of the clay, especially the hard deep yellow type, seems to be good.

5. APPROXIMATE VOLUME AND TONNAGE OF CLAY RESERVE IN GOKHERA MOUZA IN AREA PROSPECTED.

Soft Clay.—In Government Land— $460' \times 330' \times 4\frac{1}{2}' = 6,83,100$ Cu.ft. = 34,155 tons
at 5 tons per 100 Cu. ft.

In private land— $360' \times 330' \times 4\frac{1}{2}' = 5,34,600$ Cu. ft. = 26,730 tons
at 5 tons per 100 Cu. ft.

Total 60,885 tons.

Hard Clay.—In Government Land— $180' \times 100' \times 5\frac{1}{2}' = 90,000$ Cu. ft. less already excavated and taken out 80,000 Cu. ft. (approximately) = 10,000 Cu. ft. = 500 tons at 5 tons per 100 Cu. ft.

Do. $200' \times 115' \times 5' = 1,15,000$ Cu. ft. = 5,750 tons at 5 tons per 100 Cu. ft.

Total. 6,250 tons.

Grand total (60,885+6,250)=67,135 tons.

Say, 65,000 tons, approximately.
(Sixty-five thousand tons.)

6. FIELD NOTES.

(a) In Gokhera area (Near Bassein Road), district Thana.

Traverse near the clay deposit in Gokhera area.

Observations.

- (1) Good exposure of soft yellowish clay deposit in an excavation near the main road of Gokhera village.
- (2) Exposure in the above excavation of soft yellowish clay free from lime, about 3 feet below the surface. No definite dip is indicated.
- (3) Exposure in a dungri of greyish and yellowish sandstone. Massive. No definite dip.
- (4) Good exposure, on the ridge of a dungri, of white and pinkish sandstone. Massive.
- (5) Exposure of pinkish coarse grained sandstone on the above dungri. Massive. No definite dip is indicated.
- (6) Exposure of soft yellowish clay in an excavation at the foot of the above dungri. The upper portion of the clay is a mixture of pinkish and yellowish clay.
- (7) Exposure in an excavation on the other side of the main road of soft yellowish clay, like that of observation (1) above.
- (8) Exposure on a path SE. of observation (1) of greyish and yellowish sandstone. No definite dip is indicated.
- (9) Exposure of mixture of yellowish and pinkish clay on path. No definite dip.
- (10) Exposure on path of greenish sandstone. Massive, coarse grained.
- (11) Exposure on a dungri of pinkish and white sandstone. Massive, coarse grained. No definite dip is indicated.

Traverse along the Dungries in plot No. 113 in Ghokhera Mouza.

Observations.

- (12) Exposure of fine grained yellow sandstone near the path at the foot of the dungri in plot No. 113. Highly crushed. No definite dip is indicated.
- (13) Exposure of white and pinkish coarse grained sandstone on the dungri. Massive.
- (14) Exposure of fine grained yellow sandstone on the western slope of the dungri. Highly crushed.
- (15) Exposure in another dungri of coarse grained pinkish sandstone. Massive. No definite dip.
- (16) Exposure on the above dungri of coarse grained pinkish sandstone. No definite dip is indicated.

Traverse round the dungries in Plot No. 113.

Observations.

- (17) Poor exposure of coarse grained pinkish sandstone on path. Massive.
- (18) Exposure on path of coarse grained massive white and pinkish sandstone. No definite dip is indicated.
- (19) Exposure of fine-grained yellowish clay on path, highly crushed. No dip.

- (20) Good exposure of yellowish fine-grained clay on western bank of a small tank. More than 7 feet of yellowish plastic clay is exposed close by.
- (21) Good exposure in an excavation of soft yellow plastic clay, 2'-6" below the surface soil.
- (22) Poor exposure on path of fine grained yellow clay. No definite dip is indicated.
- (23) Poor exposure on path of pinkish sandstone. No definite dip is indicated.

Traverse in Gokhera Mouza.

Observations.

- (24) Exposure on path of very soft reddish laterite mixed with yellowish sandstone.
- (25) Exposure on path of yellowish sandstone. Massive, fine grained. No definite dip is indicated.
- (26) Exposure on dungri of coarse grained massive white and greyish sandstone.
- (27) Exposure on path NW of Talao, close to Temple, of massive white coarse grained sandstone. No definite dip.
- (28) Exposure on path, SE of a Talao of Gokhera of yellowish and pinkish coarse grained sandstone. No definite dip is indicated.
- (29) Exposure of greyish fine grained sandstone, near a dungri, north of Gokhera village. Massive.
- (30) Exposure of fine grained pinkish sandstone on a low dungri. No definite dip. Massive.
- (31) Exposure of greyish sandstone on the south western slope of the hillock, north-east of Gokhera village.
- (32) Exposure of coarse grained pinkish sandstone. Highly crushed. No definite dip is indicated.
- (33) Exposure of hard yellow clay at the edge of a field. Highly crushed.
- (34) Poor exposure of soft yellowish clay at the edge of a field.
- (35) Exposure on dungri, south of Deosthan, of yellowish hard sandstone in the midst of white and pinkish coarse grained sandstone. Massive. No dip is indicated.

Traverse Round Gokhera Mouza.

Observations.

- (A) On the ranges of hillocks or dungries, lying on the eastern border of Gokhera Mouza both north and south of Gokhera main mortar road, good exposures of soft laterite deposits (about 6 feet thick in some places) below pinkish and reddish sandstone, are observed in many excavations near the road. Whole of the said ranges of hillocks is composed of these rocks. These laterite beds are used as murrum for road metalling in this area. Below this laterite deposit I find soft yellowish sandstone in some places.
- (B) In passing along the road beyond the eastern boundary of Gokhera Mouza, I find same sort of laterite bed, as in observation (A) above, in the Wali Mouza also.
- (C) On the south-western side of Gokhera Mouza up to the Bassein Road Station, which is about 2 miles off, no exposure of rock is observed. Whole of the field, in that area is covered with black plastic soil, on which sea water is collected and salt is prepared under Government supervision. This black plastic clay contains a large quantity of salt.

(b) Records of Trial pits in Gokhera Mouza (In Bassein Area).

<i>Pit No. 1.</i>		<i>Pit No. 4.</i>	
Surface soil ..	3'-0"	Surface soil ..	1'-4"
Yellowish soft plastic clay ..	5'-3"	Mixed yellowish and reddish sandstone ..	1'-8"
Soft yellowish sandstone ..	1'-9"	Yellowish clay (more or less sandy) ..	3'-0"
	<hr/>	Yellowish sandstone ..	2'-0"
	10'-0"		<hr/>
			8'-0"
<i>Pit No. 2.</i>		<i>Pit No. 5.</i>	
Surface soil ..	4'-0"	Surface soil ..	1'-10"
Mixed yellowish and reddish clay ..	5'-10"	Yellowish soft plastic clay ..	5'-6"
Yellowish clay ..	1'-6"	Soft yellowish sandstone ..	0'-4"
	<hr/>		<hr/>
	11'-4"		7'-8"
<i>Pit No. 3.</i>		<i>Pit No. 6.</i>	
Surface soil ..	1'-4"	Surface soil ..	2'-7"
Soft mixed yellowish and reddish clay ..	3'-0"	Deep yellowish hard clay ..	2'-8"
Yellowish plastic clay ..	1'-6"		<hr/>
Soft yellowish sandstone ..	0'-11"		5'-3"
	<hr/>	<i>Pit No. 7.</i>	
	6'-9"	Surface soil ..	1'-10"
		Mixed yellowish and reddish plastic clay ..	2'-0"
			<hr/>
			3'-10"

7. APPROXIMATE COST OF RAISING AND TRANSPORT OF THE ABOVE CLAY OF PROSPECTED GOKHERA MOUZA, DISTRICT THANA TO BOMBAY.

The distance from clay deposit to Bassein Road is 3 miles and Bassein Road Railway Station is 30 miles from Bombay Central Station. Wages of coolies Re. 0-8-0 per head per day.

	Rs.
Approximate cost of raising	1 0 per ton.
Approximate cost of transport—	
Carting	2 0 " "
Railway freight (by goods train)	4 8 " "
	<hr/>
	6 8 " "
	<hr/>
Total	7 8 " "
	(approximately).

Market value—

Present market value of yellow or red clay is Rs. 8 per ton f. o. r. Bombay.

8. APPROXIMATE COST OF RAISING AND TRANSPORT OF CLAY IN PROSPECTED ACHOLA AREA, DISTRICT THANA.

The wages of coolies are about annas 8 per day and the distance of Nala Sopara Railway Station from clay deposit is 1½ miles and from Bombay Central is 32 miles.

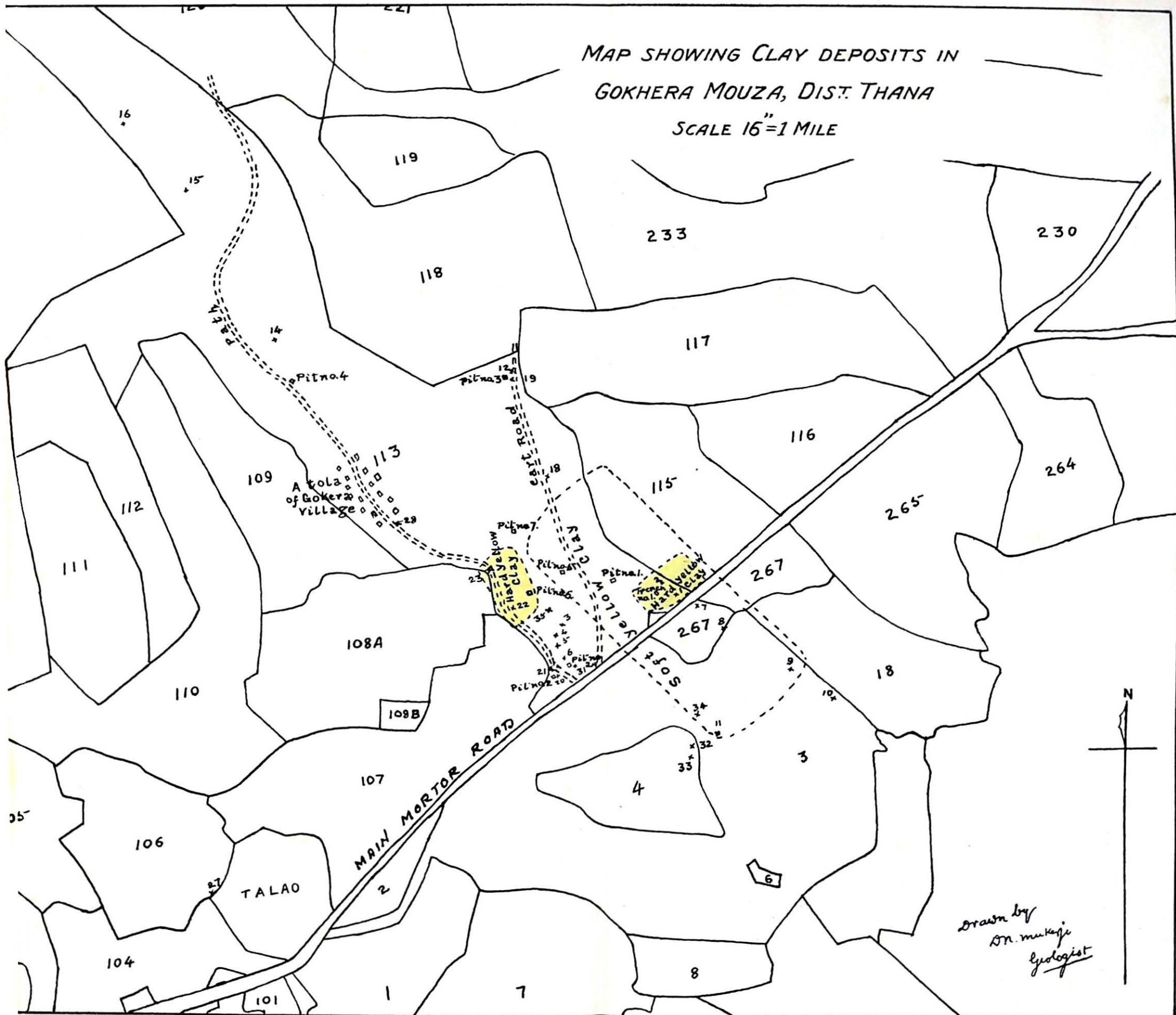
	Rs. a.
Raising cost of the yellow clay ..	1 0 per ton.
Carting from clay deposit to Nala Sopara Railway Station (including loading and unloading) ..	2 8 " "
Railway freight by goods train from Nala Sopara Railway Station to Bombay Central ..	4 8 " "
	<hr/>
Total	8 0 " "
	(approximately).
	(Rupees eight per ton)

Market value—

Present market value of yellow clay f. o. r. Bombay is Rs. 8 per ton.

MAP SHOWING CLAY DEPOSITS IN
GOKHERA MOUZA, DIST. THANA

SCALE 16"=1 MILE



5. GEOLOGICAL INVESTIGATION ON CLAY AND SANDSTONE DEPOSITS IN BELGAUM DISTRICT, BOMBAY PROVINCE.

(General Survey Work.)

1. INTRODUCTION.

I left Bombay on 27th November 1938 and went to Karad with Mr. C. P. Shah and met Mr. S. P. Ogale of Ogale Glass Works Ltd. there. After discussion it was settled that we should visit mainly Khanapur, Gunji, Kapoli, Londa and Castle Rock areas in Belgaum District and a few more that would be found necessary to see on the way. So we all left Karad and arrived Belgaum by train on 28th morning and made a long tour in Belgaum District for four days from 28th November to 1st December 1938. The important deposits, we visited in Belgaum District, of sandstone and clay beds were as follows:—

- (1) *Sandstone* ($15^{\circ}43' : 74^{\circ}31'$).—At Desur, near Kasan Talao. (Mean Magnetic Declination $1^{\circ}45'$ west in 1928.)
- (2) *White Clay Deposit* ($15^{\circ}43' : 74^{\circ}30'$).—Near Public Works Department Stores, close to Desur village.
- (3) *Sandstone and Quartz* ($15^{\circ}42' : 74^{\circ}31'$).—Between 6th and 7th mile stone from Khanapur, close to Khanapur-Belgaum mortar road.
- (4) *White Clay Deposit* ($15^{\circ}37' : 74^{\circ}31'$).—On the bank of Malaprava river south-east of Khanapur Bridge.
- (5) *White Clay Deposit* ($15^{\circ}32' : 74^{\circ}31'$).—East of Gunji village.
- (6) *White Clay Deposit* ($15^{\circ}30' : 74^{\circ}28'$).—North-west of Keerowlee village.
- (7) *White Clay Deposit* ($15^{\circ}29' : 74^{\circ}34'$).—West of Kapoli village.
- (8) *Moulding Sand Deposits* ($15^{\circ}27' : 74^{\circ}32'$ and $15^{\circ}27' : 74^{\circ}33'$).—On either sides of Londa Station (M. S. M. Railway).
- (9) *Sandstone Deposit* ($15^{\circ}28' : 74^{\circ}29'$).—South-east of Moeeshet village.
- (10) *White Clay Deposit* ($15^{\circ}23' : 74^{\circ}17'$).—On the hill west of Castle Rock Station.

2. GEOLOGY OF THE ABOVE PLACES IN BELGAUM DISTRICT.

(i) Desur ($15^{\circ}43' : 74^{\circ}31'$).—Felspathic rock of bedded structure formed by subsequent metamorphism of the disintegrated granite rock is well exposed in a nala close to Kasan Talao, quarter of a mile south-east of Desur village. It contains a high percentage of silica. Sample is taken by Mr. C. P. Shah of Bombay Potteries and Tiles Ltd., Bombay, for tests and analysis.

Desur ($15^{\circ}43' : 74^{\circ}30'$).—Near Public Works Department Stores, close to Desur village, there is a clay deposit which is being worked by one Mr. Deshpande. He states that the clay melts at $1,100^{\circ}\text{C}$ and it is being used in the glass factory at Ogalewadi. The clay is white and non-plastic. Sample is taken by Mr. C. P. Shah for tests and analysis.

The above deposits of felspathic rock and clay are only half a mile by good road from Desur Station.

(ii) Khanapur ($15^{\circ}42' : 74^{\circ}31'$).—Hard white sandstone deposit between 6th and 7th mile stone from Khanapur, near Khanapur-Belgaum mortar road, contains a high percentage of silica. Being closely associated with granite rock, the above sandstone is not pure. It is mixed with other minerals in small quantity. Sample of the rock is taken for analysis and tests by Mr. C. P. Shah. Analysis of the rock will reveal whether it contains iron. For glass manufacture the rock should be iron free. This sandstone deposit is not big enough for a large scale industry. A small quartz vein, about 3 feet thick, is observed near the above sandstone deposit. Desur Railway Station is only two miles off from the above deposit of sandstone.

Khanapur ($15^{\circ}37' : 74^{\circ}31'$).—On the bank of Malaprava river, close to and south-east of Khanapur bridge, white clay deposit is observed. It is very much contaminated with yellow clay deposit, which contains iron. Moreover the quantity of the white clay is very poor. The yellow clay, which is available in large quantity here, seems to be good for making roofing tiles. The yellow clay near Khanapur village is being used in Pioneer Clay Tile Factory and Naik's Tile Factory of Khanapur for making red roofing tiles.

Khanapur (15°41' : 74°31').—On the bank of nala, west of Garlgunji, white clay deposit is observed. It is formed by the disintegration of granite rock and contains a low percentage of clay. It is non-plastic and is more or less mixed with yellow clay, which contains iron.

(iii) Gunji (15°32' : 74°31').—White clay deposits are observed in nala and cuttings east of Gunji village. They are also formed by the disintegration of granite rock and have obtained its slight plasticity from the laterite clay mixed with it and from the decomposed felspar it contains. The white clay of this place is about 4'–6" thick, as observed in a pit dug near the nala, and about 1,000 feet long and 200 feet wide deposit has been traced in that place only. Further towards the north about half a mile off, another deposit is observed covering a wide area, near the said nala. Small pocket deposit of white clay is also observed along the nala up to another big nala where it joins. The fine grained white micaceous clay of the above deposit lies below 6 feet of coarse white sandstone. This clay is practically non-plastic and more or less mixed with yellow laterite clay. Sample is taken by Mr. Shah for test. The above clay deposit is only 350 feet east of Khanapur-Gunji main mortar road and is about a mile from Gunji Station (M. S. M. Railway) connected by good road. The overburden of the Gunji white clay is 10 feet on the average.

(iv) Keerowlee (15°30' : 74°28').—On the west of Keerowlee village which is 3 miles from Gunji by cart road, there is a high granite hill running to a great distance and a river coming down that hill passes by the said village. The portion of the granite rock, which is disintegrated, is washed by water action to a great distance. So we find vast deposit of sand and disintegrated felspathic rock, which in some places forms white non-plastic clay, all along the nala near the foot of the hill. Laterite beds are also noticed on the banks of the nala in some places and the portion of the white clay which underlies the above laterite bed is more plastic. Trial pits were dug on both plastic and non-plastic clay beds near the nala and about 5 feet of the clay deposits have been traced. Further proving operations by bore-holes up to 40 feet or 50 feet depth are necessary in this area. The average overburden of the clay is 20 feet. Sample of the clays has been taken by Mr. Shah for tests. The plastic clay has been traced 1,500 feet along nala.

(v) Kapoli (15°29' : 74°34').—Kapoli village stands on laterite bed which is almost surrounded by reserve forest. Pandri river is situated to the south-east of the village and it flows south-westerly through the low land of Kapoli Mouza. The lands both to the north-west and south-east are higher in level the farther we go away from the river. So the nalas coming out of those high levels flow south-easterly and north-westerly from those lands. Granite rocks are observed in many parts of the above reserve forest and the clay beds of Kapoli formed by the disintegration of the granite rock are noticed along the above nalas. Those clay beds which are nearer to the granite rock are coarser than those farther off and also the upper portions of them are coarser than the bottom ones. This is due to the fact that finer particles of sand or felspar of the granite rock go farther and deeper than the coarser ones. The decomposed felspar forms the clay. Moreover the portions of the clay below laterite bed are more plastic than those which do not underlie it, but the laterite contaminates the clay underlying it with red and yellow iron stains through percolation of water to a great depth. It has been ascertained that plastic white clay exists mainly along the banks of the nalas both to the north-west and south of Kapoli village in abundance and to a great depth. White clay beds of poor extent have also been traced along other nalas to the east and south-east of the village. Trial pits have been sunk both through the beds of disintegrated granite rock and the laterite bed. The pits through disintegrated granite rock go to prove the clay beds less contaminated by iron. Under the laterite bed, north-west of Kapoli village 2'–6" band of white clay, with slight yellow stain, and in area south of the village 5 feet band of white clay, slightly mixed with yellow clay but more plastic and finer in grains than above, have been detected. Samples of the above clays have been collected by Mr. C. P. Shah of Bombay Potteries and Tiles Ltd. for tests. If the yellow stain of the iron can be removed from the clay by levigation, then the above clay may be used for a large scale pottery manufacture. But there is a great doubt about it. Details of report on Kapoli Mouza are given in Section 6 of my report. (Vide pp. 45–50).

(vi) Londa (15°27' : 74°32' and 15°27' : 74°33').—Fine moulding sand deposits are observed on either side of Londa Railway Station. The finer sand deposits are on the western side, which are being worked by contractors and are supplied to the factories for moulding purposes. This sand is available in a large quantity at this place, as it extends over a very wide area to the west of Londa Station. The colour of the sand is yellow and it seems to contain iron. So it is not useful for glass manufacture. As this sand deposit is very close to Londa Station (M. S. M. Railway) the transport cost by cart to the station is very low. Moreover the overburden of the deposit is only 2 or 3 feet of surface soil. Hence it is very easy to work out.

(vii) Moeeshet (15° 28' : 74° 20').—South-east of Moeeshet village lies a good deposit of white coarse grained sandstone, which forms a high land near a field. This sandstone contains a high percentage of silica and is good for glass manufacture if it contains no iron. Of course, yellowish sandstone, which contains iron, is observed in some parts of the above white sandstone deposit. The yellow sandstone portion of the rock may be left out easily by proper mining operations. A detailed traverse work and pit work are necessary to find out its actual extent. This deposit is only half a mile west of Londa-Gunji main mortar road, and three miles from Londa Station. There is a cart road connecting the deposit to the above main road. A sample of the above sandstone has been taken by Mr. C. P. Shah for tests and analysis.

(viii) Castle Rock (15° 23' : 74° 17').—White pipe clay deposit is observed about 1½ miles west of Castle Rock Station on high hill. It is exposed about 100 feet high on the side of the hill above the level of the railway line, which runs over its middle portion. The pipe clay also extends far below the said level. The clay is non-plastic and is available in a large quantity. The pipe clay when burnt becomes perfect white in colour. It is to be proved whether, by mixing with requisite proportion of other plastic clays, it may be useful for pottery purposes. A detailed traverse work is necessary for a long period to estimate the actual extent of the said vast deposit of the clay on the high hill which runs to a great distance. The clay beds on the hill are very fine and different colours of them occur. They are close to one another. A sample of white pipe clay on the hill is taken by Mr. C. P. Shah for tests and analysis.

3. MANGANESE ORE DEPOSITS.

These are also observed on some hillocks near Castle Rock Station (M. S. M. Railway), running from a great distance. Heaps of manganese ores are dressed and are lying by the side of the railway line for a considerable period. There is practically no transport of the ore for the present on account of the dull market and also of the inferior quality of the ore. The ores are mainly pyrolusite of 2nd and 3rd class in quality. Most of them seem to contain about 40 per cent Mn₂O₃.

Besides the above rocks, good quartzites, containing a high percentage of silica, are observed on the hills close to Castle Rock Station.

Castle Rock area is so vast that it requires a long time for thorough traverse work for different kinds of rocks.

4. MODE OF FORMATION OF ROCKS IN BELGAUM DISTRICT.

The Khanapur Sub-division of the Belgaum District has got long chains of hillocks or exposures of granite rock on the west and east side of it with an intervening low land through which the Belgaum-Londa mortar road runs, besides low granite rocks in other parts of the area. The granite hillocks on the western side are much higher than those to the east. The greater part of the Khanapur Sub-division is covered with granite rock; striking, almost N-S granite rocks are easily disintegrated by weathering and water action and the grains of quartz in the form of sand and the grains of felspar in the form of clay are transported by water and wind to a great distance. The finer particles of clay go off further and deeper than those of sand. So we find white sand and sandstone deposits closer to the existing granite hillocks and rocks and clays farther off from them. In the sandstone deposits also we find finer grained sands lie to the bottom. So it can safely be concluded that the clay deposits in Belgaum District mentioned before are transported or washing deposits. There is a regular long line of clay deposits, extending N-S, along nalas east and west of Belgaum-Londa Road and in most places those deposits underlie yellow laterite clay. The clay beds are observed better in quality and more plastic in form, the further we go towards the east. So the clays of Kapoli and Ghatoli are finer in quality than those of Gunji, Khanapur and Desur. Laterite beds are observed in various parts of the district and the clay which underlies it is more plastic in nature than those which do not underlie them, as is observed in bare disintegrated granite rock deposit. In some parts of the country, as we find near Desur, the disintegrated granite rock has undergone further metamorphism in subsequent period and formed a structure of bedded sandstone. The sand also has been transformed into sandstone, either soft or hard by metamorphic process.

5. FIELD NOTES.

(a) Records of Trial Pits in Keerowlee area—

Pit No. 1.

Surface soil	3'-4"
Yellow sandstone	1'-3"
White micaceous clay (with yellow stain)	2'-0"
	<hr/>
	6'-7"
	<hr/>

Pit No. 2.

Surface soil	0'-2"
Yellow sandstone	1'-0"
White sandstone	2'-4"
	<hr/>
	3'-6"
	<hr/>

(b) Records of Trial Pits in Ghatgoli area—

Pit No. 1.

Surface soil	4'-2"
Yellow and white mixed clay	1'-0"
White plastic clay	3'-6"
	<hr/>
	8'-8"
	<hr/>

Pit No. 2.

Surface soil	3'-6"
Mixed yellow and white clay	0'-9"
White plastic clay (with yellow stain)	4'-0"
Mixed yellow and white clay	0'-2"
	<hr/>
	8'-5"
	<hr/>

(c) Records of Trial Pits in Gunji area—

Surface soil	4'-8"
Mixed yellow and white sandstone	6'-0"
Mixed yellow and white non-plastic clay	4'-4"
	<hr/>
	15'-0"
	<hr/>

6. GEOLOGICAL INVESTIGATION ON CLAY DEPOSITS IN KAPOLI MOUZA, DISTRICT BELGAUM, BOMBAY PROVINCE.

1. INTRODUCTION.

After inspection of clay and sandstone deposits in Desur, Khanapur, Gunji, Keerowlee, Kapoli, Londa and Castle Rock for four days from 28th November to 1st December 1938 with Messrs. C. P. Shah and S. P. Ogale, I was instructed by Mr. Shah, who left me at Londa on 1st December afternoon, to commence detailed traverse work at Kapoli. So I went by night train on 1st December to Khanapur to get all my camp equipments which were left there and came to Kapoli on 2nd December evening, started work there on 3rd December and completed traverse work at Kapoli on 17th December 1938.

2. GEOLOGY OF THE AREAS CLOSE TO KAPOLI MOUZA.

I found granite rocks, laterite beds and mixed white clay deposits in the adjoining villages, of which the clays of Ghatgoli, Shivthan and Patoli are worth examination in detail to estimate the actual volume of clay available there.

(I) Ghatgoli ($15^{\circ} 27' : 74^{\circ} 35'$).—I observed deposits of plastic white clay beds more or less mixed with yellow laterite clay in two places in Ghatgoli Mouza along nalas. One is situated on the northern and the other on the southern part of Ghatgoli Mouza and their average thickness as far prospected is about 4 feet. They cover a wide area along the nalas and are one and two miles respectively from Devarayi Station (M. S. M. Railway). The overburden is on the average 4 feet of surface soil. The quality of the clay is nearly that of Kapoli Mouza. The Ghatgoli clay is plastic and contains a high percentage of clay. So it may be tested whether the yellow iron stain can be removed by levigation.

(II) Shivthan ($15^{\circ} 26' : 74^{\circ} 34'$).—Plastic white clay deposit is observed along nala south of Shivthan village. The clay is not so good as that of Kapoli or Ghatgoli. It contains more silica. The overburden of the clay is 15 feet of surface soil and laterite bed. The clay bed is 4 miles from Londa and 3 miles from Devarayi Station (M. S. M. Railway) and there are cart roads connecting them. Percentage of clay in the deposit seems to be less than 15. It is more or less mixed with laterite clay which contains iron.

(III) Patoli ($15^{\circ} 28' : 74^{\circ} 32'$).—Plastic white clay is observed along nala in Patoli Mouza below laterite bed. This contains more silica than that of Kapoli. The overburden of the clay is 5 feet on the average. Not more than 15 per cent. clay seems to be found in this deposit. This clay also is more or less contaminated by iron.

(IV) Railway cutting.—Two miles east of Londa Station ($15^{\circ} 27' : 74^{\circ} 31'$) red clay deposit formed from the disintegrated laterite bed is observed $\frac{1}{2}$ mile along railway cutting, two miles east of Londa Station up to a bridge on nala. This clay is non-plastic but very fine-grained. Colour deep red.

3. MODE OF FORMATION OF THE CLAY BEDS.

By gradual disintegration of granite rocks, which contain quartz and felspar besides other minerals and by water action the quartz in the form of sand, coarse or fine-grained and felspar in the form of clay are transported to a great distance. Coarse and heavy body of sand is deposited near and fine particles of sand and clay are transported far off from the granite rock and settled in low valleys. When decomposed yellow laterite bed in the form of yellow clay is mixed with the above decomposed felspar, the latter gets its plasticity to a greater extent. The whole plastic clay beds of Kapoli Mouza are invariably mixed with and also underlie yellow laterite clay. It is to be tested whether this yellow stain can be removed by proper levigation. That portion of the white clay which does not underlie laterite bed is non-plastic and contains a high percentage of silica. The laterite bed is formed from the decomposition of Hamatite rock; so it contains a large percentage of iron, which is detrimental to the manufacture of potteries. Hence iron stains ought to be removed from white clay by proper levigation before use, if that be possible.

4. PROSPECTING FOR CLAY DEPOSITS IN KAPOLI MOUZA.

Kapoli ($15^{\circ} 29' : 74^{\circ} 34'$).—Kapoli village is 7 miles from Gunji and 6 miles from Londa Railway Station. There is no direct cart-road connection to Londa from Kapoli; the cart road goes via Gunji, which is 10 miles. So Gunji is the nearest railway station to transport Kapoli clays by cart. But Londa is the proper big station for goods traffic. A cart road from Kapoli to Londa, 8 miles long, may be constructed for direct transport to Londa. During rainy season from June to September the work on clay beds, sand or other rock cannot be continued as the roads during that time become very bad for transport through them.

Kapoli village is almost surrounded by Government reserve forest, which rests on high lands. Massive granite rocks, containing quartz and felspar and in some places micas also are observed in various parts. Good exposures of granite rocks are found along Pandri river, which flows almost along the southern boundary line of Kapoli Mouza. Stray poor exposures of granite rocks are also noticed on the borders of some cultivated low lands. The edges of granite rocks in some places near the nalas are found disintegrated and coarse white clays with a high percentage of silica are formed close by. At a greater depth the clay becomes finer, but it is more or less mixed with yellow clay.

The whole of Kapoli village and some portion of land close to it are covered by laterite beds. The granite rocks in the reserve forest almost surround them. So by gradual process of disintegration, washing and transportation we find plastic clay, close to nalas which flow inside the mouza through low valleys. Hence we find three main plastic white clay deposits in Kapoli Mouza; clay bed No. 1 is situated to the north-west and clay beds Nos. 2 and 3 to the south of Kapoli village. They run along the banks of nalas and in some portion underlie yellow laterite clay with which it is more or less mixed on the top. Besides the above three white clay beds there are also three minor deposits of clay, Nos. A, B and C, containing a large percentage of silica along other nalas to the east and south of the said deposits. A small pocket deposit of white clay mixed with yellow clay is also observed in a small nala south of Kapoli Mouza below an overburden of more than 12 feet surface soil. Pandri river does not show any out-crop of plastic white clay deposit.

The above clay bed No. 3 is more plastic and contains a higher percentage of clay than the other clay beds. The latter beds contain a large quantity of silica being closer to the granite rock. All the clay beds are mixed with yellow clay to a greater or less extent. The thickness of the mixed clay bed No. 1 is 2 feet and 6 inches, of Nos. 2 and 3 is 5 feet and of mixed clay beds Nos. A, B and C is 5 feet on the average as far as it is proved.

Quartz.—A big quartz vein, 50 feet wide in some places, is observed in the Government reserve forest north-west of Kapoli village. The quartz in the vein is fine-grained and is almost pure. It contains a high percentage of silica and runs S. 82° W.—N. 82° E. There is another quartz vein, 28 feet wide, on the north-western part of Kapoli Mouza. It runs N. 66° W.—S. 66° E. As the above quartz veins are situated 7 miles off from Gunji Station, it will not be profitable to work on them for silica for glass factory outside, though they are almost pure in quality.

Moulding Sand.—Moulding sand is available in a large quantity along the banks of Pandri river which flows to the south of Kapoli Mouza. As the said sand deposit is 7 miles off from Gunji and 10 miles from Londa Railway Station by cart road, it will not be a profitable business to transport it to Bombay market. Quality of the sand seems to be good and it is fine-grained. Colour of it is yellow and it seems to contain iron.

5. APPROXIMATE VOLUME AND TONNAGE OF YELLOW-STAINED WHITE CLAY RESERVE IN KAPOLI MOUZA—(AS FAR PROSPECTED).

Clay bed No. 1—

$$500' \times 150' \times 2\frac{1}{2}' = 210,000 \text{ c.ft.} = 10,500 \text{ tons at 5 tons per 100 c.ft.}$$

Clay bed No. 2—

$$1320' \times 132' \times 5' = 871,200 \text{ c.ft.} = 43,560 \text{ tons at 5 tons per 100 c.ft.}$$

Clay bed No. 3—

$$660' \times 130' \times 5' = 429,000 \text{ c.ft.} = 21,450 \text{ tons at 5 tons per 100 c.ft.}$$

75,510 tons.

Say, 75,000 tons, approximately.

Clay bed No. A.—

$$330' \times 150' \times 5' = 247,500 \text{ c.ft.} = 12,375 \text{ tons at 5 tons per 100 c.ft.}$$

Clay bed No. B.—

$$330' \times 60' \times 5' = 99,000 \text{ c.ft.} = 4,950 \text{ tons at 5 tons per 100 c.ft.}$$

Clay bed No. C.—

$$460' \times 60' \times 5' = 138,000 \text{ c.ft.} = 6,900 \text{ tons at 5 tons per 100 c.ft.}$$

24,225 tons.

Say, 24,000 tons, approximately.

Grand Total .. 99,000 tons, approximately.

6. FIELD NOTES.

(a) In Kapoli area (district Belgaum).

*Traverse in and round Kapoli village.**Observations.*

- (1) Exposure of laterite bed on Kapoli village path. Soft and massive. This exposure is in plot No. 1, Kapoli mouza.
- (2) Exposure of yellowish sandstone in pit No. 3, below surface soil of 2 feet 2 inches greenish clay mixed with yellowish clay is observed below the above yellowish sandstone.
- (3) Exposure of greenish clay in pit No. 2, underlying yellowish clay which contains small percentage of iron. Massive. Very soft. No definite dip is indicated.
- (4) Below 1 foot 3 inches of surface soil black plastic clay is observed in an excavation in the field N 65° W of pit No. 1.
- (5) Greyish and yellowish mixed sandstone is observed in an excavation west of paddy field, N 65° W of pit No. 1., underlying 1 foot 2 inches of surface soil. Soft and massive. No definite dip.
- (6) Exposure of greyish and yellowish mixed sandstone east of paddy field. Soft and massive. This exposure is 192 feet N 10° E of Observations (3) above.
- (7) Exposure of hard greyish granite rock on the northern portion of Kapoli mouza in reserve forest, east of Halsa Kapoli cart road. Massive.
- (8) Exposure of hard white and greyish granite rock, east of the above Halsa-Kapoli cart road and north of Plot No. 4 of Kapoli mouza. Massive. No definite dip. This exposure is S 20° W of Observations (7) above.
- (9) Exposure of hard greyish granite rock in plot No. 3 of Kapoli mouza. Massive. No definite dip is indicated.
- (10) Exposure of plastic yellow clay in nala north of plot No. 105. Massive.

*Traverse in Kapoli village.**Observations.*

- (11) Exposure of mixed yellowish and greyish clay underlying laterite deposit in reserve forest, north of plot No. 104. Massive.
- (12) Exposure of pinkish quartz vein. Strike N 66° W-S66° E. Width of the vein is about 28 feet.
- (13) Exposure of granite rock in reserve forest, just north of plot No. 102. It contains quartz, felspar and small specks of mica. The rock is massive and hard.
- (14) Exposure of granite rock in plot No. 101, containing quartz, felspar and small specks of mica as in observations (13) above. Massive.

*Traverse along nala in Kapoli Mouza.**Observations.*

- (15) Exposure of granite rock in reserve forest, just west of plot No. 91. Massive. Strike-N64° W-S64° E.
- (16) Exposure in nala of decomposed white granite. It contains quartz grains in abundance.
- (17) Exposure in nala of decomposed white granite with abundant quartz grains.
- (18) Exposure of granite rock in reserve forest west of the boundary line between plot No. 91, and 92. Massive.
- (19) Exposure in nala of soft massive coarse grained sandstone formed by the decomposition of granite rock.
- (20) Exposure of laterite rock in nala underlying the sandstone deposit of Observations (19) above.
- (21) Exposure of soft decomposed granite forming sandstone bed along the nala. Massive. No definite dip is indicated.

- (22) Exposure of granite rock in reserve forest, east of the boundary line between plot No. 89 and 87.
- (23) Exposure of massive granite on the bed of Pandri river, southeast of Kapoli village.
- (24) Exposure of massive granite rock with quartz, felspar and small specks of mica in plot No. 36, close to nala.
- (25) Exposure in pit No. 4 of greenish clay 2 feet 6 inches below 8 feet 10 inches of yellowish laterite clay which underlies the surface soil of 2 feet thick.
- (26) Exposure in pit No. 1 of mixed yellowish and greenish clay below 1 foot of surface soil.
- (27) Exposure of soft white sandstone near nala. Massive. No definite dip is indicated.
- (28) Exposure of plastic soft yellow clay in nala.
- (29) Exposure in nala of soft yellow lateritic clay as in observations (28) above.
- (30) Exposure of granite rock, in reserve forest, containing quartz and felspar. Massive.
- (31) Exposure of granite rock containing quartz, felspar and small specks of mica.
- (32) Exposure of laterite bed forming the body of an elevated land.
- (33) Exposure of laterite on the above elevated land.
- (34) Exposure of quartz vein in reserve forest, running S 82° W—N82° E. Width of the vein is 50 feet.
- (35) Exposure of mixed soft yellow and white clay in nala in plot No. 27 in a ditch. The white clay here is very fine grained and the percentage of clay seems to be high. This exposure is in pit No. 8, overburden 4 feet of surface soil on adjoining clay beds.
- (36) Exposure of mixed yellow and white clay near village path close to nala in pit No. 7. Fine grained and high percentage of clay. Soft overburden 4 feet of surface soil is on adjoining clays.
- (37) Exposure of mixed yellow and white clay in pit No. 6 near path close to nala. Fine grained and soft. Underlies 3 feet of surface soil.
- (38) Exposure in nala of yellow laterite clay. Soft and underlies 6 feet of surface soil.
- (39) Poor exposure along nala of mixed yellow and white clay. Soft.
- (40) Exposure of granite rock in the field close to nala.
- (41) Exposure of white and yellow mixed sandstone on the bank of another nala where it ends and passes over fields.
- (42) Exposure of yellow laterite clay on path. Soft and massive.
- (43) Exposure of laterite bed on plot No. 27. Massive. No definite dip is indicated.
- (44) Exposure in Pandri river of granite rock. Strike N5° E—S5° W. Massive.
- (45) Exposure on the eastern bank of Pandri river of white soft sandstone. Massive. Overburden of surface soil is 4 feet 6 inches.
- (46) Exposure of granite rock in Pandri river containing quartz and felspar. Massive.
- (47) Exposure of granite rock in Pandri river consisting of quartz, felspar and small specks of mica. Massive.
- (48) Exposure of granite rock in Pandri river. Massive.
- (49) Poor exposure of yellowish laterite bed underlying 8 feet of surface soil.
- (50) Exposure of soft disintegrated micaceous granite rock on the bank of nala.
- (51) Exposure of mixed yellow and white clay in nala. Soft. Overburden of surface soil is 10 feet.
- (52) Exposure of granite rock containing quartz and felspar and specks of mica also on Pandri river. Massive.
- (53) Almost continuous exposure of granite rock from above Observations (52) along Pandri river. Massive.

*Traverse in Kapoli Mouza away from nala.**Observations.*

- (54) Exposure of thick bed of white disintegrated granite in pit No. 5 which has gone through 8 feet 4 inches in of it. Massive.
- (55) Exposure of laterite bed in plot No. 27. Massive.
- (56) Exposure of granite rock in reserve forest. South-west of plot No. 26. Massive.
- (57) Exposure of laterite bed North-west of plot No. 26. Massive.
- (58) Exposure of yellowish clay in plot No. 21. Soft.
- (59) Exposure of yellowish clay north of plot No. 22.
- (60) Exposure of quartz conglomerate on high land, south of Nala. Strike—S65°E—N65°W.
- (61) Exposure of laterite on the high land south of plot No. 116.
- (62) Exposure of granite rock South-west of plot No. 116. Massive. No definite dip is indicated.

*Traverse along Pandri river in Kapoli Mouza.**Observations.*

- (63) Exposure of moulding sand in large quantity on the bank of Pandri river. Fine grained. May be useful for glass factory, provided it is free from iron. Cost of transport is high being 7 miles from Gunji Railway Station. The cart road becomes very bad during rainy season (June to September).
- (64) Exposure of decomposed granite rock on Pandri river.
- (65) Exposure of granite rock on the bed of the above Pandri river. Massive.
- (66) Big exposure of granite rock on the bed of the above Pandri river. Massive. No definite dip is indicated. The rock contains quartz and felspar.
- (67) Exposure of white and yellow sandstone on the southern bank of Pandri river. Soft. No definite dip.
- (68) Exposure of granite rock on the bed of Pandri river. Massive.

*Traverse along nala, South-east of Kapoli Mouza.**Observations.*

- (69) Exposure of massive granite rock, containing quartz and felspar of the same type as in observations 66 above, in the nala.
- (70) Exposure of granite rock in the nala of the same type as observations 65 above. Massive.
- (71) Exposure of greyish plastic clay on the eastern bank of nala containing a large percentage of silica.
- (72) Exposure of massive black hornblende granite in the above nala south of plot No. 74.
- (73) Exposure of mixed yellow and white sandstone on path in plot No. 11. Soft and massive.
- (74) Exposure of mixed yellow and white soft sandstone on path in plot No. 14. Massive.
- (75) Exposure of granite rock near path, south-east of Kapoli village.
- (76) Exposure of granite rock in reserve forest in Kapoli Mouza on path running to Malwar village.

(b) Records of trial pits—In Kapoli area.

<i>Pit No. 1</i>		<i>Pit No. 5.</i>	
Surface soil	2'-7"	Surface soil	1'-8"
Yellow soft clay	2'-9"	White disintegrated granite ..	5'-0"
Mixed yellow and greenish clay	4'-2"	Mixed yellow and white disintegrated granite ..	3'-4"
Yellow clay	0'-10"		<hr/>
	<hr/>		10'-0"
	10'-4"		
<i>Pit No. 1-A.</i>		<i>Pit No. 6.</i>	
Surface soil	1'-3"	Surface soil	2'-0"
Greenish clay (with yellow stain)	1'-9"	Yellowish clay	3'-7"
Mixed greenish and yellowish clay	1'-0"	Mixed yellow and white plastic clay	3'-9"
	<hr/>		<hr/>
	4'-0"		9'-4"
<i>Pit No. 2.</i>		<i>Pit No. 7.</i>	
Surface soil	4'-9"	Surface soil	4'-0"
Yellowish clay	2'-7"	Yellow clay	2'-4"
Greenish clay	2'-0"	Mixed yellow and white plastic clay	5'-0"
Yellowish clay	0'-2"		<hr/>
	<hr/>		11'-4"
	9'-6"		
<i>Pit No. 3.</i>		<i>Pit No. 8.</i>	
Surface soil	2'-2"	Surface soil	1'-3"
Yellowish clay	3'-1"	Yellow clay	1'-0"
Mixed yellow and greenish clay	3'-0"	Mixed yellow and white clay ..	5'-0"
	<hr/>	Mixed with higher percentage of yellow clay	5'-3"
	8'-3"		<hr/>
			12'-6"
<i>Pit No. 4.</i>			
Surface soil	3'-0"	Surface soil	1'-3"
Yellowish laterite clay	8'-10"	Yellow clay	1'-0"
Greenish clay (with yellow stain)	2'-6"	Mixed yellow and white clay ..	5'-0"
Mixed yellow and greenish clay	1'-0"		<hr/>
	<hr/>		12'-6"
	15'-4"		

7. APPROXIMATE COST OF RAISING AND TRANSPORT OF CLAY IN PROSPECTED KAPOLI MOUZA, DISTRICT BELGAUM.

Wages of coolies are about 6 annas per day per head and the cost of transport of clay from Kapoli to Londa (10 miles) by cart is Rs. 4 per ton. The Railway freight from Londa to Bombay is 12 annas per maund, i.e. Rs. 20-4-0 per ton:—

		Rs. a.	p.
Hence, cost of raising	..	1	8 0 per ton.
Cost of carting to Londa	..	4	0 0 per ton.
Railway freight to Bombay	..	20	4 0 per ton.

Total .. 25 12 0 per ton.

Cost of levigation .. 4 0 0 per ton.

Total .. 29 12 0 per ton.

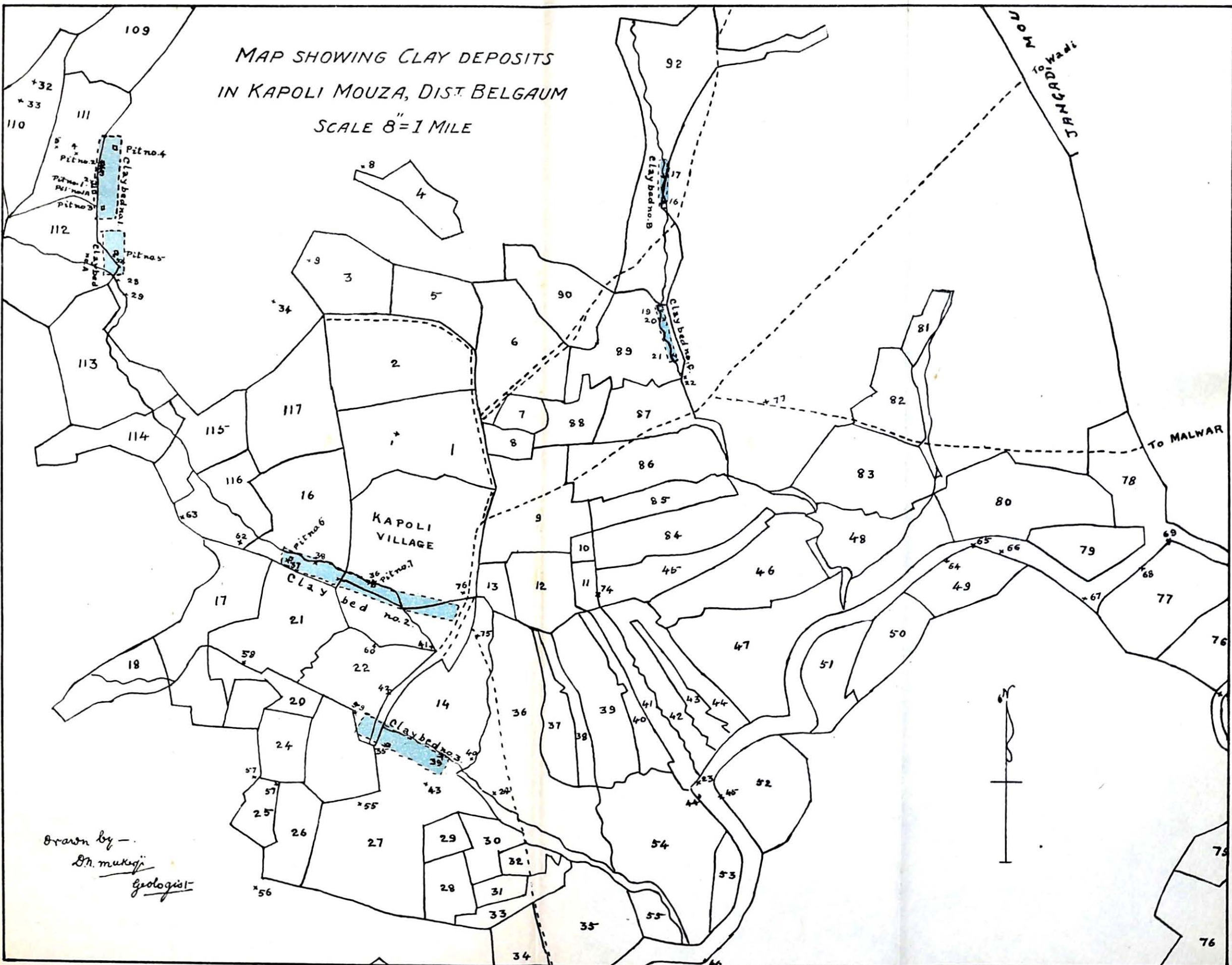
Say Rs. .. 30 per ton (approximate).

Market Value—

Present market value of good 1st class China clay f. o. r. Bombay, is Rs. 45 to Rs. 50 per ton.

MAP SHOWING CLAY DEPOSITS
IN KAPOLI MOUZA, DIST. BELGAUM

SCALE 8"=1 MILE



Drawn by -
Sh. mukaji
Geologist

7. GEOLOGICAL INVESTIGATION ON CLAY DEPOSITS IN HONAWAR AREA IN DISTRICT NORTH KANARA, BOMBAY PROVINCE.

(A General Survey Work.)

I. INTRODUCTION.

With Mr. C. P. Shah I arrived Dharieswar on 22nd December 1938 evening and inspected the red clay and asbestos deposits near Dharieswar village on next day and went to Honawar the very evening. On 24th December we went to Hadinbal and saw the white china clay mine, belonging to Mr. R. S. Haldipur, who accompanied us to the mine. We also saw the working of the mine and the lavigating plant close to it, where the sorted clays were washed and dried and afterwards transported. After the departure of Mr. Shah from Honawar on 25th December morning, I started geological traverse work, inspection and examination of white, red and yellow clay, quartz and other rocks at and near Honawar in District North Kanara, as instructed by Mr. C. P. Shah and finished my general geological operation in that area on 5th January 1939 and took necessary samples and gave them to Mr. Shah at Bombay for tests and analysis.

2. GEOLOGY OF THE AREA INSPECTED AND EXAMINED NEAR HONAWAR IN DISTRICT NORTH KANARA.

The areas are :—

- (1) *Hadinbal*—(14° 17'-30" : 74° 29'-30") for white china clay, 4 miles from Honawar.
- (2) *Nagre*—(14° 17'-30" : 74° 29') for white china clay, 3½ miles from Honawar.
- (3) *Kulkod*—(14° 17' : 74° 27'-30") for white china clay, 1 mile from Honawar.
- (4) *Opani*—(14° 15'-30" : 74° 34') for yellow clay, 7 miles from Honawar.
- (5) *Amboli*—(14° 15' : 74° 34') for yellow clay, 7 miles from Honawar.
- (6) *Padukuli*—(14° 15' : 74° 31') for plastic yellow clay, 3½ miles from Honawar.
- (7) *Jalbali*—(14° 15'-30" : 74° 32') for plastic yellow clay, 4½ miles from Honawar.
- (8) *Kaur*—(14° 16' : 74° 31') for plastic black clay, 3½ miles from Honawar.
- (9) *Hairungi*—(14° 15'-30" : 74° 32'-30") for moulding sand, 5 miles from Honawar.
- (10) *Haspatan*—(14° 28' : 74° 29') for quartz, 2 miles from Honawar.
- (11) *Dharieswar*—(14° 22'-30" : 74° 24'-30") for red clay, 11 miles from Honawar.
- (12) *Dharieswar*—(14° 22' : 74° 24') for asbestos, 11 miles from Honawar.

(i) *Hadinbal*—(14° 17'-30" : 74° 29'-30").—There is a white china clay mine belonging to Mr. R. S. Haldipur in Hadinbal Mouza in working order. The main clay bed is 17 feet wide. It is very fine-grained but it is slightly mixed with yellow clay or has slight yellow stain. To remove silica and iron out of it as far as practicable, it is levigated by water and treated with sulphuric acid in tanks close to the mine. The deposit is vast and it extends to a great distance. A detailed statement about this area has been given under the heading "Prospecting for china clay deposits near Honawar". (*Vide p. 52.*)

A quartz vein is also noticed near the bungalow of the Chief Officer of the Hadinbal mine.

(ii) *Nagare*—(14° 17'-30" : 74° 29'-30").—There is a white china clay deposit in this area, acquired by said Mr. R. S. Haldipur. This clay is like that of Hadinbal clay and the deposit is vast. A detailed account of the deposit is given separately under the heading "Prospecting for china clay deposits near Honawar". (*Vide p. 52.*)

(iii) *Kulkod*—(14° 17' : 74° 27'-30").—One mile east of Honawar on the bank of Sharavati river and at the foot of a high laterite hill close to Kulkod village fine-grained white china clay deposits have been found. It extends over a wide area and goes to a great depth. A thorough traverse work and pit work are necessary to estimate its actual volume and quality. A sample is taken for tests and sent to the factory of Bombay Potteries and Tiles Ltd. for examination and analysis.

(iv) and (v) *Opani* and *Amboli*—(14° 15'-30" : 74° 34') and (14° 15' : 74° 34') respectively.—Plastic yellow clay deposits are found in the fields close to the above Opani and Amboli villages, which are situated on the opposite banks of Sharavati river at a depth of 4 feet. Those villages are 7 miles off from Honawar. The clay contains a large percentage of silica.

(vi) and (vii) Padukuli and Jalballi—(14° 15' : 74° 31') and (14° 15'.30" : 74° 32') respectively.—Plastic yellow clay deposits are found in fields close to the above villages on the bank of Sharavati river. People of the locality prepared bricks out of those clays. Samples of the clay are taken, from a depth of 3 feet and sent to the factory of Bombay Potteries and Tiles Ltd. for tests and analysis. At a greater depth the clay is finer and is free from lime. The deposits are vast and can easily be transported by boat to Honawar, which is about 4 miles off. Some portion of the clay contains slight stain of iron.

A white sandstone deposit is noticed at the foot of a laterite hill, west of Padukuli village in a portion of the hill cutting. The above sandstone rock is slightly iron stained. It underlies a soft laterite clay bed, which again underlies a heavy mass of massive laterite forming a high hill. A sample of the rock is taken for tests and analysis.

(viii) Kaur—(14° 16' : 74° 31').—Black plastic clay is found in the field near Chots Kaur. The deposit is vast and it can be easily transported by boat through Gundbali river to Honawar which is only 3½ miles off. It contains no lime. A sample is taken for tests.

(ix) Hairungri—(14° 15'.30" : 74° 32'.30").—Fine moulding sand deposits are found on either sides of Sharavati river near Hairungri village which is 5 miles off from Honawar. There is a vast deposit of this sand on the banks of Sharavati river extending to a long distance. The colour of the sand is yellowish. It seems to contain iron. So it is not useful for glass manufacture.

(x) Haspatan—(14° 28' : 74° 29').—On the bank of Sharavati river and on the opposite side of Honawar there lies a hillock close to Haspatan village. To the south-east of this village a conglomeratic bed of soft laterite clay is observed on the hill just below a hard massive laterite bed which forms the crest of the hillock. In that conglomeratic bed pebbles of quartz in abundance are observed, which can easily be taken out and transported by boat to Honawar on the opposite side of the river.

(xi) Dharieswar—(14° 22'.30" : 74° 24'.30").—Red clay deposits in large quantities are found in two places near Dharieswar village, which is 11 miles north of Honawar. One is on the northern most foot of Devgiri hill on the coast of the Arabian Sea and the other is in the north-eastern portion of Nagtirth hillock, just north of Dharieswar village and close to the main Kunta-Honawar motor road. The former deposit being near the sea it contains a large quantity of salt and other mineral matters. The latter deposit is free from lime and salt and is more reddish than the former.

(xii) Dharieswar—(14° 22' : 74° 24').—Poor exposures of asbestos deposits are found about 1 feet thick both above and below steatite quartzite dipping at a very high angle on the slope of a hill on the coast of the Arabian Sea. The fibres of the asbestos are 1 inch to 2 inches long and some portions of them are iron stained. The deposits seem to be pocket deposits formed by the metamorphic process from the steatite rock. People of the locality use this soft greyish steatite rock for preparing pots, idols, etc. Steatite slabs are also used for flooring. Detailed traverse work and pit work are necessary to estimate the volume and quality of the asbestos deposit.

3. PROSPECTING FOR CHINA CLAY DEPOSITS NEAR HONAWAR.

(A general survey.)

(i) Hadinbal—(14° 17'.30" : 74° 29'.30").—A good china clay deposit is observed in plot No. 375 of Hadinbal Mouza which is only 4 miles from Honawar Port and 1 mile, 2 furlongs from Berolli Ghat on Gundbali river. A good cart road has been constructed by Mr. R. S. Haldipur from the Hadinbal mine to the ghat. The main white china clay bed, on which the present work in the mine is going on, is situated to the north-west corner of Hadinbal Mouza. A fault runs S. 80° W—N. 80° E in the mine through the clay deposit, thereby a portion of it is faulted 5 feet down, crushed and crumpled and shifted towards the north side of it, where we can get a china clay bed, of irregular structure, only 2 feet thick. The dip of the main clay bed is 78° to N. 25° W and its strike is S. 65° W—N. 65° E and the bed is 17 feet wide. It is worked by Mr. Golabchand of Bombay a lessee of Mr. R. S. Haldipur, about 100 feet in length and 20 feet in height in the mine after removing an overburden, 30 to 35 feet and the adjoining impure clay beds. The bottom of the deposit has not yet been reached. This clay bed has been traced 2,000 feet by traverse work and it seems that there is a connection between this clay bed and that in plot No. 83 of Nagre Mouza, passing through Berolli Mouza. On both sides of the above china clay lie yellowish and reddish

clay beds of great thickness which contain high percentages of iron due to laterite bed above it. The main white china clay bed is also contaminated by the stains of iron by percolation of water, which comes down through the upper layer of laterite bed. Almost whole of the overburden of china clay, in Hadinbal, Berolli and Nagare Mouzas, is 30 feet to 35 feet thick laterite rock and clay. Opencast quarry, as that of the present mine, along the line of the strike of the main white clay bed, namely, S. 65° W—N. 65° E should be continued. Taking 2,000 feet length 15 feet width and 20 feet height up to water level we get the volume of the clay 600,000 cubic feet which makes 24,000 tons at 4 tons per 100 cubic feet.

Working on china clay.—Due to the bad management of the working a large portion of the laterite and impure clays and rocks of the mine are stacked over the line of the strike of the white china clay bed. It would be a double task and a heavy cost to remove those laterites, impure clays, etc., again to continue the working of the clay along its strike. The white china clay contains no lime but it contains a lot of mica, which is not removed even after levigation during present working. Slight iron-stain portions in the white china clay are removed by knives by female coolies and sorted by them. Mr. Golabchand of Bombay the lessee has erected a levigating plant close to the mine and is carrying on with the mining operation and the levigation at present. After levigation and drying the clay is transported by bullock cart to Berolli ghat (1 mile). From Berolli ghat the clay is transported to Honawar Port by country boat and then to Bombay by big country craft.

Quartz.—A quartz vein, about 3 feet wide, is observed north-east of Hadinbal bungalow. Several quartz veins also exist close to Hadinbal area.

Conclusion.—Under the circumstances as the clay deposit of Hadinbal is good and as quartz, yellow and red clay and other white china clays, like that of Nagare and Kulkod, are available in large quantity close by, this area may be suitable for pottery manufacture, provided the tests and analysis of the clay stand good.

(II) Nagare—(14° 17'-30" : 74° 29').—A good china clay deposit is also observed in plot No. 83 of Nagare Mouza. The clay there is of the same quality as that of Hadinbal, moreover it contains a lower percentage of mica. The thickness of the deposit, as is shown in the outcrops in a cutting through a laterite bed, is more than 20 feet. This clay bed is S. 65° W of the clay bed of Hadinbal in plot No. 375 and seems to be connected to it as the strike of the clay bed there is S. 65° W—N. 65° E. The above clay bed seems to pass through plot No. 74 of Berolli Mouza. The above plots Nos. 74, 375 and 83 have been acquired by Mr. R. S. Haldipur. The clay bed No. 83 of Nagare Mouza has not yet been worked by Mr. R. S. Haldipur as a cart road, about a quarter of a mile long, joining the Hadinbal-Berolli cart road, is to be constructed before commencing mining operations there.

About 100 feet south-west of the above china clay deposit a big massive hard granite rock is observed and between the above clay bed and the granite, decomposed granite rocks are also noticed. Granite rock is also observed east of the Hadinbal clay deposit, just east of the levigating tanks.

Conclusion.—So it can safely be concluded that the clay deposits of Hadinbal and Nagare are formed by the decomposition of the granite rocks.

The Nagare china clay bed has an overburden of about 30 feet laterite and laterite clay. As the deposit of the white clay is a vast one, mining operation at this place, on a large scale can be started.

I have also stated previously that white china clay outcrop is also observed by me under a laterite hill, close to Kulkod village, near Honawar. So if proper geological investigation be made for further period in this area other white china clay deposits may perhaps be discovered. So prospecting operation for a considerable period is necessary in other areas close to Honawar Town.

4. APPROXIMATE CLAY RESERVE OF HADINBAL-NAGARE DEPOSIT IN AREA PROSPECTED.

White china clay .. 24,000 tons approximately. (Twenty-four thousand tons only.)

5. FIELD NOTES.

In Honawar area, district North Kanara. (Hadinbal).

Traverse in Hadinbal and along cart road leading to Berolli ghat.

Observations.

- (1) Exposure of laterite rock on hill near the road north of Berolli village. Massive.
- (2) Exposure of massive laterite rock on the northern portion of the above hill.
- (3) Exposure of soft fine grained white china clay in the mine of Mr. R. S. Haldipur at Hadinbal. About 17 feet wide, 22 feet high and 100 feet long white china clay deposit has been worked and taken of the main big deposit in the mine. The dip of the above clay bed is 78° to $N25^{\circ}$ W and it strikes $S65^{\circ}$ W— $N 65^{\circ}$ E. It extends to a great distance and its bottom has not yet been reached during the workings of the mine. It is almost free from iron stains, which are dressed and sorted by coolies before levigation. There is a levigating plant close to the above mine to levigate the clay before transport. The above clay is free from lime. It contains mica, which is not removed even after levigation. The overburden of the clay bed is 30 feet to 35 feet of laterite bed and clay. The details of the clay are given in the report about the area separately.

Traverse in Hadinbal and Nagare.

Observations.

- (4) On both sides of the white china clay in the mine of Mr. R. S. Haldipur in Hadinbal, greyish, reddish, and pinkish fine grained clay is exposed underlying 40 feet to 50 feet of reddish soft laterite bed. Dip 76° to $N 25^{\circ}$ W.
- (5) Exposure of greyish and greenish soft shale in the mine. Highly contorted.

Traverse in Hadinbal and Nagare Mouzas.

Observations.

- (6) About 200 feet north-northeast of the exposure of observations (3) another white china clay of the same type is exposed in the above mine, which is more or less iron-stained. The overburden is about 50 feet of laterite bed. Some portion of this clay bed is almost free from iron stain which may easily be dressed and sorted.
- (7) Northeast of the above exposure of observation (6) and in the excavation of the mine, yellowish soft shale is exposed.
- (8) $S 65^{\circ}$ W of observations (3), another exposure of the same type of white clay is observed in a water course below a thick bed (about 30 feet) of laterite bed. This clay contains a less percentage of mica than that of observations (3) above. This exposure of white clay is about 1,200 feet $S 65^{\circ}$ W of the white clay of observations (3) in the present mine. The total length of the white clay traced is about 2,000 feet.
- (9) Continuous exposure of white clay in the above water course in a cutting underlying the above 560 feet thick bed of laterite. About 100 feet of it in width is exposed here.
- (10) Exposure of massive hard granite at the foot of the high land, near the mouth of the above water course. Dip almost vertical.

In Honawar area, district North Kanara (in Hadinbal side).

Traverse in Hadinbal, near china clay mine.

Observations.

- (11) Exposure of greyish shaly sandstone at the foot of the above high land in the water course underlying decomposed felspathic rock. Dip 82° to $N12^{\circ}$ W.
- (12) Exposure of greyish decomposed felspathic rock east of the observations (11) above. Dip almost vertical.

- (13) Exposure of white decomposed felspathic rock east of observations (12) above. The upper portion of the rock is soft and is formed white china clay free from lime. As it contains a large percentage of sand, proper levigation is required to get the clay out of it.
- (14) Exposure of massive laterite bed, about 50 feet thick, overlying the clay deposits of the mine.
- (15) Exposure of pinkish and brownish sandstone on the top of the high land about 200 feet north of the clay mine. Massive.
- (16) Exposure of pinkish and brownish sandstone on the crest of the hill, NE of the mine. Massive. No definite dip is indicated.
- (17) Exposure of mixed yellow and white lateritic sandstone on the southwestern slope of the above hill. Dip northerly almost vertical. The bed is highly contorted.
- (18) Exposure of greyish granite, 100 feet east of the SE corner of the levigating tank of the mine.
- (19) Exposure of greyish and greenish granite, 70 feet S 80° E of the SE corner of the above tank.
- (20) Continuous exposure along a water channel, southeast of observations (19) above.
- (21) Exposure of pinkish sandstone underlying laterite bed of the hill east of the mine.

Traverse round white china clay deposits in Hadinbal and Nagare Mouzas.

Observations.

- (22) Exposure of white china clay deposit in Handinbal mine 17 feet North of observations (3) above. Dip 25° to N 20° W. This exposure is a portion of the white clay of observations (3) above, which has been crumpled and faulted here.
- (23) A fault runs S 80° W—N 80° E close to observations (23) shifting and dropping a portion of the clay bed, both yellow and white, 5 feet down towards the North. So the above clay beds, towards the north of the fault, are highly crushed, crumpled and thinned out due to great earth movement. So nothing much can be gained in extending the work towards the north. The work should go on to S 65° W along the strike of the main white clay deposit in the mine of observations (3) which is N 65° E—S 65° W.
- (24) Exposure of yellowish shaly sandstone in the mine, near the line of the above fault. Dip of the sandstone bed is 25° to N 20° W. Further towards the east the dip is almost vertical.
- (25) Exposure of white china clay in mine N 20° E of observations (24). The China clay bed is only 2 feet thick. It underlies yellow laterite clay and laterite rock of about 25 feet thickness.
- (26) Exposure of white and yellow mixed clay deposit at the Southwest corner of plot No. 83 of Nagare Mouza, close to Granite rock.
- (27) Exposure of laterite bed, about 30 feet thick north of the above plot in Nagare, as is well shown in a cutting.
- (28) Exposure of thin quartz vein NE of Hadinbal bungalow. Massive.

6. APPROXIMATE COST OF RAISING, LEVIGATION, TRANSPORT, ESTABLISHMENT, ETC.
IN RESPECT OF CLAY OF HADINHAL AREA DISTRICT NORTH KANARA.

	Rs. a. p.
Approximate cost of removing the heavy overburden ..	4 0 0 per ton.
Approximate cost of mining, dressing and sorting of clays ..	6 0 0 per ton.
Approximate cost of levigation	3 0 0 per ton.
Approximate cost of Transport from Hadinhal to Bombay.	
	Rs. a. p.
Carting	1 0 0 per ton.
Country boat charges	0 6 0 per ton.
Country craft ,,	4 0 0 per ton.
Coolies for loading and unloading ..	2 0 0 per ton.
	<hr style="width: 100px; margin-left: auto; margin-right: 0;"/> 7 6 0 per ton.
Approximate Port Trust Duties and other charges ..	1 8 0 per ton.
Approximate Establishment and machineries charges ..	10 0 0 per ton.
	<hr style="width: 100px; margin-left: auto; margin-right: 0;"/> 31 14 0 per ton.
	say 32 0 0 per ton.

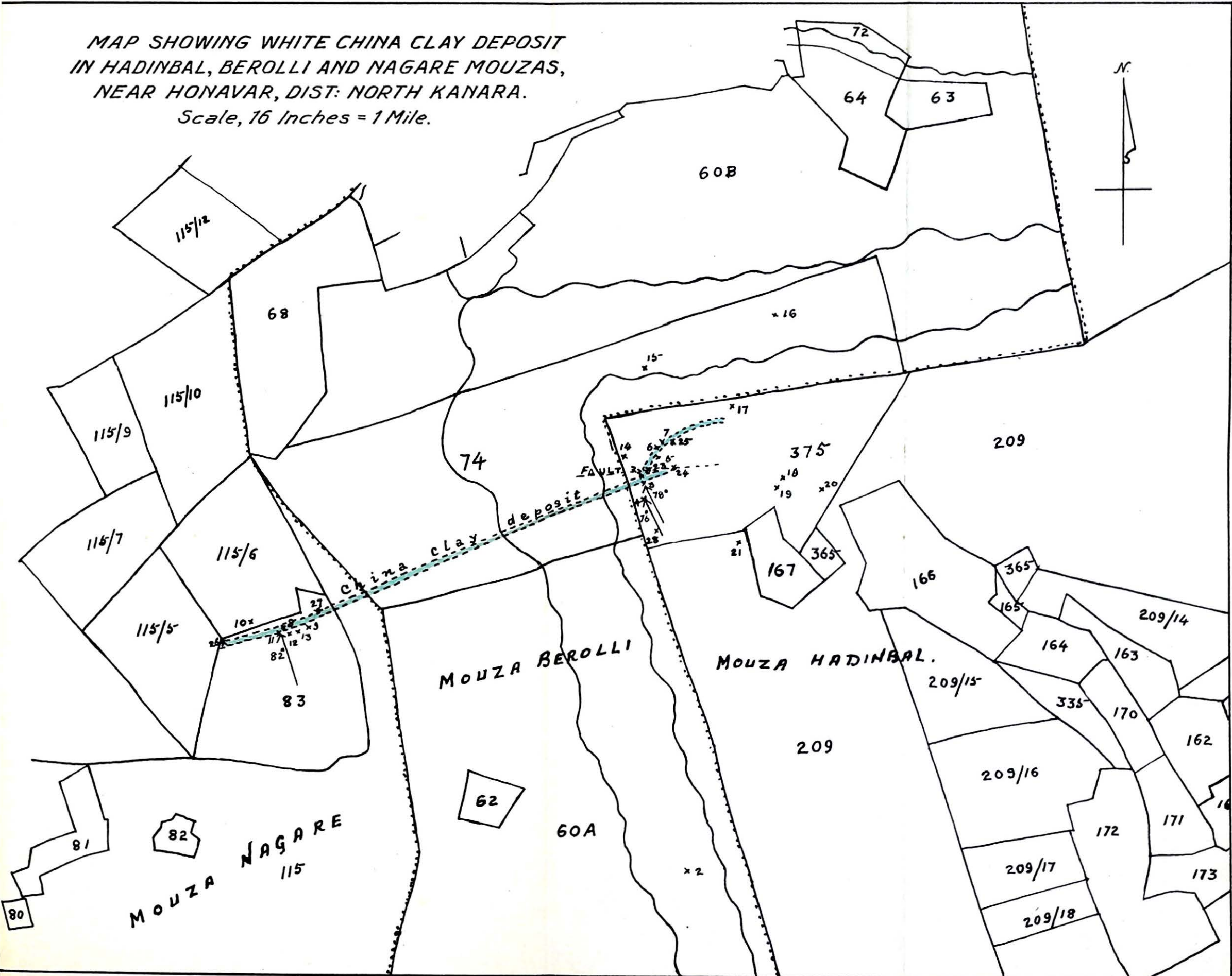
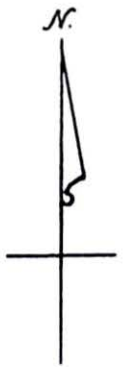
Market value—

Present market value of good white China clay f. o. r. Bombay is Rs. 45 to Rs. 50 per ton.

Hence the working on China clay beds near Honawar will be, I think, profitable.

MAP SHOWING WHITE CHINA CLAY DEPOSIT
IN HADINBAL, BEROLLI AND NAGARE MOUZAS,
NEAR HONAVAR, DIST: NORTH KANARA.

Scale, 16 Inches = 1 Mile.



8. GEOLOGICAL INVESTIGATION ON CLAY BEDS IN JALGAON MOUZA, TALUKA DAPOLI, DISTRICT RATNAGIRI.

1. INTRODUCTION.

Under instructions of the Director of Industries I arrived Jalgaon on 3rd February 1939, and started geological prospecting operation and pit work on 4th and continued them till 10th February 1939. There is a good mortar road from Jalgaon clay deposit to Harnai port on Arabian Sea, which is about 10 miles off from Jalgaon village. Lorries with heavy loads are not allowed at present, according to local report, to run through this road but carts are allowed. Arrangement for the lorries also to pass through this road is necessary. There are bus services between Harnai and Jalgaon and also steamer services from Harnai to Bombay. Country crafts also carry loads from Harnai to Bombay. There is another cart road, 7 miles long from Jalgaon to Burundi on sea coast, but the road is not good enough for carts to carry heavy loads. From the middle of June to the middle of September that is during the rainy season, the sea route is closed as steamers or country crafts do not ply during that period.

2. GEOLOGY OF JALGAON AREA.

The whole of Jalgaon mouza rests on laterite bed. The mouza is almost surrounded on all sides by laterite hillocks or dungries. A portion, on the north western portion of the mouza, near the mortar road, is low where the clay bed occurs. The laterite bed of the mouza is formed by the decomposition and hydration of hæmatite rock. The yellow decomposed and hydrated portion (called limonite) of the laterite bed forms the matrix of the reddish hæmatite rock, which contains a high percentage of iron. The laterite rock is free from lime and on both sides of the nala, north of Jalgaon village below 5 feet, to 12 feet of mixed laterite bed, good laterite clay lies upto a depth of about 25 feet, which ought to be definitely ascertained by boring operations. Wells of 25 feet to 35 feet depth on the laterite bed, close to the above nala, have not reached the bottom of the clay deposit, though they have passed more than 20 feet through it. A well on the southern portion of Jalgaon village shows the thickness of laterite bed of about 24 feet, overlying basic rock. The river east of Dapoli also shows the thickness of laterite bed of about 30 feet overlying the greyish igneous rock.

The above good laterite clay bed of Jalgaon mouza also extends towards the north in camp Dapoli in the reserve forest.

3. QUALITY OF THE CLAY.

The above red clay bed on both sides of the nala north of Jalgaon village, especially the portion along pits Nos. 2, 3 and 4 seems to be good. It is to be tested whether it is useful for red pottery manufacture, as well as for the preparation of red tiles. This clay when burnt becomes red. It is plastic and free from lime and the percentage of clay in it seems to be high. Four bags of sample of about 1 cwt. each of the said clay are taken from trial pits Nos. 1, 2, 3 and 4 and sent to Bombay Potteries and Tiles Ltd. for tests and analysis. After proper tests in the said pottery works the quality and uses of the clay will be definitely ascertained.

4. PROSPECTING ON CLAY BEDS IN JALGAON AREA.

The laterite bed near the hillocks to the east, south and west of Jalgaon mouza, contains clay in low percentage. But the laterite bed, close to the nala north of Jalgaon village consists of a high percentage of clay and is more plastic. Above 20 per cent., of clay makes it good for pottery manufacture. During a short period of traverse work about 1,300 feet long and 1,000 feet wide good laterite clay deposit, north of Jalgaon village is detected below 5 feet to 12 feet of surface soil and mixed laterite bed; out of this clay about 500 feet long and 250 feet wide area on its south eastern portion seems to be better in quality as it is more plastic and contains a higher percentage of clay. About 10 feet of the said clay lies above the water level, which can be easily taken out. Four trial pits are dug on the above clay bed and all of them have gone into it. The laterite bed of Jalgaon Mouza is about 30 feet to 40 feet thick, out of which the laterite clay is about 25 feet on the average.

In area prospected the volume of good plastic clay bed of 10 feet thickness above water level, north of Jalgaon village in Jalgaon Mouza is $(1,300' \times 1,000' \times 10')$ or 13,000,000 cubic feet and deducting the approximate volume of clay already excavated 5,000,000 cubic feet it becomes 8,000,000 cubic feet or 320,000 tons at 4 tons per 100 cubic feet. About 15 feet of clay also lies below water level, whose volume is $(1,300' \times 1,000' \times 15')$ or 19,500,000 cubic feet or 780,000 tons. So the total good clay bed seemed to be useful for pottery purpose in Jalgaon Mouza is 1,100,000 tons, say, 1,000,000 tons, approximately. Out of this clay $(500' \times 250' \times 25') = 3,125,000$ cubic feet = 156,250 tons at 5 tons per 100 cubic feet, say 150,000 tons, approximately at the southeastern portion is better in quality, being more plastic and containing a higher percentage of clay.

5. DEFECTS IN THE PRESENT WORKING.

The local potters are working on the said clay bed up to the water level and in a very crude method. They are making very narrow long excavations below the laterite rock of 5 feet or more in thickness and are digging out the clay without keeping proper sizes of pillars to support the overburden and make the excavations dangerous to work. During rainy season the heavy overburden falls down and makes the working of the clay underneath impossible for them.

6. FUTURE ASPECT OF THE DEVELOPMENT OF THE WORKING ON CLAY BED IN JALGAON MOUZA.

In Jalgaon Mouza there are more than 100 houses of potters. They are very poor and cannot get sufficient crops from their fields to provide themselves well throughout the year. So they spend some portion of their time in each day in preparing red earthenwares out of the above laterite clay. They are mostly illiterate and do not know the proper method of mining operation for taking out the clay. As the clay lies only 5 feet to 12 feet below the surface level, opencast quarrying is the best method to take the clay out. The upper 5 feet to 8 feet of the surface soil and mixed laterite should be removed over a wide area. Then the working on the clay bed which seems to be good for red pottery manufacture and red tiles would be very easy and the maximum volume of clay can be taken out. By drawing out water from the quarry by pumping machine they can work out to a great depth below the water level. A proper training may make them useful on the line and they can earn more than what they are earning now. At present they earn annas six to twelve per day per each family by selling unpolished crude red earthenware only. They also prepare round country tiles out of this clay but they do not know the method of preparing rectangular (Mangalore) roofing tiles; they may be trained to prepare those. For the last 50 years or so they are using the same old crude method of working. Modern methods ought to be adopted.

7. APPROXIMATE CLAY RESERVE IN JALGAON MOUZA IN AREA PROSPECTED.

Red clay, north of Jalgaon village (above water level)	320,000 tons (approximately).
Red clay, north of Jalgaon village (below water level)	780,000 tons (approximately).

	1,100,000 tons.
Say ..	1,000,000 tons (approximately).
	(One million tons.)

Better quality at the SE. corner of the above clay area, is—156,250 tons, say 150,000 tons, approximate. (One hundred fifty thousand tons only.)

8. FIELD NOTES.

(a) In Jalgaon Mouza, taluka Dapoli, district Ratnagiri.

Traverse round the clay deposit in Jalgaon Mouza.

Observations.

- (1) Exposure of laterite clay in an excavation in plot No. 21 below laterite rock. The overburden of the clay is 7 feet. This clay is used by local potters for preparing red earthenwares.
- (2) Exposure of laterite clay in another excavation 8 feet below surface soil and laterite rock. About 7 feet of the clay up to the water level is exposed in the excavation. Potters also use this clay.
- (3) Exposure of laterite clay in trial pit No. 1 in plot No. 21, at a depth of 10 feet from the surface. The clay seems to be good for pottery manufacture.
- (4) Exposure of good plastic laterite clay in an excavation in plot No. 20, 5 feet below the surface. It underlies soft laterite rock. The laterite clay below seems to contain more than 20 per cent. clayey matter which makes it useful for pottery manufacture. A trial pit No. 3 is dug in the excavation. It proves the good clay bed 10'—6" up to water level and it goes further down to a great depth not less than 20 feet. The potters of the locality prefer this clay to prepare red earthenwares of good quality. This clay seems to be useful both for pottery purposes and red tiles.
- (5) Exposure of good plastic laterite clay in Pit No. 4 dug on the bed of a nala. The quality of the clay seems to be the same as that of observations (4) above. Pit No. 4 proves 10'—4" of good laterite clay above water level.
- (6) Exposure of good laterite clay in Pit No. 2 which underlies 3'—2" of surface soil and mixed hard laterite bed. This clay also seems to be good for pottery purposes.
- (7) Exposure in about 25 feet deep well of laterite clay below 10 feet of surface soil and laterite rock. The well has not reached the bottom of the clay, though it has passed about 20 feet through it. This shows the huge thickness of the clay deposit in Jalgaon area.
- (8) Exposure of laterite clay in about a 25 feet deep well, west of plot No. 20 below 12 feet overburden of surface soil and laterite rock. The clay continues further down the bottom of the well.
- (9) Exposure of laterite clay at a depth of 12 feet in a well on the northern portion of plot No. 20. The well is about 35 feet deep. It has passed through about 23 feet of laterite clay; still it has not reached its bottom.
- (10) Exposure of good plastic laterite clay in excavations near the fields on the northern portion of plot No. 20. This clay seems to be good for pottery purposes and red tiles. Formerly the potters used this clay.
- (11) Laterite clay from a well here in Plot No. 20 close to the reserve forest is said by a local man named Mr. Kasinath Barve to have been analysed in Poona in 1909-10 and reported to be good for pottery manufacture as well as for red tiles.
- (12) Exposure of laterite clay in an excavation near nala in reserve forest, which the potters of Jalgaon village dug out long ago and used it for preparing red earthenwares. Now it is abandoned.
- (13) Exposure of laterite clay below laterite rock on the side of a nala, east of Dapoli-Jalgaon mortar road. This clay is inferior to that of observations (4) above.
- (14) Exposure of massive laterite rock on hillocks south of Jalgaon Mouza. No definite dip is indicated.

- (15) Exposure of massive hard greyish basic igneous rock, weathered on the surface, on the hillock south of Jalgaon Mouza.
- (16) Exposure of laterite rock on hillock south east of Jalgaon Mouza. Massive.
- (17) Exposure of laterite rock of hillock-east of Jalgaon Mouza. Massive, with low percentage of clayey matter.
- (18) Exposure of hard massive greyish basic igneous rock on the hillock east of Jalgaon Mouza.
- (19) Exposure of massive laterite rock on the hillock, north-east of Jalgaon Mouza. The percentage of clayey matter in it is low.
- (20) Exposure of laterite rock on hillock west of Jalgaon Mouza. Massive.
- (21) Exposure of dark basic rock in a well, on the southern portion of Jalgaon village, at a depth of about 24 feet underlying the laterite bed which is exposed from the top.
- (22) Exposure of basic igneous rock on the bed of the river east of Dapoli. The thickness of the overlying laterite bed on the bank of the river is about 30 feet.

General Note.—From the above observations we find that the whole of the Jalgaon Mouza rests on laterite bed and the observations (1) to (13) are on red clay bed which seems to be useful for pottery manufacture as well as for red roofing tiles and it lies at a depth of 5 feet to 12 feet, according to the height of the surface level, on both sides of the nala north of Jalgaon village, as shown in map attached herewith.

The above observations also go to prove that the thickness of laterite bed in Jalgaon area is 24 feet to 30 feet. So the clay bed seems to be about 25 feet on the average, out of which about 10 feet is above the water level.

(b) Records of Pit work, in Jalgaon Mouza, taluka Dapoli, district Ratnagiri.

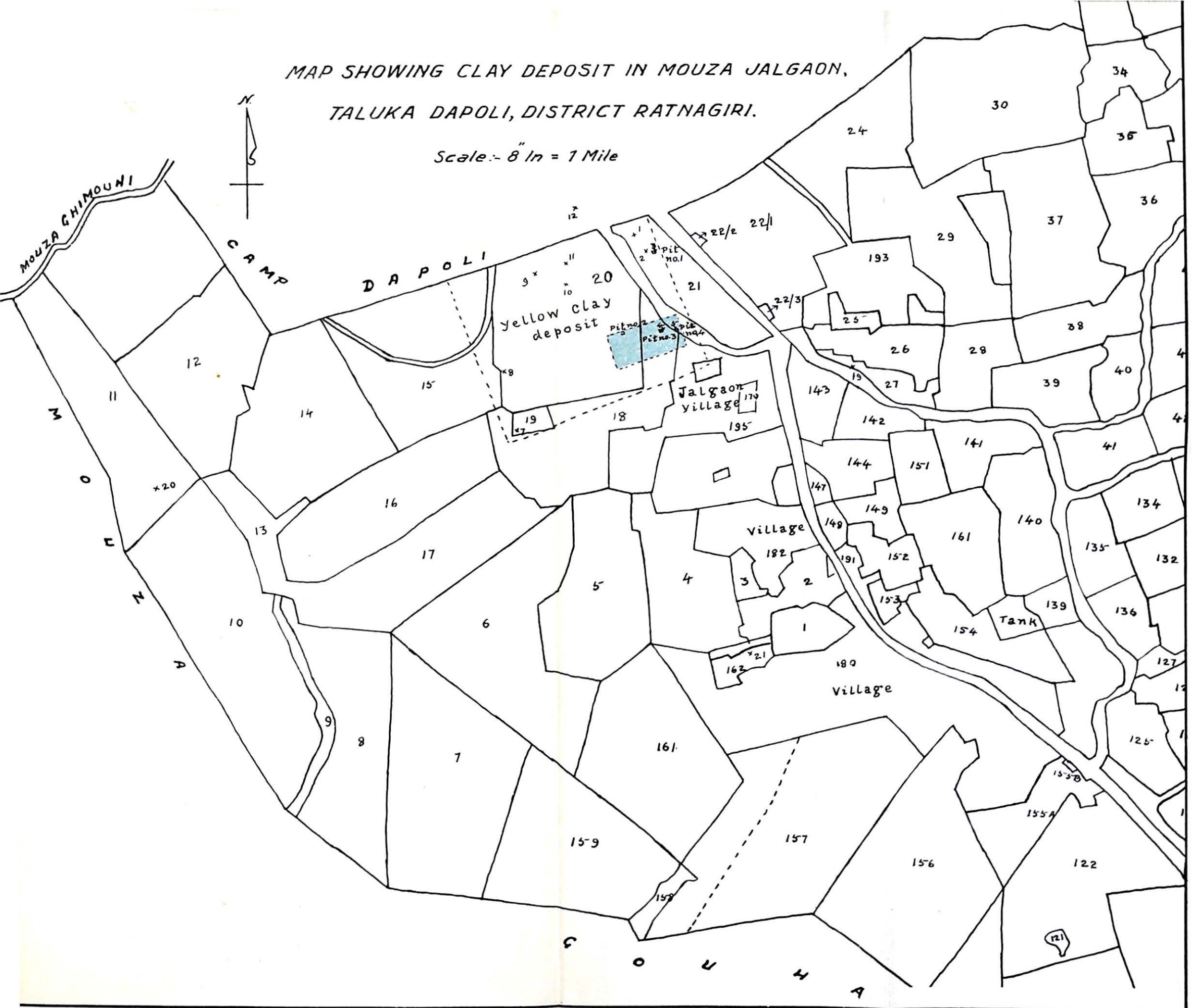
Pit No. 1.		Pit No. 3.	
Surface soil	3'—0"	Exposed surface soil ..	2'—0"
Mixed laterite clay ..	2'—8"	Exposed mixed laterite bed .	3'—0"
Blackish laterite bed ..	4'—4"	Exposed laterite clay (above water level).	10'—6"
Laterite clay	4'—6"	Laterite clay (Below water level).	2'—6"
	—————		—————
	14'—6"		18'—0"
		Pit No. 4.	
Pit No. 2.		Exposed surface soil ..	2'—0"
Surface soil	1'—0"	Exposed laterite bed (Mixed) ..	3'—0"
Mixed laterite bed ..	2'—2"	Exposed laterite clay (above water level).	4'—0"
Laterite clay	4'—5"	Laterite clay ..	6'—4"
	—————	Laterite clay (Below water level).	1'—0"
	7'—7"		—————
			16'—4"

Bombay, 28th February 1939.

D. N. MUKERJI,
Geologist

MAP SHOWING CLAY DEPOSIT IN MOUZA JALGAON,
TALUKA DAPOLI, DISTRICT RATNAGIRI.

Scale:- 8" In = 1 Mile



APPENDIX II.

CONTENTS.

(A) TESTS OF CLAY SAMPLES COLLECTED DURING THE
GEOLOGICAL SURVEY.

	Page-
1. Introduction	63
2. Method of Testing	63
3. General tests of the samples collected	63
4. Commercial experiments made from selected clays for the development of village industry—	
(i) Panch Mahals District clays	69
(ii) Thana District clays	71
(iii) Belgaum District clays	72
(iv) Ratnagiri District clays	73
(v) North Kanara District clays	73
5. Experiments for manufacturing white ware in a well equipped factory in Bombay	73
6. Analysis of the selected clays	75
7. General observations on the selected clays	76
(a) Panch Mahals District clays, felspar and quartz and their industrial prospects in the district	76
(b) Bassein clay in Thana District and its industrial prospects	78
(c) Belgaum District clays and their industrial prospects	79
(d) North Kanara District clays	79
(e) Ratnagiri District clays	80
 (B) CONSTRUCTION OF A FURNACE FOR THE USE OF VILLAGE POTTERS FOR USING WOOD FUEL FOR FIRING CHEAP GLAZED WARE.	
(a) Designing of the furnace and experiments conducted	80
(b) Conclusions	84
Plan of the Wood Burning Pottery Kiln for Villagers	(Facing) 84

APPENDIX II.

(A) TESTS OF CLAY SAMPLES COLLECTED DURING THE GEOLOGICAL SURVEY.

(1) INTRODUCTION.

The clay deposits in the various districts in Bombay Province were visited in company of Mr. Mukerji, the geologist. In the first visit, all the areas were inspected and the samples were tested for lime. The geological survey of the area containing large quantities was undertaken by Mr. Mukerji and after the traverse and pit work was completed the samples were selected on spot and brought to Bombay for further tests by myself.

(2) METHOD OF TESTING.

Average weighed sample was taken from the quantity after mixing it well. The sample was soaked in water for two days. If the sample did not disintegrate, the sample of clay was good. The ground sample was lawned through 120 mesh and the residue was weighed after drying. The residue was tested for lime. The lawned clay was dried and powdered. The powdered clay was moistened with water. Tiles were pressed and were kept drying for two weeks. After the tiles were dried, they were fired in the furnace at 1110°C.

Red clays are generally fired at 1000°C, but as these clays are intended for the use of cheap glazed ware, they were fired at 1110°C for the purpose of finding out the possibility of these clays. To test the plasticity, the lawned clays were mixed with water and made into homogeneous mass after wedging them. The clay was thrown on the potter's wheel. If the shape could be made without the clay setting down, it was considered as a plastic clay.

After burning, the clay tiles were examined for porosity.

After doing these general tests, the samples were selected for commercial experiments taking into consideration the quantity available and the quality required for the manufacture of articles.

China clay samples were also tested in the same manner except for plasticity. Samples containing large percentage of iron were rejected as they are not suitable for the manufacture of white ware.

3. GENERAL TESTS OF THE SAMPLES COLLECTED.

The serial number of clay samples begins from 9. First eight numbers were given to the mixtures made from the Bassein clay, Thana district, and felspar China clay, etc., from other areas prepared for manufacture of pottery. These mixtures did not give successful results.

Panch Mahals District Clays.

Sample No. 9.—The sample was taken from pit No. 9 at Pingli. It is hard and pink in colour. It contains traces of lime. It does not integrate easily in water. It has to be ground before use. When passed through 120 mesh, a residue of fine sand is obtained in a very small quantity. The clay is plastic and can be worked on the potter's wheel.

A sample tile was made by dust process and fired at 1130°C. The fired tile was soft and porous. The colour of the tile is yellowish; can be used for cheap earthen ware.

Sample No. 10.—This sample was taken from pit No. 1 at the bottom at Balatia village. It is hard and of grey colour. It does not contain lime and does not disintegrate in water easily. It has to be ground. The ground clay when lawned through 120 mesh left a small residue. The residue shows traces of lime.

A trial sample made as usual and burnt gave a fairly white coloured tile. When fired again at 1200°C, it became hard and warped. It is a good fire clay. If the clay is lawned through 160 mesh, it can be used as a plastic clay for manufacturing white

ware. This clay has been selected for making commercial experiments. Mr. Mukerji the geologist who made the survey of these places reports that there is abundance of this type of clay.

Sample No. 11.—This sample was taken from pit No. 7. It is slightly pink in colour and softer than Balatia clay. It is free from lime. Sample tile showed slightly cream-colour after burning. It is a good fire clay.

Sample No. 12.—This sample was taken from pit No. 1 (Balatia village) top layer. This sample is a mixture of Balatia and Pingli village deposits as they occur at the junction of the boundaries of both the villages.

The sample is very hard and the fired tile shows the presence of iron. This clay can be used for cheap coloured glazed ware.

Sample No. 13.—This sample was taken from pit No. 1 at Pingli. The sample is of brown colour and very hard. It does not contain lime. A brick made from this clay when fired at 1130°C gives yellow coloured brick. The shade of yellow is lighter than that of No. 9 sample.

The presence of iron is due to the percolation of the disintegrated laterite rock which is the overburden on the actual clay deposits. Clay taken out from the bottom of the pit is less contaminated with iron. The clay is plastic and useful for cheap glazed ware.

Sample No. 14—Felspar.—This sample was got from Toova Road. It is pink and is obtainable in small lumps. When burnt at 1210°C it fuses. It is a good sample of pegmatite.

Sample No. 15—Felspar.—This sample is the disintegrated mass of felspar obtained from the pit dug in the nala. It is pink and in coarse powder form. It fuses at 1200° but is hard. It is mixed with sand and mica. It can be used in place of felspar for the manufacture of cheap glazed ware.

Belgaum District Clays.

The following samples were collected before geological survey was done. The samples were picked up on the first visit for preliminary test.

Sample No. 16—Gunji clay.—This clay is cream in colour. When lawned through 200 mesh, it gave 40 per cent. residue. The residue contained decomposed granite, quartz and some mica.

The lawned clay was pressed by dust process and the tile was fired at 1130°C. The burnt tile was hard and of light red colour. It is China clay contaminated with iron.

Sample No. 17—Castle Rock clay.—This clay is grey in colour and contains traces of lime. When lawned through 200 mesh, it gave 12 per cent. residue. The sample tile made by dust process when fired at 1120°C gave a fairly white tile. The burnt tile is very soft. The clay is silicious. It is neither a China clay nor a pipe clay.

Sample No. 18—Desur clay.—The clay is yellow in colour and contains traces of lime. When lawned through 200 mesh gave 42 per cent. residue. The residue is composed of quartz, mica and pieces of laterite rock.

The tile burnt at 1130°C gave light buff colour. It is neither a fire clay nor a brick clay.

The origin of the clay seems to be from the disintegrated granite rock, contaminated with the decomposed laterite.

The clay is plastic and can be worked on the potter's wheel.

Sample No. 19—Kapoli clay.—The clay is cream in colour and the residue obtained after lawning the clay is 45 per cent.

Tile when fired at 1130°C gave dark cream shade and is hard. This clay is China clay but is contaminated with iron.

Sample No. 20—Desur Soft stone.—This stone was taken with a view to find out whether it contains iron.

The stone was powdered and burnt at 1130°C. The stone did not melt. It contains large quantity of iron. It cannot be used in place of sand for glass industry.

Sample No. 21—Desur Hard Stone.—Result same as No. 20.

Quartz from Panch Mahals District

Sample No. 22—Quartz was brought from Sant Road. The deposits at Sant Road are extensive. The sample burnt at 1130°C was quite white.

Thana District Clays.

Bassein Clays.

Sample No. 23.—This sample was taken from top portion, eastern side of Dungri, Gokhera area.

This clay is the deposition of the disintegrated laterite rock. It is free from lime. It is found in lumps but disintegrated in water easily. It is yellow in colour and leaves no residue when lawned. It is plastic and can be worked on the wheel. When fired at 1110°C gave good chocolate colour and the tile is hard. A good clay for red ware.

Sample No. 24.—The sample was taken from Pit No. 2 near Bhoida village.

This sample is in lumps but soft and is slightly contaminated with lime. The clay is light and of the yellow shade. When lawned through 120 mesh leaves a small residue.

A sample tile burnt at 1110°C gave dark red colour and is slightly porous. It is a good clay.

Sample No. 25.—This sample was taken from the western side of the Dungri Pit No. 2, Gokhera area. This clay is similar to No. 23 with the exception that it is more silicious. The burnt tile is porous. It is a good clay.

Sample No. 26.—This sample was taken from Pit No. 6, west of Dongri, Gokhera area. The clay is very hard and does not disintegrate in water. It requires grinding before use. If the clay is left for weathering for a season or two, it softens and does not require grinding. It is plastic and silicious. It gave the similar result as No. 23 except that the shade of the burnt tile is darker. It is a good clay.

Sample No. 27.—This sample was taken from Trench No. 1, eastern side of Dongri, Gokhera area.

The clay is hard in lumps and requires to be ground before use. There is a trace of lime. It is plastic. The burnt tile gave good red colour and is porous. In comparison to No. 23, it is silicious. It is a good clay for red ware.

Sample No. 28.—This sample was taken from Pit No. 1, top portion, eastern side of Dongri.

The clay is soft and free from lime. The burnt clay gives better shade than Nos. 23, 24, 25, 26 and is slightly porous. It is a good plastic clay.

Sample No. 29.—This sample was taken just below surface soil, western side of the Dongri.

The clay is similar to clay No. 25 and gives similar result.

Sample No. 30.—This sample was taken from Pit No. 2, western side of Dongri.

This clay is similar to clay No. 25 with the exception that the burnt tile gives lighter shade. It is a good clay.

Sample No. 31.—This sample was taken from Pit No. 1, middle portion, east of Dongri.

The clay is in lumps but disintegrated in water easily. It is free from lime. When the sample tile was burnt at 1110°C , it gave a very good red colour and was porous. It is a good clay for roofing tiles and terra cotta.

Sample No. 32.—This sample was taken from Pit No. 1, bottom portion, east of Dongri.

The clay is in lumps but disintegrated in water easily. The sample tile when burnt gives a better colour than that of No. 31 and is less porous. It is plastic.

Sample No. 33.—This sample was taken from Pit No. 7 just below surface soil, east of Dongri.

This clay is harder than Nos. 31 and 32 and does not integrate in water easily. It requires grinding. The burnt tile gave a darker shade than that of Nos. 31 and 32. The clay is plastic.

Sample No. 34.—This sample was taken from Pit No. 1 Bhoida near main road.

The clay is soft though in lumps. It disintegrates in water easily and is free from lime. The sample tile burnt at 1110°C , gave a good light red colour and is porous. Compared with No. 24 it is lighter in shade and porous. A good clay for Facing-bricks and terra cotta.

N. B.—All the samples of clays collected from Bassein are suitable for making cheap glazed ware, red building bricks and Mangalore type roofing tiles.

China clay from Hadinbal, North Kanara District.

Sample No. 35.—The sample was brought from the china clay mines at Hadinbal near Honawar. The sample is supposed to be levigated.

It is full of mica. The tile when burnt at 1110°C , gave light yellow colour which shows the presence of iron. It cannot be used for the manufacture of white ware.

Sample No. 36.—Sample No. 35 was levigated and washed. The sample though improved in quality, is not what is required for the manufacture of white ware.

Gunji clay from Belgaum District.

Sample No. 37.—This sample was taken from Pit No. 1 bottom portion.

The sample was tested similarly as No. 16. The burnt tile was lighter in shed but the presence of iron made it impossible to use as china clay.

Keerowlee clay from Belgaum District.

Sample No. 38.—This sample was taken from Pit No. 2. It is yellowish in colour. It contains 33 per cent. residue. The burnt tile is of yellow colour. It is china clay contaminated with iron.

Sample No. 39.—This sample was taken from Pit No. 1. The clay is cream in colour and contains traces of lime. It contains 50 per cent. residue. The tile was made of the lawned clay. When burnt at 1130°C , it gave cream coloured tile. Though it is better than No. 38, it cannot be used for white ware.

Ghatgoli clay from Belgaum District.

Sample No. 40.—This clay is fairly white and there are traces of lime. It gave 50 per cent. residue when lawned through 160 mesh. A tile made from lawned clay and burnt at 1130°C gave a fairly white tile.

The clay can be used as china clay for ordinary white ware.

Further Geological survey and pit work are necessary to find out the quantity and the quality of the deposits. The sample was taken from the surface. This sample is better than all other samples collected from the Belgaum District.

Ghatgoli white clay No. 2 from Belgaum District.

Sample No. 41.—This sample is cream in colour and contains 48 per cent. residue. The burnt tile is of yellow colour showing a large percentage of iron. This clay cannot be used as china clay.

N. B.—It appears that northern portion from where the sample No. 40 was taken is very little contaminated with iron while the southern one is full of contamination. Further work may be undertaken on the northern side.

Kapoli clay, Belgaum District.

Sample No. 42.—This sample was taken from Pit No. 1. The clay is reddish in colour and contains 26 per cent. residue. The tile gave buff colour after burning. It cannot be used as china clay.

Sample No. 43.—This sample was taken from Pit No. 2. The clay is grey in colour and contains 44 per cent. residue. The burnt tile is of cream colour and hard. This sample is the best among seven samples collected from various pits in the area.

Sample No. 44.—This sample was taken from Pit No. 3. The clay is of yellow colour and contains 50 per cent. residue. The burnt tile gave light pink coloured tile and is hard. The iron contamination is more than Nos. 19 and 43 samples.

Sample No. 45.—This sample was taken from Pit No. 5. The clay is of dark yellow colour and contains traces of lime and has 40 per cent. residue. The burnt tile gave a good red colour and is hard. Iron contamination is more than that in samples No. 19, 43, 44, 47.

Sample No. 46.—This sample was taken from Pit No. 7. The clay is of dark yellow colour and contains traces of lime. The residue is 25 per cent. The burnt tile is similar to No. 45.

Sample No. 47.—This clay is yellow in colour and free from lime. The residue is 17 per cent. The burnt tile is similar to No. 44.

Sample No. 48.—This sample was taken from the excavation of Pit No. 1 on the surface. The colour of the clay is black and is free from lime. It is very plastic and there is no residue. The burnt tile gave dark brown colour. It is a good brick clay.

N. B.—Kapoli clays are derived from the disintegration granite rocks. The overburden on these deposits are laterite clays. Fine laterite clay has percolated through the disintegrated mass and contaminated the deposits with iron. Only one sample No. 43 is very little contaminated. It is situated on the bank of a Nala at a low level where water accumulates and it is difficult to dig further. It is necessary to provide pumping arrangement if it is decided to dig deep for a better quality of a sample free from iron.

Patoli, Belgaum District.

Sample No. 49.—The clay is cream in colour and contains 70 per cent. residue. The burnt tile is soft and of light cream colour.

Shivthan, district Belgaum.

Sample No. 50.—The colour of the clay is cream and contains 45 per cent. residue. The burnt tile is of cream colour and hard.

Clay from North Kanara District.

Yellow clay from Padukuli $3\frac{1}{2}$ miles from Honawar.

Sample No. 51.—The colour of the clay is reddish yellow. It is plastic and does not contain any residue. The burnt tile gave buff colour and is hard. It can be used for cheap glazed ware.

Quartz and Felspar from Haspatan—Two miles from Honawar.

Sample No. 52.—This stone was brought for testing for felspar. When burnt at 1200° C it showed no effect. It is not felspar.

White clay from Kalkod one mile from Honawar.

Sample No. 53.—The clay is grey in colour and contains no residue. It is plastic and the burnt tile gave a good yellow colour. It can be used for cheap glazed ware.

Yellow clay from Padukuli, Belgaum District.

Sample No. 54.—This sample was taken from Pit No. 3. It is yellow in colour and is plastic. There is very little residue. The burnt tile is of a very good red colour. It can be used for red ware.

Dhareswar, eleven miles from Honawar.

Sample No. 55.—The colour of the clay is dark red leading to chocolate shade. It is in lumps. It is disintegrated in water easily. It is plastic. The burnt tile gave brick red colour and is soft. It is a good clay for cheap red ware.

Black clay No. 2 from Kaar village, three and a half miles from Honawar.

Sample No. 56.—The colour of the clay is black. It is in lumps and disintegrated in water easily. The burnt tile gave a buff colour and is hard.

Yellow clay from Jalbali four and a half miles from Honawar.

Sample No. 57.—The colour of the clay is yellow and it is in lumps and disintegrated easily in water. The burnt tile is of a very good red colour and is hard. A useful clay for cheap red ware.

White clay from Nagare three and a half miles from Honawar.

Sample No. 58.—The colour of the clay is grey and is fine in texture. The burnt tile is of cream colour and hard. The deposits of this clay are near Hadinbal and are of the same strata. It is possible to get better clay if sample is obtained at a good depth.

Yellow clay from Achola near Bassein in Thana District.

Sample No. 59.—The clay is in powder form and is free from lime. It is very plastic and burns very good red colour. It is good clay.

Yellow clay from Achola near Bassein in Thana District.

Sample No. 60.—This clay is similar to No. 59 but it gives better colour and is porous.

Sandstone from Bassein in Thana District.

Sample No. 61.—When burnt, it gave a darker shade and is useless.

Clays from Jalgaon in Ratnagiri District, Pit No. 1 sample.

Sample No. 62.—The colour of the clay is red and occurs in lumps. It does not disintegrate in water even after 48 hours. No residue remains when lawned through 120 mesh. It is plastic and when burnt at 1110° C, it gave a good dark chocolate colour.

Clay from Pit No. 2, Jalgaon, Ratnagiri District.

Sample No. 63.—The clay is similar to No. 62 and the burnt tile is slightly lighter in shade.

Clay from Pit No. 3, Jalgaon, Ratnagiri District.

Sample No. 64.—This clay is similar to Nos. 62 and 63. The burnt tile gave a good red shade.

Clay from Pit No. 4, Jalgaon, Ratnagiri District.

Sample No. 65.—The clay is similar to No. 64.

N.B.—All the samples of clays from Jalgaon, Ratnagiri District are of the same type. The only difference is the iron content in the clay. All the clays are good for the manufacture of Mangalore tiles and red glazed ware.

Clay from Chiplun, district Ratnagiri.

Sample No. 66.—The clay is red in colour and contains large percentage of fine sand. When burnt it gave a dark red coloured tile and was soft. It can only be used for ordinary red bricks.

Felspar from Padukuli. Three and a half miles from Honawar.

Sample No. 67.—This sample was burnt at 1210° C. It neither fused nor was soft. It is not felspar. It is sandstone.

4. COMMERCIAL EXPERIMENTS MADE FROM SELECTED CLAYS FOR THE DEVELOPMENT OF VILLAGE INDUSTRY.

(i) *Panch Mahals District.*

Derol clay.—The clay selected from Balatia village near Derol. This clay will be called Derol clay.

The sample was ground and lawned through 200 mesh and dried at 100° C.

		Analysis.			
Loss on ignition		..	..	..	7.20
Silica	SiO ₂	..	..	..	69.50
Alumina	Al ₂ O ₃	..	..	..	20.50
Ferric oxide	Fe ₂ O ₃	..	..	..	1.05
Titanium oxide	TiO ₂	..	..	..	1.06
Lime	CaO	..	..	..	0.37
Magnesia	MgO	..	..	..	0.38
					100.06

Generally potters do not lawn their clay. They mix the raw ground clay with water and make it a homogeneous mass and make articles on the potter's wheel. Clay thus prepared is gritty and the prepared articles appear to be rough. These articles are also burnt in open furnaces with dry refuse and the temperature obtained is much less than required. The result is that the articles are crude and soft. They break easily.

Articles made by modern methods and fired at the proper temperature look better and last longer. What is required is the application of new methods.

Modern method of manufacturing articles from pure clay.

The clay is ground and soaked in water. After 48 hours the clay is lawned through 120 mesh. The liquid clay is dried in open tanks. The semi dry clay is collected and made into a homogeneous mass by wedging with hand. When the clay is ready for throwing on the potter's wheel, a required quantity is weighed and made into balls for the purpose of throwing on the wheel. The articles thus made are allowed to dry leather hard. They are turned again on the wheel with turning tools and the proper shape is made, and polished with ivory tool. The articles are dried and fired in the furnace. The firing temperature of the articles depends upon the nature of the clay.

(1) The following articles have been made by the method described above :—

(1) Garden pot white.

(2) Kuja.

These articles are fired at 1110° C.

(2) The following articles were made from the raw clay;—

The clay was ground and soaked in water. It was mixed well and without lawning dried. It was collected when semi plastic made into homogenous mass by wedging with hand. Brick was made in a wooden mould from the clay. Allowed to dry and fired at 1200° C. The resultant brick is fire-brick.

The clay is ground and lawned 80 mesh. It is sold as fire-clay.

(3) The following experiment was made for vitreous ware. The materials used are Derol clay, Quartz from Sant Road, Panch Mahals District and Felspar from Toova Road, Panch Mahals District:—

Mixture of the body—

Derol clay	..	..	..	..	..	65
Flint	..	..	..	..	..	10
Felspar	..	..	..	..	..	25
						<hr/> 100

The articles were made on the potter's wheel as follows:—

- (1) Butter milk pot.
- (2) Chutney pots.
- (3) Mortars and Pestles.

These were fired at 1200° C. The articles are vitreous and do not absorb water. These can be sold cheap.

(4) Cheap glazed ware—

This body was made as follows:—

Derol clay	..	..	..	..	..	70
Quartz	..	..	..	..	..	10
Felspar	..	..	..	..	..	20
						<hr/> 100

The following articles were made on potter's wheel:—

- (1) Bowls.
- (2) Cups and saucers.
- (3) Tea pots.
- (4) Sugar basins.
- (5) Milk jugs.

These were fired at 1130° C and glazed with the following glaze:—

K ₂ O	·369	} Al ₂ O ₃	·449	{	SiO ₂	3·873
Cao	·416				Sno ₂	·23
Zno	·215					

The glazed articles were fired at 1200° C and the result was quite satisfactory.

(5) It is expensive to burn the articles for cheap glazed ware twice. This experiment was made with a view to burn body and glaze in single fire.

The following articles were fired at 1200° C after glazing them in green condition:—

- (1) Tea pot.
- (2) Milk jug.
- (3) Sugar pot.
- (4) Butter milk pot.
- (5) Bowl.

The result is quite satisfactory.

(6) Coloured glazed experiments—

All the articles were made by casting process. The body used was the same as in No. (4). The following colours were used :—

- (1) { Manganese dioxide.
Iron oxide.
- (2) Cobalt oxide.
- (3) Chrome oxide.

These colours were mixed with the glaze of the following composition :—

K_2O	·470	} Al_2O_3	·572	SiO_2	4·942
CaO	·530				

The articles dipped in the glaze are as follows :—

- Complete tea sets.
- Cup and saucers.
- Chutney pots.

The articles were fired at 1200°C.

The result is quite satisfactory.

(7) Experiment for Pickle jars and chutney pots.—

These articles were made on potter's wheel and after drying were glazed in the glaze mentioned in No. (6). Top of the jars and lids were glazed with glaze No. 1 mentioned in No. (6).

These articles were fired at 1200°C and the result was quite satisfactory.

Summary.

- (1) Articles made from raw clay by modern methods.
- (2) Articles made from raw clay such as fire-bricks and fire-clay.
- (3) Vitreous unglazed ware.
- (4) Cheap glazed ware made on potter's wheel.
- (5) Cheap glazed ware (single fire).
- (6) Coloured glazed ware made on potter's wheel and by casting process.
- (7) Pickle jars and chutney pots.

(ii) *Thana District.*

Bassein clay.—Nearly all the samples are originated from the decomposition of laterite. From general tests, they are nearly of the same quality. One sample which was brought in quantity has been selected for experiment :—

Analysis.

Loss on ignition	..	..	..	..	11·62
Silica	SiO_2	..	..	..	38·64
Alumina	Al_2O_3	..	..	..	29·16
Ferric oxide	Fe_2O_3	..	..	..	19·32
Titanium	TiO_2	..	..	..	0·83
Lime	CaO	..	..	..	0·41
Total ..					99·98

(1) Articles made from raw clay—

The clay was ground and lanned through 120 mesh. The liquid clay was semi-dried and made into homogeneous mass. It was wedged before use. The clay was thrown on the potter's wheel and after it was leather hard, the articles were turned on the wheel, polished and kept for drying.

After they were thoroughly dried they were fired at 1080°C. The result was satisfactory.

The following articles were made :—

Kujas, Garden pots, Building brick and Smoking pipe.

(2) Experiment made for glazed garden pots—

Bassein clay	..	..	..	..	90
Sand	..	..	..	..	10
					<hr/> 100

The garden pots were fired at 1080°C and glazed with the following glaze :—

Na ₂ O133	} Al ₂ O ₃	.198	} SiO ₂	1.975
K ₂ O	..	..	.085	
CaO	..	..	.248	
ZnO	..	..	.208	
PbO	..	..	.326	
						} B ₂ O ₃	0.265

The glazed pot was fired at 1110° C and the result was satisfactory.

(3) Experiment for cheap glazed ware :

A number of experiments were made and the best result was obtained from the following mixture :—

Bassein clay	..	..	..	..	60
China clay	..	..	..	..	24
Flint	..	..	..	..	10
Felspar	..	..	..	..	6
					<hr/> 100

The following articles were made on potter's wheel :—

Tea pot, Sugar basin, Milk jug, Chutney pots, Cups and saucers and Vases.

The articles were fired at 1110°C and glazed with the same glaze as mentioned in No. 2 at the same temperature. The result was quite satisfactory.

The articles were tested for shattering with boiling water and they stood the test.

(4) Experiment for the manufacture of cheap glazed ware by single fire.

Articles were made on potter's wheel of the same mixture as No. 3. When the articles were thoroughly dried, they were dipped into the same glaze as mentioned above. The glazed articles were fired at 1130°C. The result was quite satisfactory.

Summary.

- (1) Articles made from clay by modern method.
- (2) Glazed garden pots.
- (3) Cheap glazed ware.
- (4) Single fire cheap glazed ware.

(iii) Belgaum District.

(1) *Desur clay*.—This clay was lawned 120 mesh and the lawned clay was used. Tea set was made on potter's wheel.

Articles were fired at 1080° C and glazed. The result is good.

(2) *Kapoli clay*.—Tea set was made on potter's wheel and the articles were fired at 1080°C for biscuit and glazed. The result is good.

N.B.—Further experiments are necessary to prevent crazing. This defect appeared after some time. A couple of experiments will solve the problem.

(iv) *Ratnagiri District.*

Clays from Jalgaon.—These clays were sent by Mr. Mukerji at the instance of the Director of Industries—

		Analysis.				
Loss on ignition	..	..	..	..	..	13·07
Silica	SiO ₂	..	..	..	..	24·46
Alumina	Al ₂ O ₃	..	..	..	..	22·24
Ferric oxide	Fe ₂ O ₃	..	..	..	..	40·15
Lime	CaO	..	..	..	..	0·05
Magnesia	MgO	..	..	..	..	Traces
						99·97

The clay is very plastic and as it is cannot be used on the potter's wheel. It requires about 20 per cent. addition of sand before any articles can be made.

(1) A sugar basin and milk pot were made from the clay without mixture on the potter's wheel and fired at 1130°C. The clay vitrifies. The glaze is good though it has dried up.

(2) Clay was mixed with 20 per cent. fine quartz and a garden pot was made on the potter's wheel. It is fired at 1080°C and the result is satisfactory.

(3) From the above mixture two small chutney pots were made on the potter's wheel and after drying, they were glazed and fired at 1080°C. It gave a good glaze.

(4) A plastic tile was pressed on the Pillar press and fired at 1080°C. The result is satisfactory.

(v) *North Kanara District.*

<i>Honawar clay</i> —		Analysis.				
Loss on ignition	..	..	..	..	..	10·56
Silica	SiO ₂	..	..	..	..	46·54
Alumina	Al ₂ O ₃	..	..	..	..	37·67
Iron oxide	Fe ₂ O ₃	..	..	..	..	4·02
Lime	CaO	..	..	..	..	0·50
Magnesia	MgO	..	..	..	..	0·80
Total						100·09

This clay was obtained from the owner from his stock. It contains a very large percentage of mica and iron. The clay was levigated and treated with acid to remove iron. The resultant clay was grey.

The sample tiles of the original clay and the refined clay were pressed by dust process and fired at 1130°C.

The fired tiles in both the cases are not white.

The levigated clay tile is of grey colour.

5. EXPERIMENTS FOR MANUFACTURING WHITE WARE IN A WELL EQUIPPED FACTORY IN BOMBAY.

(1) All the materials are Indian body :—

Derol clay	..	..	..	..	..	30
China clay from Honawar	..	..	..	..	..	33
Flint	..	..	..	..	..	25
Felspar	..	..	..	..	..	12
						100

The body was mixed and lained 160 mesh. The slip was made for casting.

One sugar pot was made in a plaster mould by casting process. It was fired biscuit at 1130°C and glazed with the following glaze:—

Na_2O}	..	..	..	.133	} Al_2O_3 .1975	{	SiO_2	1.975
K_2O}	..	..	..	.085			B_2O_3	.265
CaO}	..	..	..	.248			SnO_2	.100
ZnO}	..	..	..	.208				
PbO}	..	..	..	.326				

The glazed article was fired at 1130°C.

Result.—A cream coloured glaze. The colour is due to the presence of iron in Honawar clay.

(2) Another trial was made by replacing part of Honawar china clay with English china clay.

Mixture of the body.

Derol clay	..	..	..	..	..	30
English china clay	..	..	..	..	..	16
Honawar china clay	..	..	..	..	..	17
Flint	..	..	..	..	..	25
Felspar	..	..	..	..	..	12
						100

The following articles were made by casting process:—

Tea pot, Sugar basin, Milk jug, Cups, Saucers and Plates.

These were fired biscuit at 1130°C and glazed.

The firing temperature of the glaze also was 1130°C.

Result.—The glazed articles are slightly yellow in shade.

N.B.—As there were no jigger and jolley machines to manufacture cups and saucers and plates, they were made in plaster moulds by casting process. The samples thus made are slightly cracked and burnt.

(3) A fresh trial was made by replacing completely Honawar china clay with English china clay.

Mixture of the body.

Derol clay	..	..	..	..	..	30
English china clay	..	..	..	..	..	33
Flint	..	..	..	..	..	25
Felspar	..	..	..	..	..	12
						100

The following articles were made by casting process:—

Tea pot, Sugar basin, Milk jug, Cups, Saucers and Plates.

These were fired and glazed at the same temperature as mentioned in No. 2.

Result.—Quite satisfactory.

The body No. 3 which gave good result with the glaze used in No. 1, was used in this experiment. The glaze used was lead-less glaze of the following composition:—

K_2O}	..	..	.369	} Al_2O_3 .449	{	SiO_2	3.873
CaO}	..	..	.416			SnO_2	.23
ZnO}	..	..	.215				

The following articles were made by casting process in plaster moulds:—

Tea pot, Sugar basin, Milk jug, Cup and saucer.

The biscuit was fired at 1130°C.

The glaze was fired at 1200°C.

Result.—Quite satisfactory. Glaze is much whiter than in No. 3.

N.B.—It will be seen that white ware can be made by using English china clay and other Indian raw materials in the body.

If cream coloured ware are preferred, these can be made with all Indian materials.

6. ANALYSIS OF THE SELECTED CLAYS.

(1) *Balatia clay commonly called Derol clay from Panch Mahals District—*

Analysis.

The sample was ground and lawned through 200 mesh and dried at 100°C.

Loss on ignition	..	..	..	7.20
Silica	SiO ₂	..	..	69.50
Alumina	Al ₂ O ₃	..	..	20.50
Ferric oxide	Fe ₂ O ₃	..	..	1.05
Titanium oxide	TiO ₂	..	..	1.06
Lime	CaO	..	..	0.37
Magnesia	MgO	..	..	0.38
Total				100.06

(2) *Quartz from Sant Road, Panch Mahals District—*

The sample was calcined and taken—

Silica	SiO ₂	99.6 per cent.
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(3) *Felspar from Toova Road, Panch Mahals District—*

The sample was ground and dried at 100°C:—

Silica	SiO ₂	..	..	65.92
Alumina	Al ₂ O ₃	..	..	21.02
Ferric Oxide	Fe ₂ O ₃	..	..	0.31
Lime	CaO	..	..	1.03
Alkalies	{ K ₂ O } { No ₂ O }	..	..	11.84
Total				100.12

(4) *Disintegrated Felspar from Toova Road, Panch Mahals District—*

The sample was ground and dried at 100°C:—

Silica	SiO ₂	..	..	75.27
Alumina	Al ₂ O ₃	..	..	9.15
Ferric oxide	Fe ₂ O ₃	..	..	4.37
Lime	CaO	..	..	0.92
Alkalies	{ K ₂ O } { No ₂ O }	..	..	10.17
Total				99.88

(5) *Bassein clay from Thana District—*

The clay was powdered and lawned through 200 mesh and dried at 100°C :—

Loss on ignition	..	..	..	..	11·62
Silica	SiO ₂	..	..	..	33·64
Alumina	Al ₂ O ₃	..	..	..	29·16
Ferric oxide	Fe ₂ O ₃	..	..	..	19·32
Titanium	TiO ₂	..	..	..	0·83
Lime	CaO	..	..	..	0·41
				Total ..	99·98

(6) *China clay from Hadinbal near Honawar, North Kanara District—*

This sample was obtained from the mine owners from their stock of sale.

The clay was dried at 100°C :—

Loss on ignition	..	..	..	..	10·56
Silica	SiO ₂	..	..	..	46·54
Alumina	Al ₂ O ₃	..	..	..	37·67
Iron oxide	Fe ₂ O ₃	..	..	..	4·02
Lime	CaO	..	..	..	0·50
Magnesia	Mgo	..	..	..	0·80
				Total ..	100·09

(7) *Red clay from Jalgaon, Ratnagiri District—*

All the samples were mixed in equal proportions and ground. The sample was then taken and dried at 100°C :—

Loss on ignition	..	..	..	..	13·07
Silica	SiO ₂	..	..	..	24·46
Alumina	Al ₂ O ₃	..	..	..	22·24
Ferric oxide	Fe ₂ O ₃	..	..	..	40·15
Lime	CaO	..	..	..	0·50
Magnesia	Mgo	..	..	..	Traces
				Total ..	99·97

N.B.—All the analyses were made by Mr. P. M. Shah, B.Sc., the Assistant Chemist at the Royal Institute of Science. Duplicate analyses were made and the average analyses have been recorded.

7. GENERAL OBSERVATIONS ON THE SELECTED CLAYS.

(a) Panch Mahals District clays, felspar and quartz.

The samples of clays taken from the village Balatia and Rajpur are suitable clays for manufacturing various pottery articles. Felspar from Toova Road gives identical results to the Felspar from Ajmer and Beawar. Quartz from Sant Road is a fine specimen available in quantity. The raw materials required to manufacture white ware are all available from this district except China clay. Mr. Mukerji, the geologist who surveyed this area reports that sufficient quantity of all these materials is available and these are likely to last a number of years for a big size commercial concern.

Having satisfied myself about the quantity and quality of raw materials I decided to carry on my trials and experiments on these clays. Having made a number of experiments, I manufactured specimens. Detailed work has been done in two directions namely for cottage industry and for a power driven up-to-date white ware factory to be established in a city like Bombay.

Cottage Industry.

The specimens are made on Potter's wheel and care has been taken not to use any power driven machinery. The processes employed are simple and do not require capital expenditure. If the processes are shown to the potters, they can easily follow them and turn out the goods without any trouble.

The village potters can manufacture the following :—

(1) White garden pots, Kujas, Drainage pipes—

These articles are made on potter's wheel from the local clays. The clays have been sifted through 120 mesh and the residue containing grit and sand is removed. The clay is semi dried and wedged by hand until the homogeneous mass is obtained. Shapes are made on the wheel and when the shapes are leather hard, they are turned on the wheel and polished. After these are dried white, they are fired in wood fired furnace at 1080°C.

(2) Vitreous ware—

Chutney pots, bowls and mortar and pestles.

These are made on potter's wheel. The bodies for making these articles are made from the mixture of clay, felspar and quartz. These articles are fired at 1200°C in the wood fired furnace.

Chutney pots and bowls are vitreous and acid proof. They do not retain any stain of either oil or organic matter after use. They are cleaned very easily with soap water.

Mortar and pestles are largely used by physicians. They are not manufactured in this country. Though the demand is limited, the price realised is very remunerative.

(3) Firebricks and fireclay—

Firebricks are made from these clays. Care has to be taken that the vein of lime stone at the clay pits has to be discarded. The clay is ground and mixed with burnt articles of clay in certain proportion and bricks are made in wooden moulds. When they are dried, they can be fired in wood fired furnace at 1200°C.

Derol is a railway station and near Ahmedabad and Baroda. In Ahmedabad alone there are a hundred factories which use firebricks. There is no place nearer to Ahmedabad which can supply firebricks as cheap as Derol can supply. If one potter engages himself to manufacture these bricks, he will only require one furnace and will make sufficient to maintain himself.

Fireclay—

The clay from the pit has to be ground and lawned 80 mesh and can be sold as fireclay for ordinary purposes.

(4) Cheap glazed ware—

Glazed bowls, chutney pots, medicinal pots, tea pots, sugar basin, milk jug, pickle jars, etc.

These are all made on potter's wheel. The body mixture is composed of clay, ground felspar and ground quartz. The shapes which could not be made on potter's wheel are made in plaster moulds and these types of ware are not included in cottage industry for the present. The handles and spout for tea pots, etc., are made by pressing the clay in plaster moulds. These moulds are to be supplied from the proposed Central factory in Bombay.

The articles made on the wheel are turned and dried. They are dipped into the glaze which is to be supplied from the proposed Central factory. The ware are fired at 1200°C. The articles made by this process are of stone ware type and there will be no trouble of crazing as experienced in earthenware.

Saggars that is boxes made from clay will have to be made. The goods will be placed in these boxes and fired in the furnace.

Quartz at Sant Road, Panch Mahals District.

The quartz deposits are in abundance and the quartz is exported to Bombay. Glass factories use this quartz in place of sand. The outside coating of iron oxide when calcined is easily removed. It contains no impurity. One can depend upon the

quality and quantity which would last a number of years; the cost is not prohibitive. It can be had at Rs. 12 per ton delivered in Bombay.

Felspar at Toova Road, Panch Mahals District.

The felsphatic deposits are under the bed of the river and by the constant flow of water out crop is decomposed. Very few pieces of pink felspar of the size of 2 inches square are available on the surface. A few pits were made and at the depth of 4 to 6 feet decomposed felspar was obtained. All the area round about is flooded in monsoon and wherever an attempt was made to dig, in all the places, the decomposed rock was obtained. In all the traverse work, we did not come across a single place where a large deposit of either felspar or granitic rock having predominance of felspar was found. It is possible that if pits were made twenty to thirty feet deep at a distance of fifty to sixty feet from the river bed and the nalas protruding from the river bed, actual deposits of the parent rock may be found out.

We did not undertake this work, as the time at our disposal was short and we were mainly concerned with china clay deposits.

Whatever felspar in the form of rock and decomposed mass was found, was used in making the bodies and the result was as good as that obtained with the felspar from Ajmer. The analysis of felspar also shows that it is pure orthoclase.

It is advisable to do thorough geological survey by digging traverse pits from the nalas where there is the exposure of felspar to the place where the actual rock not affected by water is found. The geologist will take at least three months to do thorough traversing and pit work.

Industrial prospects in the district.

From the places visited by me and the samples of clays, felspar and quartz obtained from these places, I am of the opinion that Pottery industry can be developed as a cottage industry in this district. The raw materials required for the purposes are available in the district. Fire wood also is available in abundance as there are some forests nearby. Water is also plenty. As mentioned before, prepared glazes can be supplied from the Central factory in Bombay. Technical advice can be supplied by the Industries Department and marketing of goods also can be undertaken by the marketing officer of the Department.

It is advisable that one family of potter should make only one kind of pottery article and just enough without engaging outside labour. The furnace should be supplied by Government on hire-purchase system and when not in use, the other potter can use the same under certain conditions. The following units as village industry can be brought in existence in this district.

- (1) (a) Kujas, garden pots, drainage pipes ;
- (b) Firebricks and fireclay.
- (2) Glazed tea pots, sugar basins, milk jugs, pickle jars, chutney pots, white and coloured, glazed garden pots.

(b) Bassein clay in Thana District.

The clays from Gokhera, Bhoida village areas obtained from different pits and at various depths have been tested and found to be of same quality and free from lime. Test samples showed more or less the same result except the variation in shades of colour. For commercial use it is better to take the average sample of clay available.

A large percentage of clay is very hard and requires weathering for a season or two. Alternatively it has to be crushed and ground before it can be taken in use. The clay is silicious and plastic. Varied use of this clay can be made in Pottery manufacture.

Industrial Prospects.

Bassein is a railway station and is about thirty miles from Bombay. The clays are about 2½ miles distant from the railway station.

Articles manufactured in Bassein can be conveniently sold in Bombay market and distributed to various parts of the Province due to the facility of motor service and sea transport,

The following units can be established as cottage industry :—

- (1) Building bricks, drainage pipes, kujas, and garden pots.
- (2) Glazed tea pots, sugar basins, milk jugs, garden pots, vases, chutney pots, etc.

I have included building bricks especially as the bricks made by people in the village are not so hard and compact as they should be. There is a great necessity to manufacture a good brick which would stand the test of architects. If the bricks are pressed and after firing are sufficiently hard, there will be no necessity for plastering the brick work either with chunam or cement. No machinery is necessary except that mentioned in the equipment for fire brick manufacture. (Appendix III, 3.)

(c) Belgaum District clays.

This district has the reputation of having china clay deposits at various places. Most of the places were visited. Invariably all the deposits were found contaminated with iron due to percolation of the decomposed laterite clays which form the part of overburden on these deposits. A pit was dug nearly fifteen feet under the overburden of laterite clay and the yellow contaminated china clay was obtained. Though the samples appear to be white, when burnt change into yellow mass. These deposits cannot be used in place of china clay; but these can be utilised as a mixture to any other clays where china clay has to be used and the colour is no consequence. As an instance, in Khanapur in Belgaum District, there are two roofing tile factories and if cheap glazed ware or high class *terra cotta* ware are proposed to be made, one can very well with advantage use these contaminated china clays in the body mixture.

Desur a village near Belgaum has got the same kind of deposit. Information was given to us that the clay is being sold as fire clay. When tests were made it was found that the clay is the disintegrated granite rock contaminated with laterite clay.

In Kapoli, a number of pits were made at different levels and in no case white china clay deposit was obtained.

In Gunji, a better type is available but the clay is not white.

Ghatgoli clay.—Two samples were taken from two different places. One sample when burnt gave a fairly white coloured tile. The deposits are along the nalas. On one side, the clay is contaminated with iron while on the other side, it is nearly free from iron.

It is necessary to do further investigation in this particular area in hot season when the water is dried up and it is easier to dig pits. Thorough investigation will take about three months and if the clay deposits of better quality and large quantity are found, there is a likelihood of developing a china clay industry. The indication on one side is very promising and worth trying.

Castlerock clay.—This clay is silicious and when burnt gives fairly white tile. It is non-plastic. It can be used in a mixture but not in place of china clay. China clay has got more alumina than this type of clays. This clay cannot be called pipe clay as it has not got any plasticity. Pipe clays are very plastic. The origin of the Castlerock clay appears to be from the disintegrated sandstone rocks combined with the transported deposits of the decomposed granite.

(d) North Kanara District clays.

China clay from Hadinbal near Honawar.—The deposits are extensive and are under the overburden of laterite clays about 15 to 20 feet.

Better quality can be obtained if the mining is done by step system.

Exposed clay deposits contaminate with iron during monsoon and when the mine is opened for working next season, a large quantity of china clay has to be removed before actual digging is done.

Levigation is not properly done and a large quantity of mica remains in the clay. The china clay is sold as third quality clay. If the proper levigation is done on scientific basis, there is a great potentiality of the china clay mines being worked profitably.

Most of the clay samples collected are useful for manufacturing cheap red ware and Mangalore type roofing tiles.

(e) Ratnagiri District clays.

Jalgaon clays.—The samples were received from the geologist Mr. Mukerji under the instructions from the Director of Industries.

The geological survey report has been submitted. It appears from this report that there is abundance of clay deposits of uniform type. From tests, it shows that the clay is free from lime and is plastic.

From experiments on commercial scale I am of the opinion that Mangalore tiles and cheap glazed ware can be manufactured as good as those sold in the market.

(B) CONSTRUCTION OF A FURNACE FOR THE USE OF VILLAGE POTTERS USING WOOD FUEL FOR FIRING CHEAP GLAZED WARE.

(a) The furnace was designed by Mr. M. E. Haskell, the Industrial Engineer.

The furnace has three fire mouths. It is 4 feet inside diameter and 4 feet 2 inches high inside. The dome has been made from the specially designed blocks instead of arch bricks. The outer cover of the body of the furnace is built with red bricks from the bottom of the furnace while the whole foundation and the flues are built with fire bricks. The central flue of the furnace is joined with the iron chimney about 82 feet high.

The furnace was ready for use in the month of April 1939. (See Photograph No. 21, Appendix IV.)

Experimental firing of the furnace.

(1) Date of firing	..	..	..	..	1st May 1939.
When finished	..	..	..	..	2nd May 1939.
Total time	..	..	..	..	30·75 hours.
Wood consumed	..	..	..	..	2½ khandies.
Temperature	..	..	..	..	1130°C.

Result.—Mosaic tiles 6"×6" were fired in the furnace. Temperature was not uniform and the difference from top to the bottom was about 100°C. Goods got over-fired at the top and whereas at the bottom they turned out good.

(2) Change in damper arrangement was made and the furnace was again fired on 5th May 1939—

Date of firing	..	..	..	..	5th May 1939.
When finished	..	..	..	..	6th May 1939.
Total time	..	..	..	..	20 hours.
Wood consumed	..	..	..	..	3½ khandies.
Temperature	..	..	..	..	1200°C.

Result.—Setters, porcelain glaze tea pots and chutney pots were fired. Temperature was not uniform. All the articles were deformed and the setters cracked due to quick firing.

(3) Damper kept as before—

Date of firing	..	..	..	..	8th May 1939.
When finished	..	..	..	..	9th May 1939.
Total time	..	..	..	..	21½ hours.
Wood consumed	..	..	..	..	2 khandies.
Temperature	..	..	..	..	1080°C.

Result.—Articles made from red clays were fired and at the top white clay articles were placed for firing. Temperature was not uniform. Goods placed at the bottom were under-fired and those at the top were over-fired.

(4) Change of damper and the regulation of secondary air adopted—

Date of firing	..	..	..	..	17th May 1939.
When finished	..	..	..	..	17th May 1939.
Total time	..	..	..	..	12 hours.
Wood consumed	..	..	..	..	2 khandies.
Temperature	..	..	..	..	1080°C.

Result.—Articles made from red clay were glazed and fired. Top temperature was more than that at bottom. Some articles at the top were over-burnt. The result was more satisfactory.

(5) Damper was kept 8 inches open and secondary air holes were closed—

Date of firing	..	..	..	..	21st May 1939.
When finished	..	..	..	..	21st May 1939.
Total time	..	..	..	..	12 hours.
Wood consumed	..	..	..	..	2½ khandies.
Temperature	..	..	..	..	1130°C.

Result.—All white glazed articles were fired in the furnace. The temperature was not uniform and the glaze on the articles was dried up.

(6) The damper was kept 9 inches open and secondary air holes were closed—

Date of firing	..	..	..	..	25th May 1939.
When finished	..	..	..	..	25th May 1939.
Total time	..	..	..	..	15½ hours.
Wood consumed	..	..	..	..	2½ khandies.
Temperature	..	..	..	..	1200°C.

Result.—White and coloured porcelain glaze articles were fired. Though the temperature was not uniform the result was good. There was only 10 per cent. wastage.

(7) Position of damper and secondary air holes same as No. 6—

Date of firing	..	..	..	..	31st May 1939.
When finished	..	..	..	..	31st May 1939.
Total time	..	..	..	..	13½ hours.
Wood consumed	..	..	..	..	2½ khandies.
Temperature	..	..	..	..	1200°C.

Result.—Porcelain glaze (coloured) was applied to tea sets and fired. Though the temperature was not uniform from the top to the bottom, the result was quite satisfactory.

(8) Having obtained satisfactory result in No. 7, further alteration was made in the supply of primary air—

Damper was kept 8 inches open.

Secondary air holes closed.

Primary air hole was closed 3 inches.

Date of firing	..	..	..	..	3rd June 1939.
When finished	..	..	..	..	3rd June 1939.
Total time	..	..	..	..	11 hours.
Wood consumed	..	..	..	..	2 khandies.
Temperature	..	..	..	..	1080° C.

Result.—Green goods such as tea pots, etc., from white clays and red clays were fired. White clay goods were kept at the top and the red ones at the bottom. The atmosphere in the furnace was not sufficiently oxidising and all the red ware were over-fired due to reduction.

(9) Damper kept 6" open.

Secondary air holes closed.

Primary air holes closed 3".

Date of firing 7th June 1939.

When finished 8th June 1939.

Total time 18 hours.

Wood consumed 2 khandies.

Temperature 1080°C.

Result.—Green white clay and red clay goods were fired. The atmosphere inside the furnace was reducing and the heat was not uniform. All red clay goods were over-fired and reduced.

(10) Damper kept 6" open.

Secondary air holes closed.

Primary air holes closed 6".

Date of firing 13th June 1939.

When finished 13th June 1939.

Total time 11½ hours.

Wood consumed 2 khandies.

Temperature 1080°C.

Result.—Glazed articles made from red clay were fired. The temperature was not uniform. Top ware were over-fired. There was no reduction. Result was better than that of Nos. 8 and 9.

(11) The bottom arrangement was totally changed and made similar to the one used in coal fired furnace. Flue holes at bottom closed.

Damper kept 6" open.

Secondary air holes kept closed.

Primary air holes closed 9".

Date of firing 17th June 1939.

When finished 17th June 1939.

Total time 13½ hours.

Wood consumed 2½ khandies.

Temperature 1200°C.

Result.—Porcelain glazed articles were fired. The glazed articles came out quite satisfactory. The temperature was fairly uniform from bottom to top. The difference was about 20°C.

Note.—If the furnace is fired as above, there will be no difficulty in getting uniform results. This furnace has the bag walls in the body of the furnace. This takes up

nearly 33 per cent. of the space inside the furnace. The quantity of ware is fired nearly 40 per cent. less than that of coal fired furnace. To solve this problem, it was proposed to remove the bag walls and incorporate them into the wall of the furnace.

This change was made and the firemouths were altered.

The remodelled furnace was fired.

(12) Date of firing	..	..	..	..	6th July 1939.
When finished	..	..	..	..	7th July 1939.
Total time	..	..	..	..	24½ hours.
Wood consumed	..	..	..	..	3 khandies.
Temperature	..	..	..	..	1130°C.

Result.—There was no full circulation of gases. The temperature at the top opposite the firemouths and at the bottom opposite the three holes in the wall was more than the temperature in the middle part of the furnace. The temperature at the top was highest and at the bottom more than the middle part. The temperature of the furnace between the firemouths was much less than in the body of the furnace.

Damper was kept 6" open.

Primary air holes 9" closed.

Secondary air holes closed.

Result was satisfactory.

(13) Alteration was made by closing two holes out of three in the bag wall—

Damper kept 4" open.

Secondary air holes closed.

Primary air holes closed 9".

Date of firing	..	..	..	..	12th July 1939.
When finished	..	..	..	..	13th July 1939.
Total time	..	..	..	..	23½ hours.
Wood consumed	..	..	..	..	3 khandies.
Temperature	..	..	..	..	1130°C.

Result.—The temperature at bottom and the top was nearly equal. In the middle part of the furnace the temperature was low. The fuel consumption is more as the once fired articles were fired. The drawback of poor circulation of gases still remains.

(14) Bottom flue holes were closed.

Damper kept 6" open.

Holes of primary and Secondary air kept closed.

Date of firing	..	..	..	..	19th July 1939.
When finished	..	..	..	..	19th July 1939.
Total time	..	..	..	..	17½ hours.
Wood consumed	..	..	..	..	3½ khandies.
Temperature	..	..	..	..	1200°C.

Result.—Temperature fairly uniform. Goods fired were firebricks. The weight of goods was one ton and 7 cwts. The fuel consumption is proportionately less than coal.

(15) Bottom flue holes kept closed.

One hole in the bag walls at the bottom was open.

Flue arrangement was kept similar to that of coal fired furnace.

Damper kept 6" open.

Holes for secondary and primary air kept closed—

Date of firing	..	..	..	..	27th July 1939.
When finished	..	..	..	..	27th July 1939.
Total time	..	..	..	..	17 hours.
Wood consumed	..	..	..	..	3 khandies.
Temperature	..	..	..	..	1200°C.

Goods fired :—

Butter milk pot 8" white glaze.

Jars big.

Jars small.

Tea sets porcelain white.

Result.—Fairly uniform. Temperature at the centre was little more than at the top. The difference of temperature at top and bottom was about 20°C. The only defect which remains to be solved is to get the flame from the firemouth to be drawn towards the dome and then to be drawn down. This can be done by having the firemouth six inches higher inside and to have the firemouths lengthened outside about 12".

(b) Conclusions.

(1) The furnace built as before if fired as shown in the experiment No. 11 good result will be obtained. The quantity of ware will be less fired by this arrangement.

(2) The remodelled furnace if fired as shown in the experiment No. 14 good result will be obtained. The quality of ware fired compared well with the quality fired in the coal fired furnace.

(3) The cost of wood fuel will be 25 per cent. cheaper than that of coal, and it is easier to obtain in the villages. Its photograph is at No. 21 under Appendix IV. No chimney was erected as the requisite facilities for same were readily available at the Bombay Potteries & Tiles, Ltd., Mazagaon, where this small experimental furnace was set up at an expenditure of about Rs. 1,200.

(4) After making the suggested alterations in the furnace firemouths, the remodelled furnace of a larger size and capacity can be taken as a standard wood fired furnace for the use of the village potters and may cost about Rs. 3,500.

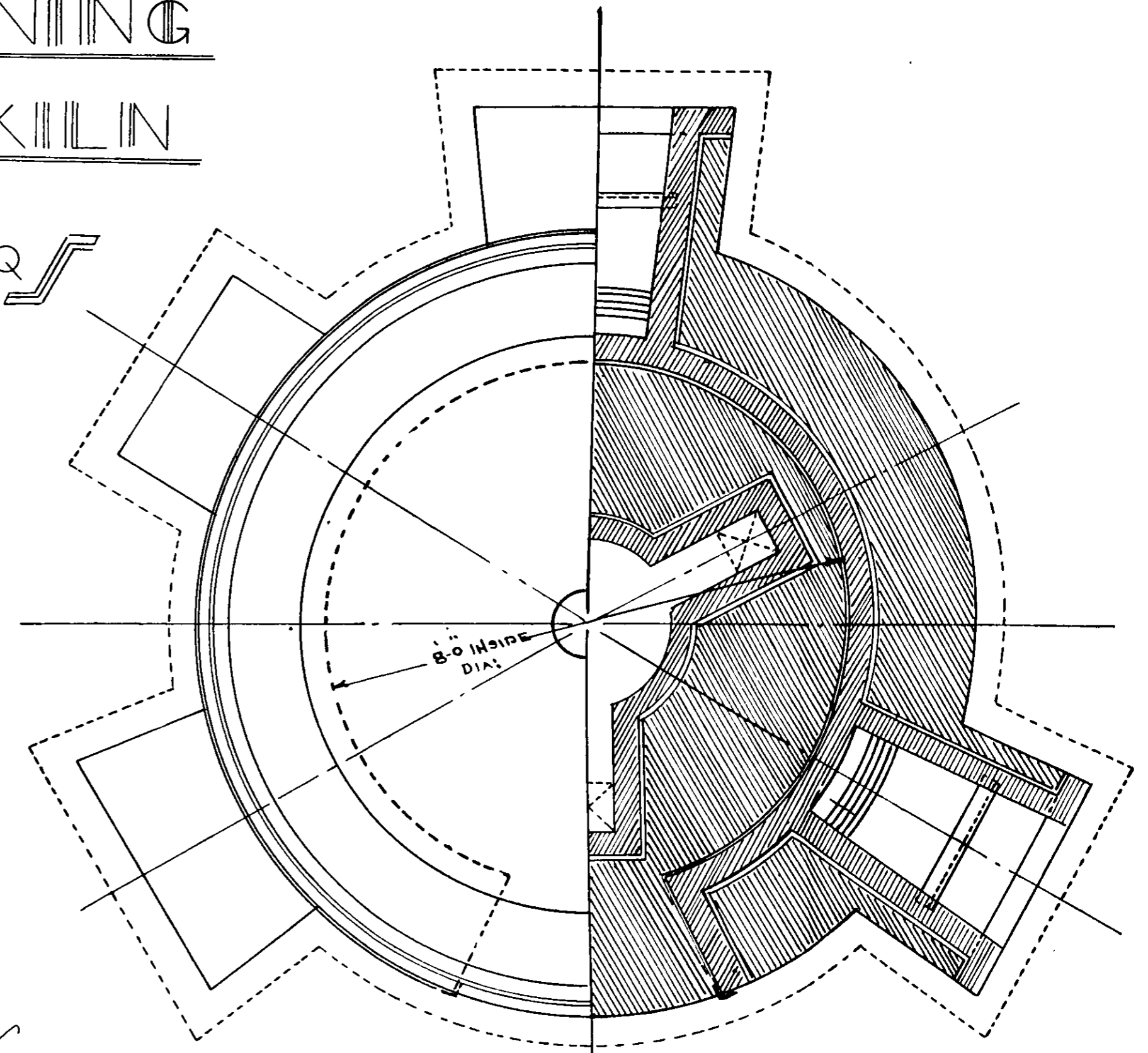
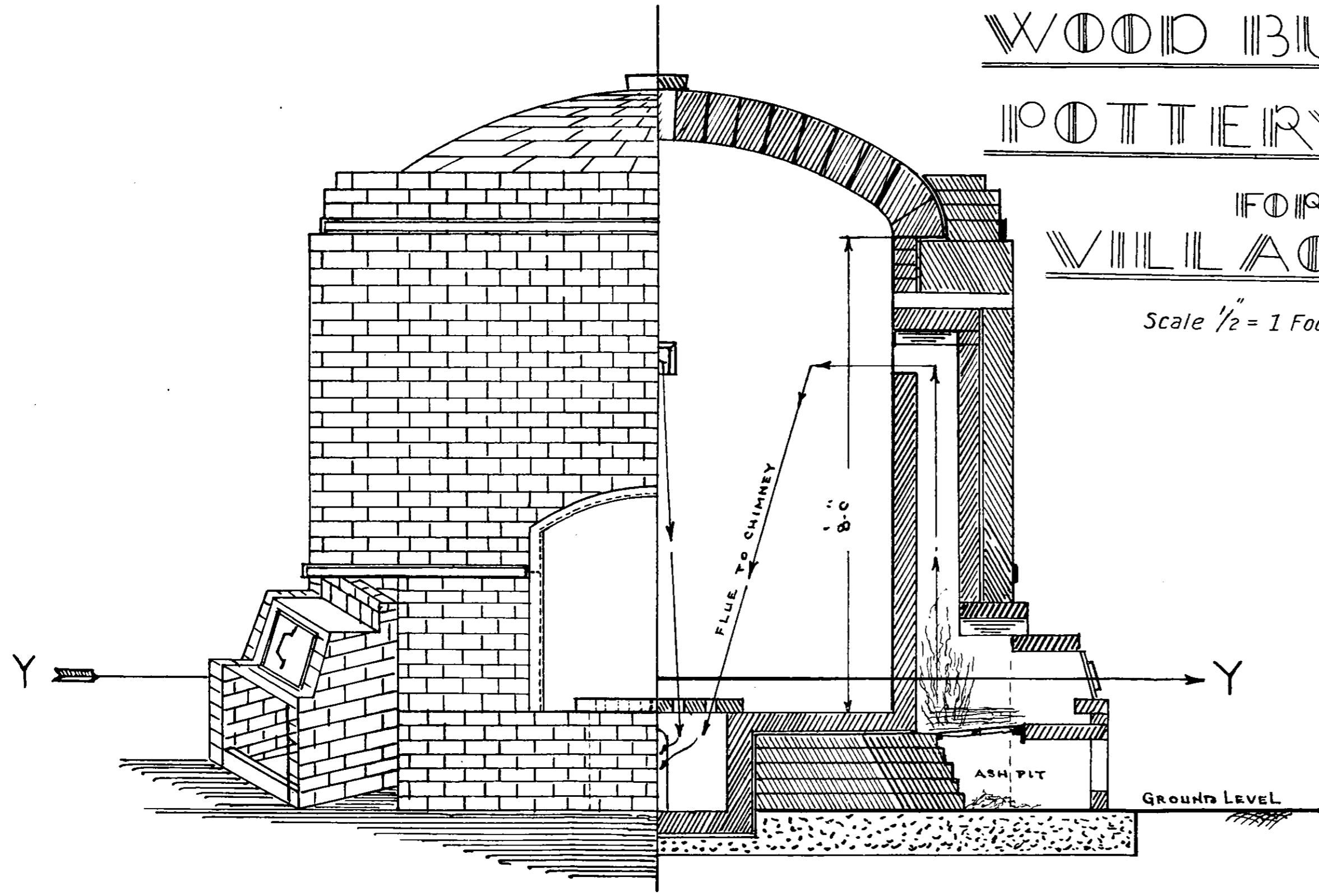
C. P. SHAH,
Pottery Expert.

WOOD BURNING

POTTERY KILN

FOR VILLAGERS

Scale $\frac{1}{2}'' = 1$ Foot



VIEW, HALF SECTION AND HALF ELEVATION.

Mastakel
INDUSTRIAL ENGINEER,
DEPT. OF INDUSTRIES,
BOMBAY
19-3-40.

PLAN AT LEVEL Y.Y.

APPENDIX III.

CONTENTS.

ESTIMATES.

	Page
(1) Estimates for a small Central Factory which would provide to the village potters in the Province, ground prepared materials for body mixing and glaze mixes for the manufacture of cheaper quality of glazed pottery ware, and unglazed pottery ware	87
Proposed plan of a small central factory (Facing)	90
(2) Estimates for the manufacture of cheap Red Glazed ware on the basis of a small scale industry at Bassein in Thana District	91
(3) Estimates for the manufacture of Kujas, Drainage pipes, Garden pots, Fire-bricks and Fire-clays on the basis of a small scale industry at Derol in Panch Mahals District	94
(4) Estimates for the manufacture of cheap glazed ware on the basis of small scale industry at Derol in Panch Mahals District	96
(5) Estimates for an up-to-date factory for the manufacture of Cups, Saucers, Plates and Dinner ware	99
Proposed plan of a factory to manufacture white ware (Facing)	114

APPENDIX III.

ESTIMATES.

(1) ESTIMATES FOR A SMALL CENTRAL FACTORY WHICH WOULD PROVIDE TO THE VILLAGE POTTERS IN THE PROVINCE GROUND PREPARED MATERIALS FOR BODY MIXING AND GLAZE MIXES FOR THE MANUFACTURE OF CHEAPER QUALITY OF GLAZED POTTERY WARE AND UNGLAZED POTTERY WARE.

The functions of such a Central Factory will be—

- (1) To provide all mixing materials for bodies to the village potters to manufacture cheap pottery.
- (2) To test the bodies and glazes for the use of village potters and teach them how to use them on commercial scale.
- (3) To train up the village potters to manufacture pottery articles from indigenous clays by modern methods.
- (4) To solve the difficulties which village potters come across in course of manufacture.
- (5) To supply glazes, colours and other necessities to village potters in order that they can carry on manufacture without difficulties.

Machinery.—

	Rs.	Rs.
(1) Stone Breaker	1,200	
(2) Crushing Rolls } Elevator } Screen }	1,000	
(3) Wet grinding cylinder	1,950	
(4) Glaze grinding cylinder	1,950	
(5) Colour grinding mill	600	
(6) Clay making plant for trial bodies	3,000	
(7) One Pug Mill	500	
(8) Potter's wheel	500	
(9) Whirlers	100	
(10) Electric Motors.		
Two 10 H.P. } Two 5 H.P. } Three 2 H.P. }	1,000	
	11,800	
Add Shafting pulleys and erection charges	1,200	
	13,000	

	Rs.	Rs.
<i>Buildings.—</i>		
(1) One Shed 20' × 15' × 12'— Stone Breaker and Crushing Rolls, Elevator and Screen		
(2) Shed 20' × 15' × 12' .. Glaze grinding, Body mixing. ..		
(3) Shed 20' × 15' × 12'— Workshop to make articles and other processes		
(4) Furnace shed, 30' × 15' × 12' ..		
(5) Office and Store room— 30' × 15' × 12' (Items 1 to 5)		20,000
<i>Furnaces.—</i>		
(1) Down draught circular furnace wood fired 4' dia. Chimney 3'-3" dia. 75' high	2,400	
(2) Frit Furnace	300	
(3) Calcining Furnace	300	
		3,000
<i>Equipment.—</i>		
Drying Racks	200	
Boards	100	
Work tables	100	
Tools	100	
Office Equipment	500	
		1,000
<i>Total Capital expenditure.</i>		
Machinery	13,000	
Buildings	20,000	
Furnaces	3,000	
Equipment	1,000	
		37,000
Total ..		37,000

Recurring Expenditure.

<i>Staff—</i>					Rs.
Manager	..	..	..	..	150
Fitter	..	..	..	..	50
Potter	..	..	..	..	50
Fireman	..	..	..	..	50
Clerk	..	..	..	..	50
Workmen	6	..	..	..	120
Sepoy	..	..	..	..	30
					500 per month
					6,000 per year

Other Expenditure.

It will be necessary to provide a contingent grant to buy raw materials, stores etc. to carry on the work of the factory. It is understood that in the beginning the village potters should be charged for the prepared raw materials for mixing and glazes etc. the actual cost. The overhead expenses should be borne by Government because the production of these materials will be small but actual expenses incurred in preparing and manufacturing raw materials and glazes should be added before fixing their prices for sale. There will be no loss in the proposed contingent grant of Rs. 3,000 a year.

Capacity of Production.

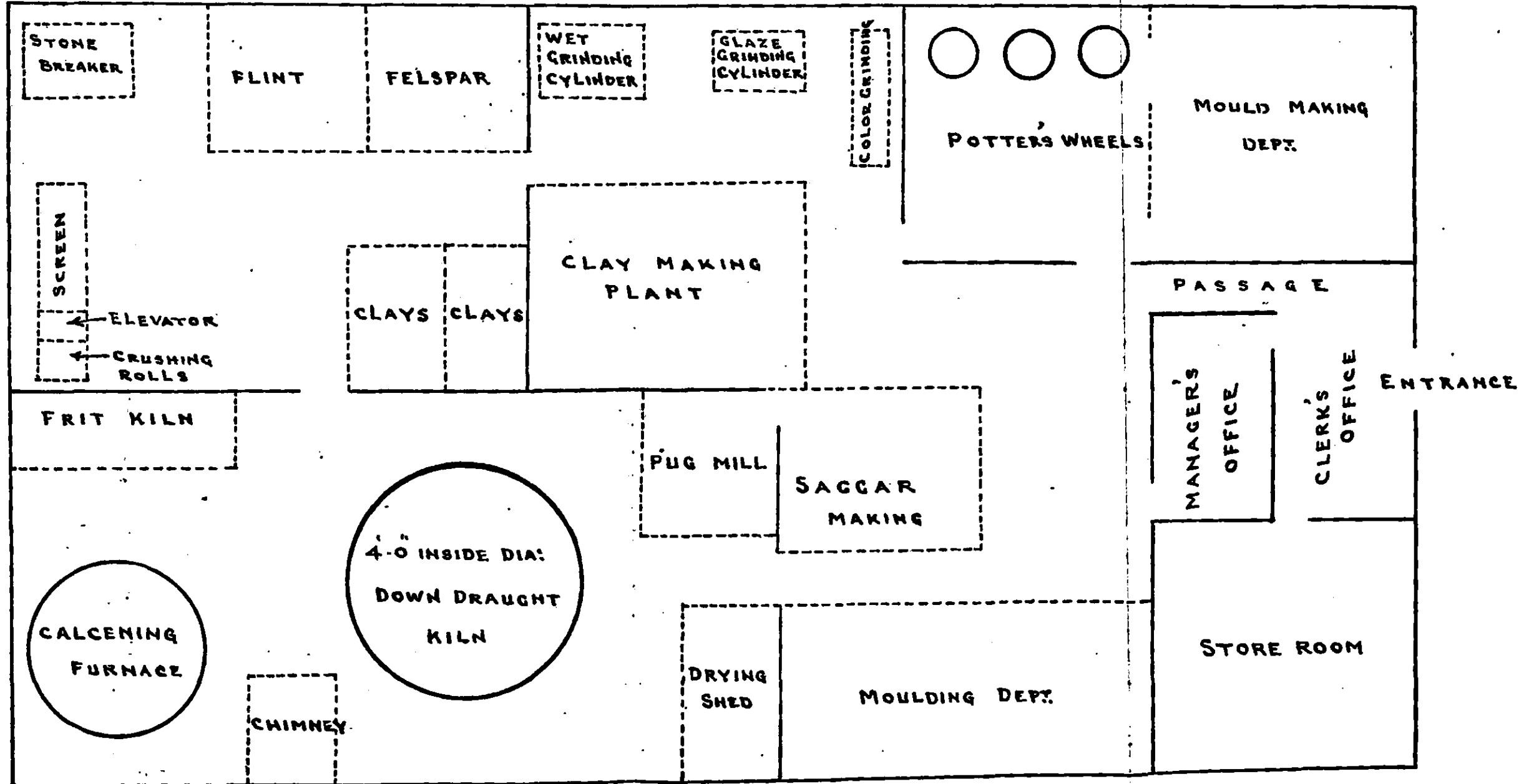
Clay bodies	..	..	..	4 cwts. a day.
Ground felspar or quartz	..	..	..	5 " "
Frit	..	..	..	2 " "
Glaze mix	..	..	..	5 " "
Saggars	..	..	..	20 per day.

Summary.

				Rs.
Capital Expenditure	..	..	..	37,000
Recurring Expenditure	..	..	..	6,000
Contingent grant	..	..	..	3,000
<hr/>				
46,000				

Note.—Prices of machinery etc. are those existing during the middle of 1939.

PROPOSED PLAN OF
A SMALL CENTRAL FACTORY



(2) ESTIMATES FOR THE MANUFACTURE OF CHEAP RED GLAZED WARE ON THE BASIS OF A SMALL SCALE INDUSTRY AT BASSEIN IN THANA DISTRICT.

The clay available is in hard lumps and requires to be weathered for one season. Grinding is not necessary later on.

(1) *Equipment*—

			Rs. a. p.
Bullock-driven pug mill	..	..	75 0 0
One cart	..	..	75 0 0
Hand-driven screen	..	..	100 0 0
Potter's wheel	..	..	50 0 0
Wooden racks	..	..	100 0 0
Wooden planks	..	..	200 0 0
Tubs, six	..	..	50 0 0
Working benches, two	..	..	25 0 0
Pair of bullocks	..	..	100 0 0
Tools, etc.	..	..	50 0 0
Saggars-making whirler	..	..	25 0 0
			<hr/>
			850 0 0
Two Tanks, 5' × 5' × 2'	..	}	250 0 0
Two Tanks, 10' × 2' × 10'	..		
			<hr/>
			1,100 0 0
			<hr/>
(2) <i>Building Sheds</i> —			
Three Sheds, 20' × 20'	..	}	1,500 0 0
One Shed, 40' × 20'	..		
			<hr/>
(3) <i>Furnace</i> —			
8' diameter with 80' chimney	..	..	3,500 0 0
			<hr/>
(4) <i>Saggars</i> —			
15" diameter, 300	..	..	400 0 0
			<hr/>

(5) *Total Capital Expenditure—*

				Rs.	a.	p.
Equipment	..	..	..	850	0	0
Tanks	..	..	..	250	0	0
Furnace	..	..	..	3,500	0	0
Buildings	..	..	..	1,500	0	0
Sundry equipment	..	..	..	100	0	0
Saggars	..	..	..	400	0	0
				<hr/>		
				6,600	0	0
				<hr/>		

(6) *Monthly production—*

- 300 Tea pots.
- 300 Sugar basins.
- 300 Milk jugs.
- 100 Chutney pots (sets of three).
- 25 Vases.
- 50 Jars (500 lbs.).
- 100 Garden pots.
- 25 Kujas.

(7) *Cost of production—*(a) *Raw Materials—*

				Rs.	a.	p.
Red clay one ton.	..	..	..	5	0	0
China clay five cwt.	..	..	..	10	0	0
Ground quartz two cwt.	..	..	..	4	0	0
Glaze	..	..	..	15	0	0
				<hr/>		

34 0 0

(b) *Firewood 12 Khandies—*

.. .. 50 0 0

(c) *Saggars*

.. .. 15 0 0

(d) *Labour—*

2 Potters at Re. 1 a day 60 0 0

2 women at annas 6 a day 22 8 0

2 Labourers at annas 8 a day 30 0 0

1 Boy at annas 8 a day 15 0 0

127 8 0

226 8 0

					Rs. a. p.
Brought forward ..					226 8 0
(e) Plaster moulds	..	..	..	..	10 0 0
(f) Stores	..	..	..	..	10 0 0
(g) Cost of maintaining bullocks	..	..	..	..	30 0 0
(h) Water	..	..	..	..	5 0 0
Total Cost ..					281 8 0
<i>Sale Proceeds—</i>					
300 Tea sets at Re. 1 a set	..	..	..	..	300 0 0
100 Chutney pot sets at annas 6 a set	..	..	..	..	37 8 0
25 Vases at annas 6 each	..	..	..	..	9 6 0
50 Jars (500 lbs.) at anna 1 a lb.	..	..	..	..	31 4 0
100 Garden pots at annas 4 each	..	..	..	..	25 0 0
25 Kujas at annas 4 each	..	..	..	..	6 4 0
					409 6 0
<i>Net result—</i>					
					Rs. a. p.
Sale proceeds	..	..	..	..	409 6 0
Cost of productions	..	..	..	..	—281 8 0
					127 14 0
<i>Deduct—</i>					
Interest on Capital Expenditure of Rs. 6,600 at 6 per cent. per annum	..	..	..	..	33 0 0
					94 14 0
<i>Deduct—</i>					
Depreciation at 5 per cent	..	..	..	..	27 8 0
					67 6 0
Net profit per month	..	..	..	..	67 6 0

(3) ESTIMATES FOR THE MANUFACTURE OF KUJAS, DRAINAGE PIPES, GARDEN POTS, FIREBRICKS AND FIRECLAY ON THE BASIS OF A SMALL SCALE INDUSTRY AT DEROL IN PANCH MAHALS DISTRICT.

Method of Working—

It is proposed that one potter and three persons to help him should work in a team.

Clay grinding is to be done with the iron rollers drawn by the pair of bullocks similar to chunam grinding. Six days in a month will be required to grind the clay. Two days will be required to grind the broken saggars. The ground material will be used as a mixture in making bricks. Clay mixing and pugging will require six days. Five days will be required for making bricks. Two days for cleaning and stocking.

Pipe making and Kuja making will require two days. Filling of the furnace, firing and emptying will require six days.

Summary—

Clay grinding 15 tons	..	Six days.
Grog grinding and lawning 2 tons	..	Two days.
Clay mixing and pugging	..	Six days.
Making of bricks, kujas and pipes	..	Seven days.
Cleaning bricks, etc.	..	Two days.
Filling the furnace, firing and emptying	..	Seven days.
		<hr/>
	Total	.. Thirty days.
		<hr/>

Capital expenditure—

Equipment.

		Rs.	a.	p.
Bullock driven roller 3"	..	75	0	0
Bullock driven Pug Mill	..	200	0	0
Hand driven screen	..	100	0	0
Potter's wheel	..	50	0	0
Wooden moulds	..	10	0	0
Pair of bullocks	..	100	0	0
		<hr/>		
		535	0	0
		<hr/>		

Buildings—

One shed 20' × 20' for furnace.

One shed 20' × 20' for manufacture.

One shed 20' × 20' for tanks.

Open space 40' × 20' for grinding clay.

Total area 100' × 20' required.

Total cost Rs. 750.

(1) Tank 10' × 5' × 2' for clay mixing.

(2) Tank 10' × 5' × 2' for clay mixing.

(3) Round Circular 20' diameter × 12" deep rack for grinding clay and pugging clay.

Total cost Rs. 125.

(4) 8' diameter furnace with chimney 80' high Rs. 3,500.

Total Capital expenditure—

	Rs.	a.	p.
Equipment	535	0	0
Tanks	125	0	0
Furnace	3,500	0	0
Sheds	750	0	0
	<u>4,910</u>	<u>0</u>	<u>0</u>

Monthly Production—

Firebricks 3,000 (9" × 4½" × 2½").
 Drainage pipes 50 (4" diameter and 2" long).
 Kujas 50.
 Garden pots 50.
 Fireclay 5 tons.

Cost of production—

Clay 15 tons at Rs. 5 per ton	75	0	0
Burnt clay 2 tons at Rs. 7-8-0 per ton	15	0	0
Cost of labour four men at annas 10 per day	75	0	0
Cost of fuel 200 mds. at as. 2 per md.	25	0	0
Cost of stores in form of oil, moulds, etc.	5	0	0
Cost of feeding the bullocks per month	20	0	0
Bags 100	6	0	0
Water	2	0	0
Total ..	<u>223</u>	<u>0</u>	<u>0</u>

Overhead expenses—

Interest on Capital invested Rs. 5,000 at 6 per cent. per month	25	0	0
Depreciation on Capital at 5 per cent. on Rs. 5,000	20	14	0
Total Cost ..	<u>268</u>	<u>14</u>	<u>0</u>

Sale price of production—

	Rs.	a.	p.
Firebricks at Rs. 8 per 100 3,000	240	0	0
Drainage pipes at annas 8 each 50	25	0	0
Kujas at annas 2 each 50	6	4	0
Garden Pots at annas 2 each 50	6	4	0
Fire clay at Rs. 12 per ton 5	60	0	0
Total ..	<u>337</u>	<u>8</u>	<u>0</u>

Net result—

	Rs.	a.	p.
Sale proceeds	337	8	0
Total cost	<u>268</u>	<u>14</u>	<u>0</u>

Profit per month. .. 68 10 0

(4) ESTIMATES FOR THE MANUFACTURE OF CHEAP GLAZED WARE ON THE BASIS OF
A SMALL SCALE INDUSTRY AT DEROL IN PANCH MAHALS DISTRICT.

Capital expenditure—

	<i>Equipment.</i>	Rs.
Iron Roller 3" diameter	75
Bullock driven Pug Mill	200
Hand driven screen	100
Potter's wheel	50
Wooden planks 1,000—8" × 8" at annas 4 each	250
Wooden racks	100
Tubs six	25
Working benches two	10
Pair of bullocks	100
Tools, etc.	50
	Total ..	960

Buildings—

3 Sheds 20' × 20'.	}	Total cost	..	750
1 Shed 40' × 20'.				

Furnace—

8 feet diameter furnace with chimney 80' high	3,500
---	-------

Total Capital expenditure—

	Rs.
Equipment	960
Tanks	125
Furnace	3,500
Buildings	750
	5,335
Sundry Equipment ..	165
Total	5,500

Monthly production—

	Rs.
Tea sets (Tea pot, sugar basin, milk jug)	50
Bowls 8" diameter	100
Bowls 7" diameter	100
Bowls 6" diameter	100
Bowls 5" diameter	100
Bowls 4" diameter	100
Bowls 3" diameter	100
Bowls 2" diameter	100

*Cost of production—**Raw Materials—*

	Rs.	a.	p.
5 tons clay at Rs. 5 per ton	25	0	0
5 cwt. flint at Rs. 40 per ton	10	0	0
3 cwt. felspar at Rs. 60 per ton	9	0	0
160 lbs. glaze materials with colour at annas 2 per lb. ..	20	0	0
350 maunds wood at annas 2 per md.	43	12	0

Cost of labour—

3 men at annas 10 a day	}	93	12	0
2 women at annas 6 a day				
2 boys at annas 4 a day				
Plaster moulds for handles		10	0	0
Stores and handles		10	12	0
Cost of maintaining 2 bullocks		20	0	0
Cost of water		2	0	0
Total		244	4	0

Overhead Expenses—

Interest on Capital of Rs. 5,500 at 6 per cent.	27	8	0
Depreciation at 5 per cent.	23	0	0
Total Cost	294	12	0

Sale Proceeds of Production—

	Rs.	a.	p.
Tea sets at Re. 1 each 50	50	0	0
Bowls 8" at Re. 0-4-0 each 100	25	0	0
Bowls 7" at Re. 0-3-6 each 100	21	14	0
Bowls 6" at Re. 0-3-0 each 100	18	12	0
Bowls 5" at Re. 0-2-6 each 100	15	10	0
Bowls 4" at Re. 0-2-0 each 100	12	8	0
Bowls 3" at Re. 0-1-6 each 100	9	6	0
Bowls 2" at Re. 0-1-0 each 100	6	4	0
Chutney sets at Re. 0-6-0 200	75	0	0
Pickle jars (five hundred pounds) Re. 0-2-0 per lb. pieces 100	62	8	0
Cups and saucers at Re. 0-2-0 each 300	37	8	0
Mortars and pestles 1-8-0 each 20	30	0	0
	Rs.	..	364 6 0

Net result—

Sale proceeds	364	6	0
Total cost	-294	12	0
Profit per month	69	10	0

Note.—The above two units (Nos. 3 and 4 of this appendix) have been proposed to start at one place and it is possible to work these units on Co-operative basis.

By buying one unit of equipment such as rollers, bullocks and pug mill and erecting one furnace, the Capital expenditure for both the units will be as follows :—

Combined Capital expenditure for both the units—

	Rs.	a.	p.
Iron Rollers 3" diameter	75	0	0
Bullock driven pug mill	200	0	0
Hand driven screen	100	0	0
Potter's wheels two	100	0	0
Wooden planks 1,000	250	0	0
Tubs six	25	0	0
Wooden racks	100	0	0
Working benches two	10	0	0
Pair of bullocks	100	0	0
Tools, etc.	50	0	0
Wooden moulds	10	0	0
Furnace	3,500	0	0
Tanks	250	0	0
Buildings	1,500	0	0
Sundry equipment	165	0	0
	Rs.	..	6,435 0 0

It will thus be seen that if worked separately, each unit will make a profit of Rs. 68-10-0 and Rs. 69-10-0 respectively and on co-operative basis the profit will be Rs. 85 per month and Rs. 89 per month and the Capital expenditure will be only Rs. 6,435 instead of Rs. 10,410.

Arrangements will have to be made for marketing these products and also for supplying prepared raw materials, glazes and technical advice.

(5) ESTIMATES FOR AN UP-TO-DATE FACTORY FOR THE MANUFACTURE OF CUPS, SAUCERS, PLATES AND DINNER WARE.

The planning of the equipment of the factory is based on the following daily production of eight hours :—

- 400 dozen cups and saucers.
- 200 tea sets.
- 25 sets of table ware of every description.
- 10 gross of sundry articles such as medicinal pots, etc.

Every day seven tons of body materials will be required for the manufacture of the above production.

The grinding cylinders for wet grinding quartz and felspar must be kept running from 16 to 20 hours every day, which may be done without hesitation, since they do not require any attendance during this working period.

The following is the short description of the working of the plant.

When laying out the plant it is considered in the first place that during the whole manufacturing process from the raw material to the finished ware the different operations should allow an uninterrupted manufacture avoiding any level crossing and the confusion which might result from it. Furthermore the use of the most modern equipment has been proposed, in order to mechanize all work with the minimum use of manual labour.

To manufacture cups, saucers, plates, etc., highly trained and experienced labour is necessary for mass production with proper finish at minimum cost to compete with foreign imported articles mainly from Japan and I have thought that this is the only method by which we can overcome the difficulty of untrained labour that is to mechanize most of the operations as far as possible.

The sides of the factory should have railway sidings, so that the coal and raw materials arriving in railway trucks can be unloaded straight into the corresponding stores whereas the finished ware can be loaded from the ware house into the railway trucks waiting for them.

The main building consists of five halls. Two of them contain the tunnel kilns. The two other halls contain the forming and finishing machines connected up to the tunnel kilns. In their prolongation line, there are storage and forwarding departments. The fifth hall contains frit making, frit furnace and the decorating department.

The preparation of body :—

As already mentioned above about seven tons of body materials will be required every day.

The composition of the white ware body is usually the following :—

Quartz and felspar	..	..	..	..	40 per cent.
China clay and other clays	..	..	..	..	60 per cent.

The felspar and quartz are rough ground by means of a separate group of machines. The materials are crushed in an Edge runner pan ; a bucket conveyor carries the crushed material to a sifting cylinder which sifts it to the desired size (of Sieve No. 30) and passes it into a Bunker below.

The sifted material is then charged on the pulverizing cylinders for wet grinding in which it is finely ground.

The china clays and other clays are conveyed by means of a bucket conveyor to the dissolving and mixing Blunger where they are dissolved. The finely ground material of the cylinders is conveyed by the compressed air plant to the dissolving and mixing Blunger and there thoroughly mixed with the dissolved clay. The finished liquid slip passes then through a sifting cylinder and as a precautionary measure through slip sifter and is made to arrive at last in the store tank which is provided with a screw Blunger acting as a stirrer after passing through the electro magnet.

A membrane pump conveys the liquid slip into the filter-press where it is passed into body cakes. In the filter-press shop there is room to spare to store up a sufficient quantity of body for scouring.

Forming or shaping of the articles to be made.—The body coming from the store shed is thoroughly pugged in the pugmill with vacuum equipment and made into rolls which are free from air bubbles and structureless. The body is then brought to the automatic plate making machine and cup making machine. Besides there is a row of jiggers with jolleys on which dishes, abnormal plates and other articles are made by jiggering. The body rolls coming from horizontal pugmill are cut into pieces of equal length and then shaped outside on the plate making machine.

The freshly made plates remaining on their plaster moulds are made to travel through the Dryer. At the end of the Dryer, the dried plates are removed from the plaster mould and the latter again placed into the Dryer, in which they are conveyed back to the automatic plate making machine. The whole period during which the moulds are kept in circulation in the Dryer is about one hour and twenty minutes. The plates removed from the plaster moulds are trimmed and finished on the jiggers arranged at the discharge end of the Dryer and then placed into racks provided for that purpose. They may also be placed into saggars directly, put on the platform wagons and conveyed through the tunnel kiln for the first fire.

The cups are made on the automatic cup making machine. The inside shaped cups remaining in their plaster moulds are made to travel through the Dryer. The cups are white hard when they are removed from the plaster moulds at the end of the Dryer. After being emptied, the plaster moulds are again placed into the Dryer, in which they return to the automatic cup making machine after a passage time of about an hour. At the discharge end of the Dryer, there are two jiggers on which the cups are trimmed. On the work bench next to it the handles are joined by slipping and the cups then placed on planks into racks.

Having achieved their drying, the cups are placed into saggars and put on platform wagons, on which they are conveyed through the Tunnel kiln for being biscuit fired.

The same methods are to be adopted for saucers and dinner ware.

Glazing operations.—The articles placed into saggars pass through the biscuit kiln. The biscuit fired ware is removed from the saggars and sorted in the space between the two tunnel kilns. It is cleaned on the dust brushing benches and then glazed.

The liquid glaze is conveyed from the cylinder in which it is finely ground, by means of a compressed air plant with the glaze tank.

Two wet glaze removers are provided to free the rims of the plates and cups from the adhering glaze. The glazed ware is again placed into the saggars and passed through the second tunnel kiln to undergo the glost fire. On leaving the kiln the ware is sorted and conveyed to the store room for undecorated ware. Here some grinding machines are located to remove any small grains of sand or the like which might have fallen on the ware.

Decorating the glazed ware.—The white glazed ware are painted with brush or lithographic prints of various designs are transferred on the ware and fired in the muffle furnaces.

Gold decorations are also made in the same way.

LIST OF MACHINERY.

(1) <i>Preliminary crushing of quartz and felspar—</i>	Rs.
(1) Edge Runner Mill with granite bottom 5" dia.	3,375
(2) Bucket Conveyor and sorting cylinder	1,125
(3) Electric Motor 7.5 H.P. shafting, etc., complete	625
Total	<u>5,125</u>
 (2) <i>Slip Mill Department—</i>	
(1) Wet grinding cylinders 6'—6" without lining and flint stones—2 only	7,700
(2) Cone Bevel Gear including an elastic coupling to get the gearing into joint with the motor and the other gearings ..	1,500
(3) Electric Motor 25 H.P.	1,250
(4) Copper Strainer	60
(5) Weight Revolution Counter—2 only	55
(6) Compressed Air Plant with Electric Motor 4 H.P.	1,025
(7) Bucket Conveyor	550
(8) Electric Motor 2 H.P.	200
(9) Vertical Blunger	1,875
(10) One Speed Reducer capable of transmitting 9.5 H.P. with flange joined electric motor	875
(11) One sifting Cylinder	1,000
(12) One Speed Reducer with flange joined electro-motor from 1.5 H.P. to 2 H.P.	850
(13) One Slip Sifter "Visco" with Electric Motor	375
(14) Screw Blungers—two only	2,250
(15) Two Electric Motors 7.5 H.P.	960
(16) Electro Magnet and Converter	900
(17) Membrane Pump	2,000
(18) Electric Motor 7.5 H.P.	250
(19) Iron Filter Press 50 chambers 2	8,500
(20) Pulverizing Cylinders 4'—7½" complete with copper strainer, revolution counters, reduction gearings	4,450
Total	<u>36,625</u>

	Rs.
<i>(3) Saggars Clay preparing Plant—</i>	
(1) Double pair of crushing rolls	1,750
(2) Electric Motor 6 H.P.	400
(3) Bucket Conveyor	550
(4) Sorting Cylinder	650
(5) Return Conveyor	700
(6) Edge Runner Mill with Hood	3,400
(7) Electric Motor 4 H.P.	250
(8) Bucket Conveyor	550
(9) Feeding Apparatus 5	1,550
(10) One complete Driving arrangement for above	450
(11) Controlling Apparatus complete with frames, Shutters, Alarm Bell and Red Lamp Indicators—5	419
(12) Spiral Conveyor and Mixer suitable for direct drive—2	970
(13) Bucket Conveyor complete with Bevel Gearing and fast and loose pulley	550
(14) Wet Mixer complete with driving gear	1,225
(15) Horizontal Pug Mills mounted on a C.I. frame and complete with driving gear and mouth-piece	1,582
(16) Electric Motor 15 H.P. 950 RPM.	925
	<hr/>
	15,921
	<hr/>
<i>Saggars Making Department—</i>	
(1) Friction Drive Saggars Press complete with one table but without dies	3,138
(2) Electric Motor 4 H.P. 935 RPM.	265
(3) Saggars Making Machine suitable for saggars 66½" dia. × 12½" high and complete with Jolley	747
(4) Electric Motor 1½ H.P. 920 RPM. complete with driving organ for above	444
	<hr/>
	4,594
	<hr/>
Saggars Clay and Saggars Making Department—Total ..	20,515
	<hr/>

	Rs.
<i>(4) Forming and Finishing Machinery—</i>	
(1) Horizontal Pug Mill complete with wheel gearing, mouth piece, charging and mixing drum and special worm knives	6,394
(2) Multicell Vacuum Pump complete with vacuum guage and automatic lubrication	745
(3) Electric Motor 20 H.P. 1500 RPM complete with starter ..	969
(4) Automatic Plate Making Machine and one Mattern for adjusting the moulds	7,234
(5) Automatic Dryer	9,325
(6) Jiggers 2 only	195
(7) Electric Motor 0.5 H.P. 1400 RPM for above	95
(8) Automatic Cup Making Machine with all its accessories for moistening two pattern profiles and two jollying pans ..	2,510
(9) Electric Motor 1½ H.P. 950 RPM	173
(10) Automatic Dryer complete with Electric Motors for driving and all accessories for speed reduction, etc., for cups ..	5,512
(11) Jiggers 2 only	196
(12) Electro Motors 0.5 H.P. 1400 RPM	95
(13) Pillar Jolley and Jigger combined	913
(14) Oval Machine complete with fast and loose pulley and belt shifter and intermediate shaft	872
(15) Electric Motor 2 H.P. 920 RPM	225
(16) Simple Jiggers—twenty only	1,985
(17) Jolleys—nineteen only	820
(18) Pillar Jolley—one only	163
(19) Electric Motor complete with transmission organ 5 H.P. 935 RPM.	1,063
(20) Complete cleaning and dust removing plant complete with all accessories	695
(21) Glaze Removing Machine	488
(22) Electric Motor 0.5 H.P. 1460 RPM complete with Speed Reducer	406
	41,073
<i>Grinding and Scouring Department—</i>	
(1) Self-contained Grinding Machine	513
(2) Grinding and Polishing Machines complete with gearing—2 only	700
(3) Vertical Grinding and Polishing Machines—2 only	763
(4) Electric Motor 2 H.P. 920 RPM complete with transmission organ	425
<i>Lining and Flint Stones</i>	1,763
Shape Making and Finishing .. Total ..	45,237

	Rs.
<i>Summary—</i>	
(1) Preliminary Crushing	5,125
(2) Slip House	36,625
(3) Saggar Clay and Saggar Making Department	20,515
(4) Shape Making and Finishing Machines	45,237
	<hr/> 1,07,502
Cost of Machinery Erection	12,000
	<hr/> 1,19,502
Total cost for Machinery ..	1,19,502
	<hr/>
Say ..	1,20,000

Note.—Prices of machinery, etc., are those existing during middle of 1939.

Furnaces.

(1) Biscuit Tunnel Furnace 240 feet long × 4 feet wide inside.	1,25,000
(2) Glaze Tunnel Furnace 240 feet × 4 feet	1,25,000
(3) Calcining Furnace	1,000
(4) Muffle Furnaces—two only	10,000
(5) Chimney for above	5,000
(6) Frit Furnace	5,000
	<hr/>
Total ..	2,71,000
	<hr/>

Tools and Equipment.

Blacksmith and Fitter's Shop—

Power driven lathe	2,000
Power driven Drilling Machine	500
Power driven Blower	100
Sundry tools including tap and dies	500
	<hr/>
	3,100
	<hr/>

					Rs.
<i>Carpenter's Shop—</i>					
Carpenter's lathe	..	..	..	..	500
Carpenter's tools	..	..	..	..	200
					700
 <i>Mould Maker's Shop—</i>					
Moulding tools	..	..	..	..	300
Whirlers	..	..	..	..	200
Drilling Machine	..	..	..	..	300
Drawing Materials and tools	..	..	..	..	300
Drawing Box and Board	..	..	..	..	100
					1,200
 <i>Chemical Laboratory—</i>					
Chemicals, Apparatus, Fittings and testing Furnaces ..				..	5,000
Fitting for shops such as working benches, tables, racks, moving platforms, etc.	..	..	..	..	10,000
 <i>Lighting in the factory—</i>					
400 Lights at Rs. 15 per point	..	..	..	..	6,000
 <i>Summary—</i>					
Blacksmith and Fitter's shop	..	..	..	..	3,100
Carpenter's shop	..	..	..	..	700
Mould Maker's shop	..	..	..	..	1,200
Chemical Laboratory	..	..	..	..	5,000
Shop Fittings	..	..	..	..	10,000
Lighting	..	..	..	..	6,000
Water connections with Storage Tanks				..	5,000
Office Equipment	..	..	..	..	2,000
Library	..	..	..	..	1,000
					34,000
				Total	34,000

	Rs.
<i>(4) Machinery Equipment—</i>	
50 Jigger heads at Rs. 30 each	1,500
50 Jigger profiles at Rs. 5 each	250
20 Oval Jolleys profiles at Rs. 10 each	200
15 Dies for stilts etc. at Rs. 75 each	1,125
400 Sagger plates different sizes at Rs. 2-8-0 each	1,000

4,075

Plaster Block Moulds—

3 Tea pot at Rs. 25 each	75
3 Sugar basin at Rs. 20 each	60
3 Milk jug at Rs. 10 each	30
20 Cup at Rs. 5 each	100
20 Saucer at Rs. 7 each	140
20 Plate at Rs. 10 each	200
10 Plate at Rs. 15 each	150
10 Plate at Rs. 15 each	150
10 Plate at Rs. 15 each	150
4 Oval moulds at Rs. 25 each	100
25 Sundry articles moulds at Rs. 10 each	250

1,405

Plaster Piece Moulds—

50 Moulds tea pot	250
50 Moulds Sugar basin	200
50 Moulds Milk jug	50
800 Moulds Cups	800
800 Moulds Saucers	1,000
800 Moulds Plates	1,200
100 Moulds Ovals	500
400 Moulds Sundry	400

4,400

Saggars—

500 Cups saggars	6"
335 Saucers saggars	8"
200 Bread plate saggars	15"
50 Tea pot saggars	8"
25 Milk jug saggars	8"
50 Sugar basin saggars	8"
20 Soup plate saggars	8"
150 Dinner plate saggars	15"
25 Pudding plate saggars	15"
400 Oval ware saggars	15"
200 Sundry saggars	8"
	6"

1,955

Say 2,000 saggars.

50 per cent. extra provision should be made.

∴ 3,000 saggars are necessary before actual firing in the tunnel oven will begin.

Glaze saggars should be of the same quantity for glaze firing tunnel oven.

∴ 6,000 saggars must be provided in Capital Expenditure.

Approximate weights of the saggars are as follows—

- 2,100 Saggars 15" dia. × 6" high.
- 2,700 Saggars 15" dia. × 8" high.
- 1,200 Saggars 18" dia. × 15" high.

Weight of saggars.

2,100 × 25 =	52,500 Lbs.
2,700 × 30 =	81,000 Lbs.
1,200 × 45 =	54,000 Lbs.

187,500 Lbs.

= 84 Tons Approximately.

	Rs.
Cost of clay	1,680
Cost of making	840
Cost of firing	1,680
<hr/>	
Cost of saggars	4,200

Stilts, thimbles, slabs etc. for firing of glazed articles.

These are required as supports for placing the various glazed articles in the saggars. About 10,000 each are required in the beginning and they have to be replenished as required just as is the case with saggars. These will be made and so the approximate cost for the lot will be about Rs. 2,000 and this is to be included in Capital Expenditure. The total cost for saggars, stilts, plaster etc. will be about Rs. 16,080.

Buildings.

The cost of buildings is estimated at Rs. 2,00,000 according to the plan of the factory attached with the scheme. Detailed drawings will have to be made by the Civil Engineer.

Capital Expenditure.

	Rs.
Buildings	2,00,000
Machinery	1,19,502
Furnaces	2,71,000
Tools and Equipment	34,000
Saggars, stilts, Plaster—	
Moulds and Machinery equipment	16,080
Motor Truck and car	7,000
<hr/>	
	6,47,582
Working Capital Approximately say	3,52,418
<hr/>	
	10,00,000

Note.—Prices of machinery etc. are those existing during middle of 1930.

Cost on Labour—

	Men.	Women.
1. Columning quartz, etc. ..	2	2
2. Grinding quartz and felspar ..	2	3
3. Wet grinding ..	2	....
4. Clay mixing ..	1	2
5. Body making ..	2	....
6. Filter pressing ..	4	....
7. Pug mill ..	2	3
8. Slip making ..	2	3
9. Casting tea pots, sugar and milk jug	6	6
10. Plate making ..	3	1
11. Cup making ..	2	2
12. Saucer making ..	2	2
13. Oval shape making ..	1	2
14. Pillar Jolley and Jigger ..	1	2
15. Medicinal pots, etc. ..	2	2
16. Handle making ..	....	20
17. Cleaning plates ..	14	14
18. Cleaning saucers ..	14	14
19. Cleaning cups ..	14	14
20. Biscuit placers ..	12	....
21. Biscuit firemen ..	2	....
22. Biscuit drawers ..	12	....
23. Dust removing ..	2	2
24. Glazing ..	15	15
25. Glaze placers ..	12	....
26. Drawing glazed ware..	12	....
27. Sorting glazed ware ..	6	6
28. Cleaning glazed ware..	4	4
29. Frit mixing ..	2	2
30. Frit making ..	3	....
31. Frit grinding ..	2	....
32. Glaze making ..	2	....
33. Crushing rolls ..	1	3
34. Pug mill ..	2	3
35. Saggar press ..	3	2
36. Saggar machine ..	3	....
37. Packing ..	4	....
38. Producer gas making..	3	....
39. Miscellaneous ..	8	8
Total ..	<u>186</u>	<u>137</u>

	Rs.	a.	p.
Men 186 at annas 12 a day	139	8	0
Women 137 at annas 8 a day	68	8	0
	<u>208</u>	<u>0</u>	<u>0</u>
Rs. 208 × 25 working days ..			25
	<u>5,200</u>	<u>0</u>	<u>0</u>

Cost on Staff—

				Rs.
Manager	..	..	..	500
Fireman	..	..	..	500
Engineer	..	..	..	200
Assistant Manager	..	..	..	200
Chemist	..	..	..	100
Grinding Foreman	..	..	..	50
Sliphouse Foreman	..	..	..	50
Forming Department Foreman	..	..	..	50
Saggar Department Foreman	..	..	..	50
Biscuit Department Foreman	..	..	..	50
Glaze Department Foreman	..	..	..	50
Mould maker	..	..	..	100
Assistant Mould maker	..	..	..	30
Assistant Mould maker	..	..	..	30
Assistant Mould maker	..	..	..	30
Oilman	..	..	..	25
Placing Foreman	..	..	..	50
Drawing Foreman	..	..	..	50
Saggar Maker	..	..	..	30
Placing Foreman	..	..	..	50
Drawing Foreman	..	..	..	50
Drawer Foreman	..	..	..	50
Producing gas foreman	..	..	..	150
Carpenter	..	..	..	50
Blacksmith	..	..	..	50
Fitter	..	..	..	50
Clerks (5)	..	..	..	250
Timekeeper	..	..	..	50
Warehouse man	..	..	..	50
Watchman	..	..	..	30
Sepoys (4)	..	..	..	100

3,075 per month.

Office Staff—

Managing Director	..	..	..	500
Secretary	..	..	..	150
Accountant	..	..	..	200
Assistant Accountant	..	..	..	100
Bill clerk	..	..	..	75
Typists (2)	..	..	..	100
Dispatch clerk	..	..	..	50
Bill Collector	..	..	..	50
Salesmen (3)	..	..	..	300
Sepoys (3)	..	..	..	90
Sepoy	..	..	..	20

1,635 per month.

Total Staff Cost—

Factory	..	..	..	3,075 per month.
Office	..	..	..	1,635 Do.
				<hr/>
				4,710 Do.

Production—

It is proposed to manufacture the following articles for sale every day :—

- 6,000 Cups.
- 6,000 Saucers.
- 2,400 Small plates.
- 200 Tea pots.
- 200 Milk jugs.
- 200 Sugar pots.
- 2,100 Plates.
- 400 Oval pots of various shapes for dinner sets.
- 1,440 Sundry articles, medicinal pots etc.

18,940

Quantity of body required—

Name of article.	Weight of article.	Quantity.	Total weight required.
	Oz.		Lbs.
Cup	4	6,000	1,500
Saucer	8	6,000	3,000
Bread plate	8	2,400	1,200
Tea pot	24	200	300
Milk jug	8	200	100
Sugar pot	16	200	200
Plates	16	2,100	2,100
Oval pots	80	400	2,000
Sundry goods	16	1,440	1,440
		18,940	11,840
	Allow 10 per cent. wastage ..		1,184
	Allow 20 per cent. breakage ..		2,605
			15,629
	Say (Seven tons) ..		

Cost of body—**Raw Materials—**

- China clay 45 per cent. at Rs. 75 per ton.
- Plastic clay 20 per cent. at „ 25 per ton.
- Flint 25 per cent. at „ 20 per ton.
- Felspar 10 per cent. at „ 30 per ton.

100

∴ Rs. 46-12-0 per ton.

Seven tons are required per day. Taking 25 working days, total quantity required is 175 tons.

∴ Cost of raw materials for body per month say, is, Rs. 8,181-4-0.

Glaze—

2½ per cent. glaze is required for 175 tons.

Glaze required is 4·375 tons.

The cost of glaze is Re. 0-4-0 a lb.

∴ Cost of glaze is Rs. 2,450 per month.

Recurring expenditure on saggars—

The breakage in saggars ordinarily comes to 10 per cent. In tunnel ovens the saggars are fired comparatively many times more than round furnaces; it is advisable to take 20 per cent. The same with thimbles and stilts.

The provision of Rs. 6,200 has been made in Capital Expenditure.

The replacement cost therefore will come to Rs. 1,240 per month.

The broken saggars will be utilised as grog or firebricks will be made from them, 50 per cent. of the value will be realised.

It is therefore taken as recurring expenditure 50 per cent. of the cost of replacement.

∴ Rs. 620 per month.

Water—

175 tons Body.

20 tons Saggars Body.

195 tons.

×6

1,170 tons water.

×240

280,800 Gallons water for manufacture.

300 people working in a factory.

×10 gallons each consumes.

3,000 per day.

×30

90,000 per month.

Total .. 280,800

90,000

370,800 Gallons per month.

The rate at Re. 0-14-0 per 1,000 gallons.

∴ Rs. 325 per month.

Electric Energy—

From the experience in the local Pottery factory it has been found that for 65 H.P. motors, the monthly cost of electric energy comes to Rs. 150 including the lighting of the factory.

Basing the calculations on the above, the cost in the proposed factory is estimated at Rs. 600 per month for a number of motors 200 H. P.

Coal—

Tunnel kiln builders estimate that each tunnel furnace will require 8 tons of coal every day. Two furnaces will require 16 tons. For 30 days working 480 tons coal will be required.

At the present rate of Rs. 16 per ton the total cost of coal for tunnel furnace is Rs. 7,680 per month.

Calcining Furnace—

Coal required will be 25 tons at Rs. 16 per ton—Rs. 400.

For Frit Kiln—

5 tons of frit is to be made.

Coal used will be	..	..	..	..	5 tons.
Coal for drying saggars	..	..	..	..	25 tons.
					<u>30 tons.</u>

∴ at Rs. 16 per ton Rs. 480.

Total—

					Rs.
For Tunnel Kilns	..	..	..	..	7,680
For Calcining Furnace	..	..	..	..	400
For Frit Kiln	..	..	..	..	480
					<u>8,560</u>

Cost of decorating the ware has not been calculated as the selling price is for white ware only.

<i>Cost of Production—</i>					Rs.	a.	p.
Labour	..	..	..	..	5,200	0	0
Staff	..	..	..	..	4,710	0	0
Raw Materials	..	..	..	..	8,181	4	0
Glaze	..	..	..	..	2,450	0	0
Saggars	..	..	..	..	620	0	0
Water	..	..	..	..	325	0	0
Electricity	..	..	..	..	600	0	0
Coal	..	..	..	..	8,560	0	0
Stores	..	..	..	..	749	0	0
					<u>31,395</u>	4	0 per month.
						× 12	
					<u>3,76,743</u>	0	0 per year.

<i>Sale proceeds—</i>				Rs.	a.	p.
6,000	Cups and saucers at As. 2 each	..	..	750	0	0
2,400	Bread plates at As. 2 each	..	..	300	0	0
200	Tea pots at As. 12 each	..	..	150	0	0
200	Sugar pots at As. 6 each	..	..	75	0	0
200	Milk jugs at As. 2 each	..	..	25	0	0
2,100	Plates at As. 4 each	..	..	525	0	0
400	Oval pots with covers at Rs. 1-4-0 each	..	..	500	0	0
1,440	Sundry articles at As. 2 each	..	..	180	0	0
				<hr/>		
Per day				2,505	0	0
				<hr/>		
Sale proceeds per day				2,505	0	0
Sale proceeds per year of 300 days				7,51,500	0	0

<i>Result—</i>				Rs.	a.	p.
Sale proceeds				7,51,500	0	0
Cost of production				3,76,743	0	0
				<hr/>		
Gross profit				3,74,757	0	0

<i>Office Expenditure—</i>				Rs.	
Rent of office				1,800	per year.
Travelling expenses				6,000	" "
Advertisement expenses				6,000	" "
Sundry office expenditure including stationery, postage, etc.				7,200	" "
Packing, forwarding charges on sales at 2½ per cent. on total sale proceeds of Rs. 7,51,500 per year, say				19,000	" "
				<hr/>	
				40,000	per year.

Ground rent for factory buildings—

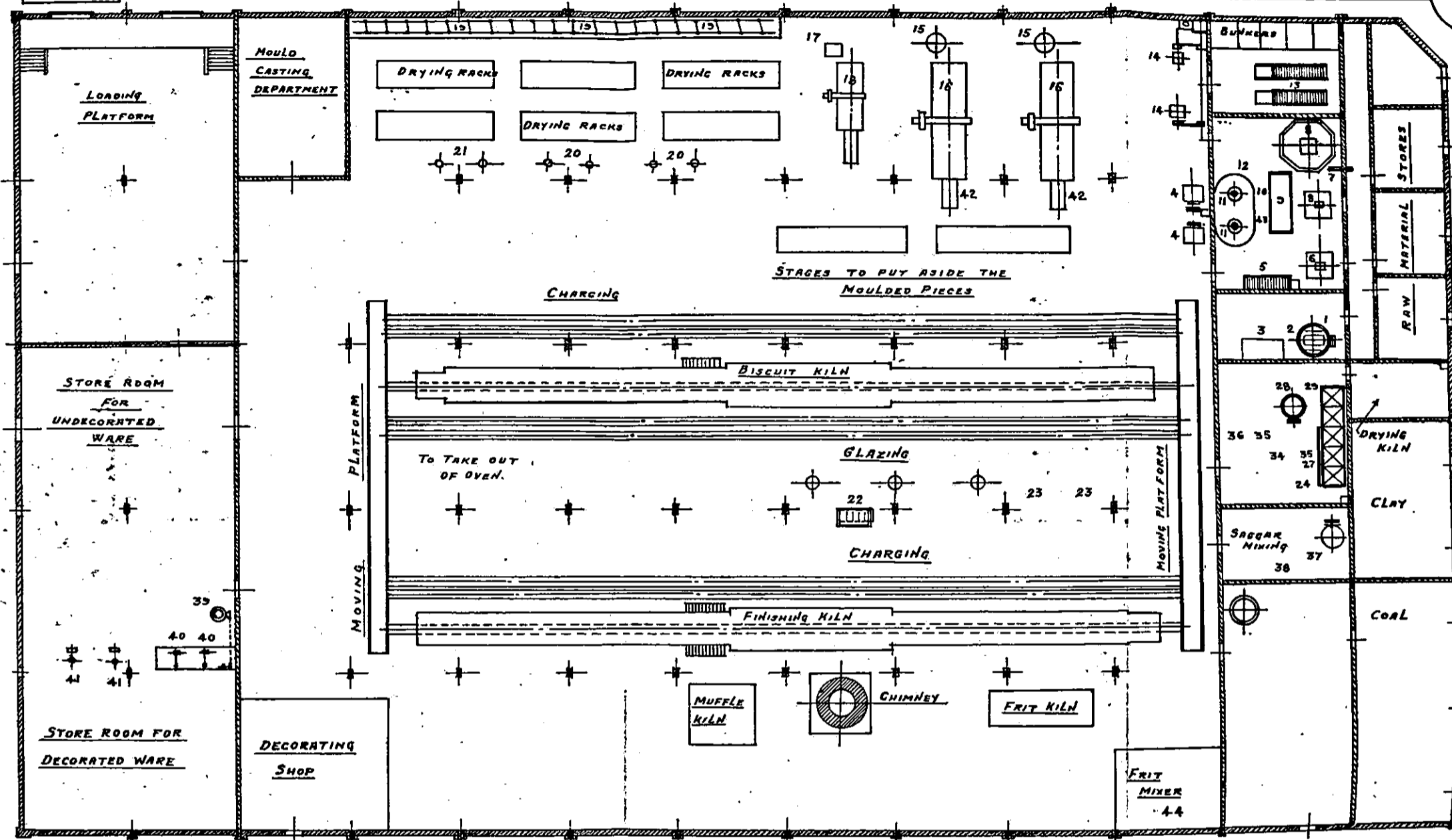
Total area required is about 25,000 square yards. The value of land is taken at Rs. 7 per square yard. The interest on the Capital value of land taken at Rs. 1,75,000 will be Rs. 10,500 per year.

<i>Depreciation—</i>				Rs.	Rs.
10 per cent. on Machinery	..	..	..	1,19,502	11,950
10 per cent. on Furnaces	..	..	..	2,71,000	27,100
10 per cent. on Saggars and Moulds, etc.	..	..	..	16,080	1,608
10 per cent. on Tools and Equipment	..	..	..	34,000	3,400
5 per cent. on Buildings	..	..	..	2,00,000	10,000
10 per cent. on Motors, etc.	..	..	..	7,000	700
				<hr/>	
				54,758	

<i>Net Result—</i>					
Gross Profit				3,74,757	
Deduct—					
Office expenditure				40,000	
Ground Rent				10,500	
Depreciation				54,758	
				<hr/>	
				1,05,258	
				<hr/>	
				2,69,499	

Note.—This return is on Capital of Rs. 10,00,000 which is equal to 26·94 per cent.

C. P. SHAH,
Pottery Expert.



No.	MACHINES.
1	EDGE RUNNER MILL.
2	BUCKET CONVEYOR.
3	SIFTING CYLINDER.
4	PULVERIZING CYLINDER FOR WET GRINDING.
5	COMPRESSED AIR PLANT.
6	PULVERIZING CYLINDER FOR WET GRINDING.
7	BUCKET CONVEYOR.
8	DISSOLVING BLUNGER.
9	WET SIFTING CYLINDER.
10	SLIP SIFTING "VISKO".
11	SCREW BLUNGERS.
12	MEMBRANE PUMP.
13	FILTER PRESSED EACH WITH 50 ROUND CHAMBERS.
14	PLATE MAKING MACHINE.
15	DORST-DRYER FOR PLATES.
16	CUP MAKING MACHINE.
17	DORST-DRYER FOR CUPS.
18	JIGGERS.
19	PILLAR JOLLEY & JIGGER COMBINED.
20	OVAL MACHINE.
21	DUST-REMOVING PLANT.
22	GLAZE REMOVERS.

No.	MACHINES.
23	DOUBLE PAIR OF CRUSHING ROLLS.
24	BUCKET CONVEYOR.
25	SORTING CYLINDER.
26	RETURN CONVEYOR BELT.
27	EDGE RUNNER MILL.
28	BUCKET CONVEYOR.
29	SILO-CONTROLLING APPARATUSSES.
30	FEEDING APPARATUSSES WITH COMPARTMENT-ROLLER.
31	SPIRAL CONVEYOR.
32	SPIRAL CONVEYOR.
33	BUCKET CONVEYOR.
34	WET MIXER.
35	HORIZONTAL PUG-MILL.
36	FRICTION DRIVEN SAGGAR PRESS.
37	SAGGAR-MIXING-JIGGER.
38	GRINDING MACHINE.
39	GRINDING AND POLISHING MACHINE.
40	VERTICAL GRINDING AND POLISHING MACHINE.
41	JIGGERS FOR CLEANING, TRIMMING AND FINISHING.
42	HORIZONTAL PUG-MILL WITH VACCUM EQUIPMENT.
43	ELECTRO MAGNET.
44	FRIT MIXER.

PROPOSED PLAN OF A
FACTORY TO MANUFACTURE
WHITE WARE

APPENDIX IV

PHOTOGRAPHS OF ARTICLES PRODUCED FROM THE SAMPLES OF
CLAYS COLLECTED DURING THE GEOLOGICAL SURVEY

Photograph No.	Description.
1	Samples of clays collected from Bombay Province.
2	Thana District Bassein Clay—Unglazed Ware.
3	Thana District Bassein Clay—Glazed Ware.
4	Thana District Bassein Clay—Glazed Ware. Once fired.
5	Panch Mahals District Derol clay—Unglazed Ware.
6	Derol clay, flint, felspar Vitreous ware. (Panch Mahals District).
7	Panch Mahals District, Derol clay, Refractories.
8	All Panch Mahals District Materials—Glazed ware.
9	All Panch Mahals District Materials—Glazed ware once fired.
10	All Panch Mahals District Materials—Once fired.
11	All Panch Mahals District Materials—Blue glazed ware.
12	All Panch Mahals District Materials—Green glazed ware.
13	All Panch Mahals District Materials—Dark Brown glazed ware.
14	Belgaum District Desur clay.
15	Belgaum District Kapoli clay—Brown glazed ware.
16	Ratnagiri District Jalgaon clay—Unglazed and glazed wares.
17	White ware, Derol clay, Honawar clay, Flint and Felspar.
18	White ware, Derol clay, Honawar clay, China clay, Flint and Felspar.
19	White ware, Derol clay, China clay, Flint and Felspar.
20	General ware made from clays collected from the Bombay Province. White ware and Red ware.
21	Wood fired furnace.



1. Samples of clays collected from Bombay Province.

G. P. Z. P. 1940.



2. Thana District Bassein Clay—unglazed ware.

G. P. Z. P. 1941.



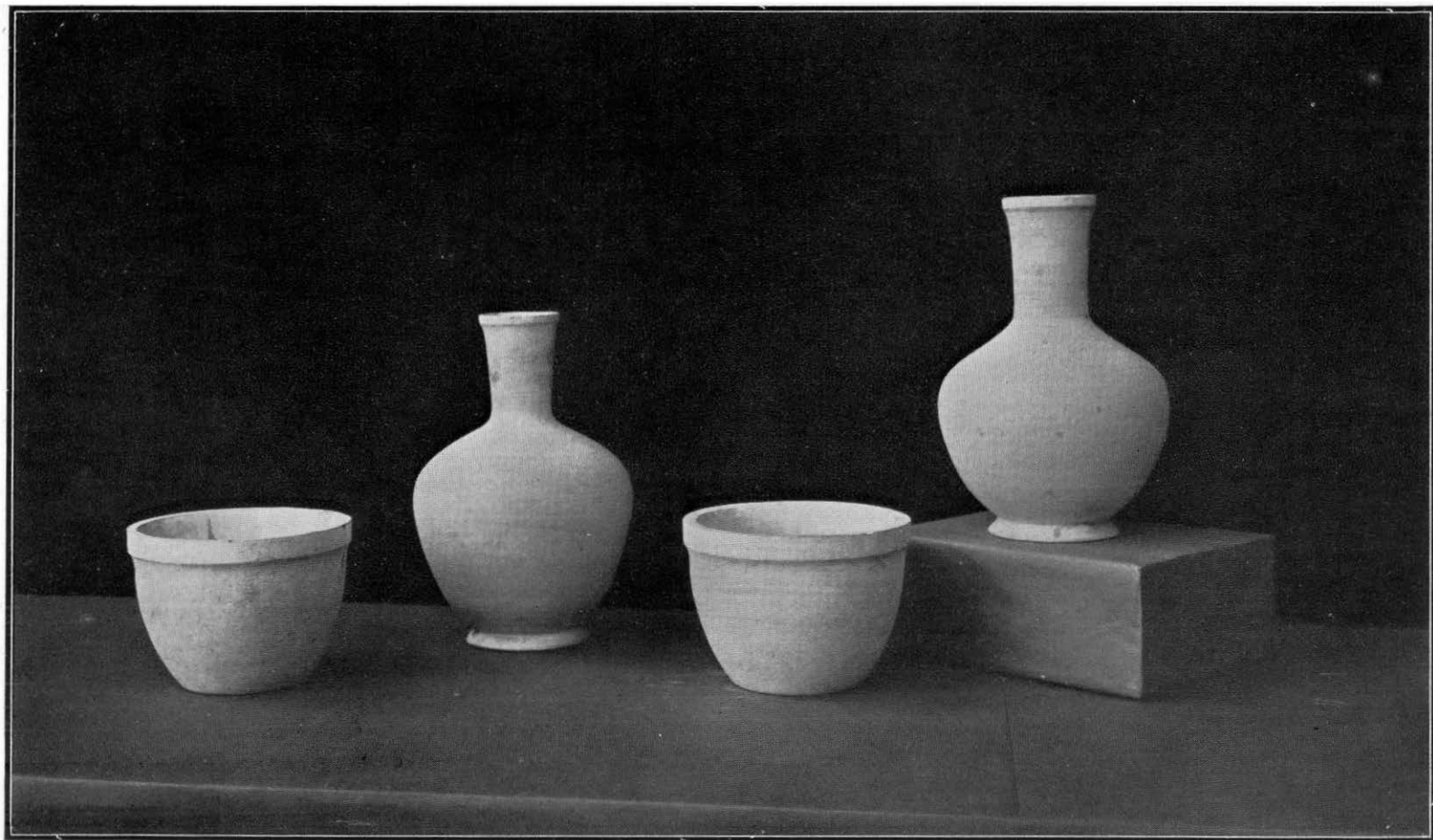
3. Thana District Bassein Clay—Glazed ware.

G. P. Z. P. 1941



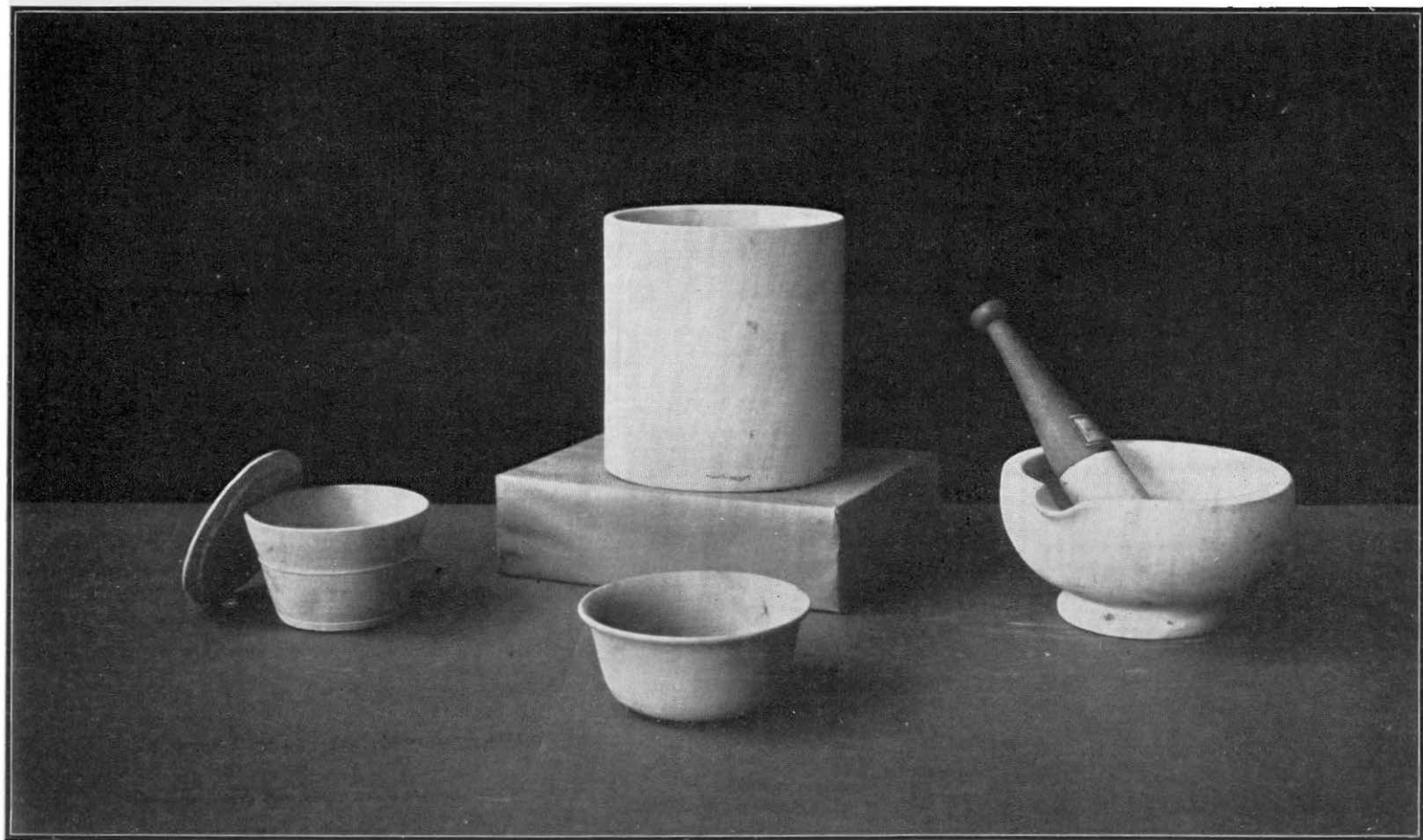
4. Thanā District Bassein Clay—Glazed ware. Once fired.

G. P. Z. P. 1941.



5. Panch Mahals District Derol clay—Unglazed ware.

G. P. Z. P. 1940.



6. Derol clay, flint, felspar Vitreous ware. (Panch Mahals District).

G. P. Z. P. 1940.



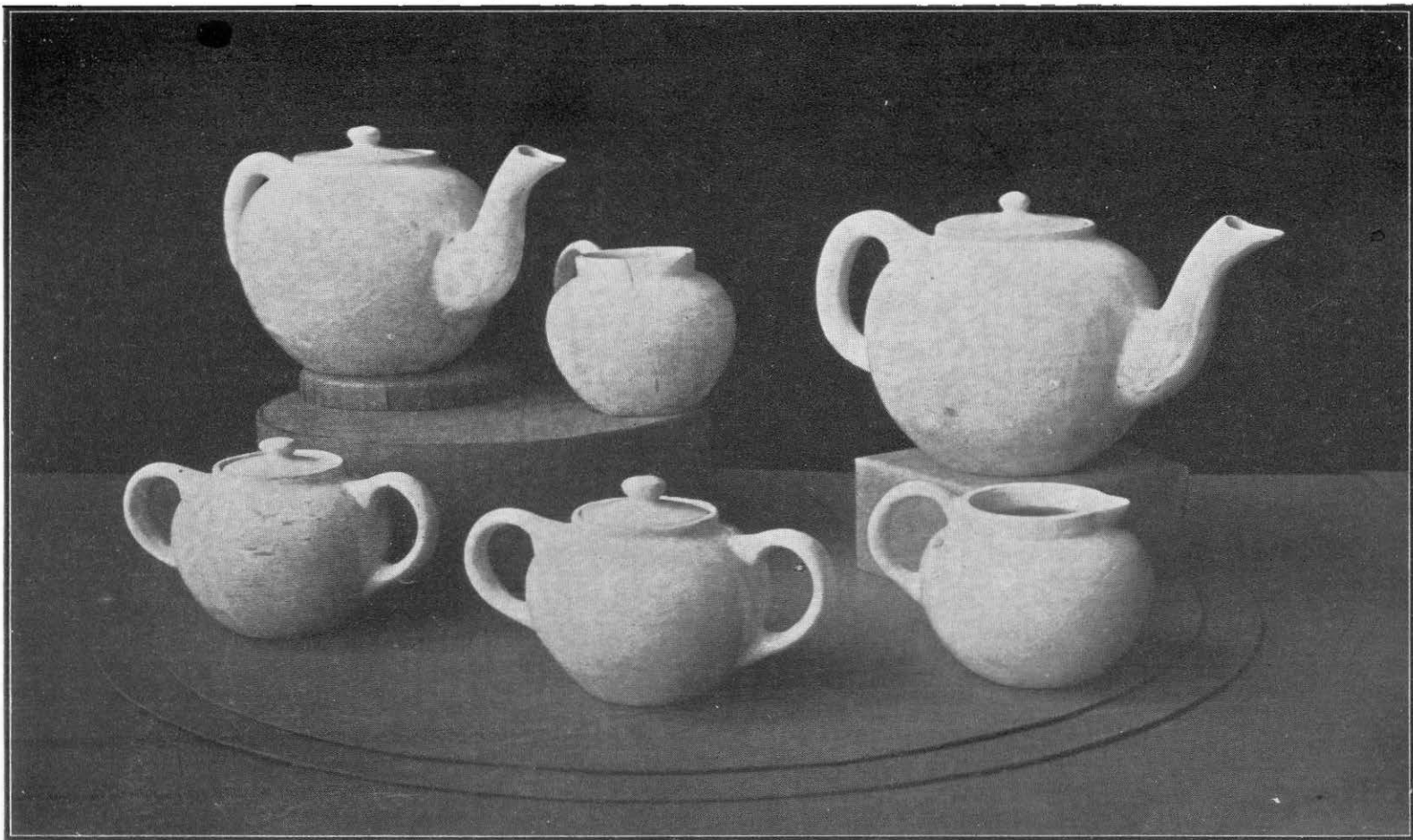
7. Panch Mahals District, Derol clay, Refractories.

G. P. Z. P. 1941.



8. All Panch Mahals District Materials—Glazed ware.

G. P. Z. P. 1940.



9. All Panch Mahals District Materials—Glazed ware once fired.

G. P. Z. P. 1940.



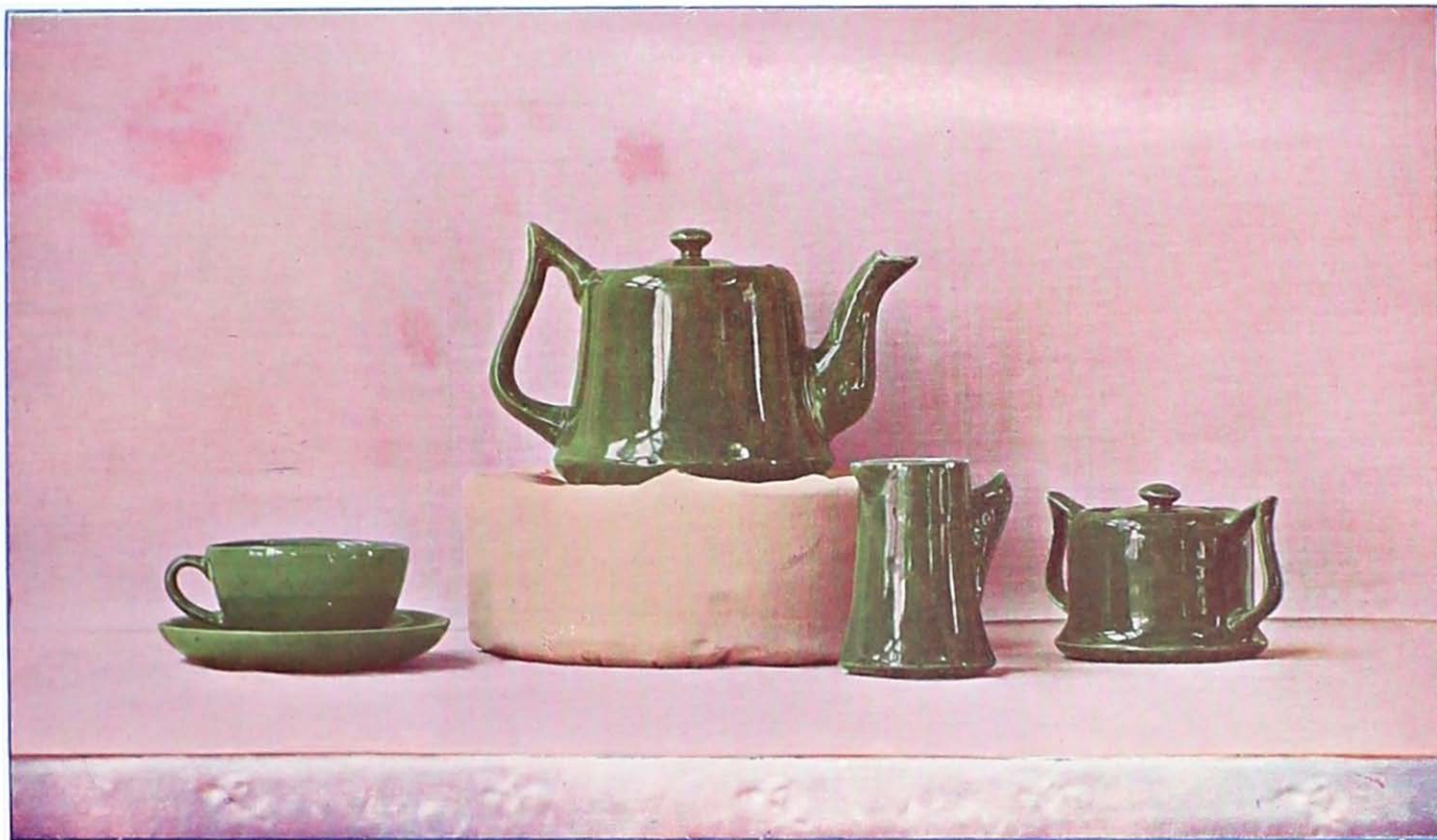
10. All Panch Mahals District Materials—Once fired

G. P. Z. P. 1941.



11. All Panch Mahals District Materials—Blue glazed ware.

G. P. Z. P. 1941.



12. All Panch Mahals District Materials—Green glazed ware.

G. P. Z. P. 1940.



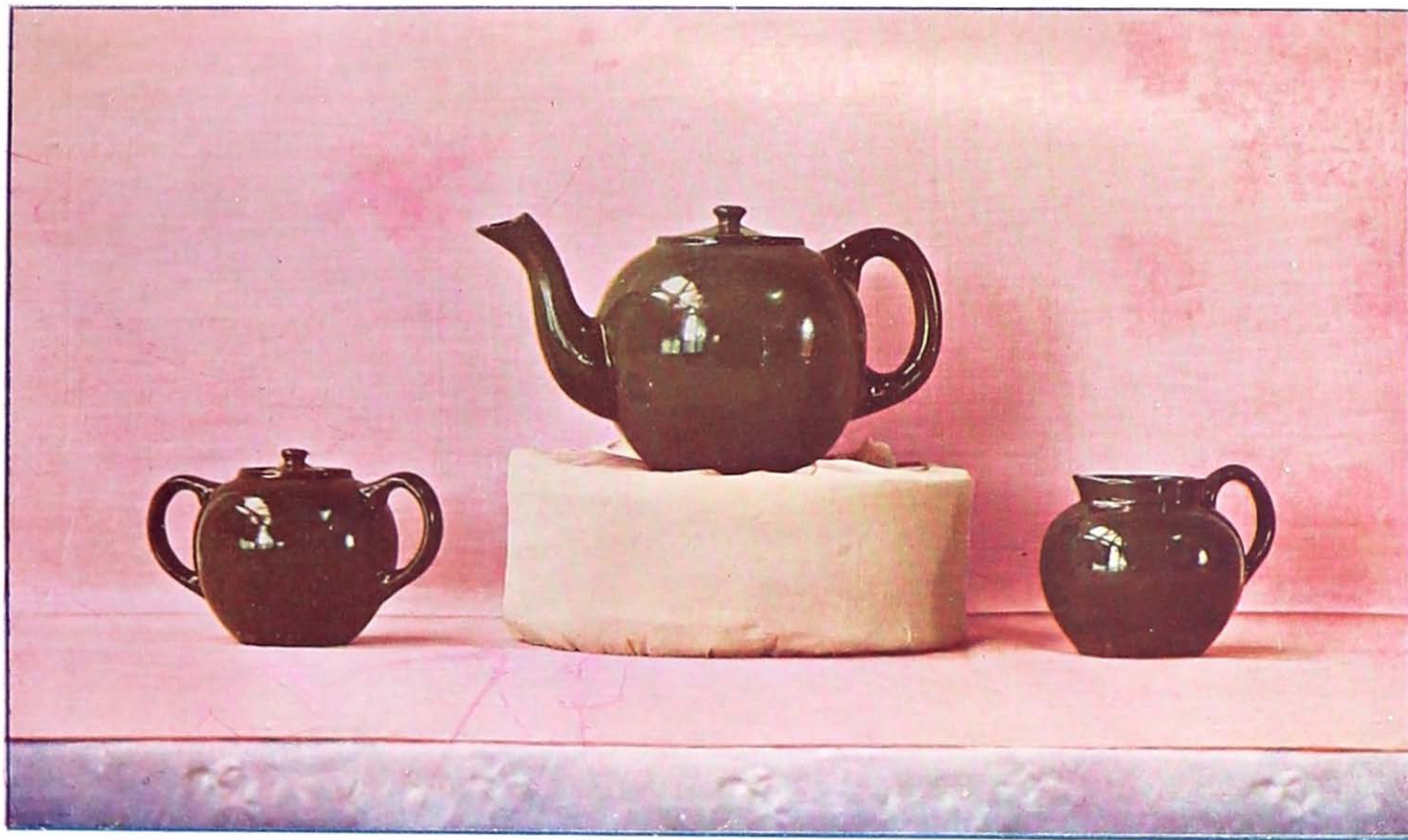
13. All Panch Mahals District Materials—Dark Brown glazed ware.

G. P. Z. P. 1941.



14. Belgaum District Desur clay.

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15. Belgaum District Kapoji Clay Brown glazed ware.

G. P. Z. P. 1940.



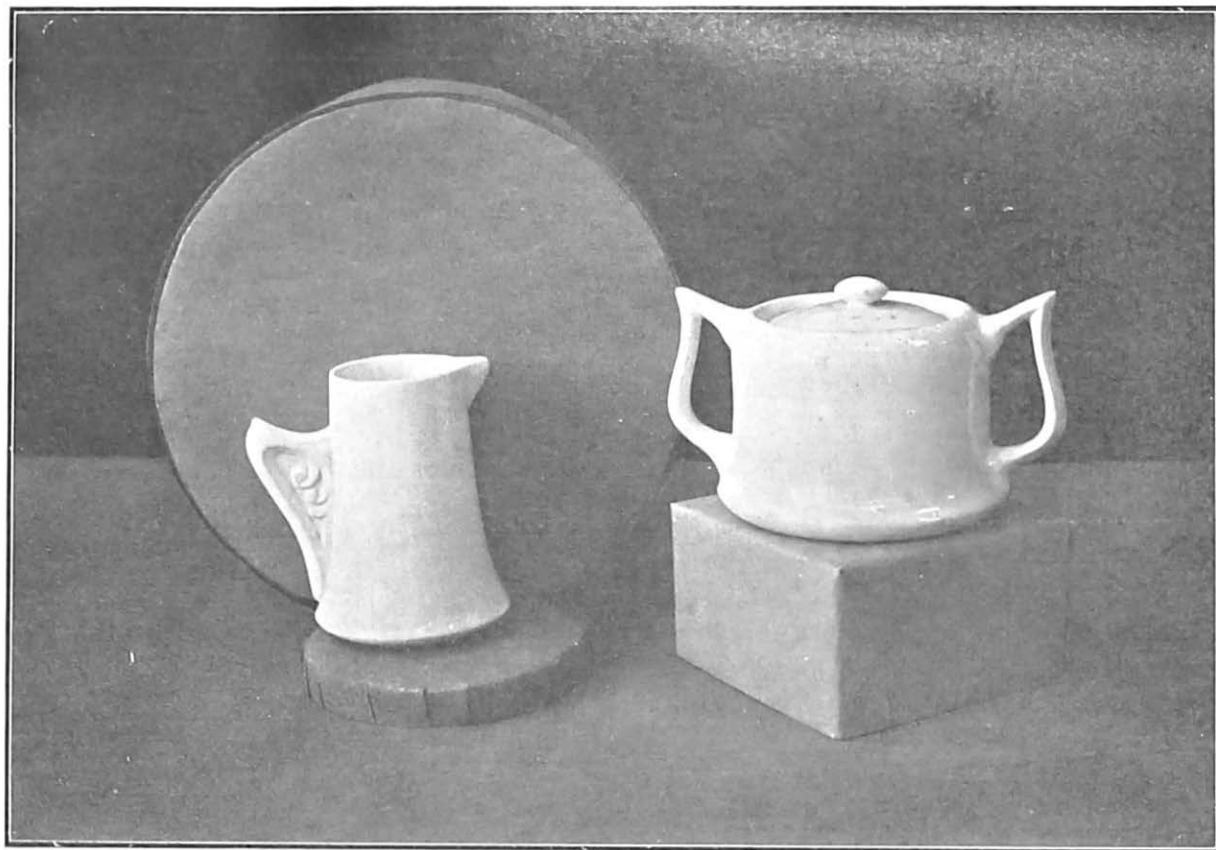
16. Ratnagiri District Jalgaon Clay. Unglazed and glazed wares.

G. P. Z. P. 1941



17. White ware, Derol clay, Honawar clay, Flint and Felsper.

G. P. Z. P. 1941.



18. White ware, Derol clay, Honawar clay, China clay, Flint and Felspar.

G. P. Z. P. 1940.



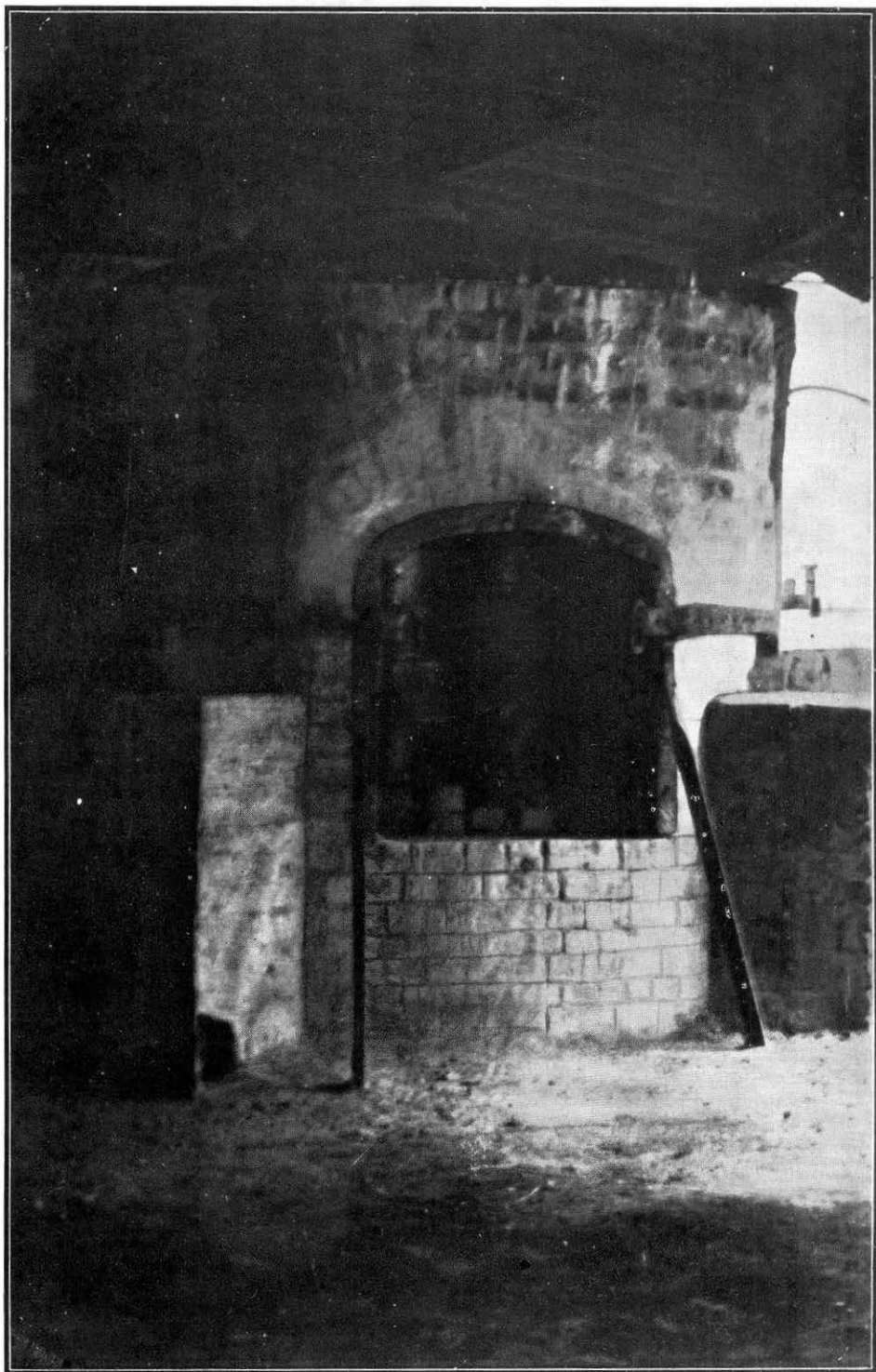
19. White ware, Derol clay, China clay Flint and Felsper.

G. P. Z. P. 1940.



20. General ware made from clays collected from the Bombay Province. White ware and Red ware

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21. Wood fired furnace.

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