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Education

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G.O. No. 322

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[Despatch Abstract.]

Glass experiments.-

Appointing a committee to consider and report on the
question of the continuance of the ----- now being carried
on by the Department of Industries.

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Government of Madras

HOME DEPARTMENT (EDUCATION)

G.O. No. 322, 8th March 1917

MISCELLANEOUS

Glass experiments

Appointing a committee to consider and report on the question of the continuance of the — now being carried on by the Department of Industries.

READ—the following paper :—

From the Officer in charge of the Department of Industries, G.C. No. 52, dated the 18th January 1917.

Order—No. 322, Home (Education), dated the 8th March 1917.

The Department of Industries has been conducting experiments in the manufacture of soda-water bottles for some time past, but the results so far achieved are not encouraging. His Excellency the Governor in Council has accordingly resolved to appoint a committee to examine the existing position and to advise him whether the experiments in the manufacture of soda-water bottles should be continued and, if not, whether experiments should be made with other forms of glassware. The committee will consist of the undermentioned gentlemen :—

- (1) Mr. C. A. Innes, I.C.S., Officer in charge of the Department of Industries (Chairman).
- (2) Mr. W. A. Beardsell.
- (3) Sir Frederick Nicholson, K.C.I.E.
- (4) Sir Clement Simpson, Kt.
- (5) The Hon'ble Sir Francis Spring, K.C.I.E.
- (6) The Hon'ble Mr. M. E. Couchman, I.C.S.
- (7) The Hon'ble Rao Bahadur K. Suryanarayanamurti Nayudu Garu.
- (8) Dr. J. L. Simonsen, D.Sc.

2. The Officer in charge of the Department of Industries is requested to arrange for the meeting of the committee and forward to the Government a copy of its proceedings with his own remarks thereon at an early date.

(True Extract)

E. A. HARVEY,
Acting Secretary to Government.

To the Officer in charge of the Department of Industries.

- „ W. A. Beardsell, Esq.
- „ Sir Frederick Nicholson, K.C.I.E.
- „ Sir Clement Simpson, Kt.
- „ the Hon'ble Sir Francis Spring, K.C.I.E.
- „ the Hon'ble Mr. M. E. Couchman, I.C.S.
- „ the Hon'ble Rao Bahadur K. Suryanarayanamurti Nayudu Garu, Coenada.
- „ Dr. J. L. Simonsen, D.Sc.

ANNEXURE

PAPERS RELATING TO GLASS EXPERIMENTS

I

Note on Glass Experiments, dated the 26th July 1916, by the Hon'ble Mr. M. E. Couchman.

The original experiments in glass-making in Madras were carried out at Ennore by the late Mr. James Short and Mr. Scholl. Satisfied with the success attained by their small scale experiments and encouraged by the advice of a German expert whom they brought out from Europe for this purpose, they floated a company in 1909 with a capital of Rs. 2,00,000 of which Rs. 1,60,000 were issued at once.

Four Austrian glass-makers were also brought out to put up the furnace and teach the local hands how to make glass.

In G.O. No. 677, Revenue, of 2nd March 1910, a free grant of half the wood used in the Company's furnace for the first two years of its working, up to a maximum of 7,200 tons for the whole period was granted by Government. After working for some time it was found necessary to get out automatic machines for blowing the bottles, and in 1911 six bottle-making machines, an air compressor and mechanical gear were obtained from Messrs. Forsters of St. Helens at a cost of £2,350 cash and £1,350 in fully paid up shares. The factory worked till November 1911, and turned out a considerable number of soda water bottles. The output varied from 1,000 to 1,600 large bottles from four machines, and from 300 to 400 bottles from two small machines daily, but about half of the bottles made cracked in the annealing process. The chief difficulties met with were the cost of fuel. This was due to the fact that the furnace was not a continuous one. Work had to be stopped entirely to recharge the tank, and during this time the furnace had to be kept at the same heat as during actual working. This meant that work could be carried on only for 12 hours out of the twenty-four, and thus the cost of fuel was doubled. The concession of free fuel was not of much assistance, as the cost of felling, freight, cart hire, etc., brought the cost of the fuel up to Rs. 8-8-0 per ton, 200 tons of fuel were used per month, at a cost of Rs. 1,600. As this quantity could have been purchased in the open market for Rs. 2,200, the actual help received from Government only amounted to Rs. 600 per month. Another difficulty was that when the tank got low, prior to recharging, the glass-makers had to dip the pipe on which they took out the glass into the tank at such an angle that the heat ran up and burnt their hands, and the pipe itself became so hot as to make it difficult to work with. Thus the cause of failure was the furnace. About Rs. 2,90,000 had been spent up to this time. In 1913 an attempt was made to raise further capital to put in a new furnace, at an estimated cost, including erection, of Rupees 42,000, but the shareholders declined to invest any more money in the concern and the Company went into voluntary liquidation. The whole plant and factory has recently been bought by Government for Rs. 23,000. As the machines are still in good order the price paid is very moderate. I have consulted Messrs. Beardsell & Co. who were the Managing Agents, and Mr. J. O. Robinson, who was on the Board of Directors, about it. They both agree that the furnace was the main cause of failure. Mr. Robinson told me that the Company made very good soda-water bottles, which Messrs. Spencer & Co. used in large quantities and found perfectly satisfactory. He thinks that the experiment was abandoned too soon, and that it is "well worth a further trial." He thinks that the local market is sufficient to absorb the whole output of the factory in bottles, if plain bottles are made as well as soda water bottles. The experiment has now the further advantages. Soda-water bottles, which used to cost 22s. a gross in Madras, now cost 48s. Before the

war, freight from Antwerp was 15s. a ton, and though, of course, the present high rates will be reduced after the war, he does not think that freights or cost of production in Europe will be so low again as they were before the war for a long time, if ever, in addition to which there is an additional import duty of 2½ per cent.

The Director began experiments on glass soon after the out-break of the war. The furnace was broken down, and the factory out of repair. At first he rented the place for Rs. 100 a month from the owner. He decided to adopt oil furnaces, and the first furnace was constructed on plans obtained from England, but it proved extravagant in fuel consumption, but it was used for experimental purposes, and the glass-makers taught by the old company were collected together, and tried. It was found that they had lost some of their skill. He then made informal enquiries to find out if experts could be obtained from Europe, but the foreman who was working under the company was found to have enlisted and to be fighting at Gallipoli, and most English glass-makers were making flint glass, a higher grade of glass than that used for soda-water bottles. In the meantime the Director was continuing his experiments to find out if the oil furnaces would give the required heat. A temperature of 1200 deg. was obtained, but without the use of an excessive amount of alkali (which added to the cost of the glass and lowered the quality) the mixture would not melt at this temperature. The furnace was again altered, and a temperature of 1400 deg. was reached, and the furnace kept working for three days and nights and 14 gross of bottles were made, most of which passed through the annealing process satisfactorily. The Director thereupon decided to entirely rebuild the furnace, and provide it with an arrangement for pre-heating the air. This is now approaching completion. The Director expects that the consumption of this furnace will not be more than 9 gallons of liquid fuel an hour at As. 3 a gallon, which means an expenditure of Rs. 24-12-0 for a day of 12 hours. The old company used to use 7 tons of wood daily, costing Rs. 59-8-0. He is confident that he can now produce glass of good quality, but anticipates that the chief difficulty will be in training the labour necessary to keep the furnace working continuously. He is not in favour of getting out an expert from Europe at present, even if such men were to be had now, which is improbable. He wishes to engage for the present a man named Klein, who has been certified to be a French subject, and has spent many years in glass works in France. He also has a good knowledge of this country. He wishes to engage him temporarily on a salary of Rs. 200 per mensem to start the training of the workmen. He also wishes to begin to enquire for an expert in England, so that if possible one may be obtained in about six months time, when the workmen here should be becoming proficient. If Mr. Klein proves good enough there may be no need to get another expert from England. As however, it takes a long time to find a suitable man, the Director may at once be authorised to make enquiries if such a man would be available if wanted.

The expenditure up to the present time is as follows—

	RS.
September 1914.—Reconstructing the furnace	1,500
October to April 1915.—Trying workmen	1,500
April to October.—Experiments with furnaces	2,500
December 1915.—Trial of furnaces	1,400
January to March 1916.—Experiments on composition of glass and remodelling of furnaces	2,500
March and April.—Second large trial of furnace	1,000
May, June and July.—Remodelling of glass furnace	6,000
Total	16,400

The above expenditure includes Rs. 4,000 still to be paid, owing to orders placed. The Director expects that the factory will be ready for working about the end of this month.

If Government sanctions the continuance of the experiments the Director proposes to make soda-water bottles, and also cheap tumblers and lamp chimneys, and glass tiles. The tiles were successfully made by the former company, but the demand for them is limited. Having gone so far, and in view of the promising

results of the trial made with the new oil furnace, I recommend that the Director's proposals may be approved, and that sanction may be granted at once for the temporary entertainment of Mr. Klein on a salary of Rs. 200 per mensem. Permission may also be granted to enquire for an expert in England, though of course no one will be engaged without the sanction of Government.

II

Letter—from M. E. COUCHMAN, Esq., I.C.S., Special Officer, Department of Industries.

To—the Secretary to Government, Home (Education) Department (through the Accountant-General, Madras).

Dated—the 22nd September 1916.

No.—E-8.

I have the honour to submit an estimate of the approximate expenditure which will be required for the experiment in glass manufacture.

2. The new furnace has been completed, but the electric connections have yet to be made, and the staff trained. Statement marked V. shows the expenditure proposed for October. It includes Rs. 4,500 for connecting the factory with the works. Most of this will be recoverable in the event of the experiment turning out unsuccessful, as the chief part of the cost is the copper wire, the price of which is very high at present. Rs. 1,500 is needed for constructing bins to hold the raw materials (sand, lime and soda) and for miscellaneous repairs to the buildings and plant (statement No. VI). The balance of Rs. 2,000 is made up of the cost of the raw materials for October, staff (including apprentices, to be trained) and experiments with oil burners.

3. Statement II shows the cost of the staff. It is proposed to work the furnace continuously, as this will be most economical. This will necessitate the employment of three shifts of workmen.

The expenditure which would be required if working was continued in February and March is also shown.

4. Statement No. III shows the cost of electricity for power and lighting. It has been decided to use electric power owing to its greater reliability, and to the fact that the oil engine installed at the factory is not powerful enough for our purpose. We have the requisite electric motors. All that is required is to connect them with the main.

5. Statement No. IV shows the estimate of profit and loss. This has been framed on conservative lines, as the price of soda-water bottles is now a good deal more than Rs. 20. It must, however, be pointed out that the success of the experiment depends very largely on the staff. If the staff proves incapable of working the machinery fast enough the experiment will fail. I believe, however, that there is a chance of success, though the chance would have been better if a professional glass-maker could have been obtained from England. If the Government approve the suggestion, an attempt may be made even now to procure an expert from England. Mr. Klein, whose entertainment was sanctioned in G.O. No. 962, Educational, dated 1st September 1916 has in the interval obtained other employment and is no longer available.

6. Assuming that the calculations have been made correctly, the figures show a net loss of Rs. 2,520 up to the end of January. From thence onwards a profit of Rs. 4,000 a month is anticipated.

7. The total expenditure up to the end of January next will be Rs. 23,000. If the estimate of Rs. 17,000 which I have submitted for the working of the pencil factory is approved, there will only remain about Rs. 6,000 out of the lump sum of Rs. 37,000 provided in the current year's budget for experimental works under "26. Bm. Scientific and Minor Departments" "Miscellaneous Experiments". An additional grant of Rs. 17,000 will therefore be necessary. I consider that as we have gone so far now, it is advisable to incur this expenditure if the money can be found. I do not think that there would be any use in attempting to start work with less expenditure. I will report in a few days if there will be savings under other heads which could be reappropriated towards meeting this amount.

ENCLOSURES

STATEMENT A—showing required quantities of raw material and liquid fuel in tons.

	Expected quantity in tons of glassware manufactured.	Raw materials required in tons.			Required quantity of liquid fuel in tons.
		Sand.	Na ₂ CO ₃	Shells (lime).	
November	10	9	3.5	2	16
December	20	18	7.0	4	24
January	48	42	16.0	10	36
Total up to January ..	78	69	26.5	16	76
February	72	62	24.0	15	36
March	84	72	28.0	18	36
Total in February and March ..	156	134	52.0	33	72

STATEMENT II showing approximate prices of the above material.

	Glassware in tons.	Sand at Rs. 8 per ton.	Na ₂ CO ₃ at Rs. 110 per ton.	Shells (lime) at Rs. 25.	Liquid fuel at Rs. 50 per ton.	Total value of materials, total of columns (3) to (6).	Value allowed in the estimate.
November	10	72	385	50	800	1,307	1,500
December	20	144	770	100	1,200	2,214	2,500
January	48	336	1,760	250	1,800	4,146	4,500
Total to January ..	78	552	2,915	400	3,800	7,667	8,500
February	72	493	2,640	375	1,800	5,311	5,500
March	84	576	3,080	450	1,800	5,906	6,000
Total in February and March ..	156	1,072	5,720	825	3,600	11,217	11,500

STATEMENT II showing provision for supervision and labour.

	November.	December.	January.	February.	March.
	RS.	RS.	RS.	RS.	RS.
Remuneration to Dr. Simonson ..	250	250	250	250	250
Engineer	100	100	100	100	100
Chemist	..	100	100	100	100
Clerk and Store-keeper	25	50	50	50	50
Existing labour including mechanics.	320	320	320	320	320
Twenty apprentices at Rs. 7-8 ..	150	150	..	..	..
Do. do. at Rs. 10	..	200	200	..	..
Do. do. at Rs. 12-8	..	..	250	250	250
Do. do. at Rs. 15	..	..	300	300	300
Do. do. at Rs. 17-8	..	..	..	350	350
Blowers 20	..	40	100	150	400
Casual labour	50	100	150	200	200
Miscellaneous	100	100	100	100	100
Total ..	995	1,410	1,920	2,180	2,420
Actuals allowed for ..	1,000	1,500	2,000	2,250	2,500
		4,500		4,750	

STATEMENT III showing the power and lighting charges to be paid to the Madras Electric Supply Corporation for electricity.

	Standing charges.	Running charges.	Lighting charges.	Total provision.
	RS.	RS.	RS.	RS.
November	200	275	75	550
December	200	300	100	600
January	200	400	100	700
February	200	400	100	700
March	200	400	100	700

STATEMENT IV showing approximate profit or loss.

	As per statement I.	As per statement II.	As per statement III.	Total expend- iture.	Approximate bottle manu- factured.	Approximate price per gross.	by Receipts sales.	Profit or loss.
	RS.	RS.	RS.	RS.	GROSS	RS.	RS.	RS.
November	1,500	1,000	550	3,050	80	20	1,600	- 1,450
December	2,500	1,500	600	4,600	160	20	3,200	- 1,400
January	4,500	2,000	700	7,200	384	20	7,680	+ 480
Total to January ..	8,500	4,500	1,850	14,850	624	20	12,480	- 2,370
February	5,500	2,250	700	8,450	576	20	11,520	+ 3,070
March	6,000	2,500	700	9,200	672	20	13,440	+ 4,240
Total February and March ..	11,500	4,750	1,400	17,650	1,248	20	24,960	7,310

STATEMENT V.

Expenditure in October 1916 for experiments.

(i) Existing staff (monthly paid including remuneration for Dr. Simonson)	430
(ii) Existing daily paid staff	220
(iii) Provision for 20 apprentices at Rs. 7-8	150
(iv) { Raw materials 350 Liquid fuel 350 }	700
(v) Provision for experimental burners	500
	2,000
(vi) Construction of bins and miscellaneous repairs as per statement VI. ..	1,500
(vii) Approximate cost of electric fittings	4,500
Total	8,000

STATEMENT VI.

Abstract referred to in page 1.

Details.	Amount.
	RS.
Repairs of ball mill	100
Exhaust passage for regenerator	65
Parapet walls across the building	35
Concreting the floor	140
Filling up the pit	45
Re-tiling the smithy shed	40
Construction of oil tanks, platforms	50
	475

Construction of bins as per suggestions of Dr. Simonson.

18 bins—	
Brick in mud 2,500 c. ft. at Rs. 25 per 100 c.ft.	625
Plastering 4,500 c. ft. at Rs. 3 per 100 c.ft.	135
Concrete floor 1,400 at Rs. 10 per 100 c. ft.	140
Repairs of gates	15
Construction of experimental furnace	110
	1,025
Total	1,500

III

Note on Glass Experiments, dated the 29th November 1916 by
Mr. C. A. Innes.

The experiments now going on in glass-making have been sanctioned by Government on the basis of Mr. Couchman's letter of the 26th July 1916 and the 22nd September 1916. But one or two statements in these letters requires clearing up, and the estimates submitted with the latter letter require considerable revision.

2 In paragraph 1 of his first letter Mr. Couchman pointed out that the main cause of the failure of the old company was the furnace. The furnace was intermittent and cost Rs. 59-8-0 per day of 12 hours in fuel alone, whereas Mr. Tressler expected that the consumption of his furnace would not be more than 9 gallons an hour, or at As. 3 a gallon, Rs. 20-4-0 per day of 12 hours.

3. These statements are misleading. In the first place, the price of liquid fuel has gone up enormously. It cost us in October Rs. 65 per ton or including cartage As. 4-4 per gallon. Now it has gone up to Rs. 70 per ton and it may go up higher.

4. Secondly, Mr. Tressler's statement that the furnace consumption was only 9 gallons per hour is not of any value. The furnace is only one part of the expense in the matter of fuel. The neck-making and annealing operations take almost as much fuel. I have gone into this matter carefully with the records of our experiments, and my estimate of consumption is as follows:—

Furnace $7\frac{1}{2}$ gallons per hour.
Neck making $7\frac{1}{2}$ gallons per hour.
Annealing 6 gallons per hour.
Total 21 gallons per hour.

5. We shall probably improve on these results, but I allow a margin in the interests of safe and cautious estimating. When, therefore, we are working continuously with 3 shifts of workmen, we may expect a fuel consumption of 2 tons a day or, at present prices Rs. 140 a day. Counting 24 days to the month, this will mean an expenditure of not far short of Rs. 3,500 a month on fuel alone against a maximum of Rs. 1,800 provided in Mr. Couchman's estimate. The figure seems very high, and since we shall not be working day or night for 24 days a month for some time to come, we shall not attain it. But also I understand that, in its prospectus issued at the time when the old company tried to raise more capital, it estimated its fuel expenditure at Rs. 4,300 a month. So even at my figure we make a saving on the company's fuel bill.

6. Another point in which, going again by Mr. Tressler, Mr. Couchman expected a saving was alkali. I do not know on what Mr. Tressler was basing his expectations, but I think he was wrong. For our mixture appears to be the same as the company's. As a matter of fact, we do not know much about mixtures yet. Our first big experiment came off yesterday, and was not a success. We shall have to make further experiments till we arrive at a satisfactory mixture, and until we get it right, we cannot say whether we shall attain a cheaper mixture than that used by the company.

7. If Government require revised estimates, I will send them up. But I do not anticipate difficulty in keeping within the limits allowed me. I have given up the proposed electrical connections. They are too expensive, and I do not take into account the Rs. 4,500 sanctioned for this purpose. But I hope to keep within the balance of Rs. 18,500 allowed for experiments till the end of January. What I am doing at present is (1) testing the new furnace, the smaller one having collapsed, and (2) training blowers and neck-makers. When Mr. Narayanamurti returns from his tour in Northern India, the question of mixture will be tackled. In January I hope to get the loan of Mr. Elland's services, and then I shall be in a better position to pronounce on our chances of success.

8. No orders are required on this note unless Government would like revised estimates to be prepared. I have written merely to correct certain mistakes in vital points in Mr. Couchman's previous letters.

IV

Letter—from C. A. INNES, Esq., I.C.S., Director of Industries.
To—the Secretary to Government, Home (Education) Department.
Dated—Madras, the 18/20th January 1917.
No.—G-Cur. 52.

I have the honour to address Government on the subject of the experiments in glass making now being conducted by the Department of Industries.

2. For a convenient history of the inception of these experiments, I may refer Government to Mr. Couchman's letter No. E-8, dated the 26th July 1916. It will be seen that following Mr. Tressler and after consulting Messrs. Beardsell and J. O. Robinson, Mr. Couchman arrived at the conclusion that the main cause of failure of the Madras glass company was the furnace. He then gave an account of Mr. Tressler's experiments in furnace construction, and proceeded as follows:—
“The Director expects that the consumption of this furnace will not be more than 9 gallons of liquid fuel an hour at As. 3 a gallon, which means an expenditure of Rs. 20-4-0 per day. The old company used to use 7 tons of wood daily costing Rs. 59-8-0.” In view of the promising results of the trial made with the new furnace, Mr. Couchman proposed that the experiments should be continued and that the Director's proposal to employ a man called Klein should be approved. The man Klein however was not available, and subsequently in sanctioning an estimate of the expenditure on the experiments up to the end of the current month, Government directed me to institute enquiries as to the possibility of getting an expert to conduct the experiments.

3. Work had just begun with the smaller of the two furnaces constructed by Mr. Tressler when I relieved Mr. Couchman at the end of October last. It was very soon evident to me that the remarks quoted above about the fuel consumption of the furnace were misleading. In the first place the cost of liquid fuel has gone up from As. 3 a gallon to As. 4-6. Secondly the calculation that fuel would cost us only Rs. 20-4-0 a day was based on an 8 hour day, whereas whether we work at night or not, we have to maintain the furnace at a high temperature all the time. Thirdly, Mr. Tressler's remark that the fuel consumption of the furnace was only 9 gallons an hour took no account of fuel consumption for the neck-making and annealing processes. As a matter of fact when we are working at full pressure we consume nearly 2 tons of fuel a day at a cost of Rs. 140. A number of practical difficulties in the way of making good glass also soon made themselves apparent, and I felt strongly that the department was in the false position of endeavouring to master an extremely technical process by purely amateur and very expensive experiments. As the readiest way of remedying partially this situation, I obtained sanction to a proposal to send M.R.Ry. J. Narayanamurthi, Sub-Engineer in charge of the Experiments, on a tour of the glass factories in India, and I was also authorised to correspond with the Director of Industries in the United Provinces with the idea of obtaining the loan, for a short time, of the services of Mr. Elland, the glass expert, in those provinces. I also wrote to Mr. Silver for advice as to how to set about getting an expert from home.

4. Mr. J. Narayanamurthi returned from his tour in Northern India on December 23. His report was received by me on January 10th, and I enclose a copy of it for information. It will be seen that as the result of what he has seen and heard and read in North India, he is of opinion that the experiments in bottle making in Madras should be brought to a close. The Hon'ble Sir George Barnes whom I have had an opportunity of consulting also strongly advocated the same course.

5. With these preliminary remarks I will proceed to examine the position as I see it.

6. The first point is that of raw materials. In the white sand from Ennore, we have sand the iron content (.125) of which is exceptionally small. It is as good sand probably as is to be got anywhere in India. Even the beach sand just outside the factory gates contain only .45 per cent of iron and could well be used for cheap forms of glass. Sea shell lime is available at fairly moderate prices. The necessary chemicals must be imported from home, but in this respect we are

no worse off than other glass factories in India; in fact we have an advantage in that Madras is a port. As regards raw materials therefore Madras is in a comparatively favourable position.

7. More important than the question of raw materials, however, is that of fuel. Cheap fuel is absolutely essential for making bottles, and moreover economy must be secured by scientifically designed furnaces. Now here we are up against a big difficulty. In the first place, there is, and probably never can be, really cheap fuel in Madras. Wood fuel may be left out of the question. It is dear to begin with, and moreover with wood fuel, it is probably impossible to obtain that regularity of temperature which is essential for making good glass. The Madras Glass Company, it may be noted, was given valuable concessions by Government in the matter of wood fuel. Even so, it found it cheaper to use coal. Now as regards coal, Madras is some hundreds of miles from the nearest coal fields, and for this reason alone, coal must always be dear in Madras. In pre-war days it was Rs. 15 per ton. Now it has gone up to Rs. 20 per ton. Thus we are in a most unfavourable position in comparison with English factories which are always situated near coal mines and get pithead coal at a few shillings per ton. This to my mind is the determining factor of the problem. Mr. Tressler tried to overcome the difficulty by the use of liquid fuel, but the nearest oil fields are hundreds of miles away, and we are no better off in respect of liquid fuel than in that of coal. Opinions differ as to the average relative calorific value of liquid fuel and coal. Mr. Narayanamurthi puts it at 2 to 1, another gentleman I have consulted puts it at 3 to 1, a third at 2½ to 1. In any case liquid fuel has now gone up to Rs. 70 for a ton which is at least 3½ times the cost of coal. But the main point is that whether we use coal or liquid fuel, we are very badly off in comparison with the English manufacturers, and even if we leave the English manufacturers out of account, a glass factory in Madras would have no chance at all in the event of a factory being started, say, in the coal areas of Bengal where in normal times coal can be obtained at about Rs. 3 a ton.

8. Another point to be borne in mind is that probably the factory would have to close down for at least two months in the hot weather. This is Mr. Beardsell's opinion, and from Mr. Chatterjee's *Notes on the Industries of the United Provinces* I find that it accords with experience gained in the United Provinces.

9. Finally there is the question of a market for the finished product. The Madras Glass Company were advised by Messrs. Forster & Sons of St. Helens that economy in fuel could not be attained unless 8 automatic blowing machines were installed, and an outturn of 200,000 bottles a month achieved. We have six machines and assuming that we train sufficient labour to run these machines continuously, we ought to aim at a maximum outturn of 150,000 bottles a month. I admit, however, that the assumption is a large one having regard to the inefficiency of Indian labour, and for purposes of argument I will take it (1) that our maximum outturn would only just exceed a lakh of bottles a month, (2) that the factory would work only ten months in the year, and (3) that our gross outturn would amount to 7,000 gross per annum. If we could sell all these bottles in Madras, we would have one great advantage over the English manufacturer in that we would save the cost of freight, port dues and other similar charges. From figures kindly supplied to me by Mr. J. O. Robinson, I find that it cost the English manufacturer Rs. 5-9-0 per gross to land soda water bottles in Madras before the war, and the charges have now gone up to Rs. 16-9-0 per gross. The latter figure is of course abnormal, but for some time after the war it is doubtful whether freight and other charges will fall below Rs. 10 per gross. But we cannot safely assume that Madras alone could absorb 7,000 gross of soda water bottles in a year. Unfortunately separate figures regarding soda water bottles are not given in the Sea Customs returns prior to 1912-13. In that year 4,932 gross were imported, in 1913-14, 8,187 gross while in the last two years doubtless owing to the war the imports have dropped to 2,225 gross and 2,311 gross, respectively. It is impossible to draw from these figures any safe inference as to the consumption of soda water bottles in Madras in a normal year; but it is probable that 7,000 gross represents about the normal consumption. But Mr. Beardsell informs me that we could not safely count on capturing the whole trade, at any rate, not for some years. The firms would not have

sufficient confidence in the factory to place their entire orders with us, and almost certainly we should have to rely on Calcutta for a market for a good proportion of our output. But probably it would cost us not much less to place our bottles on the Calcutta market than it does the home manufacturers.

10. There is one other point, and if my information is correct, it is all important. Our machines are automatic machines obtained from Messrs. Forster & Sons of St. Helens. According to the firm's own figures, the maximum output per machine is about 25,000 bottles a month, and the manipulation of the machine requires skilled labour. The skill lies mainly in knowing exactly when to apply the scissors to the melt dropping into the mould from the gatherer's rod, and can be acquired only by experience. Now there is a patent machine for the automatic blowing of bottles known as "Owens Bottle Machine." The patent has been acquired by a Trust known as the Europaischer Verband der Flaschen Fabriken, an association of all the chief bottle manufacturers of Europe. Only two unskilled men are necessary in each shift for attendance on the machine, and the net daily output, after allowing for breakages, is from 21,000 to 24,000 pint bottles a day. I am not absolutely certain whether this machine can make soda water bottles. The Hon'ble Sir George Barnes thought that it could, and if so, it is quite certain that with our machines we could not compete with a factory equipped with an Owens Machine. Mr. Oertel, the Chief Engineer of Assam, who has written a pamphlet styled *Notes on the Glass Industry of Europe* informs me that he has only seen beer bottles made by this machine, but that he believes that it can make soda water bottles.

11. The above is as careful and dispassionate an analysis of the fundamental facts of the case, as I am able to make. They may be summarised thus:—The only advantage we have over the English manufacturer is that we are spared the cost of freight, landing charges and the like which for some years to come may amount to as high as Rs. 10 per gross. On the other hand, the English manufacturer can get fuel probably at one-fourth or one-fifth of its cost in Madras, he has the necessary chemicals on the spot whereas we have to import them, and he is able to work all the year round. Add that he has probably generations of skill and experience behind him, and that he manufactures on a very large scale, and the conclusion, I think, emerges pretty clearly that it is exceedingly doubtful whether in Madras we could ever compete with him in normal times with much prospect of success. I am quite of opinion that soda water bottles ought to be made in India, but except for its store of sand, Madras is probably the last place where the experiment should be tried. As suggested in paragraph 10 of Mr. Narayanamurthi's report Saktchi is probably the most suitable place for an experimental factory. I was talking to Mr. Padshah, Managing Director of Messrs. Tata Sons & Co. today. He tells me that at Saktchi coal is from Rs. 3-12-0 to Rs. 4 per ton.

12. But it may be suggested that (1) with a difference of nearly Rs. 17 per gross between the wholesale prices of soda water bottles at home and in Madras, and (2) with a decided shortage of bottles in Madras, we ought to be able to make a good profit out of the manufacture of the bottles at any rate as long as the war lasts. It is certain that the old Madras Glass Company had it been in existence now would be doing very well. But unfortunately we did not begin at the point where the Madras Glass Company left off. That company began work with a German expert on Rs. 2,000 a month and four expert European blowers, each on £ 15 a month. The furnace was started up on January 3rd, 1910, and by January 8th faultless glass was being made. We have been working on and off for some months now, and I cannot honestly say that we have made a single decent soda water bottle. Our apprentices have certainly improved, and we have attained an output of nearly 1,500 bottles in a day of 8 hours. But the quality of the glass is bad, and the neck-making defective. For instance, on the 6th instant, I sent 4 dozen bottles to Messrs. Maclure & Co. to be tested. Eight bottles were rejected on account of defective neck-making. The remaining bottles were subjected to a pressure of 120 lb. to the square inch, and only 22 of them withstood the test. The bad quality of the glass is probably due to some defect in the design of the furnace and resultant irregularity of temperature. Probably also the furnace is too small.

Mr. Elland says that in the factories at home the melt is maintained at a depth of 4 feet in the tank and that a day's work lowers the depth only by a few inches. We practically empty our tank. Defective neck-making and unevenness in the thickness of the glass, especially at the bottom of the bottles, are signs of unskilled blowing. Our results are not to be wondered at since the furnace was designed by two Engineers who have had no experience of, and probably have never seen, the type of tank furnace used in a glass factory, and since for training our blowers, we had to rely on one or two of the old blowers of the Glass Company who had forgotten part of what they had learned. Had we been able to begin at the point where the old Glass Company left off, all would have been easy. But we had to begin practically all over again. We have not even got a proper recipe for a mixture and at present we are using only cullet. All mixture recipes are trade secrets, and recipes given in text books must be regarded with distrust. As Mr. Oertel says in his *Notes on the Glass Industry in Europe*, "no works would ever betray their own mixtures". We have a rough idea of the mixture used by the Old Glass Company, but our experiments with mixtures have hitherto been failures. Moreover the factory is not properly equipped for the mixture experiments. It is an extremely expensive business to experiment in a $7\frac{1}{2}$ ton tank furnace with liquid fuel at Rs. 70 per ton. On the other hand when we put up a small experimental furnace, we found it difficult to work up to the temperature required. Probably the solution is to be found in ovens of the type mentioned in paragraph 24 of Mr. Narayanamurthi's report, but I doubt if they could be got at present.

13. The fact is that we have arrived at a point beyond which we cannot hope to advance very much without expert guidance. We want help in training our blowers and neck-makers, and in the matter of mixtures, and above all expert advice as regards (1) the type of furnace to be constructed and (2) how to construct it. Mr. Elland, the United Provinces Glass Expert, could probably advise in regarding mixtures and methods of testing them, but he does not pretend to be an expert blower, and he knows nothing about furnaces. The Director of Industries in the United Provinces is quite willing to lend us his services for a time on payment of his travelling allowance plus a deputation allowance of Rs. 30 per diem. He would, no doubt, do some good, but the crucial point is the furnace, and he could not help us in this point nor in training the blowers. In the circumstances I doubt if it is worth while bringing him down. Mr. Oertel says "the back-bone of Glass-making" "on which its success depends is the furnace, and it is therefore generally considered that engineers with some knowledge of glass making make the best managers of Glass works." The engineer glass maker is exactly the type of man we want together with two or three blowers who are accustomed to handle the type of machines we have. Could we get hold of men of this type, I have little doubt but that we could make the making of soda water bottles pay so long as prices remain at their present level. But it would mean a large outlay, and a large recurring expenditure. In the first place I am pretty certain that we should have to scrap our present furnace and construct new furnaces designed to burn coal. Secondly, an engineer glass maker, assuming that we could get one at all, would be a very expensive person. But it seems hardly worth while to pursue this suggestion, for as long as the war goes on it would be impossible to get from home the type of experts we want. Further our object is not to run an industry which will pay only so long as abnormal war conditions last, but to establish an industry which will take permanent root in Madras. For the reasons already stated, I do not believe that there is any prospect of establishing a permanent industry in Madras in the manufacture of soda water bottles, and this being so, I am driven to the conclusion that the right course is for Government to discontinue at once the experiments now being carried on.

14. There is just a chance that we might succeed in making decent glass if in the light of the experience gained we constructed a new furnace. The trouble with the present furnace is that we get too fierce a heat at the working end and not sufficient in the third compartment where the cullet is put in. Consequently the cullet is not properly melted by the time it arrives at the melt chamber. What we require is a new furnace on a much larger scale and probably with the burners fitted at the mixture end instead of at the working end as in the present furnace.

But a furnace on the scale required would probably cost Rs. 13,000 or 14,000; it would not be easy to get the material required; at best it would be a gamble; and I am not in favour of trying any more doubtful experiments.

15. I submit therefore for the consideration of Government my proposal that the present experiments should be closed down. The Hon'ble Mr. Couchman to whom I have shown this letter agrees with me. So does Mr. Beardsell of Messrs. W. A. Beardsell & Co., the managing agents of the old Madras Glass Company. This gentleman has sent me a copy of his evidence for the Indian Industrial Commission on the glass industry and has suggested that I should submit it to Government. It will be seen that he shares my view that Madras is not a suitable place for a soda water bottle factory. I endeavoured to consult Mr. J. O. Robinson but unfortunately he was engaged and the next day he left for Europe.

16. I ask for early orders as the sanction for the expenditure on the experiments expires at the end of this month. I have not yet considered Mr. J. Narayana-murthi's proposals about bangle-making. If I decide to move in the matter, I will make a separate reference to Government.

ENCLOSURES.

(i)

Copy of report from M.R.Ry. J. Narayana Murthi Avargal, Sub-Engineer, on his tour in Northern India.

I beg to submit the following report on my tour in Northern India, the object of which as per the Director's Office No. G. Cur. 52, dated 11th November 1916, to the Government has been stated to be

(1) to enable me to answer, as far as possible, the list of questions prepared by me by the knowledge gained by me by observation and enquiry at the factories visited and by personal interview with Mr. Elland, the glass expert of United Provinces and other glass experts and

(2) to improve my practical and theoretical knowledge of glass-making to enable me to be in a position to assimilate any suggestions from any glass experts.

2. I have also been asked to visit the chief bangle-making centres and study the question of bangle-manufacture. Thus charged, I left Madras on the night of 25th November 1916 and after an extensive tour alighted within the limits of the Madras Presidency on the morning of 21st December 1916 and returned to Madras on the morning of 23rd December 1916.

3. To start with, I alighted at Poona to call upon Mr. N. C. Kelkar, one of the Secretaries of the Paisa Fund and obtain from him a letter of introduction to the Superintendent of the Paisa Fund Glass Works at Talegaon to permit me to see the works which he was kind enough to give me. With that letter I arrived at the Glass Works, Talegaon, where in the absence of the Superintendent, Mr. R. M. Bhorkar and the Chemist, Mr. A. D. Joshi, B.A., B.Sc., warmly welcomed me and took me round the works explaining every operation clearly to me.

4. The early history of this factory is very interesting. When the Swadeshi movement started in 1906, an industrial school under the name of Sadhana Vidyalaya was started at Talegaon. Simultaneously subscriptions were collected at the rate of a quarter of an anna (0-0-3) and the amount thus collected was called the Paisa Fund (paisa 0-0-3ps.) The trustees of this fund utilised nearly Rs. 40,000 for the erection of a glass factory adjacent to the above said Vidyalaya with the object of training some of the students of that Vidyalaya the art of glass blowing. Mr. S. S. Ishwardas Varshneyi who underwent training in glass-making in Japan and America for over three years was engaged to supervise the glass works and train the students. Quarters for the Superintendent and the labourers and also a laboratory were erected and the work commenced in 1908. About 20 students joined the institution naturally during 1908 and 1909; this institution lost nearly 30 to 40 thousands of Rupees as it was working as a trade school and not a commercial concern. The period was too short for the students to become expert blowers. The trustees were not willing to sink any further amount on the institution. At this juncture 6 Japanese blowers arrived at Bombay with the object of starting a Glass Factory on their own account. Hearing of this Mr. Ishwardas met them and subsequently the works were leased out to Mr. Ishwardas on the following terms:—

(1) The Paisa Fund Committee undertook to advance working capital at 4½ per cent interest.

(2) Mr. Ishwardas undertook to train the apprentices.

(3) Mr. Ishwardas was personally responsible for the return of the working capital with interest, the profit or loss being his own.

(4) The term of the lease was from 1910 to 1915.

• Mr. Ishwardas sublet the undertaking to the above said Japanese on the following terms:—

(1) The Japanese to train the apprentices.

(2) Mr. Ishwardas was to find the working capital and was also responsible for the sale of the finished products and the supply of raw materials.

(3) The Japanese had to manufacture and hand over the finished article to Mr. Ishwardas, the price of each article being fixed previously.

(4) Mr. Ishwardas to retain 28 per cent (including the interest on capital advanced to the Japanese) of the gross value of the finished products, the Japanese taking 72 per cent towards the cost of raw materials, the wages of labourers and their own remuneration.

It appears, during this period, the Japanese made Rs. 100 to Rs. 125 each and Mr. Ishwardas Rs. 400 to Rs. 450 per month.

I am told that each of those Japanese blowers used to turn out 700 to 1,000 pieces in a day of 8 hours permitting the apprentices half an hour every day before closing to practise.

The Japanese constructed a 6 closed pot (400 lb. each) direct fired furnace and manufactured chiefly chimneyware and jars. They got sand from Allahabad; slaked lime from Bombay, coal from Bengal Coal Mines (Baraboni), chemicals from Bombay and closed pots from Japan. At that period the prices of the chief of the raw materials delivered at the factory were as given below:—

	RS.
Sand	27 per ton.
Lime	70 "
Coal	15 "
Soda	88 "
400 lb. pot	Rs. 15 to Rs. 16 each.

5. At the end of 1915 Mr. Ishwardas could not obtain a renewal of the lease and left to Ambala to run the Upper India Glass Works on terms which will be explained later on. With him, he has taken 6 or 7 of the locally trained apprentices and two of the above Japanese. The rest of the Japanese and some of the trained apprentices found employment in one or other of the glass factories in Bombay Presidency and Northern India where after the war some of the defunct factories started work again. Mr. Sundaresa Ayyar, who was one of those trained here, left in 1916 for Japan to learn the manufacture of the "silky" bangles of Japan which by this time came into vogue. The Paisa Fund thus had only 5 trained blowers left, the present Superintendent and Assistant Superintendent being some of those former apprentices.

6. These trained blowers that are left are young men educated up to the matriculation standard while those that went to seek employment elsewhere are almost all uneducated workmen. These, due to their love towards the institution induced the Paisa Fund Committee to run the works on commercial basis they themselves offering to work for a pittance of Rs. 35 each rejecting offers from outside of a pay of Rs. 125 to Rs. 150 per month. The work was started early in 1916, the time being favourable due to war. But the price of "pots" went up from Rs. 15 to Rs. 40. Even at that price, the supply of the pots was not assured. There was no large stock of pots in their works. This difficulty of the pots is being felt in all the factories that restarted work after the war. So the Paisa Fund works decided (1) to work only with 3 pots for the time being (2) and to make experiments in the manufacture of the pots in India. For the latter purpose, Mr. A. D. Joshi, B.A., B.Sc., has been engaged on Rs. 75 per month. At the same time they managed to buy nearly 100 pots from factories at Baroda and Alwar which have been wound up in 1915. During 1916 till November, only three pots were kept going but now they are constructing a 6 pot furnace to increase their daily outturn on the strength of the success they had during 1916. The abovesaid 5 blowers are all on the same footing each in his turn (by months) working as Superintendent or Assistant Superintendent, two of them being actually engaged in blowing every day.

7. Working with 3 pots (nominal capacity 400 lb. actually only 225 lb. of molten glass can be had from each per day), Glassware (Madras, hurricane and 10 and 14 line chimneys) weighing 6 cwt. is manufactured daily, fetching Rs. 100 to Rs. 110 at the present prices. The cost of the raw materials for the 6 cwt. of molten glass per day amounts to Rs. 35. The daily consumption of coal is 1 ton costing Rs. 16. The cost of the establishment including blowers and their assistants, furnace attendants and their assistants, monthly paid labourers for pounding, grinding, polishing, etc., and 2 clerks is Rs. 1,000 a month or daily 33½. That is for a daily total expenditure of about Rs. 85, the net outturn is Rs. 100 to Rs. 110 leaving a profit of Rs. 15 to Rs. 25, say an average of Rs. 20, out of

which the interest on starting capital and working capital and depreciation will have to be met. The enthusiastic workers there are very much satisfied with the success but to my mind their present position seems to be far from satisfactory from a proper business point of view for the following reasons:—

- (1) Talegaon is not at all an ideal site for a glass factory. They are importing by rail all the raw materials including sand and lime in addition to coal and for marketing their finished ware they have to send again on rail to Bombay.
- (2) After the war the prices are bound to fall and the foreign cheaper article of a better quality will compete in the market.
- (3) A concern can be said to be a successful one only when the net profits cover the interest on capital.
- (4) Even the present apparent profits are due to the fact that the blowers are working only for nominal wages.

8. The raw material (soda) is pounded in wooden mortars by pestles acted upon by levers worked by men. The Chemist prepares the mixture and blowers fill up the pots as they are emptied in three lots at intervals of 2 hours each. From the time the pot is once emptied it takes full 18 hours before the fresh mixture put in it melts and refines. At the end of that period the molten mass is free of air bubbles without the addition of any vegetable matter. The temperature attained in this furnace is above 1350°C , less than 1400°C . The present consumption of 1 ton coal per day ($\frac{3}{4}$ ton for melting and $\frac{1}{4}$ ton for annealing, etc.), for 6 cwt., of molten metal is considered high. It appears the present 3 pot furnace was originally constructed for a 6 pots when the daily consumption of coal used to be only one ton for melting 12 cwt. The size of the passages have not been correspondingly reduced and the comparatively high consumption is attributed to that and that in the new 6 pot furnace they are constructing they hope to minimise the coal consumption. The furnace is capable of improvement by increasing the depth of the coal bed on the grating and constructing a passage for the air round the fire chamber so that the incoming air may be heated before entering beneath the grate. Also a damper on the exhaust will be an improvement.

By the side of this melting furnace there is a pot heating furnace for preheating of the pots to replace the broken pots in the melting furnace.

The work is commenced at about 7-30 a.m., when the blowers assistants begin by skimming off the "Gall" in the pots. The apprentices practise blowing with the "Gall" thus utilising it for heating the chimney moulds.

A young boy heats the blow pipes by holding them in the mouth of the pots and hands them over in succession to another trained young boy who by experience gathers a small quantity of metal by dipping and turning the heated end in the molten metal and blows into a very small bulb of $1\frac{1}{2}$ inches to 2 inches diameter and hand over the rod to a more experienced workman who gathers over the previous bulb a fresh quantity of metal according to the article manufactured. The blow pipe is then handed over to another man who blows it to a bulb of 3 inches to $3\frac{1}{2}$ inches in diameter and rolls it in a cast iron dish into which drops of cool water mixed with oil will be dripping. This operation is said to increase the homogeneity of the material. The blow pipe is now handed over to the expert blower who by several manipulations of twisting and swinging and blowing, blows into a long bulb and placing the bulb in a mould, which is opened and shut by a boy sitting in a pit in front of the blower, blows hard through the pipe all the while turning the pipe round and round. He closes the operation by a strong blowing keeping the rod steady. The mould is then opened and passed on to another man sitting on a chair with long horizontal arms. He rolls the pipe to and fro with his left hand and with his right separates the blown article with either slight taps or by the help of a cold iron piece. The blow pipe is then handed over to a boy who cleans the end of any glass sticking to it and takes it back to the furnace. For each blower 7 to 8 blow pipes are necessary. The blowing being over, the blown article is taken to the annealing oven of an intermittent type heated by direct firing of coal. After two days the article is taken out of oven and taken to the cutting room.

The cutting is done by a carborandum wheel which is rotated by means of a big hand wheel. After cutting it is taken to the end-polishing place. The face to be polished is held against an iron wheel, which is rotating either horizontally or vertically, on which water mixed with very fine sand will be dripping. Then the article is washed and cleaned when it is ready either to be packed and despatched or to be stored. Beyond the annealing all the operations are done only by women.

The arrangements for cutting, grinding and polishing are very crude here, the turning of the wheels being done only by hand. They are contemplating to have a $3\frac{1}{2}$ H.P. Oil Engine for this purpose very shortly.

The breakage from blowing to the packing is about 20 per cent distributed thus, 6 per cent in blowing, 6 per cent in annealing, 3 per cent in cutting, 2 per cent in polishing and 3 per cent in transit from place to place before packing.

Before leaving the place I had an estimate (given in Appendix A—not printed) drawn up for a Glass Factory to manufacture chimneys having a direct fired furnace with six closed pots.

9. In view of the fact that the life of a pot is on the average only 20 to 25 days the manufacture of pots deserves careful consideration and the experiments conducted by Mr. Joshi are to be watched with interest by all Indian Glass Factories. Several authors have different opinions; some hold that the fire clay must be tempered for at least six months and some say that three weeks time is enough. Again in the matter of drying the pot before heating some hold that 12 months drying is necessary and some 2 months. Mr. Joshi tempers the clay for 4 weeks and dries the pot for 3 weeks. The author of the latest book on refractory materials, Mr. Howard, thinks that uniform quick drying is the best. I am inclined to agree with him and perhaps such drying can be done in an "Autoclave" by steam baking as in our Lime Brick Factory. This has been suggested to Mr. Joshi and he proposes to get three or 4 pots of his to Madras to be thus baked and the experiment is worth trying in view of the fact that fire clay is available in India and if the experiment prove a success it is quite probable that Jubbulpore will be able to supply the pots now imported from Japan.

10. The next place visited was Bombay. At this place I could not get permission to see the Sivri Glass Works where chimneys are made. The proprietors, I hear, are one of the largest dealers in chimneyware and hence they are jealous about any visitors. Some Japanese and apprentices of Talegaon, I hear, are working here.

In Bombay near Matunga station, there is another factory which I hear has just commenced working with one Mr. Shaffi as the expert. Mr. Ebrahim Peer Muhammad, the largest glassware merchant of India, has capitalised this concern. I could not get permission to visit this place also.

While at Bombay I heard of two factories on the Bombay-Baroda Railway at a distance of a journey of 15 hours. One of them is at South Road manufacturing carboys only. This is run by one Mr. Kanga who learnt glass-making in Germany. I hear the factory is working at a profit.

The other factory is at Peplod. This has been constructed by Mr. Shaffi (above-mentioned). An intermittent tank furnace with gas generators to use wood fuel was constructed and the factory closed after a month's trial during which time any temperature beyond 1200° could not be attained and the glass remained "Doggy". Thus disappointed at Bombay I called upon B. J. Padshah, Esq., the Managing Director of Messrs. Tata & Sons who put me in touch with Mr. N. B. Wagle, a Government of India Scholar, who in 1904 was engaged by the Government of Bengal to report on the possibilities of glass industry in Bengal. In his admirable report he embodied his views the chief of them being that (1) the best place for glass industry is Bengal near the coal mines and (2) the line of manufacture is pressed ware to start with to get over the difficulty of getting trained blowers to start with. Mr. Padshah also agreed with Mr. Wagle. It appears that slag from iron and steel furnaces is now being used for the manufacture of cheap bottle glass in Europe and America. In view of this Mr. Padshah suggested that the question of glass industry should be treated as an imperial concern and not a provincial one and that experiments on a large scale should be conducted preferably at Saktchi in close contiguity with steel furnaces of Messrs. Tata Iron and Steel Company, where chemical and engineering experts are available. More about this will be discussed later on.

11. Leaving Bombay I arrived at Jubbulpore and called upon Diwan Bahadur Vallabhadras, the proprietor, Jubbulpore Glass Works. His office manager, Mr. M. B. Motivala who has been of late taking interest in the above Glass Works, was deputed to take me round the factory. The history of this factory is both interesting and instructive.

This factory was started in 1909 with Mr. Kanga (now at South Road) as the expert. A gas fired open pot furnace with 8 pots with gas producers and regenerators was constructed. Annealing ovens are provided. Chambers for drying sand by heating are constructed. In a long room off a long shafting run by an Oil Engine, are driven 24 iron wheels for polishing and a dozen carborandum wheels for cutting. Alongside with these there are two machines (which have never been used) for cutting glass by "petrol jet" lying idle and ready to be scrapped. There is a long row of buildings as quarters for the Superintendent and labourers. Separate rooms are provided for the manufacture of pots. Big rooms for office and stores are provided. Outside these are basins built for washing sand. Nearly 1.75 lakhs was invested as capital. For $1\frac{1}{2}$ years the factory worked with a consumption of over nearly 6 to 7 tons of coal for every ton of glass melted. During this time nearly there was a loss of nearly 50 to 60 thousands. Then Mr. Kanga left to South Road and Mr. Mosina, an Austrian, who was originally brought to Rajpur factory which subsequently closed was engaged to run the concern, and in his regime, the producers are reconstructed with smaller dimensions and work restarted. The coal consumption was brought down to $3\frac{1}{2}$ tons per ton of glass melted. This was in 1911 and 1912. Till this period bangles and glass blocks for bangle-makers were manufactured. The bangles were of the pressed Austrian type the mould for which was got from Germany. The breakage in cutting and grinding used to be as much as 60 per cent. The factory was losing. Mr. Mosina had an offer from

Allahabad Glass Works and left with 2 or 3 trained workmen from Jubbulpore. In 1913 without an expert the manufacture of the bangles was continued but early in 1914, Austria suddenly brought down the prices from 1s. a dozen pair to 3d. to 4d. a dozen pair. The factory could not stand the competition and had to be closed.

After the beginning of the war, few blowers were again gathered together and the manufacture of chimneys was started. Mr. Motivala was left in charge. His interference is being resented by the blowers as well as the poor relatives of the proprietor who were living upon the failures of the factory. In spite of these difficulties Mr. Motivala partially succeeded in confining the manufacture to particular varieties, e.g., Kitson globes and municipal lantern chimneys and obtained large orders from different railway companies. Thus the business side is fairly improved, but the internal management requires thorough overhauling. The blowers and smelters are the real masters of the factory. The result is the factory has till now lost nearly 5 lakhs and is still losing.

The pots in the furnace break very often and though the furnace is nominally a 8 pot one, on the average during the last year only 4 pots of metal could be manufactured per day. The consumption of coal in the furnace has again gone up to 5½ tons per 1 ton of glass melted. The producers and regenerators often get sooted and the cleaning of them necessitates the closing of the work for a week during which the pots break due to fluctuation of temperature. In 1916 Mr. Elland, the glass expert of the United Provinces, stopped at this factory for nearly 3 weeks. His presence in no way improved the affairs.

The failure or success of this factory at Jubbulpore has a great influence on the future of the glass industries in India.

The sand obtained within the limits of the factory is quite as good as any other sand in Northern India containing not more than 1 per cent of oxide of iron.

Jubbulpore is the place from which whole India is to be supplied with fire clay, fire bricks or blocks. The lime from Katni which is very near Jubbulpore is the best of its kind.

And above all, Jubbulpore is very near from coal mines (nearer than any other place where a glass factory has till now been started).

The only disadvantage Jubbulpore has is that the chief markets for finished ware (Bombay and Calcutta) are situated at a distance. With so many advantages the moral effect on glass industry in India caused by the success or failure of this factory is immense and deserves careful consideration at the hands of either the Government or private capitalists. The proprietor is disgusted with the factory and may close at any time.

The prices of the raw materials at this factory are given below:—

	Per ton		
	RS.	A.	P.
Sand (washed and dried)	3	8	0
Lime	20	0	0
Coal	12	0	0

12. The next factory visited was the Perfect Pottery Works at Jubbulpore. Mr. Reed, the Ceramic expert, received me and kindly showed me round the works.

This factory manufactures fire clay articles of any shape and size. They also manufacture Silica bricks which are to be preferred to fire bricks for the construction of the crown of any furnace where high temperature is required. I have arranged to have some samples of those bricks sent to Madras.

13. I next arrived at Allahabad and met Mr. Elland who was kind enough to receive me at the station. I had a long interview with him. Not being an engineer or a scientist he was not of much use in helping me to answer the list of questions. Yet he has evidently been all his life in a glass factory and though he does not profess to be able to design a furnace or analyse any raw material, he can be trusted to keep going a factory (similar to the one in which he was working) properly erected and equipped with trained labour. One important piece of information obtained from him is that the holding capacity of a continuous tank furnace in England with a daily outturn of 5½ to 6 tons, is 200 tons.

14. In the factory at Madras, our aim is to have a daily outturn of 5 tons and its holding capacity is barely 7 tons. The dimensions of the furnace in England for a daily outturn of 5½ to 6 tons is 32 feet × 14 to 15 feet inside and height of 7½ to 8 feet with a constant depth of 4 feet of metal. Mr. Elland was in charge of such a factory at London turning out cheap bottles (not soda bottles) by mouth blowing and I am told that the daily consumption for all the operations is 7½ to 8 tons. He has no drawing of the furnace with him. The furnace Mr. Elland was in charge of was a gas fired one and he is not acquainted with any oil-fired furnace. He does not believe in machine-blowing. He told me he is not acquainted with any such machines. Mr. Elland was kind enough to tell the recipe he was using for cheap bottles at home where the temperature of the furnace was always kept up at 1500° C. It is well worth to experiment that recipe with our raw materials. If the experiment be a success, the recipe we are adopting at our factory will have to give

place to Mr. Elland's recipe being a cheaper one. The only objection to Mr. Elland's recipe is that in his recipe sodium sulphate is used instead of carbonate and the use of sulphate necessitates special fire bricks for the furnace to withstand the action of sulphur vapour.

15. During my stay then at Allahabad I could not get letters of introduction to the proprietors of the Allahabad Glass Works and Naini Glass Works at Allahabad and so I left to Firozabad which is the chief bangle-making centre in Northern India.

At Firozabad there are 6 factories engaged in the manufacture of glass-blocks for the bangle-makers and there are 50 bangle-making furnaces at each of which 8 to 12 bangle-makers work, each workman turning out 1,000 to 1,500 per day. The average quantity of glass-block manufactured daily from the six factories together is 400 to 420 maunds or nearly 15 tons. Allahabad sand (13/8 per ton), Bengal coal (14/8 per ton) and Katni lime (30 per ton) are used. I visited the two biggest of the six factories. The first is Indian Glass Works owned by Mr. Nandia Moulchand with the help of Mr. M. Mozina, the Austrian expert who once worked at Jubbulpore. This factory was started about 1910 and 1911 with a direct fired open pot furnace with 8 pots but early in 1914 closed owing to two causes: (1) want of temperature in the furnace and high consumption of coal and (2) the Austrian competition which by lowering the prices of bangles threw the bangle-makers to a state of panic. After the war the work was restarted. Mr. Mozina constructed a gas fired open pot furnace with 10 pots. There is very heavy demand for the glass blocks as the whole town is full of hereditary bangle-makers, and the factory is working at a profit. The glass is not of high quality. It is full of air bubbles but still, as long as the war lasts or till German or Austrian bangles are dumped in the Indian market there will be demand even for this poor glass.

A temperature of 1400 to 1450 is easily had in the furnace.

The pots are emptied once in 12 hours and total quantity manufactured in a day is 3½ tons and daily consumption of coal is 3 tons. This is not surprising as there is no annealing and as each pot is emptied twice a day. Mr. Mozina understands his furnace very well.

16. The other factory is "The Coronation Glass Factory" where glass blocks are made in a "direct fired 8 pot furnace." The rest of the factories, I am told, are smaller factories having direct fired furnaces with 5 or 6 pots.

There is nothing deserving of special mention about these factories except that no attempt is made to produce better grade of glass. The effect is that the bangles made appear very crude and rough.

Regarding bangle-making at this place, Shaharanpur and Calcutta I propose to deal separately.

17. Leaving this place I went to Agra to meet Professor Nag, a well-known chemist, who, I was told, has been taking very keen interest in Firozabad Glass Works during the last two years. He is of opinion that the glass factories at Firozabad and the bangle-making industry are bound to fail very soon after the close of the war unless greater attention is paid to the chemistry of glass-making and glass is made, not out of empiric recipes secretly handed over from father to son irrespective of nature of raw materials but out of materials chemically tested and purified and experimented and unless the furnaces of the bangle-makers are improved so as to give a temperature of 900° C to 1000° C as really good glass can be manufactured only at high temperature, and unless machinery is adopted in bangle-making for either blowing or pressing, cutting and polishing. He deplors that, while Austria or Germany or Japan was able to bring about new designs even in bangles, the local bangle-makers merely copy and were not able till now to put into the market a new design that would attract the buyers. This is attributed to want of cultivation of the art of designing. In Austria and Bohemia, it appears, there are schools even for that purpose.

Coming to the manufacture of cheap bottle glass greenish in colour he suggests that experiments may be conducted to determine how far indigenous manganese ore as obtained from mines can be substituted for the manganese dioxide, the price of which has gone up very high. The price of manganese dioxide is at present nearly 20 times the price of manganese ore.

18. From Agra I went to Shaharanpur which is also a bangle-making centre. After visiting three bangle-making furnaces and observing how the twist bangles are manufactured (will be described under bangle-making) I reached Ambala to see the Upper India Glass Works where chimneys are manufactured. This is one of the oldest factories started on a big scale with gas producers, regenerators and an open pot furnace, and quarters for manager and labourers. After many ups and downs, manufacturing for some time glass blocks for bangles, afterwards phials and ink bottles and afterwards chimneyware, the factory never made any profit and changed hands over half a dozen times and finally it came into the hands of Mr. Panna Lal, the present proprietor, in 1913-14 when the work was restarted for the manufacture of blocks. At this period the Austrians lowered the price of these bangles and the factory had to be closed till the middle of 1915 when Mr. Ishwardas whose term of lease at Talegaon expired entered into an agreement with Mr. Panna Lal and

took over the factory on lease at a monthly rental of Rs. 75. Mr. Ishwardas brought 2 Japanese and 6 Indian blowers trained at Talegaon and started the manufacture of chimney-ware constructing a direct fired closed pot furnace with 6 pots similar to the one he had at Talegaon. Bengal coal is delivered at the factory for Rs. 16 a ton. Local burnt lime stone is delivered at Rs. 21 per ton. Mr. Ishwardas seems to be extremely satisfied with the profits he is making. As far as Mr. Ishwardas is concerned the factory is a success, but the concern as a whole is a failure as this concern over which an initial capital of 1.5 lakhs has been spent (not considering the loss of 3 to 4 lakhs that has afterwards been sustained by different people) is paying only 12 x 75 or only 900 Rupees.

Mr. Ishwardas is manufacturing only chimneys and no other article. Apart from the extremely easy terms of agreement under which he obtained the use of the factory, he is lucky in that his market, which extends an area of about 250 miles radius round Ambala, is over 1,000 miles away from either of the three ports of Bombay, Karachi or Calcutta and consequently he is able to procure a high price for his ware in comparison with factories at Talegaon, Jubbulpore or Allahabad.

19. Mr. Ishwardas has constructed a small factory of his own at Bijoi (between Shaharanpur and Lucknow) which started work just 2 months back manufacturing chimneys. A small direct fired closed pot furnace with 4 pots is erected where two blowers are working. I am told that Bijoi is selected as local labour there is cheap. Mr. Ishwardas says that this factory also is paying well at the present prices and hopes it would continue to pay even under normal conditions as the place is far away from either Calcutta or Bombay.

Mr. Ishwardas was examined on glass of India by the Industrial Commission and in his evidence he embodied a list of the several factories started subsequently and closed at different periods in India.

I should thank Mr. Ishwardas for the kindness he has shown me during my visit to his factories.

20. Thence I came back to Allahabad to visit the Allahabad Glass Works.

Having obtained letters of introduction from the Hon'ble C. Y. Chintamani, I went to Allahabad Glass Works, where in the absence of the proprietor Mr. Jagmalraj, his brother, was kind enough to take me round the works. The chief articles manufactured here are medicinal phials of pale green colour. They are also manufacturing carboys, kitson globes and chimneys. It appears that formerly they had a gas fired open pot furnace and gas producers. During the last year they constructed a direct fired open pot furnace and the work at present is out of this furnace. Just now they have repaired the old gas furnace with the intention of closing the direct fired furnace. The bottle glass manufactured is of very poor quality full of air bubbles and even the chimneyware is not quite free of bubbles. The cutting is done by "petrol" jet of the type mentioned at Jubbulpore and grinding is done on iron wheels driven by an oil engine. The proprietor of this company is a big contractor for railways and owns a portion in a coal concern. It is this contractor that supplied sand to Talegaon and Ambala and other places. So he has sand for his factory at cost price, i.e., Rs. 3-8-0 per ton. He gets his coal for Rs. 7 and Rs. 8 but still I am told he lost nearly 4 lakhs up-to-date but he is still continuing it because he is a wealthy man making large profits in his railway contracts which he is sinking in this concern. If Government gives him help he intends to import machines for bottle-making and extend the works. He engaged the services of Mr. Mozina for some period in 1914.

21. The other factory at Naini is owned by Mr. R. D. Kanga, M.A., and Mr. Bhargave. Here chimneys are manufactured in a direct fired open pot furnace of 5 pots. This factory has been closed three times during the last four years of its existence. At one time Mr. Kanga closed the works and joined Mr. Jagmal Raj's factory. After the war Mr. Kanga has restarted the factory. Cutting and grinding is done as in Talegaon.

22. Having seen these two factories I left to Calcutta where B. Lindsay, Esq., I.C.S., Director-General of Commercial Intelligence Department has been kind enough to depute Mr. Rice, Curator of Commercial Museum, to show me the bangle-making in Calcutta.

Though Mr. Rice was evidently surprised at first to hear that bangles are made in Calcutta we after enquiry found that about 500 operators in Chitpore are carrying on that industry for over 30 years and the bangles made there are about the most decent of the bangles made in any part of India. As I propose to deal with the question of bangle-making separately, I do not here go into the details.

23. The next day I visited the Calcutta Pottery Works where various porcelain articles are made. The success of this is due to the perseverance of Mr. S. K. Deb, the expert. Though originally trained in Germany when the works actually started he found his knowledge insufficient to run the works successfully and he went over to Germany twice afterwards to clear his doubts and to study the furnaces. It was during his last visit he could obtain plans for an up-to-date furnace to suit the industry. He constructed this furnace about 6 months back and his factory is working at a profit now. Electric insulators also are manufactured and he has large orders from home for electric ware. This factory I give as an instance to show that each industry requires a special furnace and the success of the concern depends mainly on the furnace. Mr. Deb may know all about porcelain

manufacture but he could not make the factory a success till he obtained a thorough knowledge of the furnace and till he constructed such a furnace. In his muffle furnace he is able to get 1,350° while formerly in an old fashioned furnace he could not get more than 1,150° to 1,200°. Porcelain manufacture does not admit of dropping of particles from the furnace crown and the inside of the crown requires a certain paint to prevent such particles from falling. A knowledge of that paint is absolutely essential for glass manufacture also and Mr. Deb has been kind enough to give me a recipe of the same which Mr. Reed of Jubbulpore was jealous to keep secret.

24. There was a "Seger-ofen" in this factory which is of great use for conducting experiments of several mixtures for glass manufacture. It appears all glass factories in Germany have at least half a dozen such experimental ovens in each factory. Mr. Deb consented to conduct some experiments for us if a fee is paid and it may be worth while to utilise his services if no such oven is available in this Presidency. He has an instrument that continuously records the draft of the chimney so that the furnace heat and air openings may be regulated properly. Mr. Deb is making a particular study of his furnace with regard to draft etc. Such an instrument will be of immense use in any furnace.

Of all the factories I have seen not only in this trip but even at other times, this factory is the most neatly kept and the best organised one.

25. The next place visited was Sodepore where in 1908 Messrs. Halgiers & Co. started a glass factory with a capital of five lakhs of rupees. Experts were entertained. A continuous tank furnace with producer and regenerators was started to manufacture bottles and pressedware. The result was a very sad failure. The factory was closed. Subsequently the factory was bought by Mr. L. R. Mullick who with the help of a Japanese expert had a direct fired open pot furnace constructed and started manufacturing glass blocks. This attempt too failed and the factory was again closed. I went there with the hope of seeing at least the remains of the continuous tank furnace and to my great disappointment I found even the foundations of the furnace demolished and there was nothing to be seen.

26. After this, I called upon the Director-General of Commercial Intelligence and borrowed from his library a copy of the report of Mr. N. B. Wagle above referred to and left Calcutta on the evening of the 20th.

27. Though originally I intended to visit Saktchi (Tata Iron and Steel Works) and with that intention obtained letters of introduction from the Managing Director, Mr. B. J. Badshah, the 25 days' period allowed to me was over on 20th December, and in the absence of the Director of Industries who happened to be away from Madras on 20th, I received a wire from Dr. Marsden suggesting to omit visiting Saktchi in reply to my request for an extension by 5 days of the deputation term. So instead of going to Saktchi I arrived at Berhampur (within the limits of the Madras Presidency) and having visited the village Ankusapuram where very crude bangles are made left Berhampur on 22nd and arrived at Madras on the 23rd December 1916.

Such is the history of my tour and the several factories I visited.

28. For a proper comprehension of the magnitude of the question of glass industry in India, I should like to add a short sketch of other factories which I have not visited. A major number of these are not working at present.

The first glass factory started in India was at Ahmedabad using wood as fuel. Afterwards a factory was started at Rajpur near Dehra Dun with half a dozen Austrian blowers. The climate of Rajpur is uniformly moderate. In spite of favourable climate and experts the factory had to be closed. An European firm started a factory at Tittagarh with an European expert. Tittagarh has the advantage of being connected by a navigable river both with Calcutta which is the chief market and Bankura the place from which sand and lime was obtained. In spite of the business knowledge of the firm that started the concern, the expert and the water carriage the factory failed. The Sodepore factory in spite of huge capital and most up-to-date furnaces failed.

At Sitarampore (near Asankol) another factory was started just near the coal fields. This too failed. The Maharajas of Gwalior and Baroda started on factories at each place. These too had to be closed. There are many other such failures not worthy of mention. Of course I need not describe the failure of the Madras factory.

29. The condition of glass industry in India up-to-date may be described thus:—

During the last 25 years, about 30 factories were started each with a capital of 1½ to 3 lakhs, each factory lost 2 to 3 lakhs of working capital; most of the factories had at one time or another experts of different nationalities (European and Asiatic). Yet all the factories failed and that very sadly.

If the success of a glass factory in India depends upon few workmen who, having spent 15 to 20 years of their life in some one or other of the big factories in Europe or Japan, come to India as glass experts, many of the above 30 factories should have been working today; if it had depended merely on the nearness of a factory to coal mines, there is no reason why Sitarampore factory should fail; if it had depended on the factory being easy reach of the distributing market, Tittagarh or Madras factories should not have failed;

if it had depended on cheapness of fire bricks or lime Jubbulpore factory should not have failed; if it had depended upon the initial capital necessary to train labour none of the factories should have failed and lastly if it had depended merely upon the business capacity of the managing concern, Madras, Sodepore and Tittagarh factories were run by renowned English firms and it is difficult to understand why these failed. The factories have failed in the past and the factories in the future are bound to share the same fate unless greater heads than mine go into the question and study the real causes of such failures.

30. The information gathered by me during my tour by observation, by interviews with experts and by reading the literature on glass-making I happened to come across, may be summed up so far as it effects Madras and the experiments conducted at Madras as follows.

31. *A. Raw materials*—(1) *Quality*.—(a) For the manufacture of cheap bottles including soda bottles, ordinary sea sand may be used, if necessary, after washing.

(b) The white sand from Ennur (which is reported to contain 0.5 to 0.75 per cent of oxide of iron) is the best sand available in India and can be used for lampware, etc. The best sand in Northern India is reported to contain 0.85 per cent of oxide of iron and the sand of Allahabad now used in different factories has as much as 1.25 per cent of iron.

(c) Raw sea shells powdered is to be preferred to slaked lime used in other places as its quality is uniform and may be depended upon.

(2) *Prices*.—(a) The cost of Ennur sand delivered at the factory after screening through a fine mesh is about Rs. 11 to Rs. 12 per ton. The price is not much lower than the price of the sand at other places.

(b) The price of shell powdered according to the lime value is about Rs. 40 to Rs. 45 per ton as against about Rs. 80 in other parts.

(c) The price of chemicals in Madras is the same as in Bombay and Calcutta and less than in places inland by the amount of railway freight.

32. *B. Fuel*.—It is a decided fact that wood fuel is of no use for glass industry. The quality of the glass depends upon the percentage of the silica in it and good glass can be melted only at 1,500° C. This temperature can be attained either with coal and liquid fuel. With coal it can be attained only by well designed regenerators. It is easier to attain that temperature with liquid fuel. But it should not be forgotten that the calorific power of liquid fuel is about twice as much as coal and to attain a temperature of 1,500° with a quantity of oil equivalent to half the weight of coal, the furnace will have to be designed by an expert who has long experience of such furnaces. It is theoretically possible to substitute 1 lb. of oil in place of 2 lb. of coal; it is impossible to reduce the quantity of oil by anything less than half the weight of coal. So from an industrial point of view it is a waste to substitute oil in place of coal if the price of oil be even one pie over twice that of coal.

In the factories I visited I found that 2½ to 5 tons of coal is consumed for every ton of glass melted while in England and the Continent in factories with a large production the consumption of coal is 1 lb. for every lb. of glass melted and annealed. To successfully compete with such factories, the consumption must not be more than that. Again most of the big factories in Europe are situated near collieries where the price of coal is 5s. to 8s. according to quality. Similarly Indian glass factories also must be as near collieries as possible. Many are of opinion that Bengal Coal Mines is an ideal place for a glass factory. The price of the best coal at pitsmouth is only Rs. 3/12 while in Madras it is as much as Rs. 17 in normal times. The amount of fuel and the cost of fuel is one of the chief factors that determines the success of the glass industry.

33. Coming to liquid fuel, it appears that at Dusseldorf and Roumania there are large continuous furnaces working on liquid fuel and in an account of such furnaces (Review of Glass manufacture published in Switzerland) I find that 1 lb. of glass is melted and annealed with ½ lb. of oil which is had at that place for 12s. to 15s. (or Rs. 9 to 11/4) per ton. The price of liquid fuel in Madras in normal times is as much as Rs. 48 per ton and now it is at Rs. 70 per ton with every chance of going up. Even the price of liquid fuel of Rs. 48 per ton as against Rs. 17 per ton coal (in normal times) decides at once the impossibility of oil ever being economically substituted for coal. If at the oil fields in Burma it is possible to get a ton of liquid fuel at a price not more than double the price of a ton of coal in Bengal Coal Mines at Pits mouth, it might be desirable to choose Burma to Bengal Coal Mines, otherwise even a site right in the centre of Burma oil fields should not be preferred to a place in Bengal Coal Mines for a glass factory. Thus it is evident that it is futile and a waste to attempt to substitute oil for coal as fuel.

34. *C. Furnace*.—The above paragraph deals with general question of the nature of fuel. But the economy of fuel or otherwise depends on the construction of the furnace. Yet the type of the furnace depends on the nature of the article manufactured, for example—

For the manufacture of cheap bottles and cheap pressedware a continuous tank furnace is the best. Only one colour of material can be produced.

For the manufacture of cheap glass blocks for bangle-making an open pot furnace may be used each pot being used for one colour.

For the manufacture of pure high class glass blocks for bangle-making, covered pots are necessary to keep off impurities as much as possible.

For the manufacture of good and pure white chimney-ware also closed pots are to be preferred.

There is yet another classification of furnaces (1) Direct fired and (2) Gas fired.

Tank, open pot or closed pot furnaces may be either direct fired or gas fired. Direct fired closed pot furnaces are very largely adopted in Europe even at the present date for the manufacture of very high class glass, for the manufacture of articles for which the demand is little though the price obtained is very high. Direct fired furnaces naturally consume more coal and the maximum temperature attained is 1,350° to 1,400° while in gas fired furnaces with properly designed regenerators a temperature of 1,500° is attained with comparatively less consumption of coal.

A description of a direct fired closed pot furnace for 6 pots will be given in Appendix B (not printed). Mere construction of regenerators and gas producers it not all that is required. Unless they are properly designed to suit the size and the climate of the country such furnaces will prove more wasteful than even direct fired furnaces. I have already shown that in Jubbulpore the consumption of coal, in a gas fired furnace with regenerators, is as much as 5¼ tons per ton of glass melted, while in the latest and most up to date Siemens Gas Furnaces the consumption is not more than 1 ton of coal both for melting and annealing 1 ton of glass.

35. Thus the cheapness of fuel, the fuel consumption and the proper design of the furnace to attain a minimum consumption of the fuel are the real secrets of the success of the glass industry. The atmospheric temperature, the direction and the intensity of the wind also I am told affect the consumption. It is not a glass blower who works at a furnace for 20 years that can construct a furnace. It requires an Engineer who has spent his life on the study of glass furnaces. One may be an exceptionally able Engineer but a furnace constructed by him may be an utter failure.

36. An example of this may be given. Messrs. Tata & Sons have engaged highly paid first-class engineers who have previous experience of steel furnaces to construct the steel furnaces at Saktchi. But I am told that during the last six years the coal consumption in those furnaces was always as much as 2½ to 3 times the consumption in similar furnaces in America. I am told that for the first time it is only this year the consumption has come down to the figure in America. In their experiments they observed that the atmospheric temperature, direction and intensity of the wind have a good deal to do with the consumption. This shows that for a proper furnace a first class furnace expert is needed and even he needs time to study the effect of local conditions. Till he is able to adjust the furnace to suit such local conditions, the consumption is bound to be high as compared with best furnaces in Europe. Higher consumption means more money lost and to keep down such a loss to a minimum the glass factory will have to be situated as near the coal mines as possible, preferably in Bengal coal mines.

With reference to oil fired furnaces and necessary regenerators, I am informed that the Dusseldorf factory has taken a patent for their oil furnace and I do not think it possible to get any plans and designs for such a furnace now as in England there are not such furnaces.

37. I should not forget to note down some important points which are of particular interest for us I gathered from the study of some publications on glass-making.

(1) The metal or mixture is to be fed not at the exhaust end but at the firing end where the temperature is the highest. The work holes must be as far away from the firing end as possible. This point is particularly noted for the reason that the so-called experts in Northern India failed to point out this grave defect which goes to prove that these experts may be experts in a particular branch of glass industry and that they cannot come under the all-comprehensive term "Glass Expert."

(2) The burners used in an oil fired continuous tank furnace, with the capacity of daily outturn of 5½ to 6 tons (equal to that which we hope to have) deal with 200 lb. or 22 gallons of oil per hour.

38. For the construction of a furnace unburnt fire clay blocks are to be preferred to burnt fire bricks. Those blocks are to be rubbed against each other and set in position after dipping them in a very thin paste of raw fire clay and large quantity of water. The first heating of the furnace must be done very gradually. Five to six weeks is required for such preheating. Once heated the furnaces are never allowed to cool down till the furnace breaks down and become useless for further work. It appears that in England work is carried on for only five days in a week while in Germany work is carried on even on Sundays and for this reason it is stated that England can never compete with Germany

in glass trade as the cost price in England is bound to be at least 10 to 12 per cent more than that in Germany. Regularity of temperature in the furnace must be carefully attended to. Irregularity is indicated by "Cordy" Glass. Every glass bottle made in our factory will serve as an example for such "Cordiness."

39. Before closing the furnace question, a mention should be made about "Pots" about the manufacture of which I have dealt with already in my account of Talegaon factory. Mr. Elland told me that there is a special type "pot" manufactured by Morgan Crucible Company in England which appears to be superior to the Japanese pot in that the English pot can be rolled over and used when one side breaks. Mr. Elland has shown me a rough sketch for a furnace using such pots. I was not allowed to copy it and Mr. Elland told me he would send us the sketch if the Director of Industries, Madras, asks the Director of Industries, United Provinces, for the same. It is desirable to get that sketch as it may be useful when "pots" from England are available.

40. *D. Recipes.*—The mixture used by the Madras Glass Factory is made up of 100 of sand, 33.8 of soda and 28 shells, 3 sodium sulphate, 1 arsenic and $\frac{1}{2}$ manganese with equal quantity of cullet. We attempted a mixture made up of 100 sand, 33.3 soda, 25 shells, 3 sodium sulphate, 1 arsenic and $\frac{1}{2}$ manganese with equal quantity of cullet. Mr. Elland tells me that he was using the following recipe for cheap bottle glass and it well worth experimenting as already noted:—

100 Sand.	} plus $\frac{1}{4}$ cullet
25 Sodium Sulphate (Salt cake).	
40 Calcium Carbonate.	
3 Sodium Carbonate.	
1 $\frac{1}{4}$ Charcoal.	
1/16 Manganese.	

41. *E. Experts.*—Glass industry is one that requires not one but quite an army of experts—

- a furnace expert who is an engineer,
- a mixture expert who is a chemist,
- a blowing expert,
- a pot-making expert and
- other experts each for different varieties of glass article, for example, Bangles, Sheet Glass, Plate Glass and Cut Glass, etc.

F. O. Oertel, now Chief Engineer, Assam, in his "Notes on Glass Industry in Europe" writes that a young engineer is trained in the work and is engaged as the manager of the concern.

The so-called experts that were till now brought to India are mostly workmen who worked for a long time on one variety of article in one particular branch. They are not to be blamed if the factories failed as it is uncharitable to expect such a man to be an engineer, a chemist, a blower and also a manager. It is almost impossible to find one man who is an all-round expert capable of erecting, starting and working a factory successfully. If such a man exists, it is absolutely certain he will never come to India for a pittance of Rs. 600 or even Rs. 1,000. I do not think it is possible to get such a man even for Rs. 3,000. To use Mr. Oertel's words, the "experts" that accept to come out to India are generally "failures" at home. Those that come out to India (especially Germans and Austrians) are heavy beer drinkers and do not care to teach the Indian apprentices the little they know. I consider the present system of recruits for special industries or branches of industries unsound. A really good man must be found, an attractive nominal salary must be offered, but he should be actually paid only a subsistence allowance till the factory begins to pay when he must be given a substantial share in the net profits after allowing a minimum percentage of interest and depreciation. The difference between his nominal salary and the allowance actually he received must be paid in shares of the company. The amount of his share in the profit must, to some extent, also depend on the number of apprentices trained. The Indians that had their training in Japan, America or England cannot be expected to be true experts. Most of them know little of everything but not even one branch perfectly. None of those seem to have cared (excepting Mr. Deb of Calcutta Pottery Works) to go again to the foreign countries to study and solve the particular difficulties they had in making a factory, in which they were engaged, a success. These experts along with other experts of other nationalities left a factory which failed to start a factory elsewhere which also failed.

42. *F. Labour Question.*—Next to the furnace problem, the labour question is the most serious one. It is difficult to induce a new apprentice to work at a furnace which is white hot. It is difficult to keep him on long enough to learn which sometimes takes as long as two to three years as in case of mouth blowing. If he learns he does not stick to the place. The Glass operative of all countries has the same tendency to strike work and move from place to place. They have the tendency to take their time easy and

cheat the manager by saying that the metal is either "doggy" or "too thin" or "too cold" or "cordy" or some such thing. A man who knows blowing is very jealous and it is very difficult to make him teach another. At present in India there are about six Japanese blowers who are moving from factory to factory. There are some hereditary Muhammadan blowers working in Harrison street, Calcutta, who make ink pots, hanging globes, etc., from broken glass auctioned by the several Railway Companies. Each man has his own small furnace and is very much satisfied with his own lot making Rs. 20 to Rs. 30 per month. These do not care to go out and work in a factory.

43. On glass industry in India, like other industries much money has to be sunk to train the labour with no expectations of returns. Taking the case of blowing of chimneys by mouth, I am told, at least two years of training is required for a man to learn. Glass industry does not admit of intermittent work. It has to be carried out every day in the year and every factory is bound to lose one to three lakhs in these two years depending on the scale on which the factory is started. Unpaid or low paid apprentices do not stick on for two years in these days of high price of foodstuffs, especially if the apprentices belong to a poor class that depend on their wages for their daily food. For the present the apprentices are to be drafted from middle class of men with sufficient education to realize that the Indian industrial regeneration depends on their apprenticeship and even these should be paid a stipend of Rs. 20 per month and bound over by an agreement to work for a period of not less than four years during the first two years of which period he learns to blowing and during the next two years he will be earning his pay by actual manufacture. The difference between educated apprentices and uneducated apprentices has already been shown while describing the Talegaon factory. The effect of entertaining low paid apprentices with pay ranging from Rs. 5 to Rs. 7 $\frac{1}{2}$ can well be realized from what happened in our own factory. Such men flock in large numbers in the beginning when there is no actual work done and once the actual work begins they fly off just like a number of birds on a tree on hearing a pistol shot.

44. The number of apprentices so taken depends on the objects with which a factory is started. If the factory be one for pressed or machine-blown ware, the number may be fairly large as the term of apprenticeship will be only 4 to 5 months while if the factory be one for blown-ware it is not advisable to have more than three to four apprentices to begin with. In any case the factory should be started on the smallest scale and gradually enlarged as the number of trained men increase. At the same time the proprietors or authorities must not be ambitious and pessimistic about the profits till a fairly large number of apprentices are trained.

45. There is room for a large number of glass factories and it is of no use to attempt training apprentices in one factory for the whole of India. The Government will have to select a certain number of stipendiary apprentices of the type mentioned above and the proprietors of the factories that are now working must be induced to entertain in each factory three or four apprentices, if necessary, paying a certain grant for each factory for every apprentice trained. The factories at Talegaon and Ambala are willing to entertain such a proposition.

46. The question of labour includes not only actual blowers but also furnace attendants, pot manufacturers furnace builders and general managers. Special attention will have to be paid for the training of these men as the success of the glass factory depends as much on these, if not more, as on the actual operatives. Young engineers and chemists must be selected and sent to an existing glass factory in India to work for at least one year during which time they gain a preliminary general knowledge of glass manufacture and also thoroughly study each a particular branch. They should then be sent to foreign countries to specialize in one particular branch. For example, it will be great boon to India especially with reference to glass industry if half a dozen young engineers are sent out to make special study of Siemen's furnaces, oil furnaces and muffle furnaces, etc. I do not assert that on return they will be experts in that branch. On their return opportunities should be given to them by the State to construct the furnaces (they have studied) of different sizes and actually experiment in India so as to find out the alterations necessary to suit the local conditions. The Chemists, on their return, should be engaged to collect the different samples of the raw material available in India and then they should be sent to a place like the Tata's Research Institute at Bangalore with a view to find out the actual recipes that suit the local raw material for the manufacture of a particular variety or colour of glass.

47. The question of labour, superior and inferior, is one beyond private enterprise and the only way in which it can be effectively dealt with is to treat it as an Imperial question.

Another point which must not be lost sight of is that the labour employed should not be of one caste or creed. Otherwise there will be strikes very often. The advanced students of technical institutions such as the Chengalvaraya Nayakar's Institution, mechanical engineers from the local Engineering College and chemists from the Arts Colleges must be selected and trained for the different branches of glass industry.

48. After the outbreak of the war, the Institute of Chemistry of Great Britain and Ireland has appointed a special committee for the purpose of research in glass to help manufacture of ware which have hitherto been mainly obtained from abroad. Indian Chemists may be sent to England and made to conduct experiments under the guidance of the above committee on Indian raw materials.

49. Answers to a major number in the list of questions prepared by me are given in Appendix D. Some are left unanswered as I could not obtain any information regarding them.

50. Now I shall attempt to give my views on the chances of Bottle Industry in Madras:

The first thing to be realized is that the attempt to manufacture soda water bottles is not new to the world, that there are factories with years of experience behind them engaged in the manufacture of these and that the factory in Madras can succeed in competition with them only if the actual cost of production is just the same as in the factories already engaged in that manufacture. It is the cost of production that determines the success of any industrial concern. The ruling market price either before the war or after the war has no bearing upon the true success. The established manufacturers will stifle any competition by lowering the prices to the rock bottom price which is the actual cost of production. In such competition, it is true that Madras has the freight from England to India as margin as far as Madras market is concerned, and in Bombay and Calcutta markets it has no margin as freight (Railway or Sea) has to be paid from Madras to Bombay and Calcutta. So it must be considered whether the demand in Madras market is enough to produce bottles at the price above indicated. It is true that the larger the production the less will be the cost of production but the actual minimum cost of production in bottle-making industry depends upon many other factors, the chief of which is the fuel question, another being the question of trained labour. The question of trained labour (superior and inferior) need not be considered as for any new industry an initial loss which is not inconsiderable cannot be helped till the labour is trained. But the question of fuel leaves no argument. Liquid fuel can never be economically substituted for coal in Madras considering their local market prices and the present experiments in that direction may be closed as hopeless. Even if the very best furnace experts are employed a bottle factory in Madras using coal as fuel can never outlive the competition from bottle-making factories at home using coal, for the price (in normal times) at Madras is Rs. 16 per ton as against Rs. 4 to Rs. 8 at home according to quality and the locality of the factory.

51. For a bottle factory in India to succeed and stand in the competition, the factory must be located where coal can be had at Rs. 4 per ton or less and such a locality can be found only in the centre of Bengal Coal Mines.

52. Moreover I hear that the use of iron slag has come into vogue for the manufacture of cheap bottles and that bottle factories are in close contiguity with iron and steel melting furnaces. This reduces the cost of production and an Indian bottle factory must be situated somewhere near Tata Iron and Steel furnaces at Saktchi.

53. It is idle to say that every industry can succeed with the cheap labour that can be had in India. The cheapness of labour is outweighed by (1) want of skill in such labour (2) want of high degree of technical knowledge (3) the higher price of chemicals in India than on the Continent. The soda water bottle industry affords a very good example for the above statement thus.

54. In England, refuse of soap factories, etc., is used as the alkali in melting glass or Salt-cake is used as fire bricks specially suited to withstand the sulphur vapours can be had there. Due to want of technical knowledge and absence of other industries sodium carbonate has to be used in India.

55. Previous to the war, unlettered 8 oz. soda-water bottles are delivered at Madras at 20s per gross in crates (c.i.f.c.i. and an ad valorem duty of 5 per cent. The freight from England used to be 24s. per ton by space or for 10 gross of 8 oz. bottles or 2½s. per gross. The cost of a crate for a gross is 1s., commission and interest and duty all come to 8 per cent equivalent to 2s. So the actual price of a gross of 8 oz. bottles is 20s.—5½s.—14½s. = Rs. 11-6-0 per gross f.o.b. England. This is the price of the merchant and the factory price cannot be more than Rs. 10 which includes interest, depreciation, etc. I am told the actual cost of production excluding interest, depreciation and profits is about Rs. 6/8 per gross of 8 oz. soda-bottles, and that the cost of fuel, cost of raw material, labour and supervision are generally in the proportion of 1, 4, 4 and 4 in case of bottles like soda-water bottles. I cannot vouch for these figures but considering the large outturn of these factories the figures are believable. For successfully running a soda-water bottle industry in Madras in competition with foreign firms it should be possible to produce in Madras 8 oz. bottles at Rs. 6-8-0 plus Rs. 1-6-0, the middleman's profit at home, plus Rs. 1-14-0, the freight, i.e., at Rs. 9-12-0 excluding the cost of a crate and the 14 oz. bottle at Rs. 11-8-0 per gross. The average quantity of coal consumed at home for 1 gross of 8 oz.

bottles is 1/13 of a ton and for a gross of 14 oz. bottles is 1/9 of a ton. So under the best of conditions in a factory at Madras the cost of production must exceed that at home by difference in the cost of fuel, assuming other things equal. Hence there is no chance of a bottle factory at Madras to stand the competition and succeed.

56. Let us now consider the question of outturn. Mr. F. O. Oertel writes that in the bottle factories on the Continent Owen's Bottle Machines are used. The net output of each machine, after deducting the breakages during the various stages of manipulation is about 21 to 24,000 bottles per day of 24 hours equivalent to 145 to 165 gross. It appears each of these machines are attended by only two unskilled labourers. When cost of production depends on the outturn, is it wise to expect a bottle factory at Madras with a theoretically maximum output of not more than 35 to 40 per day with the existing 6 machines that require two skilled attendants each?

57. So to my mind the following is the only conclusion that can be drawn:—

(1) Madras is not suited for manufacture of cheap glass-ware where cost of fuel is the most expensive of the items in India (2) liquid fuel can never be economically substituted for coal, (3) a bottle factory at Madras is bound to fail (4) the demand in India for soda-bottles is not large enough to have a factory for soda-bottles alone, (5) a factory for bottles of all kinds (including soda bottles) can be successfully started only in the middle of coal fields, (6) that such a locality can be found only in Bengal coal mines and (7) for such a factory a first-class furnace expert and chemist are required to ensure success.

58. Having come to the above conclusion I shall attempt to indicate what branch of glass industry can be attempted in Madras with any chance of ultimate success.

59. A glance at the imports into India will show that the following glass-ware to the extent shown opposite each has been imported in 1913-14 and that such import has been steadily increasing every year during the last 20 years:—

	1914. Value.	Approximate per cent of total imports.
	Lakhs of rupees.	Per cent.
Bangles	About 80	43
Beads and false pearls	24	12
Sheet and plate glass	22	11½
Lampware	15	8
Bottles and phials other than soda bottles	14	7½
Table-ware	7½	4
Soda bottles	6½	3½
Miscellaneous	18½	10
	187½	

60. Of these varieties the question of bottles has already been dealt with. Sheet glass requires costly machinery and skilled labour and it is too early to attempt the manufacture of this ware in India. Plate glass (window panes) does not require machinery and admits of small impurities in raw material but its manufacture demands skilled blowers and can be taken up only after a number of skilled blowers are trained on blowing cheap lamp-ware. The kind of cheap-ware that is in greatest demand in India need not be of perfectly white glass, as any glass with slight tint of any colour is not visible when the material is thin as in chimneys. Lamp-ware is prepared generally on pot furnaces even in Europe. The article is very fragile and hence the breakage in shipping is not inconsiderable. Also the space occupied by the articles in shipping is large and hence the freight is high. These considerations give India an advantage and this line of work may be attempted but it must be remembered that a beginning should not be made on too large a scale till a good number of blowers are trained.

61. Then bangles and beads which cover more than 50 per cent of the total imports are imported mostly from Germany and Austria. The demand for them is large and such demand can never decrease as every female in India wears bangles. The very fact that, in spite of the heavy imports, very large quantities of crude glass are still manufactured in India and that bangles made of that glass are still manufactured, is a sure indication that a large scope for the manufacture of bangles and beads exists in India.

62. An attempt was made in India by the Government of India as early as 1882. A Mr. Wilson, then assistant engineer, was put on special duty. He visited the head factories at Venice and brought out with him a set of tools employed at Venice for the manufacture of beads. He conducted experiments at Bhagalpur but it appears that for some reason found it impossible to develop sufficient heat in the furnace. Hence the glass was full of air bubbles and would not be cut homogeneously and the experiment

had to be given up. An attempt may be made to manufacture them after getting Italian experts to manufacture them or getting one or two Indians trained in Italy in that manufacture.

63. As regards bangles, Austria is making headway because she can produce pure glass of different attractive and rich colours. I consider the attempt at Firozabad, to manufacture glass blocks for bangles, almost a failure as the glass is full of air bubbles and the colours most primitive. This failure is due to want of chemical and engineering experts. If it be aimed to defend India against Austrian importation of bangles, the best way is to have a whole-timed chemist and an engineer to take up the question and to conduct experiments till success is attained. Meanwhile the bangle-makers of the Madras Presidency must be given an opportunity to study how the Austrian type bangles are made at Firozabad. I am not afraid of the competition from Japan as their bangles are very fragile though much in demand at present due to the absence of Austrian bangles.

Mere manufacture of pure coloured glass blocks is not enough. The glass must be such that would melt in the furnaces of the bangle-makers. So experiments should be conducted with a view to improve the furnace of bangle-makers so as to give a higher temperature than at present.

64. Summing up the above, my suggestions are—

- (1) To close the present experiments in bottle-making as early as possible.
- (2) To request the Government of India to conduct a series of experiments near Coal Mines in Bengal on several types of furnaces with different varieties of coal obtainable in India with a view to start an up-to-date bottle-making factory with Owen's bottle-making machines and at the same time to study how far the slag from iron and steel furnaces can be economically used for the manufacture of cheap bottles including soda-water bottles.
- (3) To attempt in Madras the manufacture of cheap lamp-ware on a small scale confining such manufacture to one or two varieties of chimneys preferably hurricane lamp chimneys and municipal chimneys.
- (4) To conduct experiments, engaging a full-timed chemist, with a view to manufacture glass of different rich colours.
- (5) To conduct experiments with a view to improve the furnaces used by local bangle-makers.
- (6) To induce local bangle-makers to use better glass and learn to manufacture better varieties of bangles than they are at present manufacturing.

For purposes mentioned, from 3 to 5 I suggest a direct fired closed pot furnace with 5 pots of 400 lb. each. Two of the pots may be used for the manufacture of chimneys from Ennur white sand, the remaining three pots being used for the manufacture of different coloured glass blocks. For the manufacture of chimneys one who has sufficient experience in blowing will have to be employed. A batch of blowers consists of one head blower and seven assistants. For the present six or seven apprentices may be entertained as assistants and in course of time these have to be trained as blowers by the head blower. For the experiments in coloured glass a chemist has to be employed. If desired, side by side with the above, an attempt may be made to manufacture Japanese silky bangles as there is one trained in such manufacture available at present. Simultaneously a bangle-maker's furnace has to be built (1) to see if the coloured glass manufactured melts in that furnace and if not (2) to see if any improvements have to be or can be made in these furnaces.

As we have a chimney and also buildings I expect the cost of the above two furnaces not to exceed Rs. 2,000 including an oven for the preheating of pots. Before starting work the supply of pots will have to be ensured for the next six months, i.e., 30 to 35 pots must be held in stock.

The intermittent annealing ovens existing in our factory may be utilized for annealing. Another Rs. 1,000 may be required for carborandum cutters and grinding wheels and chimney moulds.

The establishment required will be—

- 1 Chemist.
- 1 Engineer.
- 1 Blowing expert.
- 1 Blower with seven apprentices.
- 1 Chief bangle-maker and four apprentices.
- 2 Furnace attendants.
- 2 Assistants to above.
- 1 Engine driver.
- 1 Clerk.
- 15 to 20 daily coolies for mixing, grinding, cutting, etc.

The success of this undertaking depends on the zeal evinced by the people and apprentices employed. If they work well, it might be necessary in course of time after the apprentices are trained in blowing, to have two separate furnaces one for chimney making and the other for manufacture of high grade coloured glass blocks. The demand in Madras Presidency can easily maintain at least two chimney-making factories and two glass block-making factories.

65. From what I gathered from the factories visited I expect that with one furnace as suggested above the daily consumption of coal will not exceed $1\frac{1}{2}$ tons and it is possible to melt about cwt. of glass every day and with a first-class blower it is just possible that cost of the glass blocks manufactured and chimneys blown will be equal to the daily expenditure.

(ii)

Note on Glass Making by Mr. W. A. Beardsell, Madras.

I am Managing Director of W. A. Beardsell & Co., Limited, a company registered in 1914 to acquire and carry on the business of W. A. Beardsell & Co., General Merchants, Madras. I have no technical knowledge of glass-making.

Prior to 1909 Mr. Scholl, then German Consul at Madras, and Mr. Ramsay Unger, merchant of Madras, entertained the idea of glass-making and conducted experiments the result of which encouraged them to promote The Madras Glass Works Limited, which company was incorporated in March 1909, the capital raised (subscribed for privately by friends of the promoters) amounting to Rs. 77,200.

A German named Meier was made technical adviser, his factory plans adopted and an intermittent gas fired tank was erected under his personal direction. Four German glass blowers were brought out to start work and to train Indian labour.

Glass bottles and tiles were made in January 1910, by which time the financial resources of the company were exhausted and it had been realized by the Directors that there was no prospect of ever arriving at a profitable factory outturn if the method that had been adopted of blowing bottles by mouth was continued. The work was too laborious and too slow.

The Directors had also learned that the weight of fuel consumed per ton of glass made was much greater in case of an intermittent furnace such as they had than in a continuous furnace.

The quality of glass manufactured seemed to justify the belief that by installing more efficient plant a successful industry would be established and on the strength of such representations Rs. 1,00,000 additional capital was raised.

At this stage my firm consented to take up the duties of Managing Agents and I was informed by Mr. Scholl that the additional capital would be sufficient to cover cost of new plant and that Government had sanctioned a free grant of 10,000 tons firewood. This was on the eve of my leaving for England on business unconnected with the glass works. Whilst in England I visited the glass works of Messrs. Forster & Sons, St. Helens, and discussed as fully as possible glass-making with special reference to putting the Madras Glass Works on a profit earning basis, Messrs. Forster & Sons being not only glass manufacturers but also makers and sellers of plant.

Finding the capital available was insufficient to adopt all of Messrs. Forsters recommendations which included the erection of a continuous furnace, the Directors decided to import 6 of Forsters compressed air bottle making machines and an improved annealing lehr. It was arranged with Forsters that two competent men should come out, one an engineer to superintend erection and to get the plant going, the other an expert bottle maker to instruct workers.

The new plant was working from June 1911 and, in September 1911, 26,000 sound bottles were taken out of the annealing lehr as the month's outturn. The number of bottles actually put in the lehr that month was 44,000, the large percentage of breakages being due, according to the St. Helens expert, to the arch over the furnace having been partially rebuilt of unsuitable bricks obtained from Calcutta. These bricks melted and bits got in the glass the result being that when bottles with bits of bricks in them were annealed in the lehr the contraction of glass was different from that of the brick causing the bottles to fly.

The position of the company at the end of 1911 is indicated by a notice to shareholders dated December 14th.

"At a meeting of Directors held on 28th ultimo it was decided to stop work at the factory at the end of November and to curtail all expenses.

"Disappointing as this may appear the Directors can assure shareholders that considerable progress has been made towards establishing a profitable industry. Bottles have been made in quantity and have found a ready sale, many difficulties

"have been overcome and the results attained justify further outlay. "Since automatic machines were installed the monthly outturn of bottles has risen from 10,000 to 26,171. To obtain higher figures more money is required to carry on work as the company has reached the end of its resources.

"A meeting of shareholders will be summoned on an early date to consider a scheme for providing a continuous furnace in place of the present one in order to work two shifts during the 24 hours. This scheme can only be carried out if the shareholders provide funds and the alternative will involve liquidation of the company and loss of all money subscribed.

On January 22nd 1912, I wrote to Sir Murray Hammick, K.C.S.I., C.I.E., then Member of Council, asking for an interview and in my letter gave the following facts:—

"On formation of the company Rs. 77,200 was the capital subscribed, in February 1910 a further amount of Rs. 1,00,000 was subscribed, and Rs. 1,14,130 has been expended on machinery, tools and buildings. The monthly outturn of saleable bottles from July 1910 averaged for four months 10,000 and as with the labour available there appeared no probability of materially improving on these figures it was decided to purchase the best type of automatic machines in which compressed air superseded blowing by mouth.

"A monthly outturn of 26,000 bottles was reached with these machines, and in arriving at this result the company has exhausted all its capital.

"What has been proved is that saleable bottles can be manufactured locally and it would seem certain that with further expenditure on a continuous furnace an outturn would be reached that would show a profit on working.

"With the present furnace it is possible only to work 8 hours out of 24 whilst in a continuous furnace the level of molten metal remains constant and work may be continued by working 2 or 3 shifts the whole 24 hours.

"I will not go into further details in this letter, but merely say that there is no possibility of shareholders finding the necessary further capital and in order to establish an important industry I wish to consult you as to whether Government might at this stage step in, take over the factory, build a continuous furnace, carry on work and hand back as a going concern to the company when the industry has been established."

An interview took place at which I explained the position fully. I was informed that Government could not intervene as such action would be opposed to the policy advocated by the Secretary of State.

The company some time later went into voluntary liquidation, as additional capital was not forthcoming.

Such in brief is the history of the Madras Glass Works.

I am of opinion that, at the onset during the preliminary experimental stage, too much importance was attached by the promoters to the fact that good glass could be actually made in Madras and largely from local materials whilst too little consideration was directed to local economic conditions such as:—

- (a) Cost at Factory of raw materials and fuel.
- (b) Efficiency of labour.
- (c) Market for factory outturn.

Imported bottles incur freight from Europe to India and are subject to import duty but such items are not in themselves sufficient to off set adverse conditions inseparably connected with the introduction of a new industry.

I will now refer to matters connected with the history of the Glass Works which would seem to be relevant and to come within the scope of the Commission's enquiry.

1. A mistake was undoubtedly made in not at the onset installing a continuous furnace. Whilst with a full tank our workers could readily take out molten glass on the end of a carrying pipe held almost horizontally extraction became increasingly difficult as the day went on owing to the level of metal getting lower and lower, necessitating the sloping of the pipe at such an angle that an undue length was exposed to the fierce heat of the furnace and the workers hands were burned.

2. I was informed by the workmen sent out by Messrs. Forster & Sons that the furnace bricks suffered from the effect of the fierce gases in a way that would not have happened had the level of metal in the tank remained constant. Bits of brick became disintegrated and falling into the molten mixture caused breakages during annealing due to the unequal contraction of glass and brick.

This trouble was made greater in that fire bricks obtained from Calcutta had on one occasion been used in repairs to the furnace arch.

3. Experience showed that blowing bottles by mouth is too laborious in India and certainly less efficient under Indian conditions than blowing by compressed air machines.

4. The capital raised was insufficient to set up a continuous tank and to carry on work long enough to prove what could be done with a factory working under conditions best adapted to local labour.

• I am of opinion that Government help in January 1912 would definitely have settled the question of the cost of manufacturing glass in India under favourable factory conditions but I am more doubtful whether a successful industry would have been established. Certainly the outturn of soda water bottles from six machines worked under European conditions would far exceed the number of bottles imported into Madras.

✓ Messrs. Forster expressed the opinion that economy in fuel could not be attained with a less plant than one in which eight bottle making machines is employed the outturn of which in England is 200,000 wine or beer bottles per month. (The average number of soda water bottles imported into Madras monthly over the last four years is 52,968.)

I advocated concentrating work during the comparatively short period the factory was running on soda water bottles as being the one article most saleable and because I considered it would be detrimental to outturn to do other than specialize for some time.

It must not be implied from this that pressed tiles and other glass articles might not later be made in the factory.

In conclusion I may say that the Government concession of fuel referred to related to wood growing in the forest in the Cuddapah district and the cost of this fuel to the company when delivered at the factory was practically normal. Inasmuch as the chief item of cost in glass production is fuel, I am inclined to think a factory located in Bengal might be worked better than at Madras, moreover a larger market would be at its doors.

NOTES CONNECTED WITH G.O. No. 322, HOME (EDUCATION).
DATED THE 8TH MARCH 1917

[SUBJECT.—Glass experiment.]

*From the Officer in charge of the Department of Industries, No. 52, dated the
18th January 1917.*

In G.O. No. 1192, dated the 15th November 1916, the Government deputed M.R.Ry. J. Narayanamurti, Sub-Engineer in the Department of Industries, to visit glass factories in other provinces and to study the methods of working followed there. Mr. Narayanamurti visited almost all the important glass factories in India. He has submitted an elaborate report on the working of those factories and has also examined the question how far a glass factory in Madras can succeed. He concludes that the experiments in bottle making now carried on by the Department of Industries in Madras should be brought to a close. Mr. Innes agrees with him and recommends that this course should be adopted. It is pointed out that the furnace in the factory is defective, that fuel is too costly in Madras and that there are no experts to look after the experiment. Mr. Innes states that Mr. Elland, the glass expert in the United Provinces, could probably advise in regard to mixtures and methods of testing them; but the crucial point is stated to be the furnace and Mr. Elland could not help in this nor in the training of blowers. In these circumstances it is for orders whether the proposal to close the experiment may be approved.

2. Mr. Narayanamurti has made certain suggestions for the improvement of the bangle-making industry. Mr. Innes states that he has not yet considered these and that if he decides to move in the matter he will make a separate reference to Government. Apparently the machinery in the glass factory will be useful for experiments in bangle-making. The question of its disposal need not therefore be considered now.

S.K.—31-1-17.

N.K.—3-2-17.

It is disappointing to have to admit that a large experiment of this kind is a failure; of course an experiment is not wholly a failure that proves anything; and this experiment in spite of the blemishes and inaccurate calculations that have marred it from the scientific point of view has been sufficiently successful to prove that a glass-making industry cannot be a commercial success in Madras.

2. Mr. Innes points out that, with a glass expert to advise on the mixture and a glass engineer to build a furnace, excellent glass could be turned out in Madras which might pay during the war. The cost however of re-inaugurating the experiment on these lines will be very considerable and Mr. Innes shows pretty conclusively that the industry can never pay in Madras in the long run. The greater part of the raw material is here but the absence of cheap fuel renders the whole project futile. It may be noted in passing that as a matter of fact cullet only has been used lately and that the evolution of a satisfactory mixture has been given up as a bad job. This failure is not surprising. One must pay for one's knowledge in matters like these in two ways—

(a) by hiring an expert who combines in himself stores of experience gained by others;

(b) by gaining that experience oneself.

The department chose the latter.

Messrs. Beardsell, Short and Company chose the former; and if the department has started where they had left off as it once had the opportunity of doing, the factory might have been working at a very considerable profit in these war times; as an experiment however it would merely have proved, though in a much shorter time, the same result as Mr. Innes claims to have proved now, namely, that in Madras glass manufacture in normal conditions will not pay. The department has worked well in very unfavourable circumstances at this experiment and has gained most useful experience, the chief of which is that problems of this sort cannot be attacked successfully, no matter how enthusiastic and industrious the staff, without expert guidance.

3. Mr. Innes' argument as to fuel seems to be conclusive and fundamental to the whole problem. The alternatives now before the Government are —

(a) to engage an expert chemist (Mr. Elland is apparently not qualified to advise on the mixture) as clearly one cannot continue to use cullet only and the one advantage Madras has is in the proximity of suitable sand and lime; and at the same time to reconstruct the furnace at great cost under the guidance of an expert engineer (Mr. Deb has been mentioned in connection with ovens) and

(b) to close down and quit the experiment. All the facts of the case point to the latter as the best course.

Questions will doubtless be asked but Mr. Innes points out that the closing down may be attributed to the rise in the cost of fuel.

4. It has been suggested that the indigenous glass industry, viz., the manufacture of bangles might be encouraged; it is understood that Mr. Innes is having a survey of this industry made and will report later.

5. Mr. Narayanamurti has fully justified his deputation and in spite of meeting a closed door in certain quarters has been able to compile a very detailed and interesting report, though much of it is necessarily unintelligible to the layman. We may agree with Mr. Narayanamurti that Bengal is the most suitable place for this industry and the Government of India the most suitable authority to direct (and finance) experiments.

6. In the interests of economy Mr. Innes has actually closed down the factory already as he found that the expense of continuing the experiment was compensated for neither by the experience gained nor by the output of bottles.

For orders.

E. A. HARVEY—16-2-17.

If I recollect aright, Sir Frederick Nicholson has from the first condemned this experiment. On the other hand, Sir Francis Spring, in private conversation with me, while criticising adversely glass bottle making, has advocated the experiment of making cheap coarse window glass which would serve the purpose merely of admitting light to huts and houses which have at present no windows, and no light except from the door-way and other very cheap glass. Whether such manufacture would pay at all or would pay sufficiently to modify the essential difficulties would require further examination.

In the meantime, the temporary closing down of the factory on the grounds may be approved. And as at present advised I see no reason to differ from Mr. Innes' conclusions as to the future.

But as this is the second experiment which has been made, it would be well to examine the position carefully so as to make the present decision as informing and authoritative as possible.

For this purpose the matter should, I think, be laid before a small committee under the chairmanship of Mr. Innes, upon which the following may be invited to serve:—

2. Mr. Beardsell
3. Sir Frederick Nicholson.

4. Sir Francis Spring.
5. Sir Clement Simpson.
6. Mr. Couchman.
7. Mr. Suryanarayanamurti Nayudu (Cocanada).

The papers should first be circulated to them, and the first meeting of committee might conveniently be held during the week of the Legislative Council meeting beginning about 13th March. It might be suggested to Sir Frederick Nicholson that, if such attendance at this first meeting would be inconvenient, his observations by letter upon these present papers would be valued.

P[ENTLAND].—19-2-17.

It is presumed that before appointing the committee the non-official members should be consulted as to their willingness to serve on it. A draft demi-official is submitted for approval.

2. The following seem to be the relevant papers on the subject:—

Pages 3 to 8 of G.O. 962, 12th September 1916. (1) Note on the glass experiments, dated 26th July 1916, by the Hon'ble Mr. Couchman.

Pages 1 to 8 of G.O. 1148, 2nd November 1916. (2) Letter from the Hon'ble Mr. Couchman No. E. 8, dated the 22nd September 1916.

Pages 27 to 29 of Government Order *ibid.* (3) Note on glass experiments, dated the 29th November 1916, by Mr. C. A. Innes.

(4) Letter from Mr. C. A. Innes, No. 52, dated the 18th January 1917, with enclosures (report of M.R.Ry. J. Narayanamurti, and note by Mr. W. A. Beardsell).

Yes, print.

E.A.H.—23-2-17.

Afterwards.

E.A.H.—23-2-17.

It is for orders whether these papers may be printed and forwarded to the members of the committee along with the demi-official or whether they may be sent after they have expressed their willingness to serve on the committee.

If the latter course should be adopted, the last sentence of paragraph 1 of the draft may be omitted except in the copy addressed to Sir Frederick Nicholson. Copies of the papers may, however, be sent to Sir Frederick Nicholson in the first instance with the demi-official.

3. After issue of the demi-official the file may be sent to Mr. Innes a.o. for perusal.

S.K.—23-2-17.

N.K.—23-2-17.

I think it better that Mr. Innes should see these papers at once, and offer remarks if he wishes to do so. I am rather of the opinion that Mr. Innes who is in fairly close touch with some of the gentlemen named could more conveniently secure the consent of the proposed members of the committee to serve on it, and should be very much obliged if he would do so, if he sees no objection.

E. A. HARVEY—23-2-17.

OFFICE OF THE DIRECTOR OF INDUSTRIES.

I have written to the gentlemen named, and will report the result.

2. I think the terms of reference to the committee might be rather wider than is at present proposed. Sir Frederick is very anxious that something should be done to resuscitate the bangle industry, and a "Japan-returned" Indian has asked me to assist him in a lampware industry. The committee might be asked to advise whether the experiments in making sodawater bottles should be continued, if not, whether experiments should be made with other forms of glassware.

3. The papers may be printed up urgently. In printing, I should like the sentence bracketed in paragraph 15 of my report omitted. Some members of the committee hold strong views on the question whether full details even of a failure should be published, and the sentence referred to was not intended for publication.

C. A. INNES—26-2-17.

HOME (EDUCATION) DEPARTMENT.

Submitted for orders whether the papers referred to in paragraph 2 of office-note on page 3 supra may be printed at once with the omission of the portion indicated by Mr. Innes. After the papers are printed a draft order will be submitted embodying the suggestions made by Mr. Innes in paragraph 2 of his note above.

S.K.—27-2-17.

N.K.—27-2-17.

Yes.

E. A. HARVEY—27-2-17.

Demi-official—from C. A. INNES, Esq., I.C.S., Director of Industries.
To—E. A. HARVEY, Esq., I.C.S., Acting Secretary to Government, Home (Education) Department.
Dated—the 1st March 1917.
No.—G. Cur. 52.

In continuation of my un-official note of the 26th February, I write to say that Sir Clement Simpson suggests that a chemist should be added to the glass committee. I mentioned this to His Excellency this morning and under his instructions have written to Dr. Simonson asking him to serve.

Demi-official—from C. A. INNES, Esq., I.C.S., Director of Industries.
To—E. A. HARVEY, Esq., I.C.S., Acting Secretary to Government, Home (Education) Department.
Dated—the 3rd March 1917.
No.—G. Cur. 52.

In continuation of my *demi-official* G. Cur. 52, dated 1st March, I have to inform you that all the gentlemen except Sir Frederick Nicholson* have replied expressing their willingness to serve in the committee.

*Sir Frederick Nicholson also. I have just had this letter.

2. Orders might now issue, I think, constituting the committee.

3. Will you distribute the printed papers or shall I? I will proceed to arrange details as to the date and time of meeting without awaiting formal orders.

HOME (EDUCATION) DEPARTMENT.

The papers mentioned in paragraph 2 of office-note on page 3 supra have been printed and a proof copy obtained from the Press is submitted. It may be sent to Mr. Innes for approval before final copies are struck off. He may be

E.A.H.—6-3-17.

I think this must be done. Tell Mr. Innes so when the proofs go to him.

E.A.H.—6-3-17.

requested to distribute copies to the members of the committee, or in the alternative, the papers may be printed as an annexure to the Government Order which will be communicated to the members.

2. A draft order appointing the committee is submitted for approval.

S.K.—5-3-17.

N.K.—6-3-17.

Draft Government Order for approval.

E.A.H.—6-3-17.

P. R[AJAGOPALA ACHARIYAR]—6-3-17.

A draft *demi-official* to Mr. Innes is submitted.

S.K.—6-3-17.

N.K.—6-3-17.

E. A. HARVEY—6-3-17.

Demi-official—from E. A. HARVEY, Esq., I.C.S., Acting Secretary to Government, Home (Education) Department.
To—C. A. INNES, Esq., I.C.S., Director of Industries.
Dated—the 7th March 1917.
No.—279-2.

Will you kindly glance through the accompanying proof of the collection of papers relating to glass experiments and return it after making such additions and alterations as you may think necessary? The collection will be printed as an annexure to the order appointing the glass committee and communicated to the members direct from this office.

Demi-official—from C. A. INNES, Esq., I.C.S., Director of Industries.
To—E. A. HARVEY, Esq., I.C.S., Acting Secretary to Government, Home (Education) Department.
Dated—the 8th March 1917.
No.—G. Cur. 52.

The collection of papers sent with your *demi-official* No. 279-2 of the 7th is herewith returned.

I think the selection is all right and I have suggested the deletion of one passage on page 3.

Please have the passage deleted and the papers printed up and the orders issued as soon as possible.

E.A.H.—8-3-17.

[G.O. No. 322, Home (Education), dated 8th March 1917].

Docket

Glass experiments.-

Appointing a Committee to consider and report on the question ~~of the continuance of the same now being carried on by the Dept. of Industries~~ *of the continuance of the same now being carried on by the Dept. of Industries*

C. No. 279. From the Officer in charge of the Dept. of Industries, G.O. No. 52, dated the 18th January 1917.

ORDER. No. 322 dated 8.3.1917.

Mis.
(~~Thurs~~)

The Department of Industries has been conducting experiments in the manufacture of soda-water bottles for sometime past, but the results ~~till~~ *for* ~~now~~ achieved are not ~~very~~ encouraging. His Excellency the Governor in Council has accordingly resolved to appoint a committee ~~consisting of the~~ ~~members of the~~ to examine the existing position and to advise ~~him~~ *him* whether the experiments in the manufacture of soda-water bottles should be continued and, if not, whether experiments should be made with other forms of glassware. *The committee will consist of the undermentioned gentlemen:-*

- (1) Mr. C.A. Innes, I.C.S., Officer in charge of the Department of Industries (Chairman).
- (2) Mr. W.A. Beardsell.
- (3) Sir Frederick Nicholson, K.C.I.E.
- (4) Sir Clement Simpson, Kt.
- (5) The Hon'ble Sir Francis Spring, K.C.I.E.
- (6) The Hon'ble Mr. M.E. Couchman, I.C.S.
- (7) The Hon'ble Rao Bahadur K. Suryanarayanamurti Nayudu Garu.
- & (8) Dr. J.L. Simonson, D.Sc.

para 2 of Mr. Innes' note, page 11 & 12 supra

page 16 supra

DEPARTMENT.

CURRENT No. 1131 Eol

From

Received

191

Registered

1917

Subject.

D. O. G. cor. 52

MADRAS, POST BOX No. 112.

TELEGRAPHIC ADDRESS "CHROMIUM,"

Dated, 7th March 1917.



Dear

I propose that the Glass Committee should sit at 10.30 A.M. on the 17th instant in the Legislative Secretary's room of the Council Chamber.

The reason why I have selected this date is that His Excellency does not want the Committee to sit while the Council is sitting. The agenda list for the Council is a very long one and the Legislative Secretary advises me that probably the Council which begins on the 13th will sit for 4 days. Hence I have been compelled to fix the Glass Committee's meeting for the 17th.

Will this date suit you?

Yours sincerely,

Sd. C.A. Innes.

To

All the Members of the Glass Committee.

Copy to Mr. Harvey for information.

C. Innes
Director of Industries.

2. The Officer in charge of the Dept. of Industries is requested to arrange for the meeting of the committee and forward to the Govt. a copy of its proceedings with his own remarks thereon at an early date.

S.K.
5-3-17.

Chk
6.3.17

To the Officer in charge of the Dept. of Industries.
W.A. Beardsell, Esq.
Sir F. Nicholson, K.C.I.E.
Sir C. Simpson
The Hon. Sir Francis Spring, K.C.I.E.
The Hon. Mr. M.E. Couchman, I.C.S.
The Hon. Rao Bahadur K. Suryanarayana
namurti Nayudu Garu,
Cocanada.
Dr. J.L. Simonson. D. Sc

Annexure

To

E.A. Harvey, Esq., I.C.S.

Ag. Secretary to Government.

Home(education) Department.

Fort. St. George.

DEPARTMENT.

CURRENT No. 1205 En 22

From _____

Received _____ 191 . Registered 12.3 1917

Subject.

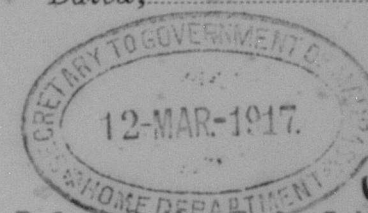
D. O. G. No. 52.



MADRAS, POST BOX No. 112.

TELEGRAPHIC ADDRESS "OHROMIUM,"

Dated, 12th March 1917.



Dear Harvey,

In continuation of my D.O. of the 3rd, I have to inform you that the printed papers intended for the Hon'ble Mr. K. Suryanarayana Murti Naidu of Cocanada may be sent to his address care the "Cosmopolitan Club", Madras.

2. All the members of the Committee have agreed to the date and time proposed by me viz, 10.30 A.M. on Saturday next the 17th Instant. Would you ask your Superintendent to see that the Legislative Secretary's room in the Legislative Council building is ready for the meeting.

3. The sooner the printed papers are distributed the better.

Yours sincerely,

To. E.A. Harvey Esq., I.C.S.

Acting Secretary to Government,

Home (Education) Department.

planned
Print this
3/2/17
4
(Annexure).
PAPERS RELATING TO GLASS EXPERIMENTS.

I

23
2/
Note on Glass Experiments, dated the 26th July 1916, by the Hon'ble
Mr. M. E. Couchman.

The original experiments in glass-making in Madras were carried out at Ennore by the late Mr. James Short and Mr. Scholl. Satisfied with the success attained by their small scale experiments and encouraged by the advice of a German expert whom they brought out from Europe for this purpose, they floated a company in 1909 with a capital of Rs. 2,00,000 of which Rs. 1,60,000 were issued at once.

Four Austrian glass-makers were also brought out to put up the furnace and teach the local hands how to make glass.

68
In G.O. No. 677, Revenue, of 2nd March 1910, a free grant of half the wood used in the Company's furnace for the first two years of its working, up to a maximum of 7,200 tons for the whole period was granted by Government. After working for some time it was found necessary to get out automatic machines for blowing the bottles, and in 1911 six bottle-making machines, an air compressor and mechanical gear were obtained from Messrs. Forsters of St. Helens at a cost of £2,350 cash and £1,350 in fully paid up shares. The factory worked till November 1911, and turned out a considerable number of soda water bottles. The output varied from 1,000 to 1,600 large bottles from four machines, and from 300 to 400 bottles from two small machines daily, but about half of the bottles made cracked in the annealing process. The chief difficulties met with were the cost of fuel. This was due to the fact that the furnace was not a continuous one. Work had to be stopped entirely to recharge the tank, and during this time the furnace had to be kept at the same heat as during actual working. This meant that work could be carried on only for 12 hours out of the twenty-four, and thus the cost of fuel was doubled. The concession of free fuel was not of much assistance, as the cost of felling, freight, cart-hire, etc., brought the cost of the fuel up to Rs. 8-8-0 per ton. 200 tons of fuel were used per month, at a cost of Rs. 1,600. As this quantity could have been purchased in the open market for Rs. 2,200, the actual help received from Government only amounted to Rs. 600 per month. Another difficulty was that when the tank got low, prior to recharging, the glass-makers had to dip the pipe on which they took out the glass into the tank at such an angle that the heat ran up and burnt their hands, and the pipe itself became so hot as to make it difficult to work with. Thus the cause of failure was the furnace. About Rs. 2,90,000 had been spent up to this time. In 1913 an attempt was made to raise further capital to put in a new furnace, at an estimated cost, including erection, of Rupees 42,000, but the shareholders declined to invest any more money in the concern and the Company went into voluntary liquidation. The whole plant and factory has recently been bought by Government for Rs. 23,000. As the machines are still in good order the price paid is very moderate. I have consulted Messrs. Beardsell & Co. who were the Managing Agents, and Mr. J. O. Robinson, who was on the Board of Directors, about it. They both agree that the furnace was the main cause of failure. Mr. Robinson told me that the Company made very good soda-water bottles, which Messrs. Spencer & Co. used in large quantities and found

W/-

perfectly satisfactory. He thinks that the experiment was abandoned too soon, and that it is "well worth a further trial." He thinks that the local market is sufficient to absorb the whole output of the factory in bottles, if plain bottles are made as well as soda water bottles. The experiment has now the further advantages. Soda-water bottles, which used to cost 22s. a gross in Madras, now cost 48s. Before the war, freight from Antwerp was 15s. a ton, and though, of course, the present high rates will be reduced after the war, he does not think that freights or cost of production in Europe will be so low again as they were before the war for a long time, if ever, in addition to which there is an additional import duty of 2½ per cent.

The Director began experiments on glass soon after the out-break of the war. The furnace was broken down, and the factory out of repair. At first he rented the place for Rs. 100 a month from the owner. He decided to adopt oil furnaces, and the first furnace was constructed on plans obtained from England, but it proved extravagant in fuel consumption, but it was used for experimental purposes, and the glass-makers taught by the old company were collected together, and tried. It was found that they had lost some of their skill. He then made informal enquiries to find out if experts could be obtained from Europe, but the foreman who was working under the company was found to have enlisted and to be fighting at Gallipoli, and most English glass-makers were making flint glass, a higher grade of glass than that used for soda-water bottles. In the meantime the Director was continuing his experiments to find out if the oil furnaces would give the required heat. A temperature of 1200 deg. was obtained, but without the use of an excessive amount of alkali (which added to the cost of the glass and lowered the quality) the mixture would not melt at this temperature. The furnace was again altered, and a temperature of 1400 deg. was reached, and the furnace kept working for three days and nights and 14 gross of bottles were made, most of which passed through the annealing process satisfactorily. The Director thereupon decided to entirely rebuild the furnace, and provide it with an arrangement for pre-heating the air. This is now approaching completion. The Director expects that the consumption of this furnace will not be more than 9 gallons of liquid fuel an hour at As. 3 a gallon, which means an expenditure of Rs. 24-12-0 for a day of 12 hours. The old company used to use 7 tons of wood daily, costing Rs. 59-8-0. He is confident that he can now produce glass of good quality, but anticipates that the chief difficulty will be in training the labour necessary to keep the furnace working continuously. He is not in favour of getting out an expert from Europe at present, even if such men were to be had now, which is improbable. He wishes to engage for the present a man named Klein, who has been certified to be a French subject, and has spent many years in glass works in France. He also has a good knowledge of this country. He wishes to engage him temporarily on a salary of Rs. 200 per mensem to start the training of the workmen. He also wishes to begin to enquire for an expert in England, so that if possible one may be obtained in about six months' time, when the workmen here should be becoming proficient. If Mr. Klein proves good enough there may be no need to get another expert from England. As however, it takes a long time to find a suitable man, the Director may at once be authorised to make enquiries if such a man would be available if wanted.

The expenditure up to the present time is as follows—

	RS
September 1914.—Reconstructing the furnace	1,500
October to April 1915.—Trying workmen	1,500
April to October.—Experiments with furnaces	2,500
December 1915.—Trial of furnaces	1,400
January to March 1916.—Experiments on composition of glass and remodelling of furnaces	2,500
March and April.—Second large trial of furnace	1,000
May, June and July.—Remodelling of glass furnace	6,000
Total	16,400

The above expenditure includes Rs. 4,000 still to be paid, owing to orders placed. The Director expects that the factory will be ready for working about the end of this month. The following statement shows the expenditure on miscellaneous industrial experiments for the four months April-July 1916.

STATEMENT of receipts and expenditure of miscellaneous industrial experiments for four months from April to July 1916.

	Budget grant for 1916-17.	Receipts.	Expenditure.			
			Staff.	Experimental.	Capital.	Total.
1. Pencil	Rs.	241	400	573	..	Rs. 973
2. Glass	37,000	117	304	1,015	4,168	* 6,487
3. Miscellaneous	..	..	..	724	..	724
Total	37,000	358	704	3,312	4,168	8,184

* This includes a sum of Rs. 2,406 being the freight on fire bricks, clay and pipes from Jubulpore.

If Government sanctions the continuance of the experiments the Director proposes to make soda-water bottles, and also cheap tumblers and lamp chimneys, and glass tiles. The tiles were successfully made by the former company, but the demand for them is limited. Having gone so far, and in view of the promising results of the trial made with the new oil furnace, I recommend that the Director's proposals may be approved, and that sanction may be granted at once for the temporary entertainment of Mr. Klein on a salary of Rs. 200 per mensem. Permission may also be granted to enquire for an expert in England, though of course no one will be engaged without the sanction of Government.

II

Letter—from M. E. COUCHMAN, Esq., I.C.S., Special Officer, Department of Industries.

To—the Secretary to Government, Home (Education) Department (through the Accountant-General, Madras).

Dated—the 22nd September 1916.

No.—E-8.

I have the honour to submit an estimate of the approximate expenditure which will be required for the experiment in glass manufacture.

2. The new furnace has been completed, but the electric connections have yet to be made, and the staff trained. Statement marked V shows the expenditure proposed for October. It includes Rs. 4,500 for connecting the factory with the works. Most of this will be recoverable in the event of the experiment turning out unsuccessful, as the chief part of the cost is the copper wire, the price of which is very high at present. Rs. 1,500 is needed for constructing bins to hold the raw materials (sand, lime and soda) and for miscellaneous repairs to the buildings and plant. (Statement No. VI). The balance of Rs. 2,000 is made up of the cost of the raw materials for October, staff (including apprentices, to be trained) and experiments with oil burners.

3. Statement II shows the cost of the staff. It is proposed to work the furnace continuously, as this will be most economical. This will necessitate the employment of three shifts of workmen.

The expenditure which would be required if working was continued in February and March is also shown.

4. Statement No. III shows the cost of electricity for power and lighting. It has been decided to use electric power owing to its greater reliability, and to the fact that the oil engine installed at the factory is not powerful enough for our purpose. We have the requisite electric motors. All that is required is to connect them with the main.

5. Statement No. IV shows the estimate of profit and loss. This has been framed on conservative lines, as the price of soda-water bottles is now a good deal more than Rs. 20. It must, however, be pointed out that the success of the experiment depends very largely on the staff. If the staff proves incapable of working the machinery fast enough the experiment will fail. I believe, however, that there is a chance of success, though the chance would have been better if a professional glass-maker could have been obtained from England. If the Government approve the suggestion, an attempt may be made even now to procure an expert from England. Mr. Klein, whose entertainment was sanctioned in G.O. No. 162, Educational, dated 1st September 1916 has in the interval obtained other employment and is no longer available.

6. Assuming that the calculations have been made correctly, the figures show a net loss of Rs. 2,520 up to the end of January. From thence onwards a profit of Rs. 4,000 a month is anticipated.

7. The total expenditure up to the end of January next will be Rs. 23,000. If the estimate of Rs. 17,000 which I have submitted for the working of the pencil factory is approved, there will only remain about Rs. 6,000 out of the lump sum of Rs. 37,000 provided in the current year's budget for experiment works under "26. Bm. Scientific and Minor Department" "Miscellaneous Experiments". An additional grant of Rs. 17,000 will therefore be necessary. I consider that as we have gone so far now, it is advisable to incur this expenditure if the money can be found. I do not think that there would be any use in attempting to start work with less expenditure. I will report in a few days if there will be savings under other heads which would be reappropriated towards meeting this amount.

ENCLOSURES

STATEMENT A—showing required quantities of raw material and liquid fuel in tons.

	Expected quantity in tons of glassware manufactured.	Raw materials required in tons.			Required quantity of liquid fuel in tons.
		Sand.	Na ₂ CO ₃	Shells (lime).	
November	10	9	3.5	2	16
December	20	18	7.0	4	24
January	48	42	16.0	10	36
Total up to January ..	78	69	26.5	16	76
February	72	62	24.0	15	36
March	84	72	28.0	18	36
Total in February and March ..	156	134	52.0	33	72

STATEMENT II showing approximate prices of the above material.

(1)	Glassware in tons.	Sand at Rs. 8 per ton.	Na ₂ CO ₃ at Rs. 110 per ton.	Shells (lime) at Rs. 25.	Liquid fuel at Rs. 50 per ton.	Total value of materials, total of columns (3) to (6).	Value allowed in the estimate.
November	10	72	335	50	800	1,307	1,500
December	20	144	770	100	1,200	2,214	2,500
January	48	336	1,760	250	1,800	4,146	4,500
Total to January ..	78	552	2,915	400	3,800	7,667	8,500
February	72	493	2,640	375	1,800	5,311	5,500
March	84	576	3,080	450	1,800	5,906	6,000
Total in February and March.	156	1,072	5,720	825	3,600	11,217	11,500

STATEMENT II showing provision for supervision and labour.

	November.	December.	January.	February.	March.
Remuneration to Dr. Simonson ..	Rs. 250	Rs. 250	Rs. 250	Rs. 250	Rs. 250
Engineer	100	100	100	100	100
Chemist	25	100	100	100	100
(Clerk and Store-keeper	320	50	50	50	50
Existing labour including mechanics.	160	320	320	320	320
Twenty apprentices at Rs. 7-8 ..	200	200	200	200	200
Do. do. at Rs. 10-3	250	250	250	250	250
Do. do. at Rs. 12-8	300	300	300	300	300
Do. do. at Rs. 15	350	350	350	350	350
Do. do. at Rs. 17-8	400	400	400	400	400
Blowers 20	50	100	100	100	100
Casual labour	100	100	100	100	100
Miscellaneous	995	1,410	1,920	2,180	2,420
Total ..	1,000	1,500	2,000	2,250	2,500
Actuals allowed for ..	4,500	4,500	4,500	4,500	4,500

STATEMENT III showing the power and lighting charges to be paid to the Madras Electric Supply Corporation for electricity.

	Standing charges.	Running charges.	Lighting charges.	Total provision.
November	Rs. 200	Rs. 275	Rs. 75	Rs. 550
December	200	300	100	600
January	200	400	100	700
February	200	400	100	700
March	200	400	100	700

STATEMENT IV showing approximate profit or loss.

	As per statement I.	As per statement II.	As per statement III.	Total expenditure.	Approximate bottle manufactured.	Approximate price per gross.	Receipts sales.	Profit or loss.
November	Rs. 1,500	Rs. 1,000	Rs. 550	Rs. 3,050	80	20	1,600	- 1,450
December	2,500	1,500	600	4,600	160	20	3,200	- 1,400
January	4,500	2,000	700	7,200	384	20	7,680	+ 480
Total to January ..	8,500	4,500	1,850	14,850	624	20	12,480	- 2,370
February	5,500	2,250	700	8,450	576	20	11,520	+ 3,070
March	6,000	2,500	700	9,200	672	20	13,440	+ 4,240
Total February and March ..	11,500	4,750	1,400	17,650	1,248	20	24,960	7,310

gross

STATEMENT V.
Expenditure in October 1916 for experiments.

	RS.
(i) Existing staff (monthly paid including remuneration for Dr. Simonson)	430
(ii) Existing daily paid staff	220
(iii) Provision for 20 apprentices at Rs. 7-8	150
(iv) { Raw materials 300 Liquid fuel 35 }	700
(v) Provision for experimental burners	500
	2,000
(vi) Construction of bins and miscellaneous repairs as per statement VI.	1,500
(vii) Approximate cost of electric fittings	4,500
Total ...	8,000

STATEMENT VI.
Abstract referred to in page 1.

Details.	Amount. RS.
Repairs of ball mill	100
Exhaust passage for regenerator	65
Parapet walls across the building	35
Concreting the floor	140
Filling up the pit	45
Re-tiling the smithy shed	40
Construction of oil tanks, platforms	50
	475

Construction of Bins as per suggestions of Dr. Simonson.

18 bins—	
Brick in mud 2,500 c. ft. at Rs. 25 per 100 c.ft.	625
Plastering 4,500 c. ft. at Rs. 3 per 100 c.ft.	135
Concrete floor 1,400 at Rs. 10 per 100 c. ft.	140
Repairs of gates	15
Construction of experimental furnace	110
	1,025
Total ...	1,500

III

Note on Glass Experiments, dated the 29th November 1916 by
Mr. C. A. Innes.

The experiments now going on in glass-making have been sanctioned by Government on the basis of Mr. Couchman's letter of the 27th July 1916 and the 22nd September 1916. But one or two statements in these letters require clearing up, and the estimates submitted with the latter letter require considerable revision.

2. In paragraph 1 of his first letter Mr. Couchman pointed out that the main cause of the failure of the old company was the furnace. The furnace was intermittent and cost Rs. 59-8-0 per day of 12 hours in fuel alone, whereas Mr. Tressler expected that the consumption of his furnace would not be more than 9 gallons an hour, or at As. 3 a gallon, Rs. 20-4-0 per day of 12 hours.

3. These statements are misleading. In the first place, the price of liquid fuel has gone up enormously. It cost us in October Rs. 65 per ton or including cartage As. 4-4 per gallon. Now it has gone up to Rs. 70 per ton and it may go up higher.

4. Secondly, Mr. Tressler's statement that the furnace consumption was only 9 gallons per hour is not of any value. The furnace is only one part of the expense in the matter of fuel. The neck-making and annealing operations take almost as much fuel. I have gone into this matter carefully with the records of our experiments, and my estimate of consumption is as follows:—

Furnace $7\frac{1}{2}$ gallons per hour.

Neck making $7\frac{1}{2}$ gallons per hour.

Annealing 6 gallons per hour.

Total 21 gallons per hour.

5. We shall probably improve on these results, but I allow a margin in the interests of safe and cautious estimating. When, therefore, we are working continuously with 3 shifts of workmen, we may expect a fuel consumption of 2 tons a day or, at present prices Rs. 140 a day. Counting 24 days to the month, this will mean an expenditure of not far short of Rs. 3,500 a month on fuel alone against a maximum of Rs. 1,800 provided in Mr. Couchman's estimate. The figure seems very high, and since we shall not be working day or night for 24 days a month for some time to come, we shall not attain it. But also I understand that, in its prospectus issued at the time when the old company tried to raise more capital, it estimated its fuel expenditure at Rs. 4,300 a month. So even at my figure we make a saving on the company's fuel bill.

6. Another point in which, going again by Mr. Tressler, Mr. Couchman expected a saving was alkali. I do not know on what Mr. Tressler was basing his expectations, but I think he was wrong. For our mixture appears to be the same as the company's. As a matter of fact, we do not know much about mixtures yet. Our first big experiment came off yesterday, and was not a success. We shall have to make further experiments till we arrive at a satisfactory mixture, and until we get it right, we cannot say whether we shall attain a cheaper mixture than that used by the company.

7. If Government require revised estimates, I will send them up. But I do not anticipate difficulty in keeping within the limits allowed me. I have given up the proposed electrical connections. They are too expensive, and I do not take into account the Rs. 4,500 sanctioned for this purpose. But I hope to keep within the balance of Rs. 18,500 allowed for experiments till the end of January. What I am doing at present is (1) testing the new furnace, the smaller one having collapsed, and (2) training blowers and neck-makers. When Mr. Narayanamurti returns from his tour in Northern India, the question of mixture will be tackled. In January I hope to get the loan of Mr. Elland's services, and then I shall be in a better position to pronounce on our chances of success.

8. No orders are required on this note unless Government would like revised estimates to be prepared. I have written merely to correct certain mistakes in vital points in Mr. Couchman's previous letters.

IV

Letter—from C. A. INNES, Esq., I.C.S., Director of Industries.

To—the Secretary to Government, Home (Education) Department.

Date—Madras, the 18/20th January 1917.

No.—G-Cur. 52.

I have the honour to address Government on the subject of the experiments in glass making now being conducted by the Department of Industries.

2. For a convenient history of the inception of these experiments, I may refer Government to Mr. Couchman's letter No. E-8, dated the 21st July 1916. It will be seen that following Mr. Tressler and after consulting Messrs. Beardsell and J. O. Robinson, Mr. Couchman arrived at the conclusion that the main cause of failure of the Madras glass company was the furnace. He then gave an account of Mr. Tressler's experiments in furnace construction, and proceeded as follows:—
"The Director expects that the consumption of this furnace will not be more than 9 gallons of liquid fuel an hour at As. 3 a gallon, which means an expenditure of Rs. 20-4-0 per day. The old company used to use 7 tons of wood daily costing Rs. 59-8-0." In view of the promising results of the trial made with the new

furnace, Mr. Couchman proposed that the experiments should be continued and that the Director's proposal to employ a man called Klein should be approved. The man Klein however was not available, and subsequently in sanctioning an estimate of the expenditure on the experiments up to the end of the current month, Government directed me to institute enquiries as to the possibility of getting an expert to conduct the experiments.

3. Work had just begun with the smaller of the two furnaces constructed by Mr. Tressler when I relieved Mr. Couchman at the end of October last. It was very soon evident to me that the remarks quoted above about the fuel consumption of the furnace were misleading. In the first place the cost of liquid fuel has gone up from As. 3 a gallon to As. 4-6. Secondly the calculation that fuel would cost us only Rs. 20-4-0 a day was based on an 8 hour day, whereas whether we work at night or not, we have to maintain the furnace at a high temperature all the time. Thirdly, Mr. Tressler's remark that the fuel consumption of the furnace was only 9 gallons an hour took no account of fuel consumption for the neck-making and annealing processes. As a matter of fact when we are working at full pressure we consume nearly 2 tons of fuel a day at a cost of Rs. 140. A number of practical difficulties in the way of making good glass also soon made themselves apparent, and I felt strongly that the department was in the false position of endeavouring to master an extremely technical process by purely amateur and very expensive experiments. As the readiest way of remedying partially this situation, I obtained sanction to a proposal to send M.R.Ry. J. Narayanamurthi, Sub-Engineer in charge of the Experiments, on a tour of the glass factories in India, and I was also authorised to correspond with the Director of Industries in the United Provinces with the idea of obtaining the loan, for a short time, of the services of Mr. Elland, the glass expert, in those provinces. I also wrote to Mr. Silver for advice as to how to set about getting an expert from home.

4. Mr. J. Narayanamurthi returned from his tour in Northern India on December 23. His report was received by me on January 10th, and I enclose a copy of it for information. It will be seen that as the result of what he has seen and heard and read in North India, he is of opinion that the experiments in bottle making in Madras should be brought to a close. The Hon'ble Sir George Barnes whom I have had an opportunity of consulting also strongly advocated the same course.

5. With these preliminary remarks I will proceed to examine the position as I see it.

6. The first point is that of raw materials. In the white sand from Ennore, we have sand and the iron content (.125) of which is exceptionally small. It is as good sand probably as is to be got anywhere in India. Even the beach sand just outside the factory gates contain only .45 per cent of iron and could well be used for cheap forms of glass. Sea shell lime is available at fairly moderate prices. The necessary chemicals must be imported from home, but in this respect we are no worse off than other glass factories in India; in fact we have an advantage in that Madras is a port. As regards raw materials therefore Madras is in a comparatively favourable position.

7. More important than the question of raw materials, however, is that of fuel. Cheap fuel is absolutely essential for making bottles, and moreover economy must be secured by scientifically designed furnaces. Now here we are up against a big difficulty. In the first place, there is, and probably never can be, really cheap fuel in Madras. Wood fuel may be left out of the question. It is dear to begin with, and moreover with wood fuel, it is probably impossible to obtain that regularity of temperature which is essential for making good glass. The Madras Glass Company it may be noted, was given valuable concessions by Government in the matter of wood fuel. Even so, it found it cheaper to use coal. Now as regards coal, Madras is some hundreds of miles from the nearest coal fields, and for this reason alone, coal must always be dear in Madras. In pre-war days it was Rs. 15 per ton. Now it has gone up to Rs. 20 per ton. Thus we are in a most unfavourable position in

comparison with English factories which are always situated near coal mines and get pithead coal at a few shillings per ton. This to my mind is the determining factor of the problem. Mr. Tressler tried to overcome the difficulty by the use of liquid fuel, but the nearest oil fields are hundreds of miles away, and we are no better off in respect of liquid fuel than in that of coal. Opinions differ as to the average relative calorific value of liquid fuel and coal. Mr. Narayanamurthi puts it at 2 to 1, another gentleman I have consulted puts it at 3 to 1, a third at $2\frac{1}{2}$ to 1. In any case liquid fuel has now gone up to Rs. 70 for a ton which is at least $3\frac{1}{2}$ times the cost of coal. But the main point is that whether we use coal or liquid fuel, we are very badly off in comparison with the English manufacturers, and even if we leave the English manufacturers out of account, a glass factory in Madras would have no chance at all in the event of a factory being started, say, in the coal areas of Bengal where in normal times coal can be obtained at about Rs. 3 a ton.

8. Another point to be borne in mind is that proba'y the factory would have to close down for at least two months in the hot weather. This is Mr. Beardsell's opinion, and from Mr. Chatterjee's *Notes on the Industries of the United Provinces* I find that it accords with experience gained in the United Provinces.

9. Finally there is the question of a market for the finished product. The Madras Glass Company were advised by Messrs. Forster & Sons of St. Helens that economy in fuel could not be attained unless 8 automatic blowing machines were installed, and an outturn of 200,000 bottles a month achieved. We have six machines and assuming that we train sufficient labour to run these machines continuously, we ought to aim at a maximum outturn of 150,000 bottles a month. I admit, however, that the assumption is a large one having regard to the inefficiency of Indian labour, and for purposes of argument I will take it (1) that our maximum output would only just exceed a lakh of bottles a month, (2) that the factory would work only ten months in the year, and (3) that our gross outturn would amount to 7,000 gross per annum. If we could sell all these bottles in Madras, we would have one great advantage over the English manufacturer in that we would save the cost of freight, port dues and other similar charges. From figures kindly supplied to me by Mr. J. O. Robinson, I find that it cost the English manufacturer Rs. 5-9-0 per gross to land soda water bottles in Madras before the war, and the charges have now gone up to Rs. 16-9-0 per gross. The latter figure is of course abnormal, but for some time after the war it is doubtful whether freight and other charges will fall below Rs. 10 per gross. But we cannot safely assume that Madras alone could absorb 7,000 gross of soda water bottles in a year. Unfortunately separate figures regarding soda water bottles are not given in the Sea Customs returns prior to 1912-13. In that year 4,932 gross were imported, in 1913-14, 8,187 gross while in the last two years doubtless owing to the war the imports have dropped to 2,225 gross and 2,311 gross, respectively. It is impossible to draw from these figures any safe inference as to the consumption of soda water bottles in Madras in a normal year; but it is probable that 7,000 gross represents about the normal consumption. But Mr. Beardsell informs me that we could not safely count on capturing the whole trade, at any rate, not for some years. The firms would not have sufficient confidence in the factory to place their entire orders with us, and almost certainly we should have to rely on Calcutta for a market for a good proportion of our output. But probably it would cost us not much less to place our bottles on the Calcutta market than it does the home manufacturers.

10. There is one other point, and if my information is correct, it is all important. Our machines are automatic machines obtained from Messrs. Forster & Sons of St. Helens. According to the firm's own figures, the maximum output per machine is about 25,000 bottles a month, and the manipulation of the machine requires skilled labour. The skill lies mainly in knowing exactly when to apply the scissors to the melt dropping into the mould from the gatherer's rod, and can

be acquired only by experience. Now there is a patent machine for the automatic blowing of bottles known as "Owens Bottle Machine." The patent has been acquired by a Trust known as the Europaischer Verband der Flaschen Fabriken, an association of all the chief bottle manufacturers of Europe. Only two unskilled men are necessary in each shift for attendance on the machine, and the net daily output, after allowing for breakages, is from 21,000 to 24,000 pint bottles a day. I am not absolutely certain whether this machine can make soda water bottles. The Hon'ble Sir George Barnes thought that it could, and if so, it is quite certain that with our machines we could not compete with a factory equipped with an Owens Machine. Mr. Oertel, the Chief Engineer of Assam, who has written a pamphlet styled *Notes on the Glass Industry of Europe* informs me that he has only seen beer bottles made by this machine, but that he believes that it can make soda water bottles.

11. The above is as careful and dispassionate an analysis of the fundamental facts of the case, as I am able to make. They may be summarised thus:—The only advantage we have over the English manufacturer is that we are spared the cost of freight, landing charges and the like which for some years to come may amount to as high as Rs. 10 per gross. On the other hand, the English manufacturer can get fuel probably at one-fourth or one-fifth of its cost in Madras, he has the necessary chemicals on the spot whereas we have to import them, and he is able to work all the year round. Add that he has probably generations of skill and experience behind him, and that he manufactures on a very large scale, and the conclusion, I think, emerges pretty clearly that it is exceedingly doubtful whether in Madras we could ever compete with him in normal times with much prospect of success. I am quite of opinion that sodawater bottles ought to be made in India, but except for its store of sand, Madras is probably the last place where the experiment should be tried. As suggested in paragraph 10 of Mr. Narayanamurthi's report Saktchi is probably the most suitable place for an experimental factory. I was talking to Mr. Padshah, Managing Director of Messrs. Tata Sons & Co. to-day. He tells me that ~~that~~ at Saktchi coal is from Rs. 3-12-0 to Rs. 4 per ton.

12. But it may be suggested that (1) with a difference of nearly Rs. 17 per gross between the wholesale prices of soda water bottles at home and in Madras, and (2) with a decided shortage of bottles in Madras, we ought to be able to make a good profit out of the manufacture of the bottles at any rate as long as the war lasts. It is certain that the old Madras Glass Company had it been in existence now would be doing very well. But unfortunately we did not begin at the point where the Madras Glass Company left off. That company began work with a German expert on Rs. 2,000 a month and four expert European blowers, each on £ 15 a month. The furnace was started up on January 3rd, 1910, and by January 8th faultless glass was being made. We have been working on and off for some months now, and I cannot honestly say that we have made a single decent soda water bottle. Our apprentices have certainly improved, and we have attained an output of nearly 1,500 bottles in a day of 8 hours. But the quality of the glass is bad, and the neck-making defective. For instance, on the 6th instant, I sent 4 dozen bottles to Messrs. Maclure & Co. to be tested. Eight bottles were rejected on account of defective neck-making. The remaining bottles were subjected to a pressure of 120 lb. to the square inch, and only 22 of them withstood the test. The bad quality of the glass is probably due to some defect in the design of the furnace and resultant irregularity of temperature. Probably also the furnace is too small. Mr. Elland says that in the factories at home the melt is maintained at a depth of 4 feet in the tank and that a day's work lowers the depth only by a few inches. We practically empty our tank. Defective neck-making and unevenness in the

thickness of the glass, especially at the bottom of the bottles, are signs of unskilled blowing. Our results are not to be wondered at since the furnace was designed by two Engineers who have had no experience of, and probably have never seen, the type of tank furnace used in a glass factory, and since for training our blowers, we had to rely on one or two of the old blowers of the Glass Company who had forgotten part of what they had learned. Had we been able to begin at the point where the old Glass Company left off, all would have been easy. But we had to begin practically all over again. We have not even got a proper recipe for a mixture and at present we are using only cullet. All mixture recipes are trade secrets, and recipes given in text books must be regarded with distrust. As Mr. Oertel says in his *Notes on the Glass Industry in Europe*, "no works would ever betray their own mixtures". We have a rough idea of the mixture used by the Old Glass Company, but our experiments with mixtures have hitherto been failures. Moreover the factory is not properly equipped for the mixture experiments. It is an extremely expensive business to experiment in a $7\frac{1}{2}$ ton tank furnace with liquid fuel at Rs. 70 per ton. On the other hand when we put up a small experimental furnace, we found it difficult to work up to the temperature required. Probably the solution is to be found in ovens of the type mentioned in paragraph 24 of Mr. Narayana-murthi's report, but I doubt if they could be got at present.

13. The fact is that we have arrived at a point beyond which we cannot hope to advance very much without expert guidance. We want help in training our blowers and neck-makers, and in the matter of mixtures, and above all expert advice as regards (1) the type of furnace to be constructed and (2) how to construct it. Mr. Elland, the United Provinces Glass Expert, could probably advise in regarding mixtures and methods of testing them, but he does not pretend to be an expert blower, and he knows nothing about furnaces. The Director of Industries in the United Provinces is quite willing to lend us his services for a time on payment of his travelling allowance plus a deputation allowance of Rs. 30 per diem. He would, no doubt, do some good, but the crucial point is the furnace, and he could not help us in this point nor in training the blowers. In the circumstances I doubt if it is worth while bringing him down. Mr. Oertel says "the back-bone of Glass-making" "on which its success depends is the furnace, and it is therefore generally considered that engineers with some knowledge of glass making make the best "managers of Glass works." The engineer glass maker is exactly the type of man we want together with two or three blowers who are accustomed to handle the type of machines we have. Could we get hold of men of this type, I have little doubt but that we could make the making of soda water bottles pay so long as prices remain at their present level. But it would mean a large outlay, and a large recurring expenditure. In the first place I am pretty certain that we should have to scrap our present furnace and construct new furnaces designed to burn coal. Secondly, an engineer glass maker, assuming that we could get one at all, would be a very expensive person. But it seems hardly worth while to pursue this suggestion, for as long as the war goes on it would be impossible to get from home the type of experts we want. Further our object is not to run an industry which will pay only so long as abnormal war conditions last, but to establish an industry which will take permanent root in Madras. For the reasons already stated, I do not believe that there is any prospect of establishing a permanent industry in Madras in the manufacture of soda water bottles, and this being so, I am driven to the conclusion that the right course is for Government to discontinue at once the experiments now being carried on.

14. There is just a chance that we might succeed in making decent glass if in the light of the experience gained we constructed a new furnace. The trouble with the present furnace is that we get too fierce a heat at the working end and not sufficient in the third compartment where the cullet is put in. Consequently the cullet is not properly melted by the time it arrives at the melt chamber. What we require is a new furnace on a much larger scale and probably with the burners fitted at the mixture end instead of at the working end as in the present furnace. But a furnace on the scale required would probably cost Rs. 13,000 or 14,000; it would not be easy to get the material required; at best it would be a gamble; and I am not in favour of trying any more doubtful experiments.

15. I submit therefore for the consideration of Government my proposal that the present experiments should be closed down. The Hon'ble Mr. Couchman to whom I have shown this letter agrees with me. So does Mr. Beardsell of Messrs. W. A. Beardsell & Co., the managing agents of the old Madras Glass Company. This gentleman has sent me a copy of his evidence for the Indian Industrial Commission on the glass industry and has suggested that I should submit it to Government. It will be seen that he shares my view that Madras is not a suitable place for a soda water bottle factory. I endeavoured to consult Mr. J. O. Robinson but unfortunately he was engaged and the next day he left for Europe.

16. I ask for early orders as the sanction for the expenditure on the experiments expires at the end of this month. I have not yet considered Mr. J. Narayana-murthi's proposals about bangle-making. If I decide to move in the matter, I will make a separate reference to Government.

ENCLOSURES.

(i)

Copy of report from M.R.Ry. J. Narayana Murthi Avargal, Sub-Engineer, on his tour in Northern India.

I beg to submit the following report on my tour in Northern India, the object of which as per the Director's Office No. G. Cur. 52, dated 11th November 1916, to the Government has been stated to be

(1) To enable me to answer, as far as possible, the list of questions prepared by me by the knowledge gained by me by observation and enquiry at the factories visited and by personal interview with Mr. Elland, the glass expert of United Provinces and other glass experts and

(2) To improve my practical and theoretical knowledge of glass-making to enable me to be in a position to assimilate any suggestions from any glass experts.

2. I have also been asked to visit the chief bangle-making centres and study the question of bangle-manufacture. Thus charged, I left Madras on the night of 25th November 1916 and after an extensive tour alighted within the limits of the Madras Presidency on the morning of 21st December 1916 and returned to Madras on the morning of 23rd December 1916.

3. To start with, I alighted at Poona to call upon Mr. N. C. Kelkar, one of the Secretaries of the Paissa Fund and obtain from him a letter of introduction to the Superintendent of the Paissa Fund Glass Works at Talegaon to permit me to see the works which he was kind enough to give me. With that letter I arrived at the Glass Works, Talegaon, where in the absence of the Superintendent, Mr. R. M. Bhorkar and the Chemist, Mr. A. D. Joshi, B.A., B.Sc., warmly welcomed me and took me round the works explaining every operation clearly to me.

4. The early history of this factory is very interesting. When the Swadeshi movement started in 1906, an industrial school under the name of Sadhana Vidyalaya was started at Talegaon. Simultaneously subscriptions were collected at the rate of a quarter of an anna (0-0-3) and the amount thus collected was called the Paissa Fund (paissa 0-0-3ps.) The trustees of this fund utilised nearly Rs. 40,000 for the erection of a glass factory adjacent to the abovesaid Vidyalaya with the object of training some of the students of that Vidyalaya the art of glass blowing. Mr. S. S. Ishwardas Varshneyi who underwent training in glass-making in Japan and America for over three years was engaged to supervise the glass works and train the students. Quarters for the Superintendent and the labourers and also a laboratory were erected and the work commenced in 1908. About 20 students joined the institution naturally during 1908 and 1909; this institution lost nearly 30 to 40 thousands of Rupees as it was working as a trade school and not a commercial concern. The period was too short for the students to become expert blowers. The trustees were not willing to sink any further amount on the institution. At this juncture 6 Japanese blowers arrived at Bombay with the object of starting a Glass Factory on their own account. Hearing of this Mr. Ishwardas met them and subsequently the works were leased out to Mr. Ishwardas on the following terms:—

(1) The Paissa Fund Committee undertook to advance working capital at 4½ per cent interest.

(2) Mr. Ishwardas undertook to train the apprentices.

(3) Mr. Ishwardas was personally responsible for the return of the working capital with interest, the profit or loss being his own.

(4) The term of the lease was from 1910 to 1915.

Mr. Ishwardas sublet the undertaking to the above said Japanese on the following terms:—

- (1) The Japanese to train the apprentices.
- (2) Mr. Ishwardas was to find the working capital and was also responsible for the sale of the finished products and the supply of raw materials.
- (3) The Japanese had to manufacture and hand over the finished article to Mr. Ishwardas, the price of each article being fixed previously.
- (4) Mr. Ishwardas to retain 28 per cent (including the interest on capital advanced to the Japanese) of the gross value of the finished products, the Japanese taking 72 per cent towards the cost of raw materials, the wages of labourers and their own remuneration.

It appears, during this period, the Japanese made Rs. 100 to Rs. 125 each and Mr. Ishwardas Rs. 400 to Rs. 450 per month.

I am told that each of those Japanese blowers used to turn out 700 to 1,000 pieces in a day of 8 hours permitting the apprentices half an hour every day before closing to practise.

The Japanese constructed a 6 closed pot (400 lb. each) direct fired furnace and manufactured chiefly chimneyware and jars. They got sand from Allahabad, slaked lime from Bombay, coal from Bengal Coal Mines (Baraboni), chemicals from Bombay and closed pots from Japan. At that period the prices of the chief of the raw materials delivered at the factory were as given below:—

	RS.
Sand	27 per ton.
Lime	70 "
Coal	15 "
Soda	83 "
400 lb. pot	Rs. 15 to Rs. 16 each.

5. At the end of 1915 Mr. Ishwardas could not obtain a renewal of the lease and left to Ambala to run the Upper India Glass Works on terms which will be explained later on. With him, he has taken 6 or 7 of the locally trained apprentices and two of the above Japanese. The rest of the Japanese and some of the trained apprentices found employment in one or other of the Glass Factories in Bombay Presidency and Northern India where after the war some of the defunct factories started work again. Mr. Sundaresa Ayyar, who was one of those trained here, left in 1916 for Japan to learn the manufacture of the "silky" bangles of Japan which by this time came into vogue. The Paissa Fund thus had only 5 trained blowers left, the present Superintendent and Assistant Superintendent being some of those former apprentices.

6. These trained blowers that are left are young men educated up to the matriculation standard while those that went to seek employment elsewhere are almost all uneducated workmen. These, due to their love towards the institution induced the Paissa Fund Committee to run the works on commercial basis they themselves offering to work for a pittance of Rs. 35 each rejecting offers from outside of a pay of Rs. 125 to Rs. 150 per month. The work was started early in 1916, the time being favourable due to war. But the price of "pots" went up from Rs. 15 to Rs. 40. Even at that price, the supply of the pots was not assured. There was no large stock of pots in their works. This difficulty of the pots is being felt in all the factories that restarted work after the war. So the Paissa Fund works decided (1) to work only with 3 pots for the time being (2) and to make experiments in the manufacture of the pots in India. For the latter purpose, Mr. A. D. Joshi, B.A., B.Sc., has been engaged on Rs. 75 per month. At the same time they managed to buy nearly 100 pots from factories at Baroda and Alwar which have been wound up in 1915. During 1916 till November, only three pots were kept going but now they are constructing a 6 pot furnace to increase their daily outturn on the strength of the success they had during 1916. The abovesaid 5 blowers are all on the same footing each in his turn (by months) working as Superintendent or Assistant Superintendent, two of them being actually engaged in blowing every day.

7. Working with 3 pots (nominal capacity 400 lb. actually only 225 lb. of molten glass can be had from each per day), Glassware (Madras, Hurricane and 10 and 14 lined chimneys) weighing 6 cwt. is manufactured daily, fetching Rs. 100 to Rs. 110 at the present prices. The cost of the raw materials for the 6 cwt. of molten glass per day amounts to Rs. 35. The daily consumption of coal is 1 ton costing Rs. 16. The cost of the establishment including blowers and their assistants, furnace attendants and their assistants, monthly paid labourer for pounding, grinding, polishing, etc., and 2 clerks is Rs. 1,000 per month or daily 33. That is for a daily total expenditure of about Rs. 85, the net outturn is Rs. 100 to Rs. 110 leaving a profit of Rs. 15 to Rs. 25, say an average of Rs. 20, out of which the interest on starting capital and working capital and depreciation will have to be met. The enthusiastic

workers there are very much satisfied with the success but to my mind their present position seems to be far from satisfactory from a proper business point of view for the following reasons:—

- (1) Talegaon is not at all an ideal site for a Glass Factory. They are importing by rail all the raw materials including sand and lime in addition to coal and for marketing their finished ware they have to send again on rail to Bombay.
- (2) After the war the prices are bound to fall and the foreign cheaper article of a better quality will compete in the market.
- (3) A concern can be said to be a successful one only when the net profits cover the interest and capital.

(4) Even the present apparent profits are due to the fact that the blowers are working only for nominal wages.

8. The raw material (soda) is pounded in wooden mortars by pestles acted upon by levers worked by men. The Chemist prepares the mixture and blowers fill up the pots as they are emptied in three lots at intervals of 2 hours each. From the time the pot is once emptied it takes full 18 hours before the fresh mixture put in it melts and refines. At the end of that period the molten mass is free of air bubbles without the addition of any vegetable matter. The temperature attained in this furnace is above 1350°C (less than 1400°C). The present consumption of 1 ton coal per day ($\frac{3}{4}$ ton for melting and $\frac{1}{4}$ ton for annealing, etc.), for 6 cwt., of molten metal is considered high. It appears the present 3 pot furnace was originally constructed for a 6 pots when the daily consumption of coal used be only one ton for melting 12 cwt. The size of the passages have not been correspondingly reduced and the comparatively high consumption is attributed to that and that in the new 6 pot furnace they are constructing they hope to minimise the coal consumption. The furnace is capable of improvement by increasing the depth of the coal bed on the grating and constructing a passage for the air round the fire chamber so that the incoming air may be heated before entering beneath the grate. Also a damper on the exhaust will be an improvement.

By the side of this melting furnace there is a pot-heating furnace for preheating of the pots to replace the broken pots in the melting furnace.

The work is commenced at about 7-30 a.m., when the blowers assistants begin by skimming off the "Gall" in the pots. The apprentices practise blowing with the "Gall" thus utilising it for heating the chimney moulds.

A young boy heats the blow pipes by holding them in the mouth of the pots and hand them over in succession to another framed young boy who by experience gathers a small quantity of metal by dipping and turning the heated end in the molten metal and blows into a very small bulb of $1\frac{1}{2}$ inches to 2 inches diameter and hand over the rod to a more experienced workman who gathers over the previous bulb a fresh quantity of metal according to the article manufactured. The blow pipe is then handed over to another man who blows it to a bulb of 3 inches to $3\frac{1}{2}$ inches in diameter and rolls it in a cast iron dish into which drops of cool water mixed with oil will be dripping. This operation is said to increase the homogeneity of the material. The blow pipe is now handed over to the expert blower who by several manipulations of twisting and swinging and blowing, blows into a long bulb and placing the bulb in a mould, which is opened and shut by a boy sitting in a pit in front of the blower, blows hard through the pipe all the while turning the pipe round and round. He closes the operation by a strong blowing keeping the rod steady. The mould is then opened and passed on to another man sitting on a chair with long horizontal arms. He rolls the pipe to and fro with his left hand and with his right separates the blown article with either slight taps or by the help of a cold iron piece. The blow pipe is then handed over to a boy who cleans the end of any glass sticking to it and takes it back to the furnace. For each blower 7 to 8 blow pipes are necessary. The blowing being over, the blown article is taken to the annealing oven of an intermittent type heated by direct firing of coal. After two days the article is taken out of oven and taken to the cutting room.

The cutting is done by a carborandum wheel which is rotated by means of a big hand wheel. After cutting it is taken to the end-polishing place. The face to be polished is held against an iron wheel which is rotating either horizontally or vertically, on which water mixed with very fine sand will be dripping. Then the article is washed and cleaned when it is ready either to be packed and despatched or to be stored. Beyond the annealing all the operations are done only by women.

The arrangements for cutting, grinding and polishing are very crude here, the turning of the wheels being done only by hand. They are contemplating to have a $3\frac{1}{2}$ H.P. Oil Engine for this purpose very shortly.

The breakage from blowing to the packing is about 20 per cent distributed thus, 6 per cent in blowing, 6 per cent in annealing, 3 per cent in cutting, 2 per cent in polishing and 3 per cent in transit from place to place before packing.

Before leaving the place I had an estimate (given in Appendix A) drawn up for a Glass Factory to manufacture chimneys having a direct fired furnace with six closed pots.

9. In view of the fact that the life of a pot is on the average only 20 to 25 days the manufacture of pots deserves careful consideration and the experiments conducted by Mr. Joshi are to be watched with interest by all Indian Glass Factories. Several authors have different opinions; some hold that the fire clay must be tempered for at least six months and some say that three weeks time is enough. Again in the matter of drying the pot before heating some hold that 12 months drying is necessary and some 2 months. Mr. Joshi tempers the clay for 4 weeks and dries the pot for 3 weeks. The author of the latest book on refractory materials, Mr. Howard, thinks that uniform quick drying is the best. I am inclined to agree with him and perhaps such drying can be done in an "Autoclave" by steam baking as in our Lime Brick Factory. This has been suggested to Mr. Joshi and he proposes to get three or 4 pots of his to Madras to be thus baked and the experiment is worth trying in view of the fact that fire clay is available in India and if the experiment prove a success it is quite probable that Jubbulpore will be able to supply the pots now imported from Japan.

10. The next place visited was Bombay. At this place I could not get permission to see the Sivi Glass Works where chimneys are made. The proprietors, I hear, are one of the largest dealers in chimneyware and hence they are jealous about any visitors. Some Japanese and apprentices of Talegaon are working here.

In Bombay near Matunga station there is another factory which I hear has just commenced working with one Mr. Shaffi as the expert. Mr. Ebrahim Peer Muhammad, the largest glassware merchant of India, has capitalised this concern. I could not get permission to visit this place also.

While at Bombay I heard of two factories on the Bombay-Baroda Railway at a distance of a journey of 15 hours. One of them is at south road manufacturing carboys only. This is run by one Mr. Kanga who learnt glass-making in Germany. I hear the factory is working at a profit.

The other factory is at Peplod. This has been constructed by Mr. Shaffi (above-mentioned). An intermittent tank furnace with gas generators to use wood fuel was constructed and the factory closed after a month's trial during which time any temperature beyond 1200° could not be attained and the glass remained "Doggy". Thus disappointed at Bombay I called upon B. J. Padshah, Esq., the Managing Director of Messrs. Tata & Sons who put me in touch with Mr. N. B. Wagle, a Government of India Scholar, who in 1904 was engaged by the Government of Bengal to report on the possibilities of glass industry in Bengal. In his admirable report he embodied his views the chief of them being that (1) the best place for glass industry is Bengal near the coal mines and (2) the line of manufacture is pressed ware to start with to get over the difficulty of getting trained blowers to start with. Mr. Padshah also agreed with Mr. Wagle. It appears that slag from iron and steel furnaces is now being used for the manufacture of cheap bottle glass in Europe and America. In view of this Mr. Padshah suggested that the question of glass industry should be treated as an imperial concern and not a provincial one and that experiments on a large scale should be conducted preferably at Saktchi in close contiguity with steel furnaces of Messrs. Tata Iron and Steel Company, where chemical and engineering experts are available. More about this will be discussed later on.

11. Leaving Bombay I arrived at Jubbulpore and called upon Diwan Bahadur Vallabhadras, the proprietor, Jubbulpore Glass Works. His office manager, Mr. M. B. Motivala who has been of late taking interest in the above Glass Works, was deputed to take me round the factory. The history of this factory is both interesting and instructive.

This factory was started in 1909 with Mr. Kanga (now at south road) as the expert. A gas fired open pot furnace with 8 pots with gas producers and regenerators was constructed. Annealing ovens are provided. Chamber for drying sand by heating are constructed. In a long room off a long shafting run by an Oil Engine, are driven 24 iron wheels for polishing and a dozen carborandum wheels for cutting. Alongside with these there are two machines (which have never been used) for cutting glass by "petrol jet" lying idle and ready to be scraped. There is a long row of buildings as quarters for the Superintendent and labourers. Separate rooms are provided for the manufacture of pots. Big rooms for office and stores are provided. Outside these are basins built for washing sand. Nearly 1.75 lakhs was invested as capital. For 1½ years the factory worked with a consumption of over nearly 6 to 7 tons of coal for every ton of glass melted. During this time nearly there was a loss of nearly 50 to 60 thousands. Then Mr. Kanga left to South road and Mr. Mosina, an Austrian, who was originally brought to Rajpur factory which subsequently closed was engaged to run the concern, and in his regime, the producers are reconstructed with smaller dimensions and work restarted. The coal consumption was brought down to 3½ tons per ton of glass melted. This was in 1911 and 1912. Till this period bangles and glass blocks for bangle-makers were manufactured. The bangles were of the pressed Austrian type the

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cap

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mould for which was got from Germany. The breakage in cutting and grinding used to be as much as 60 per cent. The factory was losing. Mr. Mosina had an offer from Allahabad Glass Works and left with 2 or 3 trained workmen from Jubbulpore. In 1913 without an expert the manufacture of the bangles was continued but early in 1914, Austria suddenly brought down the prices from 1 s. a dozen pair to 3 d. to 4 d. a dozen pair. The factory could not stand the competition and had to be closed.

After the beginning of the war, few blowers were again gathered together and the manufacture of chimneys was started. Mr. Motivala was left in charge. His interference is being resented by the blowers as well as the poor relatives of the proprietor who were living upon the failures of the factory. In spite of these difficulties Mr. Motivala partially succeeded in confining the manufacture to particular varieties, e.g., Kitson Globes and Municipal Lantern Chimneys and obtained large orders from different Railway Companies. Thus the business side is fairly improved, but the internal management requires thorough overhauling. The blowers and smelters are the real masters of the factory. The result is the factory has till now lost nearly 5 lakhs and is still losing.

The pots in the furnace break very often and though the furnace is nominally a 8 pot one, on the average during the last year only 4 pots of metal could be manufactured per day. The consumption of coal in the furnace has again gone up to 5½ tons per 1 ton of glass melted. The producers and regenerators often get sooted and the cleaning of them necessitates the closing of the work for a week during which the pots break due to fluctuation of temperature. In 1916 Mr. Elland, the glass expert of the United Provinces stopped at this factory for nearly 3 weeks. His presence in no way improved the affairs.

The failure of success of this factory at Jubbulpore has a great influence on the future of the glass industries in India.

The sand obtained within the limits of the factory is quite as good as any other sand in Northern India containing not more than 1 per cent of oxide of iron.

Jubbulpore is the place from which whole India is to be supplied with fire clay, fire bricks or blocks. The lime from Katni which is very near Jubbulpore is the best of its kind.

And above all, Jubbulpore is very near from coal mines (nearer than any other place where a glass factory has till now been started).

The only disadvantage Jubbulpore has is that the chief markets for finished ware (Bombay and Calcutta) are situated at a distance. With so many advantages the moral effect on glass industry in India caused by the success or failure of this factory is immense and deserves careful consideration at the hands of either the Government or private capitalists. The proprietor is disgusted with the factory and may close at any time.

The prices of the raw materials at this factory are given below:—

	Per ton
Sand (washed and dried)	RS. A. P.
Lime	3 8 0
Coal	20 0 0
	12 0 0

12. The next factory visited was the perfect Pottery Works at Jubbulpore. Mr. Reed the Ceramic expert received me and kindly showed me round the works.

This factory manufactures fire clay articles of any shape and size. They also manufacture Silica bricks which are to be preferred to fire bricks for the construction of the crown of any furnace where high temperature is required. I have arranged to have some samples of those bricks sent to Madras.

13. I next arrived at Allahabad and met Mr. Elland who was kind enough to receive me at the station. I had a long interview with him. Not being an Engineer or a Scientist he was not of much use in helping me to answer the list of questions. Yet he has evidently been all his life in a glass factory and though he does not profess to be able to design a furnace or analyse any raw material, he can be trusted to keep growing a factory (similar to the one in which he was working) properly erected and equipped with trained labour. One important piece of information obtained from him is that the holding capacity of a continuous tank furnace in England with a daily outturn of 5½ to 6 tons, is 200 tons.

14. In the factory at Madras, our aim is to have a daily outturn of 5 tons and its holding capacity is barely 7 tons. The dimensions of the furnace in England for a daily outturn of 5½ to 6 tons is 32 feet x 14 to 15 feet inside and height of 7½ to 8 feet with a constant depth of 4 feet of metal. Mr. Elland was in charge of such a factory at London turning out heap bottles (not soda bottles) by mouth blowing and I am told that the daily consumption for all the operations is 7½ to 8 tons. He had no drawing of the furnace with him. The furnace Mr. Elland was in charge of was a gas fired one and he is not acquainted with any oil-fired furnace. He does not believe in machine-blowing. He told me he is not acquainted with any such machines. Mr. Elland was kind enough to tell the recipe he was using for cheap bottles at home where the temperature of the furnace was always kept up at 1500° C. It is well worth to experiment that recipe with our raw materials. If the experiment be a success, the recipe we are adopting at our factory will have to give place to Mr. Elland's recipe being a cheaper one. The only objection to Mr. Elland's recipe is that in his recipe sodium sulphate is used instead of carbonate and the use of sulphate necessitates special fire bricks for the furnace to withstand the action of sulphur vapour.

15. During my stay then at Allahabad I could not get letters of introduction to the proprietors of the Allahabad Glass Works and Naini Glass Works at Allahabad and so I left to Firozabad which is the chief bangle-making centre in Northern India.

At Firozabad there are 6 factories engaged in the manufacture of glass-blocks for the bangle-makers and there are 50 bangle-making furnaces at each of which 8 to 12 bangle-makers work, each workman turning out 1,000 to 1,500 per day. The average quantity of glass-block manufactured daily from the six factories together is 400 to 420 maunds or nearly 15 tons. Allahabad sand (13/8 per ton), Bengal coal (14/8 per ton) and Katni lime (30 per ton) are used. I visited the two biggest of the six factories. The first is Indian Glass Works owned by Mr. Nandia Moulchand with the help of Mr. M. Mozina, the Austrian expert who once worked at Jubbulpore. This factory was started about 1910 and 1911 with a direct fired open pot furnace with 8 pots but early in 1914 closed owing to two causes: (1) want of temperature in the furnace and high consumption of coal and (2) the Austrian competition which by lowering the prices of bangles threw the bangle-makers to a state of panic. After the war the work was restarted. Mr. Mozina constructed a gas fired open pot furnace with 10 pots. There is very heavy demand for the glass blocks as the whole town is full of hereditary bangle-makers, and the factory is working at a profit. The glass is not of high quality. It is full of air bubbles but still, as long as the war lasts or till German or Austrian bangles are dumped in the Indian market there will be demand even for this poor glass.

A temperature of 1400 to 1450 is easily had in the furnace.

The pots are emptied once in 12 hours and total quantity manufactured in a day is 3½ tons and daily consumption of coal is 3 tons. This is not surprising as there is no annealing and as the each pot is emptied twice a day. Mr. Mozina understands his furnace very well.

16. The other factory is "The Coronation Glass Factory" where glass blocks are made in a "direct fired 8 pot furnace." The rest of the factories, I am told, are smaller factories having direct fired furnaces with 5 or 6 pots.

There is nothing deserving of special mention about these factories except that no attempt is made to produce better grade of glass. The effect is that the bangles made appear very crude and rough.

Regarding bangle-making at this place, Shaharanpur and Calcutta I propose to deal separately.

17. Leaving this place I went to Agra to meet Professor Nag, a well-known Chemist, who, I was told, has been taking very keen interest in Firozabad Glass Works during the last two years. He is of opinion that the Glass Factories at Firozabad and the bangle-making industry are bound to fail very soon after the close of the war unless greater attention is paid to the chemistry of glass-making and glass is made, not out of empiric recipes secretly handed over from father to son irrespective of nature of raw materials but out of materials chemically tested and purified and experimented and unless the furnaces of the bangle-makers are improved so as to give a temperature of 900° C to 1 000° C as really good glass can be manufactured only at high temperature, and unless machinery is adopted in bangle-making for either blowing or pressing, cutting and polishing. He deplors that, while Austria or Germany or Japan was able to bring about new designs even in bangles, the local bangle-makers merely copy and were not able till now to put into the market a new design that would attract the buyers. This is attributed to want of cultivation of the art of designing. In Austria and Bohemia, it appears, there are schools even for that purpose.

Coming to the manufacture of cheap bottle glass greenish in colour he suggests that experiments may be conducted to determine how far indigenous manganese ore as obtained from mines can be substituted for the manganese dioxide, the price of which has gone up very high. The price of manganese dioxide is at present nearly 20 times the price of manganese ore.

18. From Agra I went to Shaharanpur which is also a bangle-making centre. After visiting three bangle-making furnaces and observing how the twist bangles are manufactured (will be described under bangle-making) I reached Ambala to see the Upper India Glass Works where chimneys are manufactured. This is one of the oldest factories started on a big scale with gas producers, regenerators and an open pot furnace, and quarters for

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manager and labourers. After many ups and downs, manufacturing for sometime glass blocks for bangles, afterwards phials and ink bottles and afterwards chimneyware, the factory never made any profit and changed hands over half a dozen times and finally it came into the hands of Mr. Panna Lal, the present proprietor in 1913-14 when the work was restarted for the manufacture of blocks. At this period the Austrians lowered the price of these bangles and the factory had to be closed till the middle of 1915 when Mr. Ishwardas whose term of lease at Talegaon expired entered into an agreement with Mr. Panna Lal and took over the factory on lease at a monthly rental of Rs. 75. Mr. Ishwardas brought 2 Japanese and 6 Indian blowers trained at Talegaon and started the manufacture of chimneyware constructing a direct fired closed pot furnace with 6 pots similar to the one he had at Talegaon. Bengal coal is delivered at the factory for Rs. 16 a ton. Local burnt lime stone is delivered at Rs. 21 per ton. Mr. Ishwardas seems to be extremely satisfied with the profits he is making. As far as Mr. Ishwardas is concerned the factory is a success, but the concern as a whole is a failure as this concern over which an initial capital of 1.5 lakhs has been spent (not considering the loss of 3 to 4 lakhs that has afterwards been sustained by different people) is paying only 12×75 or only 900 Rupees.

Mr. Ishwardas is manufacturing only chimneys and no other article. Apart from the extremely easy terms of agreement under which he obtained the use of the factory, he is lucky in that his market, which extends an area of about 250 miles radius round Ambala, is over 1,000 miles away from either of the three ports of Bombay, Karachi or Calcutta and consequently he is able to procure a high price for his ware in comparison with factories at Talegaon, Jubbulpore or Allahabad.

19. Mr. Ishwardas has constructed a small factory of his own at Bijoi (between Shaharanpur and Lucknow) which started work just 2 months back manufacturing chimneys. A small direct fired closed pot furnace with 4 pots is erected where two blowers are working. I am told that Bijoi is selected as local labour there is cheap. Mr. Ishwardas says that this factory also is paying well at the present prices and hopes it would continue to pay even under normal conditions as the place is far away from either Calcutta or Bombay.

Mr. Ishwardas was examined on glass of India by the Industrial Commission and in his evidence he embodied a list of the several factories started subsequently and closed at different periods in India.

I should thank Mr. Ishwardas for the kindness he has shown me during my visit to his factories.

20. Thence I came back to Allahabad to visit the Allahabad Glass Works and whose term of lease at Naini Glass Works at Naini near Allahabad.

Having obtained letters of introduction from the Hon'ble C. Y. Chintamani, I went to Allahabad Glass Works, where in the absence of the proprietor Mr. Jagmalraj, his brother, was kind enough to take me round the works. The chief articles manufactured here are medicinal phials of pale green colour. They are also manufacturing carboys, kitson globes and chimneys. It appears that formerly they had a gas fired open pot furnace and gas producers. During the last year they constructed a direct fired open pot furnace and the work at present is out of this furnace. Just now they have repaired the old gas furnace with the intention of closing the direct fired furnace. The bottle glass manufactured is of very poor quality full of air bubbles and even the chimneyware is not quite free of bubbles. The cutting is done by "petrol" jet of the type mentioned at Jubbulpore and grinding is done on iron wheels driven by an oil engine. The proprietor of this company is a big contractor for railways and owns a portion in a coal concern. It is this contractor that supplied sand to Talegaon and Ambala and other places. So he has sand for his factory at cost price, i.e., Rs. 3-8-0 per ton. He gets his coal for Rs. 7 and Rs. 8 but still I am told he lost nearly 4 lakhs up-to-date but he is still continuing it because he is a wealthy man making large profits in his railway contracts which he is sinking in this concern. If Government gives him help he intends to import machines for bottle-making and extend the works. He engaged the services of Mr. Mozina for some period in 1914.

21. The other factory at Naini is owned by Mr. R. D. Kanga, M.A., and Mr. Bhargave. Here chimneys are manufactured in a direct fired open pot furnace of 5 pots. This factory has been closed three times during the last four years of its existence. At one time Mr. Kanga closed the works and joined Mr. Jagmal Raj's factory. After the war Mr. Kanga has restarted the factory. Cutting and grinding is done as in Talegaon.

22. Having seen these two factories I left to Calcutta where B. Lindsay, Esq., I.C.S., Director-General of Commercial Intelligence Department has been kind enough to depute Mr. Rice, Curator of Commercial Museum to show me the bangle-making in Calcutta.

Though Mr. Rice was evidently surprised at first to hear that bangles are made in Calcutta we after enquiry found that about 500 operators in Chitpore are carrying on that industry for over 30 years and the bangles made there are about the most decent of the bangles made in any part of India. As I propose to deal with the question of bangle-making separately, I do not here go into the details.

23. The next day I visited the Calcutta Pottery Works where various porcelain articles are made. The success of this is due to the perseverance of Mr. S. K. Deb, the expert. Though originally trained in Germany when the works actually started he found his knowledge insufficient to run the works successfully and he went over to Germany twice afterwards to clear his doubts and to study the furnaces. It was during his last visit he could obtain plans for an up-to-date furnace to suit the industry. He constructed this furnace about 6 months back and his factory is working at a profit now. Electric insulators also are manufactured and he has large orders from home for electric ware. This factory I give as an instance to show that each industry requires a special furnace and the success of the concern depends mainly on the furnace. Mr. Deb may know all about porcelain manufacture but he could not make the factory a success till he obtained a thorough knowledge of the furnace and till he constructed such a furnace. In his muffle furnace he is able to get 1,350° while formerly in an old fashioned furnace he could not get more than 1,150° to 1,200°. Porcelain manufacture does not admit of dropping of particles from the furnace crown and the inside of the crown requires a certain paint to prevent such particles from falling. A knowledge of that paint is absolutely essential for glass manufacture also and Mr. Deb has been kind enough to give me a recipe of the same which Mr. Reed of Jubbalpore was jealous to keep secret.

24. There was a "Seeger-oven" in this factory which is of great use for conducting experiments of several mixtures for glass manufacture. It appears all glass factories in Germany have at least half a dozen such experimental ovens in each factory. Mr. Deb consented to conduct some experiments for us if a fee is paid and it may be worth while to utilise his services if no such oven is available in this Presidency. He has an instrument that continuously records the draft of the chimney so that the furnace heat and air openings may be regulated properly. Mr. Deb is making a particular study of his furnace with regard to draft etc. Such an instrument will be of immense use in any furnace.

Of all the factories I have seen not only in this trip but even at other times, this factory is the most neatly kept and the best organised one.

25. The next place visited was Sodepore where in 1908 Messrs. Halgiers & Co. started a Glass factory with a capital of five lakhs of rupees. Experts were entertained. A continuous tank furnace with producer and regenerators was started to manufacture bottles and pressed ware. The result was a very sad failure. The factory was closed. Subsequently the factory was bought by Mr. L. R. Mullick who with the help of a Japanese expert had a direct fired open pot furnace constructed and started manufacturing glass blocks. This attempt too failed and the factory was again closed. I went there with the hope of seeing at least the remains of the continuous tank furnace and to my great disappointment I found even the foundations of the furnace demolished and there was nothing to be seen.

26. After this, I called upon the Director-General of Commercial Intelligence and borrowed from his library a copy of the report of Mr. N. B. Wagle above referred to and left Calcutta on the evening of the 20th.

27. Though originally I intended to visit Sakchi (Tata Iron and Steel Works) and with that intention obtained letters of introduction from the Managing Director, Mr. B. J. Badshah. The 25 day's period allowed to me was over on 20th December, and in the absence of the Director of Industries who happened to be away from Madras on 20th, I received a wire from Dr. Marsden suggesting to omit visiting Sakchi in reply to my request for an extension by 5 days of the deputation term. So instead of going to Sakchi I arrived at Berhampur (within the limits of the Madras Presidency) and having visited the village Ankusapuram where very crude bangles are made left Berhampur on 22nd and arrived at Madras on the 23rd December 1916.

Such is the history of my tour and the several factories I visited.

28. For a proper comprehension of the magnitude of the question of glass industry in India, I should like to add a short sketch of other factories which I have not visited. A major number of these are not working at present.

The first glass factory started in India was at Ahmedabad using wood as fuel. Afterwards a factory was started at Rajpur near Dehra Dun with half a dozen Austrian blowers. The climate of Rajpur uniformly moderate. In spite of favourable climate and experts the factory had to be closed. An European firm started a factory at Tittagarh with an European expert. Tittagarh has the advantage of being connected by a navigable river both with Calcutta which is the chief market and Bankura the place from which sand and lime was obtained. In spite of the business knowledge of the firm that started the concern, the expert and the water carriage the factory failed. The Sodepore factory in spite of huge capital and most up-to-date furnaces failed.

At Sitarampore (near Asankol) another factory was started just near the coal fields. This too failed. The Maharajas of Gwalior and Baroda started on factories at each place. These too had to be closed. There are many other such failures not worthy of mention. Of course I need not describe the failure of the Madras factory.

29. The condition of glass industry in India up-to-date may be described thus:—
During the last 25 years, about 30 factories were started each with a capital of 1½ to 3 lakhs, each factory lost 2 to 3 lakhs of working capital; most of the factories had at one time or another experts of different nationalities (European and Asiatic). Yet all the factories failed and that very sadly.

If the success of a glass factory in India depends upon few workmen who, having spent 15 to 20 years of their life in some one or other of the big factories in Europe or Japan, come to India as glass experts, many of the above 30 factories should have been working today; if it had depended merely on the nearness of a factory to coal mines, there is no reason why Sitarampore factory should fail; if it had depended on the factory being easy reach of the distributing market, Tittagarh or Madras factories should not have failed; if it had depended on cheapness of fire bricks or lime Jubbulpore factory should not have failed; if it had depended upon the initial capital necessary to train labour none of the factories should have failed and lastly if it had depended merely upon the business capacity of the managing concern, Madras, Sodepore and Tittagarh factories were run by renowned English firms and it is difficult to understand why these failed. The factories have failed in the past and the factories in the future are bound to share the same fate unless greater heads than mine go into the question and study the real causes of such failures.

30. The information gathered by me during my tour by observation, by interviews with experts and by reading the literature on glass-making I happened to come across, may be summed up so far as it effects Madras and the experiments conducted at Madras as follows.

31. A. Raw materials—(1) Quality.—(a) For the manufacture of cheap bottles including soda bottles, ordinary sea sand may be used, if necessary, after washing.

(b) The white sand from Ennur (which is reported to contain 0.5 to 0.75 per cent of oxide of iron) is the best sand available in India and can be used for lamp ware, etc. The best sand in Northern India is reported to contain 0.85 per cent of oxide of iron and the sand of Allahabad now used in different factories has as much as 1.25 per cent of iron.

(c) Raw sea shells powdered is to be preferred to slaked lime used in other places as its quality is uniform and may be depended upon.

(2) Prices.—(a) The cost of Ennur sand delivered at the factory after screening through a fine mesh is about Rs. 11 to Rs. 12 per ton. The price is not much lower than the price of the sand at other places.

(b) The price of shell powdered according to the lime value is about Rs. 40 to Rs. 45 per ton as against about Rs. 80 in other parts.

(c) The price of chemicals in Madras is the same as in Bombay and Calcutta and less than in places inland by the amount of railway freight.

32. B. Fuel.—It is a decided fact that wood fuel is of no use for glass industry. The quality of the glass depends upon the percentage of the silica in it and good glass can be melted only at 1,500° C. This temperature can be attained either with coal and liquid fuel. With coal it can be attained only by well designed regenerators. It is easier to attain that temperature with liquid fuel. But it should not be forgotten that the calorific power of liquid fuel is about twice as much as coal and to attain a temperature of 1,500° with a quantity of oil equivalent to half the weight of coal, the furnace will have to be designed by an expert who has long experience of such furnaces. It is theoretically possible to substitute 1 lb. of oil in place of 2 lb. of coal; it is impossible to reduce the quantity of oil by anything less than half the weight of coal. So from an industrial point of view it is a waste to substitute oil in place of coal if the price of oil be even one part over twice that of coal.

In the factories I visited I found that 2½ to 5 tons of coal is consumed for every ton of glass melted while in England and the Continent in factories with a large production the consumption of coal is 1 lb. for every lb. of glass melted and annealed. To successfully compete with such factories, the consumption must not be more than that. Again most of the big factories in Europe are situated near collieries where the price of coal is 5s. to 8s. according to quality. Similarly Indian glass factories also must be as near collieries as possible. Many are of opinion that Bengal Coal Mines is an ideal place for a glass factory. The price of the best coal at pitmouth is only Rs. 3/12 while in Madras it is as much as Rs. 17 in normal times. The amount of fuel and the cost of fuel is one of the chief factors that determines the success of the glass industry.

83. Coming to liquid fuel, it appears that at Dusseldorf and Roumania there are large continuous furnaces working on liquid fuel and in an account of such furnaces (Review of Glass manufacture published in Switzerland) I find that 1 lb. of glass is melted and annealed with 5 lb. of oil which is had at that place for 12s. to 15s. (or Rs. 9 to 11/4) per ton. The price of liquid fuel in Madras in normal times is as much as Rs. 48 per ton and now it is at Rs. 70 per ton with every chance of going up. Even the price of liquid fuel of Rs. 48 per ton as against Rs. 17 per ton coal (in normal times) decides at once the impossibility of oil ever being economically substituted for coal. If at the oil fields in Burma it is possible to get a ton of liquid fuel at a price not more than double the price of a ton of coal in Bengal Coal Mines at Pitsmouth, it might be desirable to choose Burma to Bengal Coal Mines, otherwise even a site right in the centre of Burma oil fields should not be preferred to a place in Bengal Coal Mines for a Glass factory. Thus it is evident that it is futile and a waste to attempt to substitute oil for coal as fuel.

34. C. Furnace.—The above paragraph deals with general question of the nature of fuel. But the economy of fuel or otherwise depends on the construction of the furnace. Yet the type of the furnace depends on the nature of the article manufactured, for example—

For the manufacture of cheap bottles and cheap pressed ware a continuous tank furnace is the best. Only one colour of material can be produced.

For the manufacture of cheap glass blocks for bangle-making an open pot furnace may be used each pot being used for one colour.

For the manufacture of pure high class glass blocks for bangle-making, covered pots are necessary to keep off impurities as much as possible.

For the manufacture of good and pure white chimney-ware also closed pots are to be preferred.

There is yet another classification of furnaces (1) Direct fired and (2) Gas fired.

Tank, open pot or closed pot furnaces may be either direct fired or gas fired. Direct fired closed pot furnaces are very largely adopted in Europe even at the present date for the manufacture of very high class glass, for the manufacture of articles for which the demand is little though the price obtained is very high. Direct fired furnaces naturally consume more coal and the maximum temperature attained is 1,350° to 1,400° while in Gas fired furnaces with properly designed regenerators a temperature of 1,500° is attained with comparatively less consumption of coal.

A description of a direct fired closed pot furnace for 6 pots will be given in Appendix B. Mere construction of regenerators and Gas producers is not all that is required. Unless they are properly designed to suit the size and the climate of the country such furnaces will prove more wasteful than even direct fired furnaces. I have already shown that in Jubbulpore the consumption of coal, in a gas fired furnace with regenerators, is as much as 5½ tons per ton of glass melted, while in the latest and most up to date Siemens Gas Furnaces the consumption is not more than 1 ton of coal both for melting and annealing 1 ton of glass.

35. Thus the cheapness of fuel, the fuel consumption and the proper design of the furnace to attain a minimum consumption of the fuel are the real secrets of the success of the Glass industry. The atmospheric temperature, the direction and the intensity of the wind also I am told affect the consumption. It is not a glass blower who works at a furnace for 20 years that can construct a furnace. It requires an Engineer who has spent his life on the study of glass furnaces. One may be an exceptionally able Engineer but a furnace constructed by him may be an utter failure.

36. An example of this may be given. Messrs. Tata & Sons have engaged highly paid first-class Engineers who have previous experience of steel furnaces to construct the steel furnaces at Sakchi. But I am told that during the last six years the coal consumption in those furnaces was always as much as 2½ to 3 times the consumption in similar furnaces in America. I am told that for the first time it is only this year the consumption has come down to the figure in America. In their experiments they observed that the atmospheric temperature, direction and intensity of the wind have a good deal to do with the consumption. This shows that for a proper furnace a first class furnace expert is needed and even he needs time to study the effect of local conditions. Till he is able to adjust the furnace to suit such local conditions, the consumption is bound to be high as compared with best furnaces in Europe. Higher consumption means more money lost and to keep down such a loss to a minimum the Glass factory will have to be situated as near the Coal Mines as possible, preferably in Bengal Coal Mines.

With reference to oil fired furnaces and necessary regenerators, I am informed that the Dusseldorf factory has taken a patent for their oil furnace and I do not think it possible to get any plans and designs for such a furnace now as in England there are not such furnaces.

37. I should not forget to note down some important points which are of particular interest for us I gathered from the study of some publications on glass-making.

(1) The metal or mixture is to be fed not at the exhaust end but at the firing end where the temperature is the highest. The work holes must be as far away from the firing end as possible. This point is particularly noted for the reason that the so-called experts in Northern India failed to point out this grave defect which goes to prove that these experts may be experts in a particular branch of glass industry and that they cannot come under the all-comprehensive term "Glass Expert."

(2) The burners used in an oil fired continuous tank furnace with the capacity of daily outturn of $5\frac{1}{2}$ to 6 tons (equal to that which we hope to have) deal with 200 lb. or 22 gallons of oil per hour.

38. For the construction of a furnace unburnt fire clay blocks are to be preferred to burnt fire bricks. Those blocks are to be rubbed against each other and set in position after dipping them in a very thin paste of raw fire clay and large quantity of water. The first heating of the furnace must be done very gradually. Five to six weeks is required for such preheating. Once heated the furnaces are never allowed to cool down till the furnace breaks down and become useless for further work. It appears that in England work is carried on for only five days in a week while in Germany work is carried on even on Sundays and for this reason it is stated that England can never compete with Germany in glass trade as the cost price in England is bound to be at least 10 to 12 per cent more than that in Germany. Regularity of temperature in the furnace must be carefully attended to. Irregularity is indicated by "Cordy" Glass. Every glass bottle made in our factory will serve as an example for such "Cordiness."

39. Before closing the furnace question, a mention should be made about "Pots" about the manufacture of which I have dealt with already in my account of Talegaon factory. Mr. Elland told me that there is a special type "pot" manufactured by Morgan Crucible Company in England which appears to be superior to the Japanese pot in that the English pot can be rolled over and used when one side breaks. Mr. Elland has shown me a rough sketch for a furnace using such pots. I was not allowed to copy it and Mr. Elland told me he would send us the sketch if the Director of Industries, Madras, asks the Director of Industries, United Provinces, for the same. It is desirable to get that sketch as it may be useful when "pots" from England are available.

40. *D. Recipe.*—The mixture used by the Madras Glass Factory is made up of 100 of Sand, 33.8 of Soda and 28 Shells 3 Sodium Sulphate, 1 arsenic and $\frac{1}{2}$ manganese with equal quantity of cullet. We attempted a mixture made up of 100 Sand, 33.3 Soda, 25 Shells, 3 Sodium Sulphate, 1 Arsenic and $\frac{1}{2}$ Manganese with equal quantity of cullet. Mr. Elland tells me that he was using the following recipe for cheap bottle glass and it is well worth experimenting as already noted:—

100 Sand.	} plus $\frac{1}{2}$ cullet.
25 Sodium Sulphate (Salt cake).	
40 Calcium Carbonate.	
3 Sodium Carbonate.	
1 $\frac{1}{2}$ Charcoal.	
1/16 Manganese.	

41. *E. Experts.*—Glass industry is one that requires not one but quite an army of experts—

furnace expert who is an Engineer,
a mixture expert who is a Chemist,
a blowing expert,
a pot-making expert, and
other experts each for different varieties of glass article, for example, Bangles, Sheet Glass, Plate Glass and Cut Glass, etc.

F.O. Oertel, now Chief Engineer, Assam, in his "Notes on Glass Industry in Europe" writes that a Young Engineer is trained in the work and is engaged as the Manager of the concern.

The so-called experts that were till now brought to India are mostly workmen who worked for a long time on one variety of article in one particular branch. They are not to be blamed if the factories failed as it is uncharitable to expect such a man to be an Engineer, a Chemist, a Blower and also a Manager. It is almost impossible to find one man who is an all-round expert capable of erecting, starting and working a factory successfully. If such a man exists, it is absolutely certain he will never come to India for a pittance of Rs. 600 or even Rs. 1,000. I do not think it is possible to get such a man even for Rs. 3,000. To use Mr. Oertel's words, the "Experts" that accept to come out to India are generally "failures" at home. Those that come out to India

(especially Germans and Austrians) are heavy beer drinkers and do not care to teach the Indian apprentices the little they know. I consider the present system of recruits for special industries or branches of industries unsound. A really good man must be found, an attractive nominal salary must be offered, but he should be actually paid only a subsistence allowance till the factory begins to pay when he must be given a substantial share in the net profits after allowing a minimum percentage of interest and depreciation. The difference between his nominal salary and the allowance actually he received must be paid in shares of the company. The amount of his share in the profit must, to some extent, also depend on the number of apprentices trained. The Indians that had their training in Japan, America or England cannot be expected to be true experts. Most of them know little of everything but not even one branch perfectly. None of those seem to have cared (excepting Mr. Deb of Calcutta Pottery Works) to go again to the foreign countries to study and solve the particular difficulties they had in making a factory, in which they were engaged, a success. These experts along with other experts of other nationalities left a factory which failed to start a factory elsewhere which also failed.

42. *F. Labour Question.*—Next to the furnace problem, the labour question is the most serious one. It is difficult to induce a new apprentice to work at a furnace which is white hot. It is difficult to keep him on long enough to learn which sometimes takes as long as two to three years as in case of mouth blowing. If he learns he does not stick to the place. The Glass operative of all countries has the same tendency to strike work and move from place to place. They have the tendency to take their time easy and cheat the Manager by saying that the metal is either "Doggy" or "too thin" or "too cold" or "cordy" or some such thing. A man who knows blowing is very jealous and it is very difficult to make him teach another. At present in India there are about six Japanese blowers who are moving from factory to factory. There are some hereditary Muhammadan blowers working in Harrison street, Calcutta, who make ink pots, hanging globes, etc., from broken glass auctioned by the several Railway Companies. Each man has his own small furnace and is very much satisfied with his own lot making Rs. 20 to Rs. 30 per month. These do not care to go out and work in a factory.

43. On Glass industry in India, like other industries much money has to be sunk to train the labour with no expectations of returns. Taking the case of blowing of chimneys by mouth, I am told, at least two years of training is required for a man to learn. Glass industry does not admit of intermittent work. It has to be carried out every day in the year and every factory is bound to lose one to three lakhs in these two years depending on the scale on which the factory is started. Unpaid or low paid apprentices do not stick on for two years in these days of high price of foodstuffs, especially if the apprentices belong to a poor class that depend on their wages for their daily food. For the present the apprentices are to be drafted from middle class of men with sufficient education to realize that the Indian industrial regeneration depends on their apprenticeship and even these should be paid a stipend of Rs. 20 per month and bound over by an agreement to work for a period of not less than four years during the first two years of which period he learns to blowing and during the next two years he will be earning his pay by actual manufacture. The difference between educated apprentices and uneducated apprentices has already been shown while describing the Talegaon factory. The effect of entertaining low paid apprentices with pay ranging from Rs. 5 to Rs. 7½ can well be realized from what happened in our own factory. Such men flock in large numbers in the beginning when there is no actual work done and once the actual work begins they fly off just like a number of birds on a tree on hearing a pistol shot.

44. The number of apprentices so taken depends on the objects with which a factory is started. If the factory be one for pressed or machine blown-ware the number may be fairly large as the term of apprenticeship will be only 4 to 5 months while if the factory be one for blown-ware it is not advisable to have more than three to four apprentices to begin with. In any case the factory should be started on the smallest scale and gradually enlarged as the number of trained men increase. At the same time the proprietors or authorities must not be ambitious and pessimistic about the profits till a fairly large number of apprentices are trained.

45. There is room for a large number of Glass factories and it is of no use to attempt training apprentices in one factory for the whole of India. The Government will have to select a certain number of stipendiary apprentices of the type mentioned above and the proprietors of the factories that are now working must be induced to entertain in each factory three or four apprentices, if necessary, paying a certain grant for each factory for every apprentice trained. The factories at Talegaon and Ambala are willing to entertain such a proposition.

46. The question of labour includes not only actual blowers but also furnace attendants, pot manufacturers furnace builders and general managers. Special attention will have to be paid for the training of these men as the success of the Glass factory depends as much on these, if not more, as on the actual operatives. Young Engineers and Chemists must be selected and sent to an existing Glass factory in India to work for at least one year during which time they gain a preliminary general knowledge of Glass manufacture and also thoroughly study each a particular branch. They should then be sent to foreign

countries to specialize in one particular branch. For example, it will be great boon to India especially with reference to glass industry if half a dozen young engineers are sent out to make special study of Siemen's furnaces, oil furnaces and Muffle furnaces, etc. I do not assert that on return they will be experts in that branch. On their return opportunities should be given to them by the State to construct the furnaces (they have studied) of different sizes and actually experiment in India so as to find out the alterations necessary to suit the local conditions. The Chemists, on their return, should be engaged to collect the different samples of the raw material available in India and then they should be sent to a place like the Tata's Research Institute at Bangalore with a view to find out the actual recipes that suit the local raw material for the manufacture of a particular variety or colour of glass.

47. The question of labour, superior and inferior is one beyond private enterprise and the only way in which it can be effectively dealt with is to treat it as an imperial question.

Another point which must not be lost sight of is that the labour employed should not be of one caste or creed. Otherwise there will be strikes very often. The advanced students of technical institutions such as the Chengalvaraya Nayudhar's Institution, Mechanical Engineers from the local Engineering College and chemists from the Arts Colleges must be selected and trained for the different branches of glass industry.

48. After the outbreak of the war, the Institute of Chemistry of Great Britain and Ireland has appointed a special committee for the purpose of research in glass to help manufacture of ware which have hitherto been mainly obtained from abroad. Indian Chemists may be sent to England and made to conduct experiments under the guidance of the above Committee on Indian raw materials.

49. Answers to a major number in the list of questions prepared by me are given in Appendix D. Some are left unanswered as I could not obtain any information regarding them.

50. Now I shall attempt to give my views on the chances of Bottle Industry in Madras:

The first thing to be realized is that the attempt to manufacture soda water bottles is not new to the world, that there are factories with years of experience behind them engaged in the manufacture of these and that the factory in Madras can succeed in competition with them only if the actual cost of production is just the same as in the factories already engaged in that manufacture. It is the cost of production that determines the success of any industrial concern. The ruling market price either before the war or after the war has no bearing upon the true success. The established manufacturers will stifle any competition by lowering the prices to the rock bottom price which is the actual cost of production. In such competition, it is true that Madras has the freight from England to India as margin as far as Madras market is concerned, and in Bombay and Calcutta markets it has no margin as freight (Railway or Sea) has to be paid from Madras to Bombay and Calcutta. So it must be considered whether the demand in Madras market is enough to produce bottles at the price above indicated. It is true that the larger the production the less will be the cost of production but the actual minimum cost of production in bottle-making industry depends upon many other factors, the chief of which is the fuel question, another being the question of trained labour. The question of trained labour (superior and inferior) need not be considered as for any new industry an initial loss which is not inconsiderable cannot be helped till the labour is trained. But the question of fuel leaves no argument. Liquid fuel can never be economically substituted for coal in Madras considering their local market prices and the present experiments in that direction may be closed as hopeless. Even if the very best furnace experts are employed a bottle factory in Madras using coal as fuel can never outlive the competition from bottle-making factories at home using coal, for the price (in normal times) at Madras is Rs. 16 per ton as against Rs. 4 to Rs. 8 at home according to quality and the locality of the factory.

51. For a bottle factory in India to succeed and stand in the competition, the factory must be located where coal can be had at Rs. 4 per ton or less and such a locality can be found only in the centre of Bengal Coal Mines.

52. Moreover I hear that the use of iron slag has come into vogue for the manufacture of cheap bottles and that bottle factories are in close contiguity with iron and steel melting furnaces. This reduces the cost of production and an Indian bottle factory must be situated somewhere near Tata Iron and Steel furnaces at Sakchi.

53. It is idle to say that every industry can succeed with the cheap labour that can be had in India. The cheapness of labour is outweighed by (1) want of skill in such labour (2) want of high degree of technical knowledge (3) the higher price of chemicals in India than on the Continent. The soda water bottle industry affords a very good example for the above statement thus.

54. In England, refuse of soap factories, etc., is used as the alkali in melting glass or salt-cake is used as fire bricks specially suited to withstand the sulphur vapours can be had there. Due to want of technical knowledge and absence of other industries Sodium Carbonate has to be used in India.

55. Previous to the War, unlettered 8 oz. Soda-water bottles are delivered at Madras at 20s per gross in crates (c.i.f.c.i. and an ad valorem duty of 5 per cent. The freight from England used to be 24s. per ton by space or for 10 gross of 8 oz. bottles or 2½s. per gross. The cost of a crate for a gross is 1s., commission and interest and duty all come to 8 per cent equivalent to 2s. So the actual price of gross of 8 oz. bottles is 20s.—5½s.—14½s. = Rs. 11-6-0 per gross f.o.b. England. This is the price of the merchant and the factory price cannot be more than Rs. 10 which includes interest, depreciation, etc. I am told the actual cost of production excluding interest, depreciation and profits is about Rs. 6/8 per gross of 8 oz. soda-bottles, and that the cost of fuel, cost of raw material, labour and supervision are generally in the proportion of 1, 4, 4 and 4 in case of bottles like Soda-water bottles. I cannot vouch for these figures but considering the large outturn of these factories the figures are believable. For successfully running a Soda-water bottle industry in Madras in competition with foreign firms it should be possible to produce in Madras 8 oz. bottles at Rs. 6-8-0 plus Rs. 1-6-0 the middleman's profit at home plus Rs. 1-14-0 the freight, i.e., at Rs. 9-12-0 excluding the cost of a crate and the 14 oz. bottle at Rs. 11-8-0 per gross. The average quantity of coal consumed at home for 1 gross of 8 oz. bottles is 1/13 of a ton and for a gross of 14 oz. bottles is 1/9 of a ton. So under the best of conditions in a factory at Madras the cost of production must exceed that at home by difference in the cost of fuel, assuming other things equal. Hence there is no chance of a bottle factory at Madras to stand the competition and succeed.

56. Let us now consider the question of outturn. Mr. F. O. Oertel writes that in the bottle factories on the Continent Owen's Bottle Machines are used. The net output of each machine, after deducting the breakages during the various stages of manipulation is about 21 to 24,000 bottles per day of 24 hours equivalent to 145 to 165 gross. It appears each of these machines are attended by only two unskilled labourers. When cost of production depends on the outturn, is it wise to expect a bottle factory at Madras with a theoretically maximum output of not more than 35 to 40 per day with the existing 6 machines that require two skilled attendants each?

57. So to my mind the following is the only conclusion that can be drawn:—
(1) Madras is not suited for manufacture of cheap glass-ware where cost of fuel is the most expensive of the items in India (2) liquid fuel can never be economically substituted for coal, (3) a bottle factory at Madras is bound to fail (4) the demand in India for soda-bottles is not large enough to have a factory for soda-bottles alone, (5) a factory for bottles of all kinds (including soda bottles) can be successfully started only in the middle of coal fields, (6) that such a locality can be found only in Bengal Coal Mines and (7) for such a factory a first-class furnace expert and chemist are required to ensure success.

58. Having come to the above conclusion I shall attempt to indicate what branch of glass industry can be attempted in Madras with any chance of ultimate success.

59. A glance at the imports into India will show that the following glass-ware to the extent shown opposite each has been imported in 1913-14 and that such import has been steadily increasing every year during the last 20 years:—

	1914- Value.	Approximate per cent of total imports.
	Lakhs of rupees.	Per cent.
Bangles	About 80	43
Beads and false pearls	24	12
Sheet and plate glass	22	11½
Lampware	15	8
Bottles and phials other than soda bottles	14	7½
Table-ware	7½	4
Soda bottles	6½	3½
Miscellaneous	18½	10
	87½	

60. Of these varieties the question of bottles has already been dealt with. Sheet glass requires costly machinery and skilled labour and it is too early to attempt the manufacture of this ware in India. Plate glass (window panes) does not require machinery and admits of small impurities in raw material but its manufacture demands skilled blowers and can be taken up only after a number of skilled blowers are trained on blowing cheap lamp-

ware. The kind of cheap-ware that is in greatest demand in India need not be of perfectly white glass, as any glass with slight tint of any colour is not visible when the material is thin as in chimneys. Lamp-ware is prepared generally on pot furnaces even in Europe. The article is very fragile and hence the breakage in shipping is not inconsiderable. Also the space occupied by the articles in shipping is large and hence the freight is high. These considerations give India an advantage and this line of work may be attempted but it must be remembered that a beginning should not be made on too large a scale till a good number of blowers are trained.

61. Then bangles and beads which cover more than 50 per cent of the total imports are imported mostly from Germany and Austria. The demand for them is large and such demand can never decrease as every female in India wears bangles. The very fact that, in spite of the heavy imports, very large quantities of crude glass are still manufactured in India and that bangles made of that glass are still manufactured, is a sure indication that a large scope for the manufacture of bangles and beads exists in India.

62. An attempt was made in India by the Government of India as early as 1882. A Mr. Wilson, then Assistant Engineer was put on special duty. He visited the bead factories at Venice and brought out with him a set of tools employed at Venice for the manufacture of beads. He conducted experiments at Bhagalpur but it appears that for some reason found it impossible to develop sufficient heat in the furnace. Hence the glass was full of air bubbles and would not be cut homogeneously and the experiment had to be given up. An attempt may be made to manufacture them after getting Italian experts to manufacture them or getting one or two Indians trained in Italy in that manufacture.

63. As regards bangles, Austria is making headway because she can produce pure glass of different attractive and rich colours. I consider the attempt at Firozabad, to manufacture glass blocks for bangles, almost a failure as the glass is full of air bubbles and the colours most primitive. This failure is due to want of Chemical and Engineering experts. If it be aimed to defend India against Austrian importation of bangles, the best way is to have a whole-timed Chemist and an Engineer to take up the question and to conduct experiments till success is attained. Meanwhile the bangle-makers of the Madras Presidency must be given an opportunity to study how the Austrian type bangles are made at Firozabad. I am not afraid of the competition from Japan as their bangles are very fragile though much in demand at present due to the absence of Austrian bangles.

Mere manufacture of pure coloured glass blocks is not enough. The glass must be such that would melt in the furnaces of the bangle-makers. So experiments should be conducted with a view to improve the furnace of bangle-makers so as to give a higher temperature than at present.

64. Summing up the above, my suggestions are—

- (1) To close the present experiments in bottle-making as early as possible.
- (2) To request the Government of India to conduct a series of experiments near Coal Mines in Bengal on several types of furnaces with different varieties of coal obtainable in India with a view to start an up-to-date bottle-making factory with Owen's bottle-making machines and at the same time to study how far the slag from Iron and Steel furnaces can be economically used for the manufacture of cheap bottles including soda-water bottles.
- (3) To attempt in Madras the manufacture of cheap lamp-ware on a small scale confining such manufacture to one or two varieties of chimneys preferably hurricane lamp chimneys and municipal chimneys.
- (4) To conduct experiments, engaging a full-timed chemist, with a view to manufacture glass of different rich colours.
- (5) To conduct experiments with a view to improve the furnaces used by local bangle-makers.
- (6) To induce local bangle-makers to use better glass and learn to manufacture better varieties of bangles than they are at present manufacturing.

For purposes mentioned from 3 to 5 I suggest a direct fired closed pot furnace with 5 pots of 400 lb. each. Two of the pots may be used for the manufacture of chimneys from Ennur White Sand, the remaining three pots being used for the manufacture of different

coloured glass blocks. For the manufacture of chimneys one who has sufficient experience in blowing will have to be employed. A batch of blowers consists of one head blower and seven assistants. For the present six or seven apprentices may be entertained as assistants and in course of time these have to be trained as blowers by the head blower. For the experiments in coloured glass a chemist has to be employed. If desired, side by side with the above, an attempt may be made to manufacture Japanese Silky bangles as there is one trained in such manufacture available at present. Simultaneously a bangle-maker's furnace has to be built (1) to see if the coloured glass manufactured melts in that furnace and if not (2) to see if any improvements have to be or can be made in these furnaces.

As we have a chimney and also buildings I expect the cost of the above two furnaces not to exceed Rs. 2,000 including an oven for the preheating of pots. Before starting work the supply of pots will have to be ensured for the next six months, i.e., 30 to 35 pots must be held in stock.

The intermittent annealing ovens existing in our factory may be utilized for annealing. Another Rs. 1,000 may be required for carborandum cutters and grinding wheels and chimney moulds.

The establishment required will be—

- 1 Chemist.
- 1 Engineer.
- 1 Blowing Expert.
- 1 Blower with seven apprentices.
- 1 Chief Bangle-maker and four apprentices.
- 2 Furnace attendants.
- 2 Assistants to above.
- 1 Engine Driver.
- 1 Clerk.
- 15 to 20 daily coolies for mixing, grinding, cutting, etc.

The success of this undertaking depends on the zeal evinced by the people and apprentices employed. If they work well, it might be necessary in course of time after the apprentices are trained in blowing, to have two separate furnaces one for chimney-making and the other for manufacture of high grade coloured glass blocks. The demand in Madras Presidency can easily maintain at least 2 chimney-making factories and two glass block-making factories.

65. From what I gathered from the factories visited I expect that with one furnace as suggested above the daily consumption of coal will not exceed $1\frac{1}{2}$ tons and it is possible to melt about 10 cwts. of glass every day and with a first class blower it is just possible that cost of the glass blocks manufactured and chimneys blown will be equal to the daily expenditure.

(ii)
Note on Glass Making by Mr. W. A. Beardsell, Madras.

I am Managing Director of W. A. Beardsell & Co., Limited, a company registered in 1914 to acquire and carry on the business of W. A. Beardsell & Co., General Merchants, Madras. I have no technical knowledge of glass-making.

Prior to 1909 Mr. Scholl, then German Consul at Madras, and Mr. Ramsay Unger merchant of Madras, entertained the idea of glass making and conducted experiments the result of which encouraged them to promote the Madras Glass Works Limited, which company was incorporated in March 1909, the capital raised (subscribed for privately by friends of the promoters) amounting to Rs. 77,200.

A German named Meier was made technical adviser, his factory plans adopted and an intermittent gas fired tank was erected under his personal direction. Four German glass blowers were brought out to start work and to train Indian labour.

Glass bottles and tiles were made in January 1910, by which time the financial resources of the company were exhausted and it had been realized by the Directors that there was no prospect of ever arriving at a profitable factory outturn if the method that had been adopted of blowing bottles by mouth was continued. The work was too laborious and too slow.

The Directors had also learned that the weight of fuel consumed per ton of glass made was much greater in case of an intermittent furnace such as they had than in a continuous furnace.

The quality of glass manufactured seemed to justify the belief that by installing more efficient plant a successful industry would be established and on the strength of such representations Rs. 1,00,000 additional capital was raised.

At this stage my firm consented to take up the duties of Managing Agents and I was informed by Mr. Scholl that the additional capital would be sufficient to cover cost of new plant and that Government had sanctioned a free grant of 10,000 tons firewood. This was on the eve of my leaving for England on business unconnected with the Glass Works. Whilst in England I visited the Glass Works of Messrs. Forster & Sons, St. Helens and discussed as fully as possible glass making with special reference to putting the Madras Glass Works on a profit earning basis, Messrs. Forster & Sons being not only glass manufacturers but also makers and sellers of plant.

Finding the capital available was insufficient to adopt all of Messrs. Forsters recommendations which included the erection of a continuous furnace, the Directors decided to import 6 of Forsters compressed air bottle making machines and an improved annealing lehr. It was arranged with Forsters that two competent men should come out, one an engineer to superintend erection and to get the plant going, the other an expert bottle maker to instruct workers.

The new plant was working from June 1911 and, in September 1911, 26,000 sound bottles were taken out of the annealing lehr as the month's outturn. The number of bottles actually put in the lehr that month was 44,000, the large percentage of breakages being due, according to the St. Helens expert, to the arch over the furnace having been partially rebuilt of unsuitable bricks obtained from Calcutta. These bricks melted and bits got in the glass the result being that when bottles with bits of brick in them were annealed in the lehr the contraction of glass was different from that of the brick causing the bottles to fly.

The position of the company at the end of 1911 is indicated by a notice to shareholders dated December 14th.

"At a meeting of Directors held on 28th ultimo it was decided to stop work at the factory at the end of November and to curtail all expenses.

"Disappointing as this may appear the Directors can assure shareholders that considerable progress has been made towards establishing a profitable industry. Bottles have been made in quantity and have found a ready sale, many difficulties have been overcome and the results attained justify further outlay. "Since automatic machines were installed the monthly outturn of bottles has risen from 10,000 to 26,171. To obtain higher figures more money is required to carry on work as the company has reached the end of its resources.

"A meeting of shareholders will be summoned on an early date to consider a scheme for providing a continuous furnace in place of the present one in order to work 24 hours during the 24 hours. This scheme can only be carried out if the shareholders provide funds and the alternative will involve liquidation of the company and loss of all money subscribed.

On January 22nd 1912, I wrote to Sir Murray Hammick, K.C.S.I., C.I.E., then Member of Council asking for an interview and in my letter gave the following facts:—

"On formation of the company Rs. 77,200 was the capital subscribed, in February 1910 a further amount of Rs. 1,00,000 was subscribed, and Rs. 1,14,130 has been expended on machinery, tools and buildings. The monthly outturn of saleable bottles from July 1910 averaged for four months 10,000 and as with the labour available there appeared no probability of materially improving on these figures it was decided to purchase the best type of automatic machines in which compressed air superseded blowing by mouth.

"A monthly outturn of 26,000 bottles was reached with these machines, and in arriving at this result the company has exhausted all its capital.

"What has been proved is that saleable bottles can be manufactured locally and it would seem certain that with further expenditure on a continuous furnace an outturn would be reached that would show a profit on working.

"With the present furnace it is possible only to work 8 hours out of 24 whilst in a continuous furnace the level of molten metal remains constant and work may be continued by working 2 or 3 shifts the whole 24 hours.

"I will not go into further details in this letter, but merely say that there is no possibility of shareholders finding the necessary further capital and in order to establish an important industry I wish to consult you as to whether Government might at this stage step in, take over the factory, build a continuous furnace, carry on work and hand back as a going concern to the company when the industry has been established."

An interview took place at which I explained the position fully. I was informed that Government could not intervene as such action would be opposed to the policy advocated by the Secretary of State.

The company some time later went into voluntary liquidation, as additional capital was not forthcoming.

Such in brief is the history of the Madras Glass Works.

I am of opinion that, at the outset during the preliminary experimental stage, too much importance was attached by the promoters to the fact that good glass could be actually made in Madras and largely from local materials whilst too little consideration was directed to local economic conditions such as:—

- (a) Cost at Factory of raw materials and fuel.
- (b) Efficiency of labour.
- (c) Market for factory outturn.

Imported bottles incur freight from Europe to India and are subject to import duty but such items are not in themselves sufficient to off set adverse conditions inseparably connected with the introduction of a new industry.

I will now refer to matters connected with the history of the Glass Works which would seem to be relevant and to come within the scope of the Commission's enquiry.

1. A mistake was undoubtedly made in not at the outset installing a continuous furnace. Whilst with a full tank our workers could readily take out molten glass on the end of a carrying pipe held almost horizontally extraction became increasingly difficult as the day went on owing to the level of metal getting lower and lower, necessitating the sloping of the pipe at such an angle that an undue length was exposed to the fierce heat of the furnace and the workers hands were burned.

2. I was informed by the workmen sent out by Messrs. Forster & Sons that the furnace bricks suffered from the effect of the fierce gases in a way that would not have happened had the level of metal in the tank remained constant. Bits of brick became disintegrated and falling into the molten mixture caused breakages during annealing due to the unequal contraction of glass and brick.

This trouble was made greater in that fire bricks obtained from Calcutta had on one occasion been used in repairs to the furnace arch.

3. Experience showed that blowing bottles by mouth is too laborious in India and certainly less efficient under Indian conditions than blowing by compressed air machines.

4. The capital raised was insufficient to set up a continuous tank and to carry on work long enough to prove what could be done with a factory working under conditions best adapted to local labour.

I am of opinion that Government help in January 1912 would definitely have settled the question of the cost of manufacturing glass in India under favourable factory conditions but I am more doubtful whether a successful industry would have been established. Certainly the outturn of soda water bottles from six machines worked under European conditions would far exceed the number of bottles imported into Madras.

Messrs. Forster expressed the opinion that economy in fuel could not be attained with a less plant than one in which eight bottle making machines is employed the outturn of which in England is 200,000 wine or beer bottles per month. (The average number of soda water bottles imported into Madras monthly over the last four years is 52,968.)

I advocated concentrating work during the comparatively short period the factory was running on soda water bottles as being the one article most saleable and because I considered it would be detrimental to outturn to do other than specialize for some time.

It must not be implied from this that pressed tiles and other glass articles might not later be made in the factory.

In conclusion I may say that the Government concession of fuel referred to related to wood growing in the forest in the Cuddapah district and the cost of this fuel to the company when delivered at the factory was practically normal. Inasmuch as the chief item of cost in glass production is fuel, I am inclined to think a factory located in Bengal might be worked better than at Madras moreover a larger market would be at its doors.

In approval

SK
9/4/17

Prin

Please file

11/11/17

NOTES CONNECTED WITH G.O. NO. 322, HOME (EDUCATION),
DATED THE 8TH MARCH 1917

[SUBJECT.—Glass experiment.]

From the Officer in charge of the Department of Industries, No. 52, dated the
18th January 1917.

In G.O. No. 1192, dated the 15th November 1916, the Government deputed M.R. Ry. J. Narayanamurti, Sub-Engineer in the Department of Industries, to visit glass factories in other provinces and to study the methods of working followed there. Mr. Narayanamurti visited almost all the important glass factories in India. He has submitted an elaborate report on the working of those factories and has also examined the question how far a glass factory in Madras can succeed. He concludes that the experiments in bottle making now carried on by the Department of Industries in Madras should be brought to a close. Mr. Innes agrees with him and recommends that this course should be adopted. It is pointed out that the furnace in the factory is defective, that fuel is too costly in Madras and that there are no experts to look after the experiment. Mr. Innes states that Mr. Elland, the glass expert in the United Provinces, could probably advise in regard to mixtures and methods of testing them; but the crucial point is stated to be the furnace and Mr. Elland could not help in this nor in the training of blowers. In these circumstances it is for orders whether the proposal to close the experiment may be approved.

2. Mr. Narayanamurti has made certain suggestions for the improvement of the bangle-making industry. Mr. Innes states that he has not yet considered these and that if he decides to move in the matter he will make a separate reference to Government. Apparently the machinery in the glass factory will be useful for experiments in bangle-making. The question of its disposal need not therefore be considered now.

S.K.—31-1-17.

N.K.—3-2-17.

It is disappointing to have to admit that a large experiment of this kind is a failure; of course an experiment is not wholly a failure that proves anything; and this experiment in spite of the blemishes and inaccurate calculations that have marred it from the scientific point of view has been sufficiently successful to prove that a glass-making industry cannot be a commercial success in Madras.

2. Mr. Innes points out that, with a glass expert to advise on the mixture and a glass Engineer to build a furnace, excellent glass could be turned out in Madras which might pay during the war. The cost however of re-inaugurating the experiment on these lines will be very considerable and Mr. Innes shows pretty conclusively that the industry can never pay in Madras in the long run. The greater part of the raw material is here but the absence of cheap fuel renders the whole project futile. It may be noted in passing that as a matter of fact cullet only has been used lately and that the evolution of a satisfactory mixture has been given up as a bad job. This failure is not surprising. One must pay for one's knowledge in matters like these in two ways—

(a) by hiring an expert who combines in himself stores of experience gained by others;

(b) by gaining that experience oneself.

The department chose the latter.

Messrs. Beardsell Short and Company chose the former; and if the department has started where they had left off as it once had the opportunity of doing, the factory might have been working at a very considerable profit in these war times; as an experiment however it would merely have proved, though in a much shorter time, the same result as Mr. Innes claims to have proved how, namely, that in Madras glass manufacture in normal conditions will not pay. The department has worked well in very unfavourable circumstances at this experiment and has gained most useful experience, the chief of which is that problems of this sort cannot be attacked successfully, no matter how enthusiastic and industrious the staff, without expert guidance.

3. Mr. Innes' argument as to fuel seems to be conclusive and fundamental to the whole problem. The alternatives now before the Government are —

(a) to engage an expert chemist (Mr. Elland is apparently not qualified to advise on the mixture, as clearly one cannot continue to use cullet only and the one advantage Madras has is in the proximity of suitable sand lime; and at the same time to reconstruct the furnace at great cost under the guidance of an expert engineer (Mr. Deb has been mentioned in connection with ovens) and

(b) to close down and quit the experiment. All the facts of the case point to the latter as the best course.

Questions will doubtless be asked but Mr. Innes points out that the closing down may be attributed to the rise in the cost of fuel.

4. It has been suggested that the indigenous glass industry, viz., the manufacture of bangles might be encouraged; it is understood that Mr. Innes is having a survey of this industry made and will report later.

5. Mr. Narayanamurti has fully justified his deputation and in spite of meeting a closed door in certain quarters has been able to compile a very detailed and interesting report, though much of it is necessarily unintelligible to the layman. We may agree with Mr. Narayanamurti that Bengal is the most suitable place for this industry and the Government of India the most suitable authority to direct (and finance) experiments.

6. In the interests of economy Mr. Innes has actually closed down the factory already as he found that the expense of continuing the experiment was compensated for neither by the experience gained nor by the output of bottles.

For orders.

E. A. HARVEY—16-2-17.

If I recollect aright, Sir Frederick Nicholson has from the first condemned this experiment. On the other hand, Sir Francis Spring, in private conversation with me, while criticising adversely glass bottle making, has advocated the experiment of making cheap coarse window glass which would serve the purpose merely of admitting light to huts and houses which have at present no windows, and no light except from the door-way; and other very cheap glass. Whether such manufacture would pay at all or would pay sufficiently to modify the essential difficulties would require further examination.

In the meantime, the temporary closing down of the factory on the grounds may be approved. And as at present advised I see no reason to differ from Mr. Innes' conclusions as to the future.

But as this is the second experiment which has been made, it would be well to examine the position carefully so as to make the present decision as informing and authoritative as possible.

For this purpose the matter should, I think, be laid before a small committee under the chairmanship of Mr. Innes, upon which the following may be invited to serve:—

2. Mr. Beardsell
3. Sir Frederick Nicholson.
4. Sir Francis Spring.
5. Sir Clement Simpson.
6. Mr. Couchman.
7. Mr. Suryanarayanamurti Nayudu (Cocanada).

The papers should first be circulated to them, and the first meeting of committee might conveniently be held during the week of the Legislative Council meeting beginning about 13th March. It might be suggested to Sir Frederick Nicholson that, if such attendance at this first meeting would be inconvenient, his observations by letter upon these present papers would be valued.

P[ENTLAND].—19-2-17.

It is presumed that before appointing the committee the non-official members should be consulted as to their willingness to serve on it. A draft demi-official is submitted for approval.

2. The following seem to be the relevant papers on the subject:—

Pages 3 to 8 of G.O. 962, 12th September 1916. (1) Note on the glass experiments, dated 26th July 1916, by the Hon'ble Mr. Couchman.

Pages 1 to 8 of G.O. 1148, 2nd November 1916. (2) Letter from the Hon'ble Mr. Couchman No. E. 8, dated the 22nd September 1916.

Pages 27, to 29 of Government Order ibid. (3) Note on glass experiments, dated the 29th November 1916, by Mr. C. A. Innes.

(4) Letter from Mr. C. A. Innes, No. 52, dated the 18th January 1917, with enclosures (report of M.R.Ry. J. Narayanamurti, and note by Mr. W. A. Beardsell).

Yes, print. E.A.H.—23-2-17. It is for orders whether these papers may be printed and forwarded to the members of the committee along with the demi-official or whether they may be sent after they have expressed their willingness to serve on the committee.

Afterwards. E.A.H.—23-2-17.

If the latter course should be adopted, the last sentence of paragraph 1 of the draft may be omitted except in the copy addressed to Sir F. Nicholson. Copies of the papers may, however, be sent to Sir Frederick Nicholson in the first instance with the demi-official.

3. After issue of the demi-official the file may be sent to Mr. Innes u.o. for perusal.

S.K.—23-2-17.

N.K.—23-2-17.

I think it better that Mr. Innes should see these papers at once, and offer remarks if he wishes to do so. I am rather of the opinion that Mr. Innes who is in fairly close touch with some of the gentlemen named could more conveniently secure the consent of the proposed members of the committee to serve on it, and should be very much obliged if he would do so, if he sees no objection.

E. A. HARVEY—23-2-17.

OFFICE OF DIRECTOR OF INDUSTRIES.

I have written to the gentlemen named, and will report the result.

2. I think the terms of reference to the committee might be rather wider than is at present proposed. Sir Frederick is very anxious that something should be done to resuscitate the bangle industry, and a "Japan-returned" Indian has asked me to assist him in a lampware industry. The committee might be asked to advise whether the experiments in making sodawater bottles should be continued, if not, whether experiments should be made with other forms of glassware.

9
Note 322, Edn.

4

3. The papers may be printed up urgently. In printing, I should like the sentence bracketed in paragraph 15 of my report omitted. Some members of the committee hold strong views on the question whether full details even of a failure should be published, and the sentence referred to was not intended for publication.

C. A. INNES—26-2-17.

HOME (EDUCATION) DEPARTMENT.

Submitted for orders whether the papers referred to in paragraph 2 of office-note on page 3 supra may be printed at once with the omission of the portion indicated by Mr. Innes. After the papers are printed a draft order will be submitted embodying the suggestions made by Mr. Innes in paragraph 2 of his note above.

S.K.—27-2-17.

N.K.—27-2-17.

Yes.

E. A. HARVEY—27-2-17.

(1)

Demi-official—from C. A. INNES, Esq., I.C.S., Director of Industries.

To—E. A. HARVEY, Esq., I.C.S., Acting Secretary to Government, Home (Education) Department.

Dated—the 1st March 1917.

No.—G. Cur. 52.

In continuation of my un-official note of the 26th February, I write to say that Sir Clement Simpson suggests that a chemist should be added to the glass committee. I mentioned this to His Excellency this morning and under his instructions have written to Dr. Simonson asking him to serve.

(2)

Demi-official—from C. A. INNES, Esq., I.C.S., Director of Industries.

To—E. A. HARVEY, Esq., I.C.S., Acting Secretary to Government, Home (Education) Department.

Dated—the 3rd March 1917.

No.—G. Cur. 52.

9
In continuation of my demi-official G. Cur. 52, dated 1st March, I have to inform you that all the gentlemen except Sir Frederick Nicholson also. I have just had his letter. Nicholson have replied expressing their willingness to serve in the committee.

2. Orders might now issue, I think constituting the committee.

3. Will you distribute the printed papers or shall I? I will proceed to arrange details as to the date and time of meeting without awaiting formal orders.

HOME (EDUCATION) DEPARTMENT.

The papers mentioned in paragraph 2 of office-note on page 3 supra have been printed and a proof copy obtained from the Press is submitted. It may

E.A.H.—6-3-17.

I think this must be done.

E.A.H.—6-3-17.

9
Tell Mr. Innes so when the proofs go to him.

E.A.H.—6-3-17.

which will be communicated to the members.

2. A draft order appointing the committee is submitted for approval.

S.K.—5-3-17.

N.K.—6-3-17.

Draft Government Order for approval.

E.A.H.—6-3-17.

P. R. [AJAGOPALA ACHARIYAR]—6-3-17.

A draft demi-official to Mr. Innes is submitted.

S.K.—6-3-17.

N.K.—6-3-17.

E.A.H.—6-3-17.

Note 322, LBN.

5

(1)

Demi-official—from E. A. HARVEY, Esq., I.C.S., Acting Secretary to Government,
Home (Education) Department.
To—C. A. INNES, Esq., I.C.S., Director of Industries.
Dated—the 7th March 1917.
No.—279-2.

Will you kindly glance through the accompanying proof of the collection of papers relating to glass experiments and return it after making such additions and alterations as you may think necessary? The collection will be printed as an annexure to the order appointing the glass committee and communicated to the members direct from this office.

(2)

Demi-official—from C. A. INNES, Esq., I.C.S., Director of Industries.
To—E. A. HARVEY, Esq., I.C.S., Acting Secretary to Government, Home
(Education) Department.
Dated—the 8th March 1917.
No.—G. Cur. 52.

The collection of papers sent with your *Demi-official* No. 279-2 of the 7th is herewith returned.

I think the selection is all right and I have suggested the deletion of one passage on page 3.

Please have the passage deleted and the papers printed up and the orders issued as soon as possible.

E. A. HARVEY—8-3-17.

[G.O. No. 322, Home (Education), dated 8th March 1917].

Achuthanathan

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