

Department of Agriculture, Bombay.

BULLETIN No

POONA FURNACE

(In the Sátára District)

BY

P. C. PÁTIL, L.Ag.,

Divisional Inspector of Agriculture, C. D.



BOMBAY

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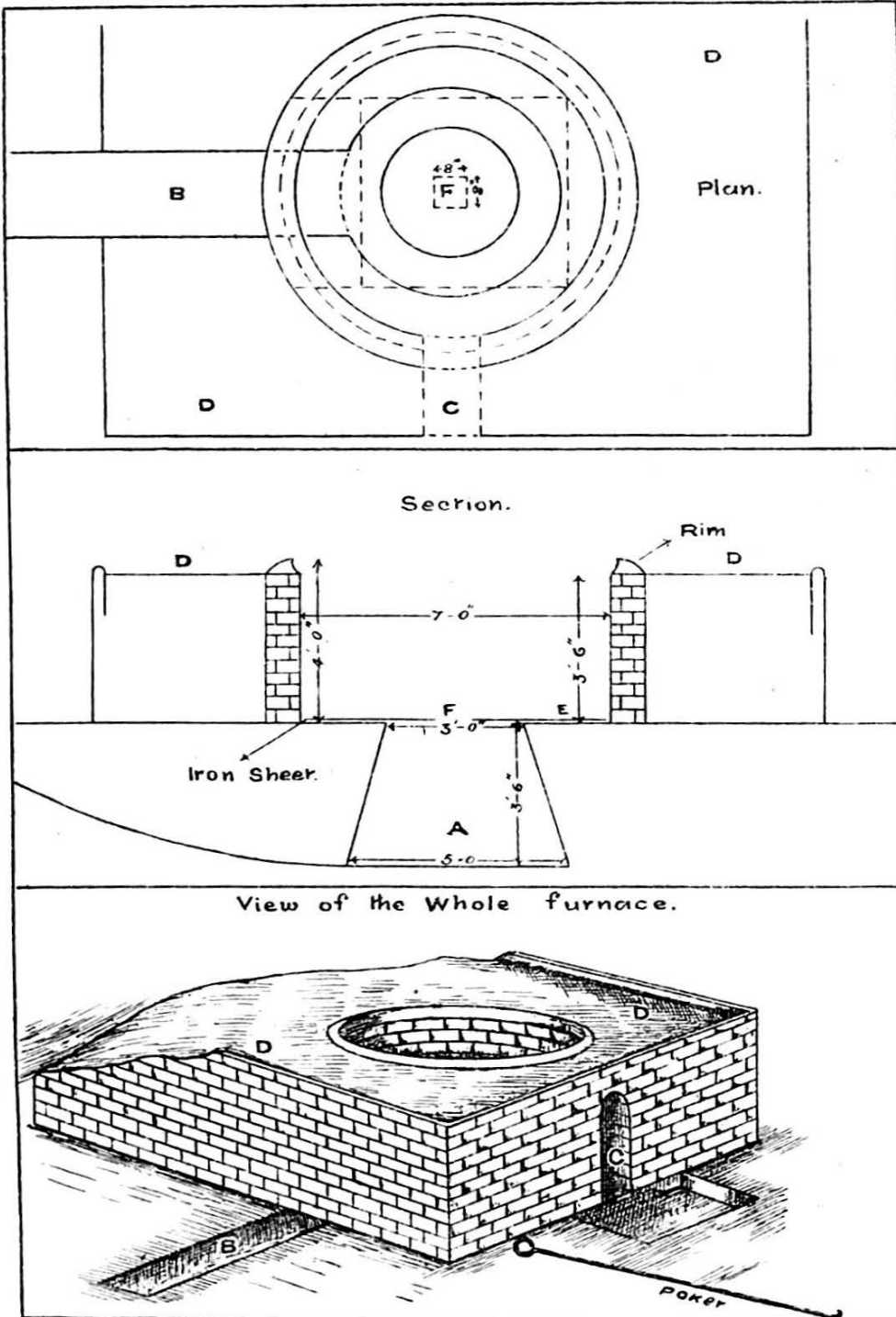
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Poona Furnace.

Fig. I

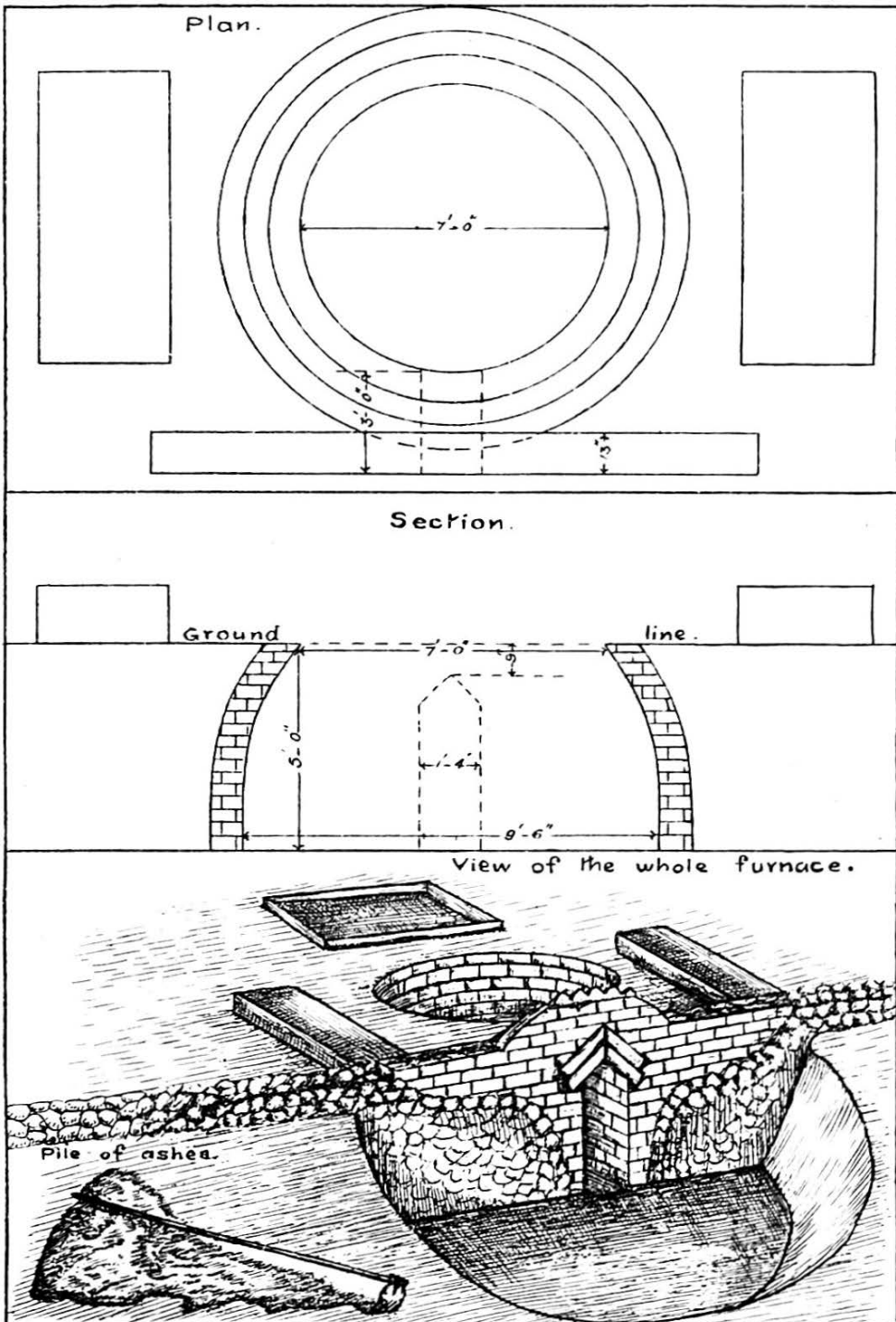


K. R. TUAK.

Scale $\frac{1}{4}'' = 1$ foot.

Sarara Furnace.

Fig. II



K.R.TILAK.

Scale $\frac{1}{4}'' = 1$ foot.

GENERAL REMARKS.

This Bulletin does not profess to explain the most scientific or up-to-date method of evaporating sugarcane juice. It is designed only to show a simple and very economical change which may easily be introduced by cultivators in many parts of the Bombay Presidency, and which involves very little alteration in the present organisation. The facts here mentioned relate to the Sátára District ; but the argument applies with equal or even with greater force to most parts of the Southern Marátha Country, and to many other parts of the Deccan, such as Násik District, where the method of *gul*-making, in general, and the furnace used, in particular, are the reverse of economical, and might be greatly improved with little effort or outlay. For the information of cultivators and benefit of others who may wish to demonstrate the advantages of the Poona furnace, the following resumé may be useful :—

In 1908-09 when the work was first taken up, only a couple of days were spent at each place in order to show the balance of fuel which we had saved by our methods. This time, however, was found to be insufficient ; and we decided to adjust the comparative tests so as to show the saving of fuel per acre of cane boiled, expressed in its money value. This plan was found to work and during the season of 1909-10 this plan was followed. Last year (1910-11) the superiority of Poona furnace was generally recognised in almost all quarters of the Deccan and Southern Marátha Country.

Extracts of opinions of the owners of the cane dealt with, are given in the appendices.

POONA FURNACE.

In southern Sâtára the method of boiling juice for making *gul* is wasteful of fuel. The sugarcane grower is in the habit of spending from Rs. 20 to Rs. 30 for fuel in addition to sugarcane leaves and the crushed cane refuse or megass, while in Poona District the leaves and megass are all that is required for boiling down juice. The reason of this extraordinary consumption of fuel in Sâtára District is the defective construction of the furnace there (fig. 2). The Sâtára furnace consists of a deep capacious hole about 7 feet in diameter at the top and 9 feet 5 inches at the bottom and 5 feet in depth, with a feeding door on one side. Unlike the improved furnaces in any industry, whether it may be the smelting of iron in a factory or the boiling of water to steam in a steam engine, the Sâtára furnace has no special passage for admitting air, so necessary for combustion or for removing the ashes. The feeding hole is the only passage for the entrance and the exit of the air and for removing the ashes. For want of a regular supply of fresh air, the heat and fire are never steady; for the cold air from outside enters and the hot air and flames from inside issue indiscriminately. The fuel is never completely burnt and the charred material collects to an excessive extent in the furnace.* As a consequence there is an enormous waste of fuel. The work of feeding the furnace also is very difficult, since flames are liable to issue suddenly from the feeding hole.

The Poona furnace is built on scientific principles, though of a primitive type. It has got two separate passages—one for the fresh air to come in and the other for the spent gases to go out (fig. 1).

Usually it is about 7 feet in diameter and $3\frac{1}{2}$ feet deep. The walls are perpendicular. It has got a cellar-like ash pit (A) connected by an air passage (B) which opens outside the mouth of the pit, and is covered over by an iron sheet (E) $3\frac{1}{2} \times 3\frac{1}{2}$ feet with a 7 or 8 inch hole in the centre (F). Crossed iron bars are placed over this hole to prevent fuel from falling into the pit (see plan in the diagram). By this arrangement a regular supply of fresh air is received through the air passage which is necessary for combustion. The hole in the sheet allows ashes to drop in the pit; so the furnace is never clogged. Exhausted air

* In fact this charred mass becomes a regular nuisance to the furnace feeders and others, inasmuch as the feeders have to take out and remove the hot charred mass once or twice every day. It is a troublesome work to take out this hot mass, and large quantities of water have to be put on it before and while taking it out. As a rule the *Adohari* sometimes called *Adada* supplies this water.

goes out through the feeding hole.(C) The fire is always steady and the feeder can do his work without much difficulty.

In building* such a furnace a hole about 3 feet deep, 3 feet wide at the top and 5 feet at the bottom (A, in section) is dug for the ash pit. This is connected with a trench (B) $1\frac{1}{2}$ feet wide, opening out on one side of the furnace. Over this pit the regular walls of the furnace are built and the soil excavated from the pit and from the ground in front of the feeding mouth (C), as seen in the picture, is used to make the platform (D) which contains the real furnace. In fact this real furnace is above the level of the ground leaving the ash pit below, as will be clear from the diagram (fig. 1).

The feeding hole of such a furnace should not be windwards but in the opposite direction of it, while the passage for admitting air should be at right angles to the usual direction of wind.

The feeding, though it requires skill, is not so troublesome as in the case of the Sâtára furnace. The latter must be fed with large doses of fuel since it is a large and a high furnace. The Poona furnace does not require this mass of fuel, but has to be fed by small handfuls, thrown in regularly to keep the fire uniform. When ashes collect on the iron sheet and clog the air holes these should be drawn into the pit with a long iron poker. This feeding, though easy, requires care and attention; and in new tracts, where this furnace is introduced, care must be taken to instruct the feeders. Near Poona itself, feeding is considered to be a skilled labour. If left in the hands of untrained feeders the furnace will not give as good results; and it must be clearly recognised that the Poona method of feeding is an essential factor of success in using the Poona furnace.

Under existing methods the practices in Poona District and in Sâtára District respectively may be compared as follows. The evaporating pan used in Poona contains 1,150 to 1,250 lbs. of juice; that used in Sâtára contains 1,300 to 1,500 lbs. of juice.

* Generally *kacha* bricks are used for constructing the furnace and the platform. The cost of putting this works as follows:—

				Rs.	a.	p.
600 brix	...	...	...	1	13	0
2 masons	...	...	...	1	8	0
6 coolies	...	...	...	1	14	0
Iron sheet and cross	...	...	...	2	4	0
				7	7	0

Sâtára furnace has not got any platform and does not require an iron sheet and a cross; so it requires only Rs. 5 or so.

The relative efficiency is shown in the table below :—

Type of furnace and pan used.	Quantity of juice boiled in the pan, (Average of 6 places.)	Quantity of fuel (megass) required to boil it.
	Lbs.	Lbs.
I Sâtára pan on the Sâtára furnace ...	1,353	656 *
II The Poona pan on the Poona furnace ...	1,150	373

Reducing the quantity of juice in each case to a uniform standard of 36,000 lbs. (which will be required to make 6,000 lbs. of gul which is about the average outturn in Sâtára per acre) the consumption of fuel is shown below :—

I Sâtára pan on Sâtára furnace ...	17,455 lbs. megass.
II Poona pan on Poona furnace ...	11,677 " "

From this the superior efficiency of the Poona furnace is obvious as regards the saving of fuel.* This saving of 5,778 lbs. of megass-fuel means a net saving of Rs. 19-13-1.

Question of time.—The question of time is important and requires consideration.

In each case one furnace and one crushing mill work together. The two operations of crushing and boiling are interdependent as regards time. If the juice is boiled and the pan taken off the furnace, before sufficient juice for a second boiling is ready, the bullocks are driven fast to obtain the necessary quantity; while if the quantity of juice be obtained before the previous pan is boiled the furnace feeder feeds the fuel faster in order to boil it sooner. In short, the crushing staff and the boiling staff have to keep pace with each other.

In Sâtára District the sugarcane growers crush and boil generally 5 to 6 boilings (*ádans*) a day. In each *ádan* they get from 1,200 to 1,500 lbs. of juice. In Poona they boil 4 pans each containing from 1,050 to 1,250 lbs. of juice.

It might be thought from this that the Sâtára people save in time what they lose in fuel; but this is not so; since they have a larger staff of bullocks and men and give them specially higher wages†

* The saving is calculated upon the average outturn in Sâtára District which is about 40 per cent. below the Poona average. The cost of fuel per pan (or 656 lbs. of fuel) varies from Rs. 1-8-0 to Rs. 3-0-0, and often more.

† *Vide* Appendix A (a).

and further they give the rollers of the mills a loose adjustment, and drive the bullocks very fast, so as to extract the juice the quicker. This however results in rather a poor extraction of juice *; and it may be confidently stated that the Poona system is the more efficient, both as regards the construction of the furnace and as regards the organisation of the operation.

When the work of introducing the Poona furnace into the Sâtára District was taken up first, the Sâtára people objected to the slow rate of progress in boiling. This was overcome by increasing the size of the pans and furnaces used; and as soon as the Poona men became accustomed to the Sâtára conditions they showed that they could work as fast as the Sâtára people. Inasmuch, however, as fast boiling involves fast crushing, and fast crushing means loss of juice, the Poona organisation is to be regarded as the more profitable.

With the object of finishing the crushing early some cultivators may prefer to crush more cane and turn out more *gul* without minding the quality of the work. They can do so and at the same time economise fuel if they maintain their original organisation, and only replace their old furnaces with the Poona furnaces. At Chikurde, in this way, Mr. Vinayakrao Kulkarni boiled 8 *ádans* a day (of 228 lbs. *gul* each) for several days, taking only about 2 hours for each pan. At Retre Mr. Pándurang Anandrao Mohite boiled 6 *ádans* (of 279 lbs. *gul* each) for several weeks taking about 3 hours for each pan. Similarly, at Mangale Mr. Divan boiled 7 *ádans* for several weeks. These gentlemen have increased the dimensions of their pans and consequently of the furnaces for treating such large doses of juice.

The question of time, which, in the beginning seemed hard, has now been solved without affecting the saving of fuel, which is the principal thing aimed at in the southern Sâtára.

The furnace is being demonstrated for the last three years with very good results and the following tables will show the relative results actually obtained by the two systems in the Sâtára District during the past season (1910-11).

The quantities of juice in the table are not uniform. However, for easy comparison of fuel consumption, the quantities of juice

* Vide Appendix A (6).

treated are reduced to a uniform standard of 36,000 lbs. (*i. e.*, say 6,000 lbs. of *gul*) at the bottom of the table.

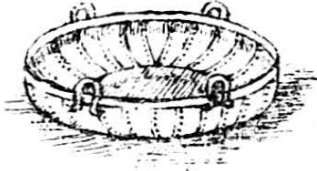
Poona Furnace.			Sátára Furnace.		
Serial No. trial.	Quantity of juice boiled.	Megass fuel required to make <i>gul</i> .	Serial No. trial.	Quantity of juice boiled.	Megass fuel required to make <i>gul</i> .
	Lbs.	Lbs.		Lbs.	Lbs.
1	1,334	598	1	1,400	615
2	1,334	660	2	1,360	694
3	1,334	589	3	1,339	664
4	1,304	472	4	1,339	700
5	1,365	567	5	1,339	575
6	1,342	531	6	1,399	689
7	1,363	385			
8	1,560	528			
9	1,260	465			
10	1,260	490			
11	1,309	519			
Reducing to a uniform standard.					
	36,000	14,151		36,000	17,335

The average consumption of fuel for the year 1910-11 per 36,000 lbs. of juice therefore works to 14,151 lbs. for the Poona and 17,335 lbs. for the Sátára furnaces. The Poona furnace thus shows a saving of 3,184 lbs. of fuel or Rs. 10-14-8 per acre.

If we consider the question from the point of view of the fuel saved, the facts are these: the two kinds of the fuel used in the Sátára District to supplement the megass and the trash for boiling down the juice are *shevari* (*Sesbania Egyptica*) and *tág* or sun-hemp (*Crotalaria Juncia*). Both are grown for the purpose of fuel for *gul*-making. If they are saved by the use of a more economical furnace, as has been shown to be possible, they will form a useful addition to the cultivators' means. The *shevari* can be used as household fuel, thus setting free, for manurial purposes, the cow-dung now used as fuel; and *tág* can be used either as green manure or for fibre extraction, which yields a good profit.

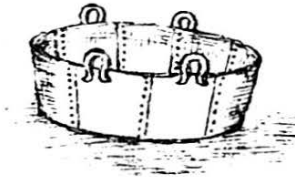
PANS FOR POONA FURNACE.

It will be desirable to give some idea of the shapes and sizes of the pans used in the Poona and the Sâtâra Districts.

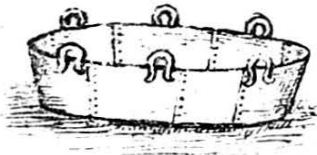
Poona Pan.

are .0526 inch in thickness with a bed plate .0926 inch. The pan weighs about 340 lbs. and costs Rs. 30 to Rs. 35.

It is made of thick iron sheets cut and rivetted to form a shallow vessel with a nearly flat bottom which is bent towards its periphery to form the sides. It has got 4 ring-handles. In Poona District it is built to boil 1,050 to 1,250 lbs. of juice and is 7 feet in diameter and 10 inches deep at the centre. The sheets used

Sâtâra Pan.

It is made of thinner iron sheets (.0526 inch). The surrounding sides, which are from 18 to 24 inches in height, are rivetted to the flat bottom, about 7 feet in diameter, at an angle of about 120 degrees. It has got 6 ring-handles. It boils from 1,200 to 1,600 lbs. of juice. It weighs about 170 to 180 lbs. and costs Rs. 18 to Rs. 20.

Improved Sâtâra Pan.

Since the introduction of the Poona furnace in the Sâtâra District the local pan has undergone certain modifications to suit the changes in boiling. Before the introduction of the Poona furnace and the Poona pans the diameter of the local pans was between $6\frac{1}{2}$ and 7 feet and to accommodate the large quantity of juice on this surface its sides were kept high. The present pan is 7 feet 8 inches in diameter with 16 to 18 inches sides which are set nearly at 112 degrees. It costs about Rs. 20.

Since the introduction of the Poona furnace in the Sâtâra District the local pan has undergone certain modifications to suit the changes in boiling. Before the introduction of the Poona furnace and the Poona pans the diameter of the local pans was between $6\frac{1}{2}$ and 7 feet and to accommodate the large quantity of juice

in the Poona District the cultivators boil only 1,050 to 1,250 lbs. of juice, while in the southern Sâtára they boil always 1,300 to 15,00 lbs. in each pan. When we first began the Poona furnace demonstrations in the Sâtára District we tried Poona pans of the ordinary size (7 feet in diameter and 10 inches deep) with the usual dose of 1,100 lbs. but could not, with such small doses, turn out as much *gul* as the cultivators there do, and with our small pans we took longer to boil such large doses wherever tried. We therefore increased the diameter of the pan to 8 feet and then found that we could treat such heavy doses rapidly. The main principle is that the evaporating surface of the pan must be commensurate with the quantity of the juice in order to boil quickly. The depth of juice in the pan should not be more than 7 inches.

The furnace for such a large pan (7'-8" in diameter) must be proportionately larger. The diameter must be equal to that of the bottom of the pan. The ash pit should be more capacious with two more smaller holes (2 × 2 inches) to the iron sheet in addition to the central square hole. In such large furnaces fuel should be fed on to the holes or a little on the further side of them. It has been found that the modified Sâtára pan works equally well, provided Poona furnace is used. It is, however, advisable to use the Poona pan, as it is stronger, less unwieldy and lasts longer. If carefully used it lasts for 6 to 10 years. The Sâtára pan, which is rather unwieldy and thinner, lasts only for 2 or 3 years. Though the Sâtára pan costs less it is not as economical in the end.

In this connection it may be mentioned here that a pan should have sufficient evaporating surface. Its sides should be set at 95 to 110 degrees, but not more. The height of the sides should not be unnecessarily high; 12 to 18 inches height is quite enough.

APPENDICES.

APPENDIX A.

(a) The crushing season in the Sâtara District is short. The labourers get in this season about double the usual rates of wages. While in the Poona District which grows a very large acreage the season lasts for over 5 months and the wage-earners get only a trifle more than the usual rates, though they are usually high. It must therefore be remembered that the Sâtara labourers work so hard only because the season is short and they get especially high wages. Even with the increased wages, however, they cannot work at this rate if they were to work several months together as in the Poona District.

The following gives the strength of the gangs usually employed in different parts of Sâtara and Poona Districts:—

SÂTARA.

Name of the place.	Hours of work daily from the time the crushing begins till the last boiling is over.	Men in the gang.	Bullocks in the gang.	Quantity of juice in a working day.	Quantity of <i>gul</i> in a working day.	Daily expenses.	Cost of making 10,000 lbs. of <i>gul</i> .
	No.	No.	No.	Lbs.	Lbs.	Rs. a. p.	Rs. a. p.
Wadgaon (Kolhapur)	20	17	16	7,422	1,100	10 11 0	97 2 6
Sarud (Kolhapur) ...	21	17	16	8,400	1,260	10 11 0	84 13 2
Yellur I, Taluka Valva ...	...	16	12	...	1,450	8 9 9	59 6 0
Yellur II, Taluka Valva ...	...	16	16	...	1,450	9 3 9	63 11 0
Karanjawa de, Taluka Valva.	...	20	12	8,004	1,393	11 15 6	85 14 6
Chikurde I, Taluka Valva.	20	22	12	8,897	1,600	11 12 0	73 7 0
Chikurde II, Taluka Valva.	21	23	16	10,560	1,800	12 10 0	70 2 2
Retre, Taluka Karad ...	23	18	12	9,000	1,675	12 13 9	76 12 4
Mangale, Taluka Valva ..	...	20	16	10,800	2,000	14 2 0	70 10 0

POONA.

	Hours.	Men	Bullocks	Quantity of juice	Quantity of <i>gul</i>	Daily expenses.	Cost of making 10,000 lbs. of <i>gul</i> .
						Rs. a. p.	Rs. a. p.
Hadapsar I ...	About 15 hours.	11	8	5,304	760	This year's rates vary from Rs. 19 to 24 a <i>thar-gadi</i> .	Maxi. this year. 76 3 5 Mini. " 60 5 4 Normal average. 68 4 4
Do. II ...		11	8	4,928	812		
Do. III ...		11	8	5,172	792		
Do. IV ...		11	8	5,188	780		
Loni Kabhor.		11	8	5,084	792		
Manjari ...		11	8	4,512	760		

From the last column one sees that even in the Sátára District the expenses of manufacture per 10,000 lbs. of *gul* vary from place to place from Rs. 59-6-0 to Rs. 97-2-6. Round about Poona expenses per 10,000 lbs. of *gul* vary from Rs. 60-5-4 to Rs. 76-3-5 according to rates per *bhar-gádi* (the rates vary from Rs. 16 to Rs. 24 a *bhar-gádi*: *bhar-gádi* is not a fixed weight, it weighs from 3,040 to 3,250 lbs.). Taking Rs. 21-8-0 a *bhar-gádi* as the average normal rate, the expenses of making 10,000 lbs. of *gul* come to Rs. 68-4-4 which is less than that incurred at several places in Sátára.

The writer is not prepared, and he does not think it necessary to introduce a change in the organisation employed in Sátára for crushing cane. It is however obvious that the Poona cane planter under existing condition, has to spend less under this head than the majority of the Sátára cane planters.

(b) Moisture from megass was determined from about half a dozen places near Poona and also from several places in southern Sátára, and it was found that near Poona the freshly crushed megass contained 60·4 per cent. water against 64·1 per cent. in southern Sátára, which means that Poona crushing is better.

At the same time extraction of juice from cane was tested in several places in these tracts, and it was found that Poona stands a little better, extracting 65·4 per cent. against 65 per cent. in southern Sátára.

APPENDIX B.

Opinions of the sugarcane growers.

(I)

To

The Divisional Inspector of Agriculture,
C. D., Poona.

Sir,

I am using the Poona furnace (*i.e.*, with air passage) for the last three years and I find it economical. Last season I had got 6 acres of sugarcane and I had not to spend anything for extra fuel since I used Poona furnace.

On the Poona furnace we boil 7 pans a day, turning about 1,507 to 1,675 lbs. of *gul*. Each boiling takes from 3 to 3½ hours.

Often cultivators cannot construct this new furnace properly, and so I hope the Government officers will keep an eye on this.

When I was using the local furnace I had to buy extra fuel worth Rs. 20 per acre.

We are much benefited by this Poona furnace.

(Signed) PANDURANGAO ANANDRAO MOHITE.

Retre Budruk, 12th March 1911.

(2)

To

The Divisional Inspector of Agriculture,
C. D. POON

Sir,

We have been using the Poona furnace for the last three years. In this village there are now 15 to 20 furnaces of this type. The cultivators who made *gul* on the old furnaces could do so with megass and trash alone without any extra fuel.

2. Those who used old type furnaces (local ones) required extra fuel worth Rs. 20 to 25 per acre.

3. For the last three years I have been using this furnace (Poona) for my 4-acre cane plantation. I have to use outside fuel for a couple of days to start with, but this much is saved at the end; (this is necessary as the megass takes about 2 days to dry).

4. In the year 1909-10 one of my partners insisted upon having the local furnace which I had to purchase extra fuel of about Rs. 25 for one acre. The partner repented, and this year he agreed to make *gul* on Poona furnace and we did not spend money for extra fuel.

5. I report this from my personal experience.

(Signed) GOVIND VASUDEV DHAVALA,

Retre Budruk, 12th March 1911.

(3)

*Extract from a letter from Mr. Deshmukh the Inamdar of Chikaride,
Tadlika Valva, to the Director of Agriculture, Bombay,
dated 6th February 1910.*

The cultivators on this side require Rs. 25 to 30 worth extra fuel (in addition to megass and sugarcane leaves) on the local furnaces. I boiled 29 pans (output of one acre) on the Poona furnace and required extra fuel for only 4 of these instead of for 13 as usual, thus saving about Rs. 18 per acre. We are indebted to the Government for this.