THE ALL-INDIA VILLAGE INDUSTRIES ASSOCIATION

OIL EXTRACTION

(With the bullock oil press)

By

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MAGANVADI
WARDHA

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PREFACE

It is gratifying to note that it has become necessary to bring out the third edition of the book. After the first edition was published a supplement was issued to it, giving the results of further experiments in the ghani and detailed instructions about its construction so as to enable local carpenters to make or repair it. The second edition was only a reprint of the first. This third edition, thoroughly revised in the light of later experiments in regard to the construction of the ghani and further study made in regard to the economics of the industry, incorporates the matter of both the previous books into one comprehensive volume.

Appendix A relating to the construction of the cement ghani mortar has been prepared in consultation with Sh. Bhartanand. Appendix C has been prepared by Shri D.Y. Athawale of the H.B. Technological Institute, Cawnpore. Appendix D and the portion relating to the keeping qualities of oils in the last chapter of the book have been prepared in consultation with our chemists. Appendix E on "Magan Dipa" A Vegetable Oil Lamp has been taken from the pamphlet 'Magan Dipa" by Shri J. C. Kumarappa. The portion relating 'to the feed and care of the ghani bullock, has been prepared by Shri Y.M. Parnerkar.

My grateful thanks are due to all those who have contributed to make this book useful.

Maganvadi,
Wardha.
9th August, 43

J. P. Patel

INTRODUCTION

Economics of Enterprise, though aided by science for much of its technique, has to depend largely on propaganda to justify itself as it is based not on the interests of all, but only on that of the Capitalist. To make the man in the street believe that it works also in his interests it resorts to all kinds of half truths promulgated under the dignified name of economics. When pupils are of a tender age such propaganda is injected into their unsuspecting and receptive brains and hence are often accepted as gospel truth. Then when they attain maturity it is almost impossible to disabuse them of such prejudices at an impressionable age.

We are told that this is an age of machinery, only machines can produce in large enough quantities to make life worth while, machines alone can endure a high grade product of fine quality, efficiency is an attribute to machine production and so on and so forth. In effect they would have machinery and civilisation and progress as interchangeable terms. At least in the west a small group of people—the industrialists—have had the benefit of this propaganda and have reaped a rich harvest of profits for themselves, but in India such theories have served only to create an inferiority complex and make us a secure market for foreign products bringing in its wake unemployment, poverty and misery.

The A.I.V.I.A., with its unswerving faith in the efficiency of human talents and its capacity to meet all the needs of the people efficiently and satisfactorily have battled with preconceived notions to prove its confidence in the way of non-violence and truth and to dispel the myths of inefficiency and inadequacy of cottage industries to meet the present day needs. In this little book will be found an answer, based on experiment and research, to all false propaganda against cottage industries. We admit our efforts have been feeble, our resources meagre, and our equipment simple. Yet within the short space of hardly seven years it has been possible to lift the veil from a few industries and enable them to come out without any apology in the open and face the much vaunted large scale industries. If the villages and their industries have been languishing it is not because of any inherent defect in their very nature but rather due to lack of proper research, guidance and organisation. In the text of this book Sjt. Jhaverbhai P. Patel advances arguments to this end based on the examination of one of the most important of village industries —Oilpressing. We hope this convincing experiments will induce other enterprising and adventurous youth to come forth into this enchanting sphere and take up the gauntlet on behalf of the masses. There is much work to be done before confidence can be restored and people drawn to take up these industries without misgivings.

In the political sphere everybody is intent on attaining democracy yet they fail to see that such a formal cloak will not bring us the reality unless the everyday life of the people is firmly established in democracy. The Village Industries programme alone will ensure such economic democracy which will usher in the rule of the people, by the people and for the people. To attain this end we have to blow away all cobwebs of untruth and false propaganda by sustained research and experiment. We trust this book will give the lead to solid work divorced from speculation, superstition and prejudice.

Maganvadi,
Wardha,
15th November.43.

J.C. Kumarappa.

MAHATMA GANDHI'S REVIEW*

The village ghani, the village chakki, the village loom and charkha and the village sugar cane crusher were once inseparable parts of the village. The A. I. S A. and the A. I. V. I. A are trying to revive some of them. We know fairly well how the loom and the charkha can be revived. Khadi has become a science to be mastered in all its aspects. Maganlal Gandhi laid the foundation of that science. The village chakki and the village sugar cane crusher have yet to discover their science men. But the ghani has. Shri Jhaverbhai Patel of Maganvadi is studying the ghani in all its aspects with the zeal and precision of a scientist. He has made improvements which he claims have lessened the labour of both men and animals who work at the ghani and at the same time have increased the output of oil. He has studied the oil markets and the movement of seeds. The result is that he is today able to sell his oil at almost the bazar rates and therefore commands a ready market. His oil is superior to the machine product which is, as a rule, adulterated and never fresh. But Shri Jhaverbhai is not satisfied merely because he competes successfully with the local markets of Wardha.

He has found out why the machine oil is at all cheaper than the ghani oil. He gives three reasons, two of which are unavoidable. They are capital and the ability of the machine to extract the last drop of oil and that too in a shorter time than the ghani. These advantages are neutralized by the commission the owner of the oil mill has to pay to the middleman. But Shri Jhaverbhai cannot cope with the third reason, adulteration, unless he also takes to it. This naturally he will not do. He therefore suggests that adulteration should be dealt with by law. This can be done by enforcing the Anti-Adulteration Act if there is one or by enacting it and by licensing oilmills.

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* " Machine oil and Ghani " by M. K. Gandhi: 'Harijan,' September 2, 1939

Shri Jhaverbhai has also examined the cause of the decline of the village ghani. The most potent cause is the inability of the oilman to command a regular supply of seeds. The villages are practically denuded of seeds after the season. The oilman has no money to store the seeds, much less to buy them in the cities. Therefore he has disappeared or is fast disappearing. Lakhs of ghanis are today lying idle causing a tremendous waste of the country's resources. Surely it is the function of the State to resuscitate the existing ghanis by conserving seeds in the places of their origin and making them available to the village oilman at reasonable rates. The Government loses nothing by giving this aid. It can be given, so Shri Jhaverbhai contends, through co-operative societies. If this is done, Shri Jhaverbhai is of opinion, based on research, that ghani oil can compete with the machine product and the villager can be spared the infliction of the adulterated oil he gets today. It should be borne in mind that the only fat the villager gets, when he gets any, is what the oil can give him. To ghee he is generally a stranger.

PUBLISHER'S NOTE TO THE FIRST EDITION

One of the burning topics of the day is the method by which unemployment can be banished. Various suggestions of bringing about economic activity by Government or social means are being mooted. However good medicine may be, it cannot take the place of natural food. Unemployment doles do not create national wealth nor can a nation be permanently engaged in road construction or canal building. If we really seek a solution, we must try to diagnose the ailment and right the wrong for the functioning of a healthy nation.

The cause of unemployment lies in the fact that every one of us chooses to employ foreigners to supply all our needs. When we export raw materials which we can ourselves convert into consumable goods, we are exporting so much employment in foreign countries. If this is understood the solution is crystal-clear.

We have to convert our own raw materials into consumable goods. We must use locally made aricles. This creates employment. This is permanent and natural solution and forms the basis of the programme of the All India Village Industries Association.

A glance at the foreign trade statistics shows India is exporting about a million tons of oilseeds per year. Crushing one ton of oilseeds brings to the presser Rs. 28/- which means we are exporting employment worth nearly 3 crores under this one head. This is not all. There are many kinds of industries dependent on oil, the products of which India imports such a soaps, paints, lubricants and a host of others. The manufacturing of these is also employment lost to our country. Therefore a true solution of our unemployment question should take the form of a properly conducted economic activity round the conversion of raw materials available in the neighbourhood into consumable goods.

This booklet sets forth the efforts made by the All India Village Industries Association in the last few months to increase the efficiency of the Ghani and improve its technique.

If similarly every one of the raw materials is tackled and made to yield its quota to employment, our land ought to be humming with economic activity and there will be no need to resort to doles or road building to keep idle hands from mischief.

It is hoped that in its own little way, this booklet will help towards solving one of our major problems.

Maganvadi
Wardha
9th January. 30

J. C. Kumarappa

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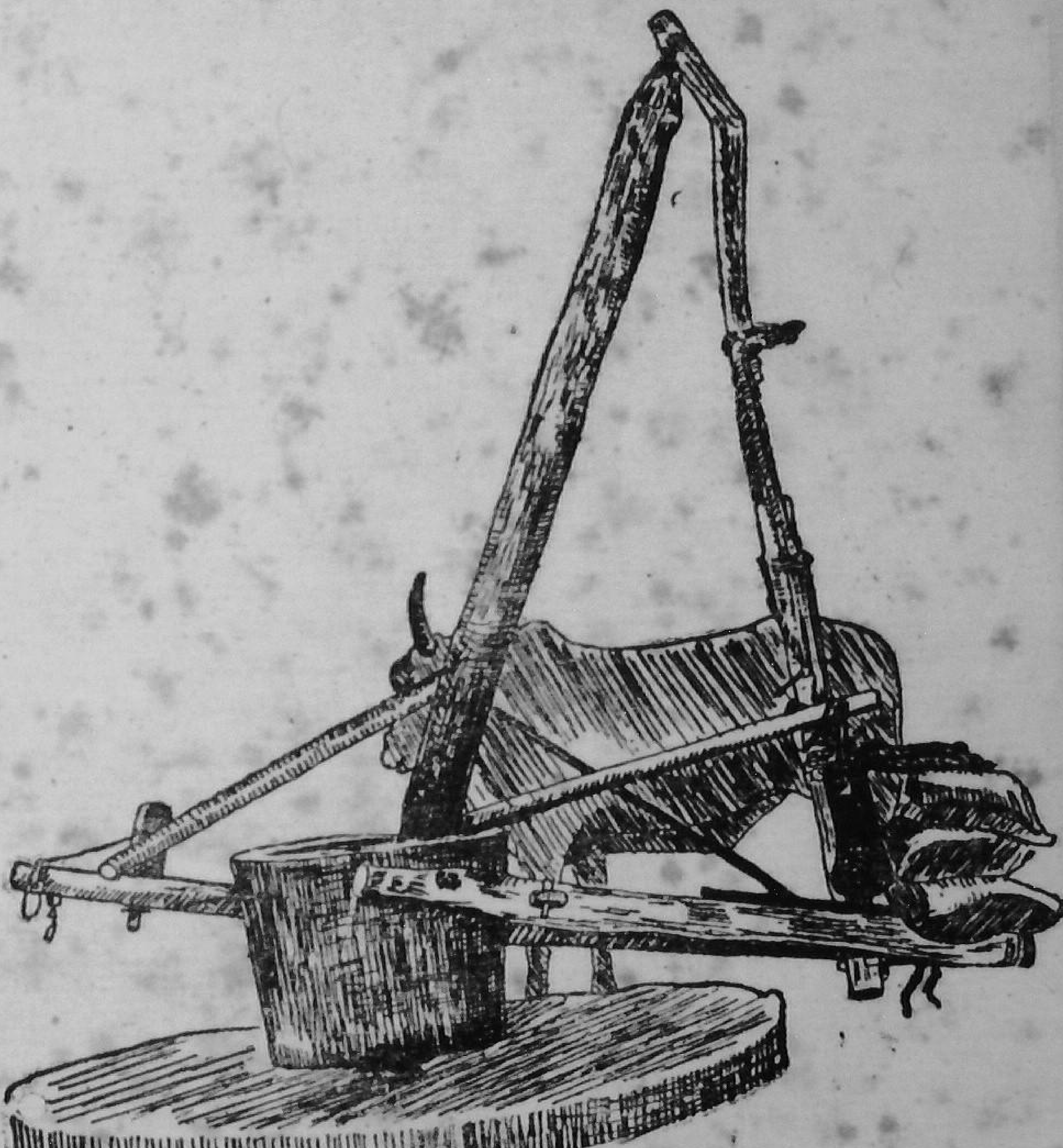
Maganvadi Ghani



THE OIL MILLS VS. THE GHANIS

1. The Position of the Ghani to-day.

Large scale oilmills in India, being the concern of vested interests, who can employ not only capital but also conduct much propaganda, have received more attention from the public than they deserve, so much so that there is in the minds of people an unreasoning faith in the greater efficiency of these in as much as they are a form of large scale machinery. Taking this greater efficiency for granted, their advocates, on the one hand, support them for the purpose of raising our standard of life, and their opponents, on the other hand hesitate to discuss the question from the purely economic point of view. This one sided propaganda has also created a general impression that the oilmills have practically ousted the ghanis from the field and it is now difficult to revive them. This, however, is far from the truth. The mills are there and their number has increased. But they are engaged more in pressing oil for the nation's growing needs for industrial purposes than for edible uses. In this sense, the mills have supplemented the ghanis rather than replaced them. Secondly, the mills have introduced an element of competition and thereby made the life of the ghani precarious.

Notwithstanding this, the ghani to-day enjoys an honourable position and still supplies the bulk of the oils used for edible purposes. Unfortunately, no information is available in connection with the proportion of oil pressed by ghanis and mills, except in regard to linseed and groundnut oils which are meant for industrial purposes. This is typical of the interest the Government has shown towards small industries. Of the two oils for which information is available 11% of the total production of oilseeds in India is pressed in ghanis and 17% in mills as will be clear from the following table :

1935—36

Seeds	Production (in tons)	Quantity retained after exports (in tons)	Quantity crushed (in tons) In ghanis	In Mills
Linseed	488,000	255,000	67,000	133,000
Groundnut	2822,000	1710,000	480,000	720,000
			547,000	853,000
Percentage of total oilseeds production			11	17

Linseed and groundnut together with castor form about two thirds of the production of oilseeds in India. But after export and other domestic uses the quantity crushed comes to only 28% of the total production, 17% being crushed in the mills and 11% in the ghanis. Of the other oilseeds, the export is negligible and the quantity crushed comes to about the same as in the first group i.e. 28% of the total production. For this group it is difficult to tell the proportion between ghani pressed and mill pressed oil for want of information, but if we take as a guide the oil production in U.P. and Madras for which we have information, the proportion is as 2: 1 or roughly 17% and 11% of the total production of oilseeds in the country. Combining both the groups, the total quantity of seeds pressed is 56% divided half and half between the ghanis and the mills.

2. A claim betrayed

A special claim advanced by the Indian oilmills in their support is that if more mills are started they will press oilseeds here and export extra oil instead of oilseeds being exported and thereby save a valuable item of oilcake for the nation. The inefficient ghani, they say, will not be able to do this. A perusal of the statistics relating to the export of oilseeds from India does indicate a progressive reduction in their export but that has not helped to retain the oilcake in the country. On the other hand, the mills have betrayed the very purpose for which they claimed support and have, until forced by the exigencies of the war, been exporting the bulk of the oilcake they produced, thus playing the role of the opportunist.

3. Efficiency Compared

We are accustomed to associate efficiency with big machinery and large scale production. If the test of efficiency be taken as greater production of national wealth and increased purchasing power of the masses and not the capacity of one class of people to earn more at the cost of another class of people, it will be a surprising revelation for most of us to learn that the large scale oilmills do not possess greater efficiency than the improved ghanis. Many oilmills, which are engaged in only crushing the seeds and not in side industries such as the manufacture of soaps or paints and varnishes are not paying, and so they often change owners. There seems to be a craze for starting oilmills among a section of the monied people, who run them on unbusiness-like lines, make losses and then sell them away. In Berar and Khandesh, for example, there are more oilmills than the supply of seeds warrant, and therefore they are underworked. These mills are run because of the capacity of the proprietors for suffering losses, and not because of their efficiency.

What the mills save by way of greater percentage of oil-extraction and less crushing colst goes in the distribution cost of oil and cake. Thus the mills have no advantage over the ghanis. But their large scale production enables them to keep the smallest possible margin between the cost and selling prices and thus to enter into unfair competition with the ghanis. The same thing can be done if a proprietor employs a large number of ghanis and produces on a mass scale. But this we should guard against, because it results in concentration of wealth and the simultaneous low purchasing power of the masses.

Thus centralised production, which turns independent artisans into wage earners and transfers their profit to middlemen, and reduces many to poverty at whose oxpense only a few make profit, does not add to national wealth, and therefore should not be allowed to continue, no matterwhether it is done with the help of big machinery or of simple tools.

That the mills by themselves do not possess greater efficiency than the improved ghanis is borne out by the following table showing the comparative crushing cost per ton of oil in the ghani and the mill:—

	Ground-nut Rs.as.ps.	Gingelly Rs.as.ps.	Linseed Rs.as.ps.	Castor Rs.as.p.
In a Bombay Mill	21-I4-6	24-2-9	35-10-9	32-2-0
In Maganvadi Ghani	47-0-0	47-0-0	83-7-9	47-0-0
Diffeənce in crushing cost	25-1-6	22-13-3	47-13-0	14-14-0
Difference on account of lower percentage of extraction in Ghani	15-0-0	15-0-0	22-8-0	15-0-0
Total Difference	40-1-6	37-13-3	70-5-0	29-14-0
Difference per lb.	0-0-32	0-0-3	0-0-6	0-0-2½
Commission ,, to be paid by the mill	0-0-2	0-0-4	?	?

It must be noted that in computing the crushing cost in the case of the mill, interest charges on the sinking capital of about 4 lakhs of rupees and depreciation on machinery are not taken into account as is done in the case of the ghani.

In the case of the ghani the crushing cost includes the wages of the oilman at the rate of 8 annas a day, which means that he can afford to sell the oil at the same rate as the retail mill rate and the cake at the (wholesale) mill rate. If he sells the ghani cake directly to custo mers he will get in addition an amount eaqual to the commission charged by the retailer.

Again, the position of all the oilmills situated in different parts of the country is not the same. Mllls at ports enjoy many advantages over those in the interior. The frieght policy of railways help such mills to get oilseeds at cheap rates and throughout the year. They are therefore worked to their full capacity for the whole year, and hence their crushing cost is less than that of the mills in the interior. As the mills export most of their oilcake, those in the interior get less price for their cake equal to the frieght charges upto the nearest port. All this means that the mills in the interior have to sell their oil at higher rates than mills in ports. The table given above relates to a mill in a port.

As the mill in question converts linseed and castor oils into varnish and medicinal oil respectively the exact commision charges for raw oils are not available. But elsewhere they certainly cover the difference between the crushing cost of oil in the ghani and the mill. It is important to remember in this connection that these commision charges which are less in the place of the mill become very much more when oil reaches distant villages.

Thus, so far as the consumer goes the crushing cost of oil in an oilmill, including the indispensable distributing charges, is the same as that in the improved ghanis. In other words, customers get no advantage from the so called greater efficiency of the large scale oilmills.

Let us see if the oilmills serve any other useful purpose.

Taking the case of mustard oil, for example, we shall consider the working of an oilmill with power driven ghanis and expellers as having a crushing capacity of 200 maunds of seeds per day of 24 hours and producing 1750 maunds of oil per month of 25 working days. The table below gives the different items of cost on the basis of pre-war prices of working such a mill and those of working the number of Maganwadi ghanis required for an equal output, bearing in mind that while the mill works for 24 hours the ghani works only for 8 hours a day. The cost of one ghani together with the bullock is taken to be Rs. 125. Though in a normal unit one man works two ghanis, the following has been calculated on the basis of one man and a boy for two ghanis in order to facilitate work and sale.

	Capital for equipment	Crushing cost analysed					
		No of workers	Wages	Power	Repairs Depre- ciation	Interest	Total
	Rs.		Rs.	Bs.	Rs.	Rs.	Rs.
In mill	30,000	19	500	800	250	350	1900
In Magan- vadi ghani	26,500	140	2100	2120	265	235	4720

For the extraction of I750 maunds of oil the mill requires 5000 maunds of seeds. As the ghani extracts about 2 percent less oil, to produce the same quantity of oil it requires 130 maunds more of seeds costing Rs. 780 at the rate of Rs. 6 per maund. The commission charged to the the mill for distribution of the oil at the rate of 12½ percent comes to Rs. 3500, at Rs. 2. per maund of oil which sells at about Rs. 16 per maund. On this basis the total price of 1750 maunds of oil works out as follows:

	Cost including crushing charges Rs.	Extra seeds Rs.	Commission Rs.	Total cost Rs.
In Mill	31,900		3500	35,400
In Magnvadi ghani	34,720	780		35,500

In addition to this the mill has to bear the freight on seeds, oil and cake and this extra cost will easily be much more than the apparent nominal margin between the prices of mill oil and ghani oil in the above table. As the oilman sells his oil himself there will be no commision to pay and as he crushes local seeds there will be no freight to bear. Thus looked at from the consumer's point of view the mills are not able to supply oil cheaper than the ghanis. The mill requires more capital for equipment than the ghani; it gives employment to less than one seventh the number of persons; it distributes less than one fourth of wealth by way of wages; it employs the wrong power in so far as it does not employ the cattle and the carpenters available in villages and in their place uses machinery imported from abroad, and after all is not able to supply cheap oil to customers.

The story does not end here. Raw mill oil is not regarded as fit for consumption. It has to be refined to be freed from the rancidity it acquires. The cost of refining oil should therefore invariably go into the total cost of the mill oil. In fact it is unjust to compare the prices of the ghani oil with those of raw mill oil. The rule should be to compare the prices of fresh ghani oil with those of the refined vegetable oil or the vegetable ghee. If this is done, the simple looking ghani will be established to be far more efficient and useful than the costly and complicated oil mills together with their attendant refining and hydroganeting plants.

After all people should realise that the comparison is not between the small tool that the ghani is and the big machinery that the mill is. The comparison is between two systems of organisations, one decentralised and the other centtralised. This is an instance to show that one can't always associate inefficiency with the decentralised method or efficiency with the centralised one.

Large scale production in a centralised form is by itself an evil in that it provides the basis of exploitation which is the root cause of violence in the world. It becomes still more an evil if it cannot even put forward the plea of efficient service to eociety like the large scale oilmills.

To solve the problems of overproduction and uneven distribution of wealth arising out of the use of power driven machinery two alternatives have been suggested, both based on the belief that these problems are not the outcome of the use of machinery as such but of factors outside it, and that if these factors are altered, full benefits of the use of machinery can be realised. One is to socialise production and distribution. The other is to substitute in the place of large scale centralised factories small power driven units worked in cottages all over the country side. This is not the place to enter into the merits or otherwise of these suggestions. Here we shall concern ourselves with a practical instance and show that, at least in regard to industries concerned with a simple process such as oil pressing, power driven machinery, whether large or small, does not establish its superiority over the village implement. And if the machine is not superior purely from the economic point of view nobody wants it for its own sake.

To estimate the efficiency of the ghani as compared with that of the oilmill, we may compare the production costs in each case. The costs, which vary with the size of the unit, are as under:

Size of the pressing unit		*Crushing cost per maund of oil* Rs.	as.	ps.
1. Oilmills having a capacity of production of 800 to 1000 maunds of oil per day.		1	0	0
2. ,,	500 to 800	1	2	0
3. ,,	100 to 500	1	4	0
4. ,,	40 to 100	1	8	0
5. ,,	10 to 40	1	12	0
6. ,,	5 to 10	2	0	0
7. From a unit of two improved type of bullock ghanis having a capacity of 8 seers per charge and requiring $1\frac{1}{2}$ hours for extration, the output in a day of 8 hours from 2 maunds of mustard seed will be 26 seers of oil. The working cost per day will be Rs 1-6-0. Thus per maund of oil produced the cost will be		2	2	0

The above table reveals some interesting facts. It clearly shows that it is not the power driven machinery, but it is the largeness of business that accounts for cheapness in production. This is a fundamental factor which should be clearly realised, if the controversy regarding machinery vs. handicrafts is to be properly understood.

Again, it is not production cost at the factory godown that is of real consequence to consumers. They are concerned with retail prices which include distribution charges in addition to production cost. Now, since the crushing cost varies inversly with the size of the pressing unit, the largest producing unit will be the one which achieves the lowest cost of production. But as we have seen above the larger the production at any one place the greater will be the distribution cest entailed, so that the lower the crushing cost the more the distribution cost and vice versa. Consquently the lower production cost is made up by the higher distribution cost and the consumer gains nothing thereby. If the mill produces a maund of oil for Re. 1, it spends a large amount on packing; freight, insurance advertisement commission to salesmen, damage in transit and such like all of which expenditure is saved by the oilman who sells his oil on the spot.

In the last power driven unit No. 6 in the table, the distribution cost will be the minimum, but the production cost is practically the same as in the bullock driven ghanis no. 7 in the table. Thus in this case niether the power driven machnery nor the largeness of its business are helpful. On the contrary, the smallest unit of machinary suchs as it would employ will require a population of 5,000 to 10,000 as compared with 700 in the case of the ghani unit, if we take 2½ tolas as the daily per capita consumption of oil and 25 as the working days in a month in both the cases. That is to say, even the smallest power driven unit will not suit most of our villages which have populations of less than 5000.

Further, large scale machinery may be profitable where several complicated prccesses are involved in production, but in oil-pressing this is not so. The machinery of the oilmill can no doubt operate with greater speed and exert more pressure on the seeds than the ghani and thereby secure the advantage of a lower crushing cost and a greater percentage of oil extracted. But as the process involved is simple and only one, the advantage scored by the mill over the ghani in the above two respects is not such as to be more than made up by its greater distribution cost.

All this shows that the much advertised efficiency of the oilmills is only a piece of propaganda for which there is no justification. It also proves the need for studying each industry separately, examining the nature of the processes and the implements and their effect on society as a whole before we come to conclusions in regard to its worth in the life of the nation. If that is done, the idea of collecting oilseeds from distant places to operate a very simple process of pressing them and then distributing the separated products, viz, oil and cake, to the same places again would seem absurd. From the standpoint of planned economy oilmills appear to be mountains made to labour to produce rats.

4. Ghahi Oilcake Vs. Mill Oilcake

Further proof of how only one side of the picture is presented before the public can be found in the propaganda made by some in favour of mill oilcake as against ghani oilcake both from the point of view of nutritive value as well as cheapness. Their argument against the common belief in the higher food value of ghani cake is not only that the quantity of oil contained in the ghani cake is not necessary for the animals but that it is also not assimilated and therefore causes digestive trouble. They further contend that in as much as the extra quantity of oil contained in the ghani cake is not assimilated it constitutes a national waste.

We invited expert opinion on the subject in reqard to the following points:

1. Is the higher content of oil in the cake of the ghani not assimilated at all and is therefore only wasted, or is it assimilated but is costly considered from the point of view of food units?

2. Is there an upper limit beyond which the animal can not assimilate oil in the cake ? If so, what is this limit? Does excessive oil in the cake have an injurious effect on the animal?

3. If the oil in the cake is assimilated does it play any part in increasing the fat content of milk produced by milch-animals?

We reproduce here in extenso the replies which we have received from the Officer in charge, Animal Nutrion Section, Imperial Veterinery Research Institute, Izatnagar, U. P. and from the Imperial Agricultural Chemist to the Imperial Agricultural Reseaɹch Institute, New Delhi.

The former writes:

1. Between the range 8 to 13% (8% to 11% from power driven mills and 11% to 13% from country ghanis) the animals should assimilate the oil if the cake is not fed evessively, *i. e.* not over 3 lbs to non-producing animals of 1000 lbs. live weight, or, not over 5 lbs. to producing animals of 1000 lbs. live weight. If more than this quantity is fed to animals, the oil may not only escape complete assimilation, but may also cause digestive trouble. However, within the range already mentioned, the sample having more oil (*i. e.* 13%) will naturally supply more nurition then the other having 8% only."

2. "Excessive amount of oil in ration of dairy animals tend to lower milk yield; this is specially the case with certain oils. It has been found however that no untoward effect is shown on feeding on a ration which supplied a pound of oil per day per 1000 lbs. live weight. We have already pointed out that excessive oil in feed may produce injurious effect on the animal by upsetting the digestive capacity."

3. "Some oils like cotton seed oil, palm kernel oil etc. increase the fat content of the milk, but the effect is not permanent. Morever when the milk fat is increased due to extra ingestion of certain type of food fat (or oil) the normal quality of milk fat is markedly altered and assumes more or less the chemical and physical nature of the particular type of food fat (or oil) fed."

In the opinion of the Imperial Agricultural Chemist.

1. "The higher content of oil in the ghani cake is assimilated as food and not wasted. The food unit value of ghani

cake is higher than that of press cake. The relative costs of cake from ghani and oilmill would ultimately determine the usefulness of one or the other."

2. "There is no upper limit of oil in the cake for assimilation. Even the ground oilseeds are fed and assimilated by the cattle. But this should not be interpreted to mean that any amount of oil in the feed would be assimilated. The digestible co-efficient of oil in the oilseeds is approximately 95% provided it is given in proper proportion in the ration. In regard to the upper limit to the oil content in the cakes, that will, as would be expected, vary with the breed of the animal and its age but an oil content upto 15% in the cake may be considered not wasteful."

3. "The oil in the cake is utilized by the animal as food and is not reflected in the percentage composition of the milk."

4. "The quality of the milk fat is affected by the fat of the oil cakes, but not the quantity of fat. This is governed by the secretive power of the mammary glands which are not affected by the general well being of the cattle."

These two eminent authorities thus definitely confirm the common belief that the food unit value of ghani cake is higher than that of the mill cake. In view of this fact, if the ghani cake sells at a little higher rate than the mill cake, it is only justified.

And after all, the range of oil content betweeu the ghani cake and the mill cake is not so wide as is made out. The oil content in the ghani cake is rarely beyond the limit of 15% as prescribed by the Imperial Agricultural Chemist and is usually below that limit in case of most ghanis prevelent in the country.

(5) Oil contents of cakes pressed in different units

The oil contents of cakes obtained from various pressing units analysed in the laboratory of the Harcourt Butler Technological Institute, Cawnpore, are as under:—

Pressing unit	Linseed cake	Mustard cake	Til cake
1. Ordinary teli kolhu driven by bullocks	14-15%	15-16%	14-15%
2. Improved Wardha Kolhu driven by bullocks	12.58%*	11.2%	12.54%*
3. Bengal type power driven ghani	11%	10.5-11%	11-12%
4. Bombay type power driven ghani	11%	10.5%	11%
5. Expellers	7-7.5%	8%	9%
6. Anglo-American or cage type hydraulic Presses	8-9%	8%	8%

(6) Handicaps of the ghani industry

The handicaps from which the ghani is suffering at present are:

(a) Lack of capital for stocking oilseeds.
(b) Difficulty in disposal of oilcake
(c) Inefficiency of the present ghanis.
(d) Lack of side industries.
(e) Loss of oilmen's prestige for genuine oil.
(f) The dwindling number of ghani carpenters.

(a) Lack of capital for Stocking Oilseeds

To-day in India all roads to wealth and prosperity seems to lead to cities. The villages which are the producers of wealth are drained of it. It is usual to find that materials produced in villages are not only sold cheaper in cities than in their place of production but often enough they cannot be had in the villages after the season. This is also the case with oilseeds. Being short of capital the farmers are obliged to sell away their seeds as soon as they produce them. Only very few of them can afford to wait for better prices before disposing of them. And still fewer people can stock seeds sufficient even for their use; nor are the seeds held by the village merchants to be sold again to the villagers or the oilman, as the village merchants generally act merely as middlemen for large scale oilmills situated in a central place where seeds flow from all directions like

(* Analysed by the cotton Oil Mill, Navassari Gujarat.)

water towards a low level. It is due to this that ghanis ply in big cities and towns and other market places where the oilman can obtain seeds throughout the year, though at higher rates, while the village ghanis are lying idle as no seeds are available there during the off-season. In fact villages are the logical and convenient places for ghanis to work as now mill oil is being sold there dearer and in a worse from than in cities, as commission, adulteration and dirt are added at every stage.

In the meantime the ill-fated country ghani is given a bad name and hanged. It is not supplied with the seeds and is condemned as inefficient. The ordinary farmers and the oilmen cannot stock the seeds for lack of capital, and the ghanis do not get enough work. They cannot keep on plying just for a while for a few rich people in the village who can afford to stock their seeds. Even they are few and far between as owing to the difficulty of getting ghani oil they have given up the habit of using it.

The problem is therefore one of conserving the seeds in their place of production. The simplest and the most effective way of doing this is to induce the consumers to store their own seeds and get them pressed on hire. This system is indigenous to our land and if properly developed can slove the many problems connected with the industry, such as capital for the oilmen stocking seeds, marketing of oil and cake, adulteration and rancidity. In the case of flour, people store or buy corn and get it ground on hire. They should do likewise for oil also.

The village merchants can also be persuaded to stock seeds if they are assured of ghanis being able to ply on. If necessary, stocking of seeds may be organised on cooperative basis.

It is but proper that the artisan is left to do the technical side of the industry and is not overburdened with the financing of it. In the absence of such a sound arrangement, the resourceless oilman is left to struggle against the resourceful mill-owner. This ls so not merely in regard to the stocking of oilseeds, but also in the marketing of oil. Living on day-to-day earnings, the poor oilmen can ill afford to make sales on credit, which is tha demand of most people in the villages, while the bania acting as the agent of a mill is able to sell on credit and thus attract customers.

(b) Disposal of oilcake

The giving up of the practice of consumers storing their own seeds has created another problem for the ghanis. When people stored their own seeds they fed the oilcake to their cattle. Now when they buy oil very few of them are inclined to purchase in addition oilcake for their cattle. So, for lack of customers for oilcake oilmen find it difficult to work their ghanis with profit. The mills get over this difficulty by exporting the major portion of their produce of cake. Thus the giving up of the practice of storing oilseeds by consumers has helped to hand over the industry of oil-pressing from the ghanis to the mill and deprived our cattle of a valuable source of food.

While some of the oilcakes are popular and therefore readily sold, others find no market. There is also no proper relationship maintained between the food values of oil cakes and their market values. This raises further complications for the ghani. We give below statistical data to enable people to make a proper selection as between different cakes as cattle feeds.

FOOD VALUES OF DIFFERENT OIL CAKES PRESSED IN MILLS*

Name of 5ake	Mois-cure	Fat	Protein	Carbo Hydrates	Fibre	Ash	Food Unit	Co-effi cient of price Index
1. Ground-nut cake	7.95	9.60	48.06	23.49	4.15	5.35	168	100
2. Til Cake	5.10	10.75	41.31	24,44	4.70	13.70	156	92.85
3. Rape & Mustard	3.15	10.20	34.61	36.04	8.35	7.15	148	88.10
4. Decorti-cated cotton cake	5.20	9.50	34.94	34.51	9.55	8.30	146	86.90
5. Safflow	7.00	9.20	39.62	20.43	14.35	9.15	143	95.10
6. Linseed	700	9.10	33.25	35.70	7.50	7.45	142	84.50

*"Some cattle feeds of Western India"-by D.L. Sahasrabudhe

7. Niger	9.35	7.95	34.06	24.94	13.45	9 85	130	77.40
8. Coconut	4.55	1485	22.94	34.27	16.80	6.60	129	76.80

The proper money value of foodstuffs depends upon the value of the different constituents and their proportion in the foodstaffs. Digestible fat and digestible proteins are considered to be equal in value, while each of these is taken to have 2.5 times the value of digestible carbohydrates. When these values are added together the sum represents what should be the comperative money value of the food stuff itself. In short formula.

(Fat x 2.5) + (Protein x 2.5) + Caabohydrates-Food units

(c) Inefficiency of the Ghanis

The decline of the ghanis is due to some extent also to their own inefficiency Even making allownce for the seeds having different oil contents at various places, the varying skill of the oilmen and the strength of the bullocks, the wide range which exists between one ghani and another of 12 to 52½ pounds in the output of oil in a day, of 26 to 50 in the percentage of oil extracted and of Rs. 72 to 385 in the crushing cost of one ton e.g. of gingelly oil, can only be accounted for by the inefficiency of the ghanis. There is undoubtedly great scope for improvement in the ghani, and the industry of oil-pressing in villages can be revived only if the ghani is improved and made more efficient.

(d) Lack of Side Industries

As we have seen before oilmills which are engaged in only Crushing the seeds and not in side industries are not paying. Taking advantage of this experience the mills are usually taking to side industries such as the manufacture of soaps, paints, varnishes, vegetable ghee and so on. The ghanis can profit likewise and adopt such side industries as are possible. Two such have been suggested in appendix "D"

(e) Loss of oilman's prestige for genuine oil

The giving up of the consumers, stockIng their own seeds on the one hand and the competition of the oilmills on the other hand have driven the oilmen to adopt dishonest methods in dealing in oil. Being unable to sell genuine ghani-pressed oil at the same rate as mill oil they have begun to adulterate ghani oil with mill oil or to deal largely in the mill oil, keeping up the ghani just for show. Once they took to this evil practice customers lost faith in the genuineness of the ghani oil. People did not want to pay a little more for ghani oil and yet get oniy mill oil.

Moreover, oilmen keep oil in unclean vessels and in unhygenic condition till the oil often becomes rancid. All this has created a new impediment in the way of oilmen trying to make some progress in their business. Even oilmen who want to deal only in genuine ghani oil are not trusted and they find it difficult to market their oil. We came across this experience while trying to introduce the improved ghanis among oilmen. Their chief difficulty in adopting the new ghanis was as regards the disposal of the increased production of oil obtained in these ghanis. When they are unable to dispose of even the smaller quantity of oil produced on their old ghanis how are they to sell the greater production of oil ?

While oilmen found this difficulty, others outside the caste who started this industry for the first time in life found ready market for their oil, even at higher rates. This they could do because they had not to overcome the obstacle of previous prejudice and were able to win the trust of the costomers for genuine oil. It is clear that if the industry is to be fully resuscitated and permanently established, it can only be organised through the system of hereditary oilmen. It is, therefore, essential that the oilmen should be educated so as to be able to maintain the trust of their customers for the genuineness of the oil supplied by them.

These and other difficulties can best be overcome through the establisment of an Association of oilmen which can act as the co-ordinating body for the whole country and be in touch with the day-to-day problems of the industry. This is the age of organisation rather than of machinery as is commenly called. Anything can be successfully and efficiently done only through organisation. The oilmills are better off because they are organised. The ghanis are worse off because they are unorganised.

(f) The dwindling number of the ghani carpenters

All the factors such as difficulties of stocking and marketing, competition with the mills etc. have made the position of the ghani precarious. Oilmen who can work the ghani fully and make a living out of it alone will be found to be few and far between while the number of those, who keep the ghani playing for show in order to exploit the sentiments of the masses for the ghani oil but in reality who deal in mill oil, is proportionately large. This state of affairs created under employment of the ghani mistrees who found less occassions for making and repairing the ghanis which were only partially worked. The profession of the ghani mistrees thus did not pay and there was no incentive left for new mistrees to be trained with the passing away of the old ones, with the result that today there is a great dearth for mistress for the ghanis that have survived. The number of ghani mistrees doing this work is so low in some parts of the country that it has beome very difficult for oilmen to get their ghanis repaired at proper times. Thus scarcity of mistrees has become a chief reason for the decline of the ghanis and any efforts to resuscitate these will have to include a programme of training new ghani mistrees.

It should be noted, in this connection, that along with the difficulty of getting timely assistance of the ghani mistrees, the oilmen also find it hard to obtain the required equipment and spare parts at reasonsable rates and in good time. There are places where wood suitable for ghani parts is not within easy reach and at others the ginning and other factories consume by way of fuel an enomous amount of such wood which can be profitably used for making ghanis and parts. It is essential therefore, that arrangements should be made at suitnble centres where the ghani parts can be stocked and distributed to individual oilmen at fair prices. This arrangement while supplying the felt need of the oilmen will go a long way in introducing any standard or improved gnani in place of old, inefficient ones. Such manufacturing and distrihutiug centres will be the suitable placces for training new ghani mistrees.

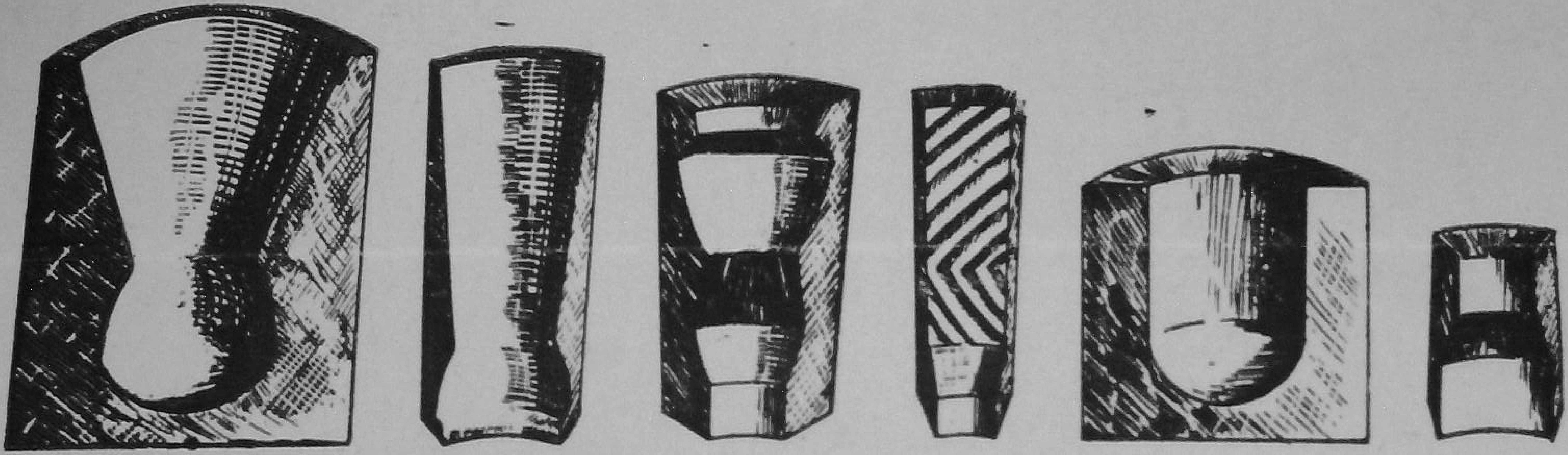


Fig 2, Replaceable parts of Provincial ghanies—To face Page 19.

2. PROVINCIAL TYPES OF GHANIS

1. Types of ghanis and local conditions.

Our artisans have adapted both the construction of the ghanis and the method of working them to suit loeal conditions. Where there is plenty of rain, ghanis have to be run indoors. This is possible only if they can be worked in a small area. For this reason, in the north and east of the country single bullock ghanis are in vogue. While in Madras and some parts of Orissa where rain is not so abundant, ghanis are worked in the open with two bullocks walking over a lerge area. Some of these ghanis are very big and press large quantities of seeds per charge.

Another consideration which has weighed with our artisans for making the capacity of ghanis small or large is the strength of the local draught animals which are mostly bullocks, except in Sind and Orissa where crmels and sometimes buffaloes are used respectively. Bullocks and camels are swift while buffaloes are slow. Where the bullocks are strong as in the Punjab, Bombay and Madras, the ghanis are big, and where they are weak as in the case of U. P. Bihar, Assam, Bengal Orissa and C. P., the ghanis are relatively small.

2. The organisation of the artisans

A noteworthy feature is the organisation which exists among the artisans. The manufacture of the ghani being spacialised art is done by professional ghani carpenters who work on the basis of the caste system and have groups of villages alloted to them as their field of work, making permanent customers in these groups and charging fixed rates for work done. These carpenters know the traditions and the problems of the industry and serve as important links among the oilmen, circulating their experiences and up-to date information regarding the details of the industry. Though at present they know only the construction of the local ghani and though their number is today considerably reduced it is best to utilise them for introducing the improved ghanis, and to keep to the organisation which they have been following till now.

Good though this organisation was, it could not in the very nature of the case act as co-ordinating agency between the various provinces of the country. Had there been one, many of the unnecessary diversities and deficiencies found in the existing ghanis would have been eliminated and a standard pattern, modified to suit local conditions, would have obtained throughout the country. Thus, in some ghanis wearable parts are made replaceable, while in others no such arrangement is found, the main body being scooped out according to plan and thrown away on wearing out. In some ghanis drainage is provided to let out the oil into a vessel while in others the oil in collected by dipping pieces of cloth into the ghani and then squeezing them out into a vessel. In some ghanis the pestle has to be taken out in order to dig out the cake from the mortar, while in others the pestle need not be removed for this purpose. Apart from such diversities, the details of structure also vary, not only from province to province, but also within the same province, which means that the variations cannot be accounted for as due to varging local conditions.

3. Tests of a good ghani

Let us briefly review some of the provincial ghanis in the light of the following tests which make for a good ghani.

2) ~~(1)~~ The percentage of oil extracted should be as high as possible.

\ ~~(2)~~ Capacity to receive seeds per charge should be large.

(3) Time taken per charge should be little.

(4) Human and bullock power required should be reduced to the minimum, and

(5) Capital expenditure and repairing charges should be small.

4. Provincial ghanis

(*a*) *The Gujarat Ghani*

Good points: 1, 2, 3,

Bad points: 4, 5,

(4) There is no provision for the automatic stirrer to push the seeds over the pit and so the constant attendance of

oilman is needed, who can therefore manage only one ghani at a time.

(5) The platform which serves the purpose of a seat for the oilman involves unnecessary capital expenditure.

(b) *The South Indian Ghani*

Good points: 1, 2, 3,
Bad points: 4, 5.

(4) The bullocks' circuit is very large, being of 12. ft. radius and two persons are required to attend to it, one for pressing the seeds and a boy for driving the bullocks.

The load beam being very long tends to rise up on the morter. To prevent this it is made to move about in a groove. The beam thus rubs againt the side of the groove and makes a tremendous noise which means friction and therefore exertion for the bullocks.

There is no drain to allow oil to run down.

(5) Instead of making the pit of replaceable parts the cavity which is scooped out in the mortar is used for pressing with the result that the whole mortar has to be discarded every four or five years. And as it has to be so discarded it is kept running for some time even after it has become inefficient due to wear and tear.

(c) *The Berar Ghani.*

Good points: Nothing special.

Bad points: Practically all, except the fifth, which by itself is of no special advantage without reference to the first four.

The pit is constructed in a crude manner and pressing is in effective. There is no drain and oil is collected by dipping pieces of cloth into the pit. It is heavy for the bullock.

(d) *The Bengal Ghani* (Diamond Harbour type)

Good point: One person can manage two ghanis at a time.

Bad points: It is not suitable for seeds other than mustard and cocoanut.

It takes as long a time as 5 to 6 hours to finish one charge of 20 seers mustard seeds. It also requircs two bullocks to relieve each other during one charge. That is to say, two bullocks are necessary to work one ghani. If the charge, however, is considerably reduced, one bullodk will do. The main defect in the construction is that the pit is very small, allowing very little crushing space. The inclination of the pestle is only of 7° and so much of the pressure applied is brought to bear on the bottom where no pressing takes place and is therefore wasted. That is the reason why the charge takes such a long time to finish. There are no replaceable parts' but the portion of the trunk in use is cut off every time it is worn out.

(e) *The Punjab Ghani*

Good points:2, 4, 5,

Bad points: 1, 3.

The cake allowed to form is thick and so pressing is not very effective.

A little improvement in the design of the stirrer can make it possible for one person to manage two ghanis simulataneously.

(f) *The Marwari Ghani*

Good points: Prrctically all except the designs of the stirrer and the load beam.

This pattern in conjunction with the Gujarat ghani have formed the basis of further experiments in ghani work at Maganvadi.

5. Working efficiency of Provincial ghanis

Let us now give a table, prepared from reports received by us giving a practical idea of the working of many of the provincial ghanis. We have selected gingelly seed for comparison, because it is the only seed commouly pressed in all parts of the country.

Place	Gingelly in lbs. in	Oil lbs.	Percentage of Oil	Charges per day	Working Hours
Pandharpur (Maharashtra)	92	24	26	4	8
Bhadrak (Orissa)	42	13⅛	31¼	3	9
Badadangal (Bengal)	50	16	32	2	8
Chhapara (Bihar)	36	12	33	6	12
Comilla (Bengal)	50	17	34	4	12
Chittoor (Andhra)	108	37½	34¾	2	8
Bijnor (U.P.)	38	14	36¾	4	12
Tiruvannamalai (Tamil Nad)	151	52½	37¼	5	8
Jullundur (Punjab)	40	15	37½	2	7
Bhusaval (Khandesh)	43½	17¼	39½	3	10
Sabarmati (Gujarat)	100	42½	42½	5	8
Rajkot (Kathiawar)	112	49	43¾	8	13
Bombay	72	32	44½	4	8
Cudappa (Andhra)	90	42	46⅔	3	11
Calicut (Malabar)	62	30	48½	2	9
Pithapuram (Andhra)	36	18	50	3	10

The table shows that the oil extracted in a day varies from 12 to 52½ lbs. and the perscentages range from 26 to 50. This only emphasises the need to standardise the best ghani all over India.

It is necessary to go still further and compare the efficiency of the various ghanis in terms of crushing cost of a fixed quantity of oil. For this purpose we shall ignore, for the time being, the actual local conditions such as the standard of wages, the upkeep of the bullocks, etc. and take for granted a uniform standard for all these. On this basis we give below a table worked out from the one stated above.

Place	Seeds Required for one ton of Oil (in approximate lbs.)	Daily output of Oil in lbs. (8 hours a day)	No. of days required for crushing one ton of oil	Crushing cost of one ton of Oil
Pandharpur	8587	24	93	127-14-0
Bhadrak	7168	11.1	203	279- 2-0
Badadangal	7000	16	140	192- 2-0
Chhapara	6720	8	280	385- 0-0
Comilla	6588	11.3	198	272- 4-0
Chittoor	6451	37.5	60	105- 0-0
Bijnor	6080	9.3	240	330- 0-0
Tiruvannamalai	6061	52.5	42	84- 0-0
Jullundur	5974	17.1	132	181-8 -0
Bhusaval	5648	13.8	160	220- 0-0
Sabarmati	5270	42.5	53	72-14-0
Rajkot	5120	30	75	103- 2-0
Bombay	5040	32	70	96- 4-0
Cudappa	4800	30.8	72	144- 0-0
Calicut	4630	26.6	84	168- 0-0
Pithapuram	4480	14.4	154	211-12-0

In the above table, the crushing cost is calculated thus on the basis of prewar prices:

Wages of oilman	Rs.	15	per	month
Upkeep of bullock		10	,,	,,
Depreciation on ghani and bullock		4	,,	,,
House rent		2	,,	,,
Interest.etc.		3	,,	,,
Total	Rs.	34	per	month

Taking 25 as the number of working days in a month, the daily average crushing cost amounts, therefore, to Rs. 1-6.0.

In the South Indian ghanis the daily crushing cost is taken as Rs. 2-0-0, because two persons and two bulloks are required there. As their capacity to receive seeds is great, their daily output of oil is also great. In some places, as in Rajkot, two bullocks work alternately on one ghani for 13 to 14 hours a day and thus obtain a higher output per day. In regard to the percentages of oil extracted, the ghanis of Cuddapa, Calicut and Pithapuram seem to be superior. Such a high percentage can either be due to the higher oil content in the seeds, or to the inaccuracy of the figure supplied to us as sometimes happens when due allowance is not made for the sediment contents in the the freshly extracted oil.

After a study of the provincial ghanis and further experiments made at the Headquarters, the A. I. V. I. A. has evolved the Maganvadi Ghani the efficiency of which is given below.

6. Working Efficiency of the Maganvadi Ghani

Seeds	Capacity per charge in lbs.	Percentage of oil extracted	Time taken per charge in hours
Gingelly	18	45	1¼ to 1½
Groundnut	18	45	1
Coconut	20	55 to 60	¾ to 1
Mustard	16	30	1½
Sarson	16	35 to 40	1¼ to 1½
Mahua	16	35	¾
Castor	18	40	1

In terms of the second table above, the crushing cost of one ton of gingelly oil on a unit of two Magnavadi Ghanis comes to about Rs. 53. at the rate of Rs. 1-12-0 per day, 0-6-0 extra than the average of Rs. 1-6-0 being the expenses of the second bullock.

A monthly estimate of pressing gingelly on a unit of two Maganvadi Ghanis is given in Appendix B to give an idea of the income that can be derived by working this ghani.

3. PRINCIPLES OF GHANI CONSTRUCTION

The main parts of the ghani are stated and described below :

1. The mortar (ओखली) including the cavity (कुंड) and the drain (मुहरी)
2. The pit (कोठा)
3. The pestle (लाट)
4. The stirrer (समेटनी)
5. The curved wood (वांकडी)
6. The load beam (बोझापाट)

The Mortar

(*a*) *Nature of wood* :

The wood of the mortar should be strong, heavy, solid, such as will not colour the oil, readily procurable and seasoned. If the wood is not strong, it will break due to heavy pressure exerted by the pestle. If it is not heavy, then the ghani will tumble over. If it is not solid and seasoned the oil will leak out due to cracking and if it colours the oil will be spoiled. Thus it is not any wood which can be used as the mortar of the ghani. Moreover, trees having big girthed wood as is required for making ghanis are few and far between. The wood that is generally used for mortar at present is that from Tamarind, Neem, Jack wood, Bhera and Sireesh. Occasionally Rayan, Mahua, Aajan and Babul are also used. But there is a possibility of these being cracked. Tamarind wood is used in most parts of India. Neem is popular in Gujarat, Khandesh and Bihar. Sireesh is common in Central Provinces. Besides these, it may be possible to find other kinds of wood that may be useful for the purpose. But at present the carpenters seem to think that they have exhausted every possible kind of wood. Without, however, trying to discover new kinds of wood it is better to utilise the many mortars that are lying idle at present because they are seasoned and save labour charges provided they are of the required dimensions and are not cracked.

(*b*) *Dimensions*;

The height of the mortar above the ground should be such as will not require the attendant to bend too much over it while working at it. Moreover the slantlng drain in its pit will also require a certain height. Therefore it is desirable that the height above the ground should be about 2¼ feet, and in order that it may stand the strain of the accentric load of the beam and the working of the pestle, it should be burried underground about 3 feet. Thus in all, the total length comes to about 5¼ feet. In places having sandy soil the length required will be still more. The wood should be straight as far as possible.

Sometimes it is difficult to secure such large wood having 5¼ft. length and to meet that difficulty extra pegs or a cross seat may be attached at the bottom.

The diameter of the mortar should be such as would leave its wall strong after the cavity for the pit is scooped out of it. Also, there should be sufficient space to contain the quantity of seeds. Moreover if the girth is less than the minimum required the wood is likely to crack. The diameter shoud therefore be at least 2¼ feet. However, if the girth is a little less, extra pieces of wood can be attached for space. An iron belt can be fitted round it for strength.

(*c*) *The Drain*:

The drain is to be bored from the bottom of the cavity on a side to come out at the other end near the ground. This drain has to be bored from the inside after the cavity for the pit is made in order that the hole for the drain is exactly where it is needed in the pit.

If the wood is defective then a zinc pipe should be fixed to guard it against leakage and wear. The drain should not come out much below the ground level, for then the pit for the receptacle for oil will have to be rather deep. When the pit is deep it is difficult to take out the receptacle when it is full of oil as well as to thrust the rod to clear the drain straight in order to clear it off and on with the rod.

The drain can come out well above the ground level, if it is bored at the bottom nearer the wall of the cavity but it is necessary to bore it a little away from the wall so that it may not be left open to be filled up with cake powder when the pestle revolves on the opposite side of the drain hole. To do this, the drain should be bored at the place where it will be left half open under the pestle in the empty pit.

The butt end of the iron rod which is inserted in the drain to close it, should be just enough to fit into the drain.

The Pit.

The pit is that part of the ghani where the pestle presses the seeds. It is the most important part of the ghani. The working efficiency of the ghani as represented by the oil percentage, the amount of the oil produced, the time taken per charge etc. depend chiefly upon the construction of the pit. The differences in the output of the ghanis are due not so much to their outward appearence as to the diversities in the construction of the pits. The inside of it is panelled by exactly fitting replaceable parts. To one who has no idea of the construction of the pit, there will be no visible differences between the Marwari and the Punjabi ghanis.

(*a*) *The inclination of the pestle*:

The construction of the pit should be such that the pestle should be brought into such relationship to the pit as to cause the seeds to be well crushed and the oil to be pressed effectively. To bring about this result, the first condition is that the pestle should revolve in the pit at as great an inclination as possible, because the lateral pressure responsible for crushing the seeds increases with the inclination.

The force acting along the pestle is mainly responsible for producing the heat in the pit which helps the extraction of oil and the lateral forces crush the seeds. Both these forces vary as the vertical inclination of the pastle varies: i. e. as the vertical inclination of the pestle increases the force along the pestle would decrease while the lateral forces would increase and if its vertical inclination decreases the force along the pestle increases while the lateral forces decrease.

Now the inrease in the vertical inclination decreases the depth of the pit and increases its width. This we cannot do beyond a certain limit as that will decrease the charge and for the construction of the mortar a bigger tree trunk would be required, which is generally not available.

In order to determine the right inclination of the pestle we must also see that the lateral pressure must not go to an extent which would push out the cake before thoroughly pressing it against the side of the pit, which, we observed, happens when the inclination reaches 22°. It seems, therefore, that the limit to the inclination of the pestle which it is profitable to have should vary between 20° to 22°, 21° being the proper inclination.

(b) *The thickness of the cake formed:*

We saw above that to make pressure effective, the pestle should revolve at an inclination but that is not enough. Besides this inclination the pestle should revolve without leaving much space between it and the sides of the pit. If there is unnecessary space between it and the sides the pressing is ineffective. The cake formed will be in proportion to this hollow space and if it is too thick it will take more time to be pressed out and even then the oil percentage will be less. Thus to get the maximum pressure the sides of the pit should be designed so as to approximate the slant of the pestle.

If we do not want to leave much space between the pestle and the sides, the side should converge gradually from the top down to a certain depth of the pit, and should again diverge up to the curve of the bottom of the pit. In other words the slant of the sides should follow the slant of the pestle. This convergence upto a certain point and divergence after that are necessary because the pestle touches opposite sides from that limit. Thus the pit is divided into two parts, the opposite slopes of which meet at a point which forms a narrow circular band or a bottle neck.

In thus making the sides convergent, we must see that the neck does not become too small because there must be enough space to allow the pestle of the necessary breadth to go down. If that part of the pestle is too thin it will leave much space on the side below the neck as well as at the bottom. This results in forming thicker cake on the side and the pestle may sometimes come off if the seeds settle down.

The side below the neck should not be so high as to create a greater hollow space and allow thicker cake to be formed to clear which it becomes necessary to take out the pestle at the end of each charge. The shorter side below the neck also helps the circulation of the cake. As, however, this part is the area of the highest pressure in the pit, it should be kept as high as possible, consistent with the above condition of not creating much hollow space.

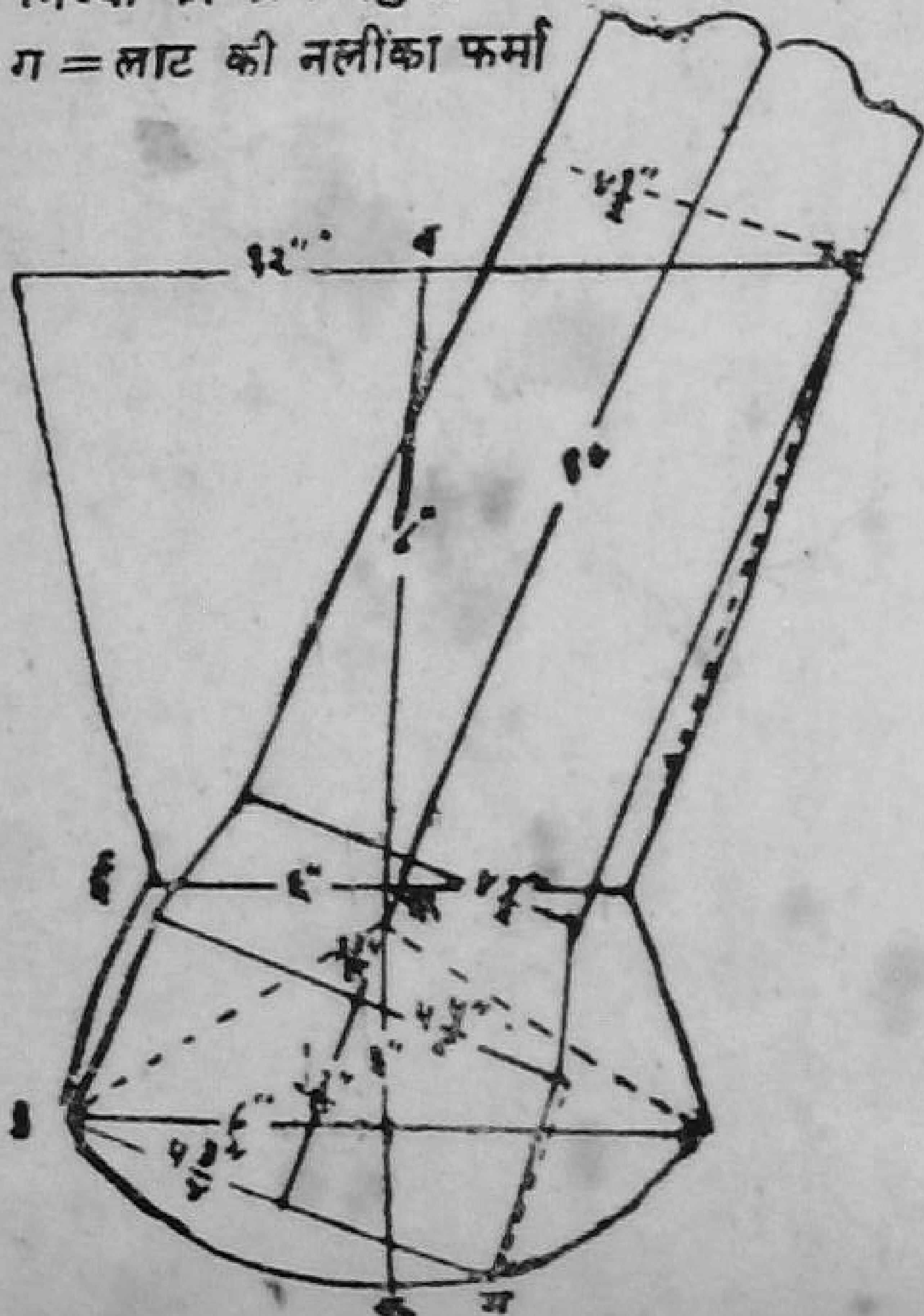
This condition is best fulfilled by marketing the pestle of bulging shape at the bottom. This shape of the pestle allows very thin cake to be formed at the lower par of the pit. This cake is not required to be cleared out at the end of each charge as it gets pushed up and mixed with the crushed seeds of the new charge. As the quantity of the cake that thus remains over from the previous charge is small it does not affect the new charge in any way.

As the necessity for the removal of the pestle at the end of each charge is thus eleminated unyoking of the bullock is also not required. But it is better to give the bullock a little rest between two charges and to remove the yoke from its neck which otherwise gets heated and swelled up. The streneous part of the ghani work being thus reduced running the ghani mostly means attendance and light work which can be suitably done by women or those who are not accustomed to do hard labour.

Sketch of the 'Kotha' & Pastle

रेखा चित्र नं. २ अ Sketch N. 2 A

अ ब क ड ई = फाचर का फर्मा
ई फ त्रिज्या का अर्ध वर्तुल = गले का फर्मा
ड क ग = लाट की नलीका फर्मा



रेखा चित्र नं. २ अ Sketch N 2 A

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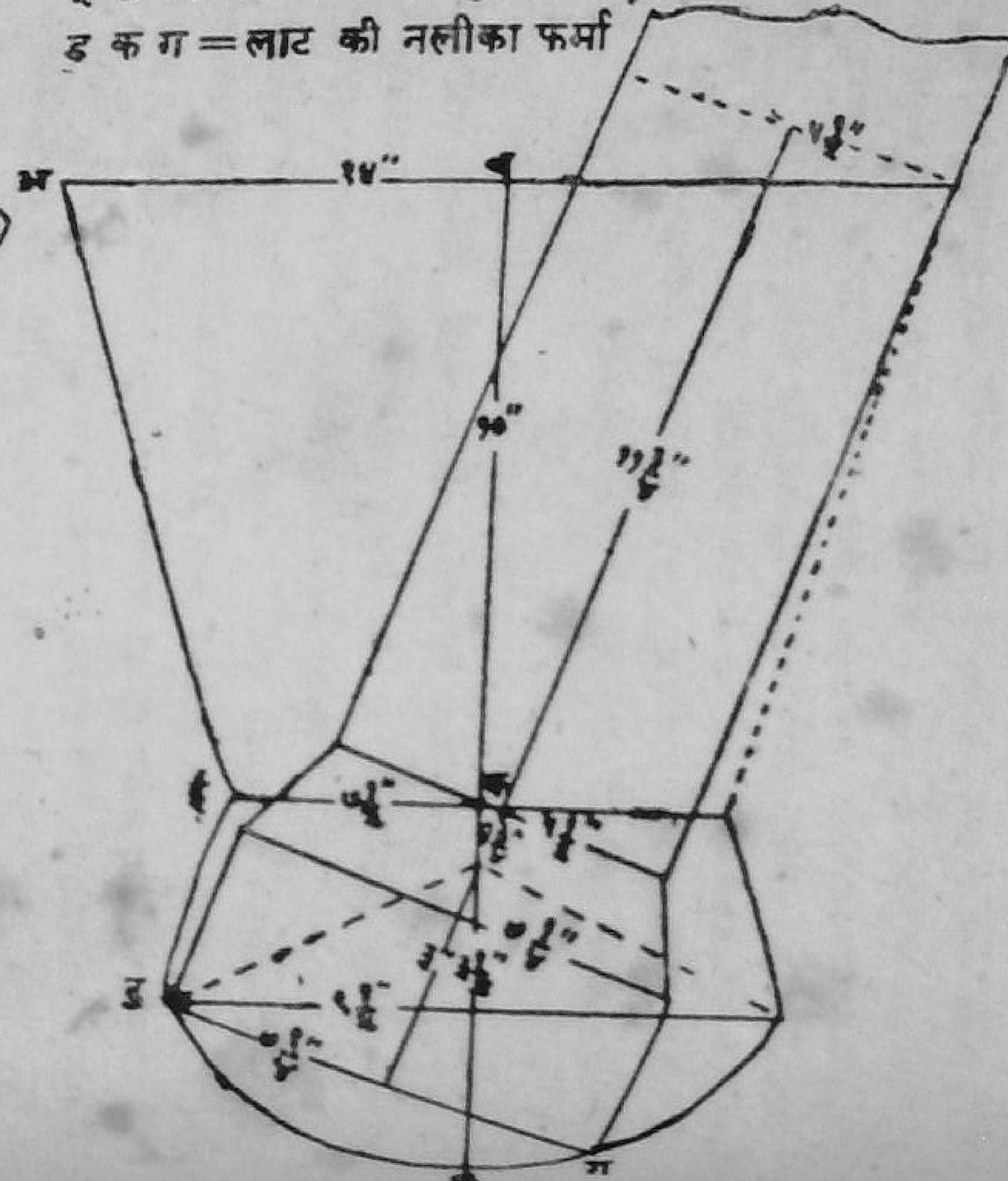


(c) *Circulation of the cake·*

As can be seen from the analysis of the cake formed in the lower, the middle and the top parts of the pit, the pressure is unevenly distributed over the pit. This necessitates the circulation of the cake. If time is to be saved in pressing out oil, the cake inside the pit should circulate as quickly as possible. On the other hand, if the speed of circulation of the cake is slow it will be pressed where it is and as a result, it will take more time to finish the charge. For, that part of the cake which is under highest pressure will be pressed sooner while the part under low pressure will take longer time. Thus if the cake speedily changes its place the less pressed portion of it comes under high pressure and gets easily pressed. So the circulation brings in turn all the cake under the point where the pressure is highest and in addition turns it over, i. e. the portion of the cake touching the side is turned over till it now touches the pestle and vice versa.

Now the speed of the circulation of the cake depends in its turn upon the construction of the pit. The direction of the circulation is from the bottom to the top. So the factor that can disturb the circulation is the neck. If there is too much slope in the side below the neck the cake will not easily come up. This means the diameter of the bottom of the pit should not be more than about two inches greater than the diameter of the neck. At the same time, the circumference of of the bottom should be big enough to allow the pestle to slant, so that the only thing we can do is to make the diameter of the bottom as well as of the neck proportionately larger. The neck should not taper into a fine edge but should be rounded off to merge into both the slopes.

(d) *The slope in the bottom:*

Since the pestle revolves in the pit at a slant it would leave some space underneath it if the bottom of the pit is flat. This space will be filled up by seeds. And if the seeds settle at the bottom in this way they block the passage of oil through the drain and at the same time push up the pestle which will have to be taken out to clear the seeds from there. It is thus absolutely necessary that there should be no holllow space left between the bottom of the pestle and the pit. This can be brought about by making slopes of equal circumference in both the bottoms. This is done by drawing a common arc for both the bottoms as shown in sketch No. 2 article 8.

(e) *Capacity per charge*

To increase or decrase the capacity per charge the depth or the width of the pit should be increased or decreased. But in doing that the capacity of the bullock should be taken into consideration. For an ordinary single bullock, a charge of about 18 lbs. of ginegelly seeds is convenient.

Moreover, a large capacity does not always increase the output per day as it depends upon the time taken to finish one charge.

How to draw the sketch of the pit

(Sketch No. 2)

Two pits of different capacities are drawn in this sketch. They are based on experiments carried out at Maganvadi and represent the standard pits adopted for the Maganvadi ghani at present. The bigger pit, A, is meant for ordinary strong bullocks and the smaller one, B. for weak bullocks. Regarding their capacity to receive seeds per charge refer to chapter six.

The measurements and curvatures given in the sketch are empirical. They are not based on any mathematical calculations, but on the results of practical experiments. In the description that follows, fulcrum refers to the top part of the pit where the pestle rests while revolving, neck refers to the first depth line from the top, and socket line refers to the second depth line from the top.

This sketch is drawn to the full scale so as to enable carpenters to prepare wooden or tin templets required in making the replaceable parts and the pestle as mentioned in chapter four.

Construction :

1. Draw the perpendicular axis of the pit through ब क,
2. On the axis, mark out the depths of the neck and the socket line.
3. Draw three horizontal lines passing through the fulcrum, the neck and the socket line equal to the widths of the pit at those three places respectively.
4. Join अ ई and ई ड. Similarly join the extremities on the other side.
5. With fulcrum as centre and a radius equal to half the diameter of the pestle at the fulcrum part draw an arc. Similarly, with ड the socket line end, opposite to the fulcrum, as centre and a radius equal to half the diameter of the pestle at the lower part, draw an arc.
6. Draw a tengent common to both the arcs. This tengent represents the central line or the axis of the pestle.
7, Locate the point of intersection of the axis of the pit and the axis of the pestle.
8. With this point of intersection as centre and a radius extending to either end of the socket line describe the arc connecting the two ends of the socket line.

   This arc being drawn from a centre common to the axis of the pit as well as to to that of the pestle forms a common bottom to both the pit and the pestle.
9. With ड as centre and a radius equal to the diameter of the pestle at the the lower part, cut the above arc at G
10. From ड and ग draw lines parallel to the axis of the pestle and extending to a height which is less by $\frac{1}{2}$" than the height of the axis of the pit between the neck line and the socket line. Join the two ends of the parallel lines.
11. At a distence of $1\frac{3}{4}$" from and parallel to the line joining the above two ends draw another line. Make this line equal to the diameter of the pestle at the fulcrum part and

equally divided on either side of the axis of the pesle. Let the extermities of these two lines falling on the same side of the axis of the pestle be joined.

12. Connect the fulcrum point to one end of the line referred to above. From the other end of the line, draw a line parallel to the axis of the pestle.

13. Make curvatures having necessary space between the pestle and the pit.

3. The Pestle

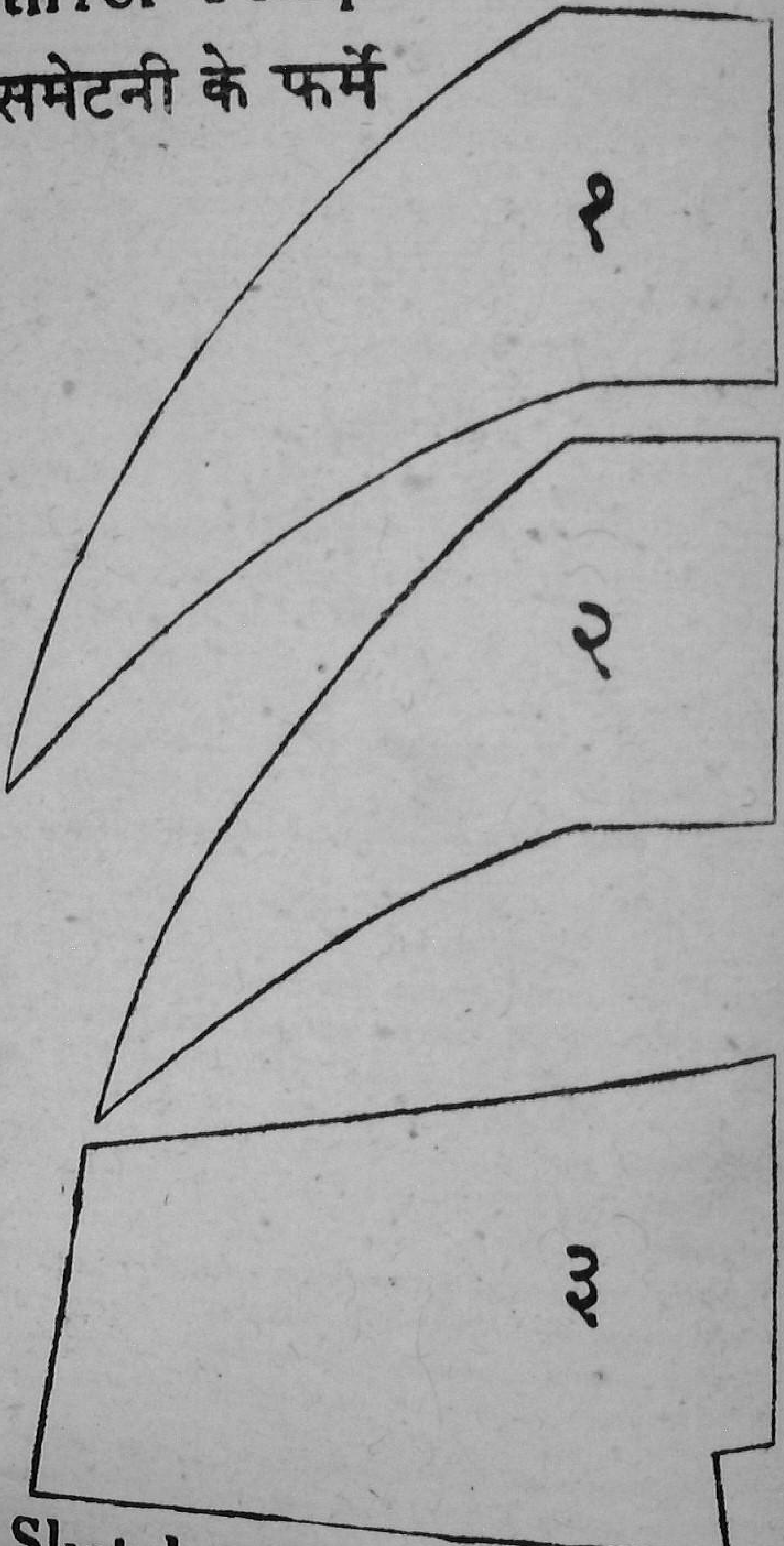
As in the case of replaceable parts of the pit the wood of the pesle should be hard. Babul or Kusum is such wood, but Babul is more commonly used. Sometimes Bhera wood is used, but it is not used in the replaceable parts. If the pestle is long enough, its ends can be reversed to take each other's place, but it is difficult thus to economise in a short pestle. On wearing out, the pestle can be utilised in making the load beam or the replaceable parts.

Because of the leverage it provides, the length of the pestle is an important factor in the efficiency of pressing out the oil. Like the beam of the weight scales, the pestle is divided into two parts, the top edge of the pit becoming its fulcrum. Of course, the length of the pestle should not be unwieldy for the man, and it will also be restricted by the height of the roof where it is worked. But where there is facility, and where the ghanis are worked in the open as in the south, the principle of leverage may be taken advantage of. From this point of view it is convenient to keep the pestle about 10 feet long, and in order that it may not be too heavy, it should be kept as thin as possible, say about six inches in diameter above the fulcrum part.

While revolving, the pestle should move uniformly without jecks, othorwise there is a danger of the curved wood falling down. For this purpose, both the ends and the fulcrum point of the pestle should be in alignment. Moreover the circumference

Stirrer Templets

समेटनी के फर्में



Sketch no. 3 **रेखा चित्र नं. ३**

Fig. 6 The Stirrer templets—Page 35

of the pestle at the fulcrum point should be uniform, i. e. of uniform radii. Preparing the pestle on a lathe ensures this test.

For the top end of the pestle there is no particular shape or size to be kept in mind except the tapering point which is about 1½" in diameter. The shape or sieze to be brought about in the pestle is only at the lower end starting from the fulcrum point. In the first place, the cut in the pestle above the fulcrum point should be about five inches above the point. If the cut touches the pit, it will press the cake which will stick outside the pit and will have to be removed from there all the time. Also, if the cut rests on the top surface of the pit, pestle will not revolve on the wall but slip off. The cut in the pestle helps in taking it out occasionally when required. A small peg should be fixed above tha part which may also help in taking out the pestle.

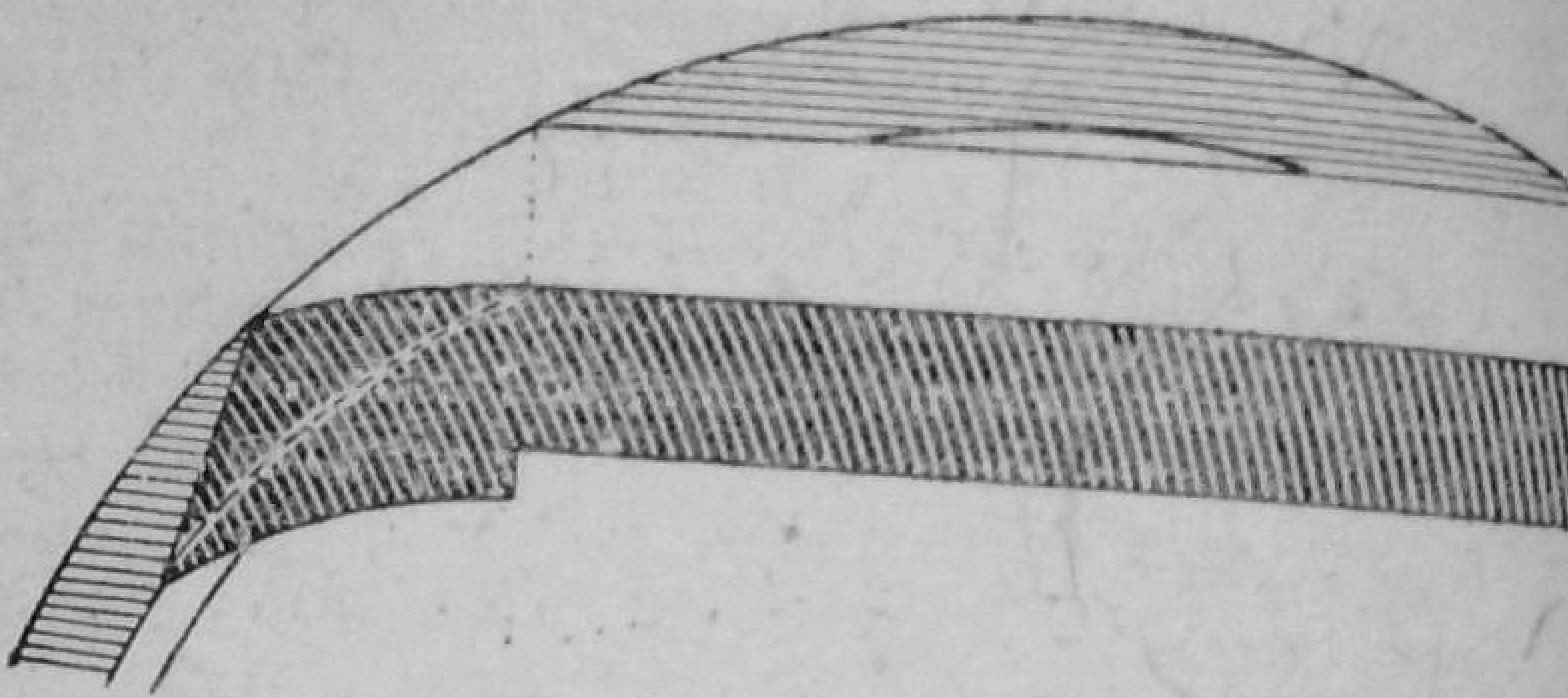
If the pestle is to be alloweed to slant at a greater angle, it should either be made thinner at the fulcrum point or the circumference of the pit at the top should be widened.

4. The stirrer

The stirrer is an ingenious device to brush the seeds into the pit and it is because the stirrer is contrived to work automatically that it is possible for one oilman to conveniently attend to two ghanis at a time, and with the help of a boy even to three.

The stirrer moves over the pit in advance of the pestle. It is hung from a nail to the beam post, where it is tied to the post, an extra load of about ten seers being hung over it to give it force to push the seeds.

The end of the stirrer which touches the wall of the mortar should be curved in the same way as the wall in order that it may move smoothly. That is to say, the curvature of of the outer side of the stirrer should have the same circumference as the wall of the mortar.

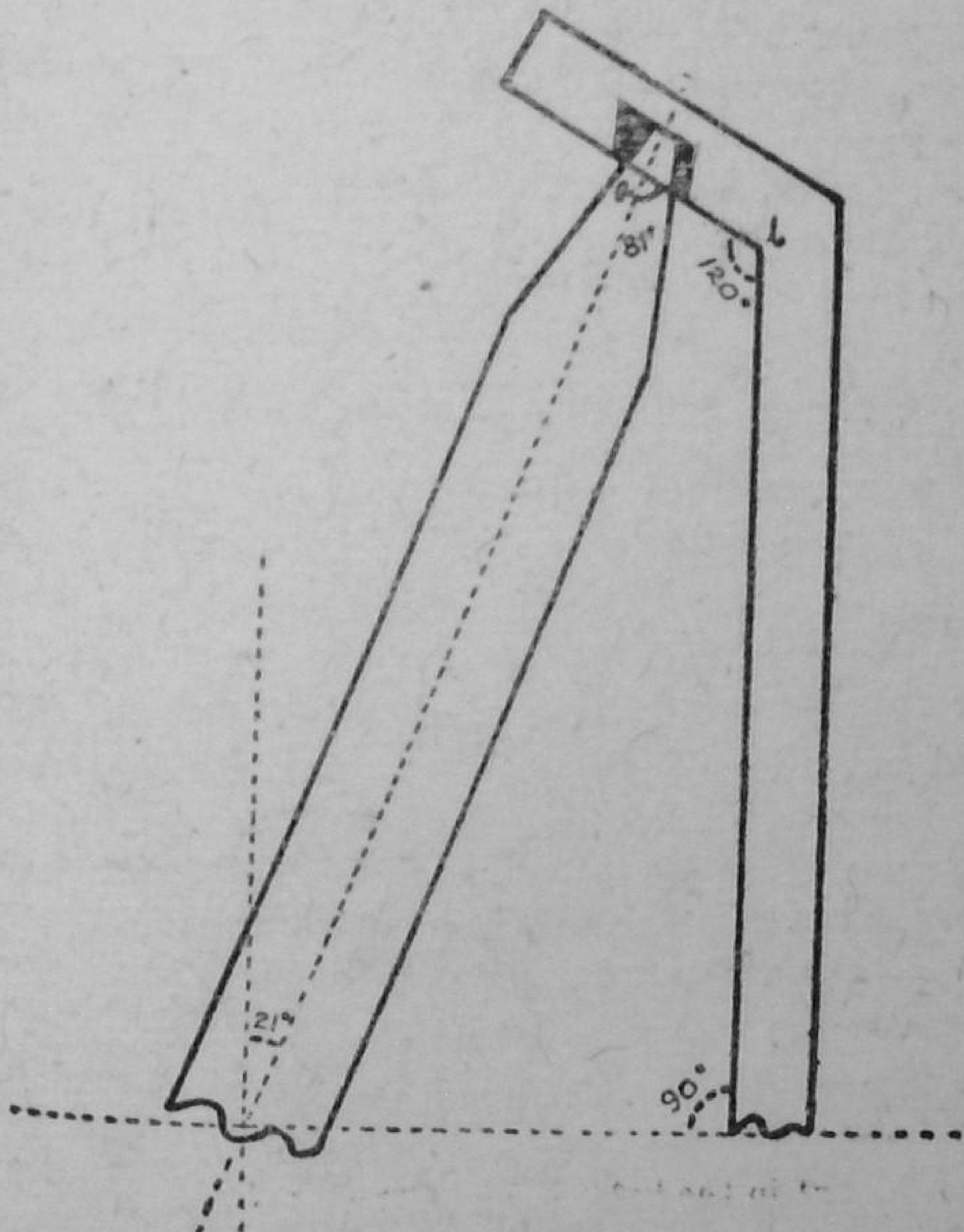


One end of the stirrer is tied to the beam post and the other passing over the stirrer margin wall makes in the margin. It is, thus, not moving horizontally but at an angle. This does not allow the whole portion of the outer curvature side of the stirrer to touch the margin wall, but only the upper corner, leaving space between the curvature side and the wall. For the same reason of the stirrer moving in the margin at an angle, space is left between the bottom of the margin and the bottom of the stirrer, except at the very small portion at the front. The empty space is filled up by seeds and stirring becomes ineffective. It is, therefore, necessary that no space is left between the stirrer and the margin, either on the wall or at the bottom. In other words, both the curvature side and the bottom of the stirrer should completly coincide with the wall and the bottom of the margin respectively. This is brought about by choping off the curvature side from the top till no space is left. That is to say, the side should be sloped from the top to the bottom, the top width being reduced by about ½", depending on how high the stirrer is made to move over the margin wall. To remove the space at the bottom of the stirrer, it should be similarly sloped by about ½" from the front part towards the centre. The widths at the lower and the top ends of the curvature and the slope in the bottom of the stirrer are indicated in templets No. 1, 2 and 3 respectively in Sketch No. 3.

As the face part of the stirrer is shaped from a wider wood, and, as it is the only part affected by wear, it is better to prepare it from a seperate piece of wood and join it on to any ordinary rod of about 2" diameter.

5. **The curved wood**

The load of the load beam that brings the pressure to bear on the pestle is hung on a curved wood which moves resting on the pestle. Since it has to carry a big load this wood must be strong. Thick wood of any inferior kind will do but if it wears out soon, it will have to be replaced every now and then. Hence Babul wood is preferable.



The angle which the top of the pestle makes with the curved wood depends on the angle the wood itself has at its curve. These two angles together with the third one which is a right angle made by the wood with the ground level and the fourth one which the pestle makes with the mortar form a quadrangle having 360° for its four angles. Of the four angles the third is fixed and the fourth also is fixed being the complementary angle of the one made by the axis of pestle with the axis of the pit (Ref. Sketch No. 2). The remaining two angles are variable. If we know the angle at the curve of the curved wood we can find out the angle made by the pestle with the curved wood. Thus if we call these two angles as 'b' and 'a' respectively, we can give the formula for 'a' as follows:

$$a = 360° - [90° + (90° - 21) + b]$$
$$= 360° - (90° + 69° + b)$$
$$= 201° - b$$

Thus, if b stands for say 120°

$$a = 201° - 120°$$
$$= 81°$$

Another short cut formula derived from the rule of parallel lines may be given thus:

The supplement of angle a

= angle b − the angle made by the axis of the pestle with the axis of the pit.,

= angle b − 21°

As far as possible one single piece of wood with the required curved should be used, as that ensures strength. But in case it is difficult to obtain such wood of the desired length, a short curved wood may be joined with another piece of wood to bring about the necessary length. The joint can also be so made as to bring about the curve.

As the load hanging on the curved wood is heavy, the friction between the tapering end of the pestle and the hole of the curved would is great, to minimise which a small piece of soap can be put in the hole.

6. The load beam

The strain that the bullock has to bear depends mainly on the contrivance of the load beam. The length of the beam, its friction with the mortar and the yoking arrangement are factors that play their part in reducing or increasing the strain on the bollock, If the beam is contrived satisfactorily from these points of view, it becomes easy for the bullock to drag the heavy load of about $4\frac{1}{2}$ maunds which is required to produce the necessary pressure on the seeds.

The load beam serves two purposes.

(1) It bears the necessary load to convey the required pressure over the upper end of the pestle.

(2) It acts as a lever, one end of which is attached to the bullock (by means of a rope) which provides the driving force, and the other end sliding along the outer surface of the mortar becomes the fulcrum; while the vertical post connected with the pestle is the point where the entire resistence, due to the motion of the pestle contrivence, is centred.

(*a*) *Leverage and Speed*

The longer the load beam, the easier it is for the bullock to drag it, because length furnishes leverage. At the same time the length is a disadvantage in the sense that it increases the area over which the bullock has to move. That is to say, to get leverage speed has to be lost, which means that the time per charge will be increased. Therefore a compromise has to be effected between the leverage and the spead. Besides, the convenient span of the shed should be considered. Thus we find that we can afford to make the beem only of the length as will allow the bullock to drage it conveniently, that is, the bullock should be able to turn without much bending on the side. These conditions are fulfilled by the maximum outer diameter of the passage of the bullock being of 16 ft.

(*b*) *The Yoking Arrangement*

(1) The Gujarat Pattern

In almost all ghanis, except in the Gujarat and the Berar ones, the yoke is not supported anywhere except at the bollock's neck, and the bullock has nothing to lean on while moving and so has to bend on a side unsupported to obtain a circular motion. The yoke is supported on the neck by ropes. tied to the load beam on both sides of the bullock who is constrained to walk in between the two ropes and who requires to maintain a balance between his motion and the bending. It is very difficult for new bullocks to maintain this ballance and they require to be trained for about a month to do so. Even then, not all bullocks are able to learn it.

Another defect of this design in which the yoke is supported only on the bullock's neck is the fact that the yoke rapidly spoils the neck. The yoke does not have free play on the neck but is kept up in one particular place by ropes tied to it. This place on the neck, remaining under constant presure and having no free passage of air, gets heated and consequently swells up.

The Gujarat pattern of the load beam, though inconvenient to the oilman because of the provision of the yoke being connected to the load beam which overtakes the standing man quickly, seems to be convenient for the bullock. In this design, the yoke gives the bullock a lateral support which helps him to maintain his ballance, at the same time giving him free movement because the outer rope is dispensed with, the yoke being connected to the load beam by a rope only on the inner side of the bullock.

If the yoke is supported on the load beam it is necessary that it remains as high as the level of the neck. This requires the end of the load beam supporting the yoke to be raised up as high as the beam can possibly go on the mortar and the remaining height necessary to bring the yoke in level with the neck of the bullock is provided by the introduction of the vertical peg about 1¼ ft. high at the beam end, fitting it loosely in the hole so as to allow it to move freely. The yoke is connected to this peg with the help of a horizontal nutbolt or a small wooden peg again loosely. These loose conections of the peg with the beam and of the yoke with the peg provide a sort of universal joint for the yoke to move forwards or backwords as also upwards or downwards, thus allowing easy movements to the bullock without causing any jerks on the neck.

(c) *Friction with the Mortar*

The load, placed on the beam at the end beyond the vertical post on which the beam hangs, creates a tendency in the beam to rise up along the mortar and thus give an upward thrust against it, if the beam is made to move in a horizontal way. This upward thrust and the consequent friction can be minimised if the beam is allowed to take its own course to move slantingly, remaining as high on the mortar as possible.

The part of the load beam touching the mortar can be raised by keeping the vertical post slanting towards the mortar. The rope connecting the post with the curved-wood lifts up the slanting post and so the beam end along with it. That is to say, the post fixed at an acute angle with the beam is brought in line with the perpendicular dropped from the top end of the pestle and thus makes a right angle with the ground level.

The place of the post in the beam and the slant at which it is fixed play an important role in bringing about the contact of the load beam with the mortar so as to cause greater or less-friction. If the post is nearer the mortar, the centre of gravity of the beam falls further away and the end resting on the mortar goes up. If the post is further away from the mortar the centre of gravity of the beam falls towards the mortar and makes the beam go down. The post should therefore be exactly where it will balance the beam. The measure of this distance depends upon the length of the pestle. If the pestle is short, the beam will be balanced by keeping the post nearer the mortar, while if the pestle is long, it will be necessary to fix the post at a greater distance from the mortar. The position of the post is where the perpendicular dropped from the top end of the pestle falls on the beam. The peg inserted with the post allows some scope for adjustment beyond helping to fix the post tightly.

(d) The Driving Force:

In the Gujarat pattern of the load beam the driving force is exerted partly through the rope and partly through the beam lever. This is made clear by a spring balance tied in the rope and varying the length of the rope. When the rope was kept 5 feet long allowing just enough space for the bullock to walk the spring showed a tension of 75 to 115 lbs. When the rope was lengthened to 5½ feet the tension became 70 to 85 lbs. With 6 feet length of the rope it came to 55 to 75 lbs. and with 7 feet length, it remained only between 50 to 60 lbs.

This only means that as the rope is released the power applied is being partly transferred from the rope to the beam lever. Thus, if the beam acts as a lever, the longer it is the more leverage it will provide. The longer beam accommodates a longer yoke which does not require the bullock to bend so much as in the Gujarat pattern. With the longer beam, however, the yoke makes an obtuse angle with the bullock's neck and this gives him side thrust, so a compromise has to be struck even here.

In the ordinary pattern the driving force is exerted through the side ropes. The longer the ropes, the more acute the angle the bullock makes with the beam and the consequence is less effective pull. It is therefore advisable to keep the rope just sufficiently long to allow the bullock to walk conveniently. The inner rope should also be as near the outer end as possible.

(e) The Bullock's Trench:

Our experience in making a trench for the bullock's track about 1½' below the ground level shows that in addition to the hygienic purpose it serves in keeping the dust, urine and the dung of the bullock from the oil receptacle, it also lessons the load of the bullock and thereby increases efficiency.

When the bullock's track is on the ground level the draft line is at an angle to the horizontal motion of the bullock. The pull caused by this at the yoke, as it is not parallel to the spine of the animal, causes a strain.

Again, when we resolve the draft line which is a resultant of two forces, into its componant parts, one of which will be horizontal and the other vertical, we find that only the horizontal component is effective while the vertical component is responsible not only for the extra strain on the animal, referred to above, but it also lessons the effeciency by decreasing the power exerted by the load at the end of the beam.

By the trenched track we estimate the vertical component and utilise only the horizontal on as the draft line now becomes horizontal and parallel to the spine of the animal.

In addition to the trench, the rope tied between the curved wood and the beam post can also be so adjusted as to bring the draft line as near to the bullock's spine as possible.

A spring balance tied in the rope between the load beam and the yoke showed a decrease in the tension by at least 10 lbs. in a total tension of abont 60 to 80 lbs, by bringing the draft line near the bullock's spine.

4. HOW TO MAKE THE GHANI

1. List of Equipment

(a) *Wood*

(b) *Accessorties*

(c) *Carpentry tools*

(d) *Carpenter's wagcs*

2. Construction

1. *The morar*
2. *The pit*
3. *The pestle*
4. *The stirrer*
5. *The curved wood*
6. *The load beam*

1. List of

(a) Wood

No.	*Purpose*	*Kind*	
1.	The Mortar	Tamarind, Sirish, Neem Jack-wood. Ajan, Bhera, Babul	
2.	The Replaceable parts	Babul or Kusum	
3.	The Pestle	Babul, Kusum, Bhera	
4.	The Stirrer	Babul, Kusum, Bhera Any wood	
5.	The Stirrer weight	Any wood	
6.	The Curved wood	Babul or any hard wood	
7.	The Load beam:		
1.	The Gujarat Pattern		
	beam lever	Any wood	
	post beam	,,	
	yoke beam	,,	
	neck wood	,,	
	post	,,	
	collar	,,	
2.	The ordinary pattern.	Babul or any other wood	5 $1\frac{1}{2}$'
	Washer	Teak wood, Any wood softer than the mortar	2' long 5" broad and 3" thick
	Yoke	Teak wood, Seasoned	$2\frac{1}{2}$' long 10" broad and 6"
3.	The Drain channel	Any wood	
4.	The handle peg	Any wood	

Equipment

(a) Wood

Features	*Dimensions*
Seasoned, without hollows and straight	5' to 5½' long 2¼" to 2½' diameter
Fairly straight and without knots	18" long, 17" diameter
Seasoned, without knots and straight	9' to 10" long 8" diameter
	1½' x 5" x 4"
	4½' x 3" x 3"
	Having about 10 seers weight
Curved at an obtuse angle	4' at the longer end, 1' at the shorter
Ordinary round wood	12' x 5" x 5"
"	6' x 6" 5"
	8' x 4" x 4"
Curved at an obtuse angle	1½' either way
Ordinary round wood	5' x 4" x 4"
"	3' x 3" x 3"
	10" long, 4" x 4"
Like a small curved wood	1' at the longer end 8" at the shorter

(b) Accessories

No. Name	Purpose	Dimensions
1. Iron rod	To clear the drain	1" round, $1\frac{1}{2}$' long
2. Crow bar	To dig cake	$\frac{3}{4}$" octangular. $2\frac{1}{4}$' long
3. Scale and weights		Double set
4. Tins and buckets	To contain oil and cake	
5. Shovel	To remove the dung	
6. Pans	For feeding cake to the bullocks	
7. Strainer	To strain oil	
8. Ropes	To tie the beam post To the curved wood	1" thick, 12' long.
	For yoking	$\frac{1}{2}$" thick, 12' long.
9. Water measure	For adding water to seeds	Metal vessel to contain 30 tolas of water
10. Eye covers	To blindfold the bullock	Made of baskets covered with gunny
11. Two tin trays	(1) to be placed below the drain in the pit	Enough for the pit
	(2) For oil tins	2' x 4'
12. Iron band	To be fitted round the mortar	Just enongh to fit round the wood
13. Lime and gunny cloth	Packing materials	3 lbs. 2 yards

(c) Carpentry tools

1. Three basulas	1 Curved and round 1 Flat and round 1 Flat
2. Auger	$1\frac{1}{4}''$ in diameter, the handle lengthened by a joint by about $1\frac{1}{4}'$
3. Iron rod	$1\frac{1}{8}''$ in diameter, $1\frac{1}{2}'$ long to be placed in the drain while thrusting the key in to keep the part in its place
4. Chisels	
5. Two saws	Small and big
6. Plane	
7. Mason's square	
8. Village lathe	
9. Marking gauge	
10. Compass, plumb-scale	
11. Templets	Made on the basis of Sketch No. 2

(d) Carpenter's wages

No.	*Ghani part*	*Days required* *For carpenter*	*For coolie*	*Total wages (at wartha)*
1.	Complete ghani	20	5	Rs. 35-0-0
2.	Mortar	10	-	,, 15-0-0
3.	Replaceable parts	4	3	,, 6-0-0
4.	Pestle	1½	1½	,, 3-0-0
5.	Load beam	2½	½	,, 3-0-0
6.	Stirrer	1	-	,, 0-10-0
7.	Curved wood etc.	1	-	,, 0-12-0
8.	Fitting & other charges		-	,, 6-8-0

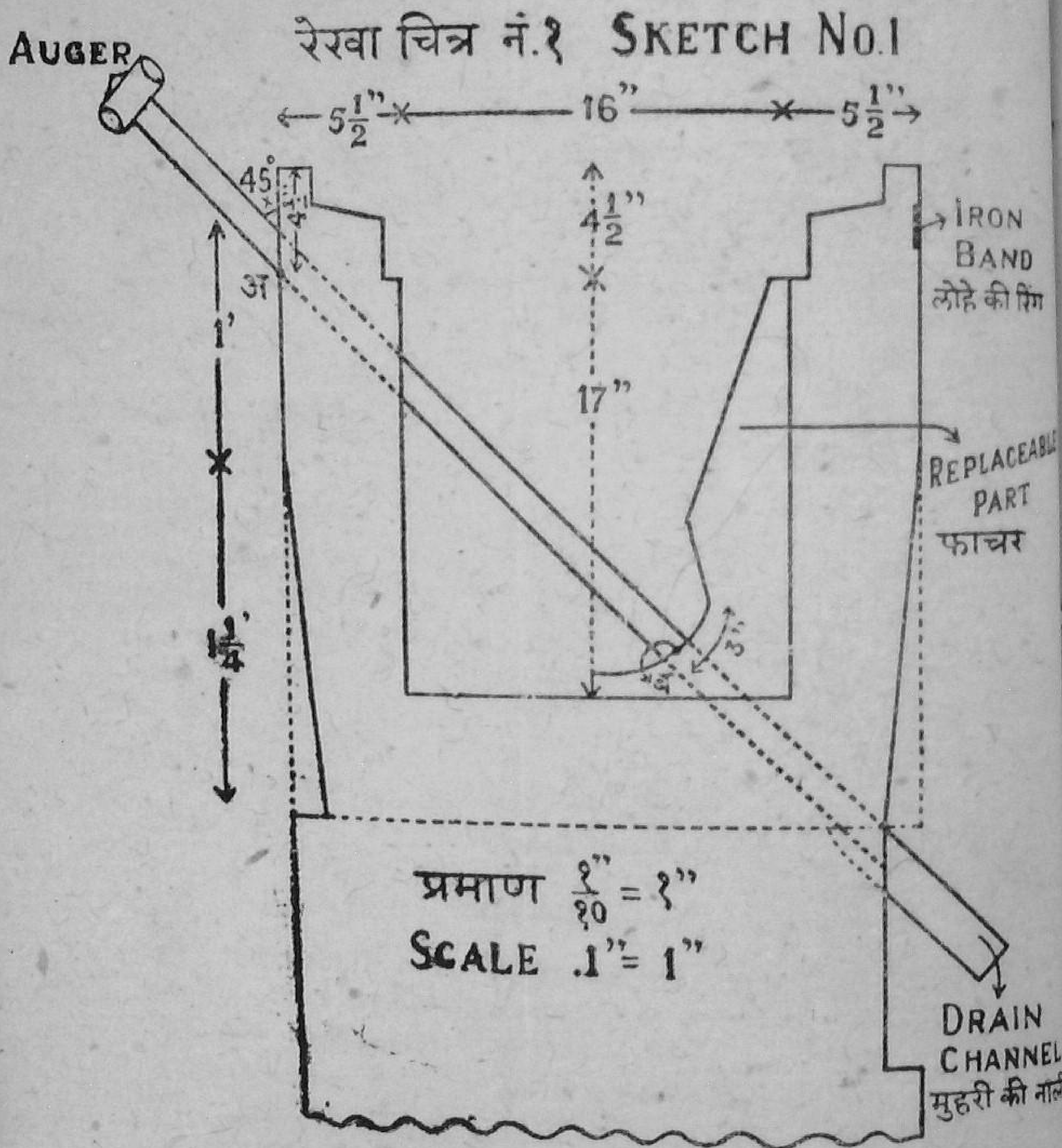


Fig. 10. The mortar, the cavity, the drain. To face Page 48.

2. Construction

The Mortar (Ref. Sketch No. 1)

(1) Saw the log straight at both ends.

(2) Starting from about a foot below the broader end of the log make a gentle slope just sufficient to remove the unevenness on the circumference of the log, and running down the side to about a foot and a quarter. Along this slope the log should be made perfectly round and smooth as it is to be the part in contact with which the load beam will revolve. If it is not perfectly round and smooth it will increase the friction between the mortar and the load beam and cause jerks on the pestle.

(3) The lower end of the log which is to be buried underground should be coated with tar and sand. Care should be taken while fixing the log that it is perfectly upright and its top surface is in level. The part of the mortar above the ground level should be about two and a quarter feet.

Cavity for the pit:

(4) Fix the centre of the top surface of the mortar and draw a circle of 8" radius.

(5) Scoop out the whole circle to the depth of 21½" making it into a perfectly cylindrical cavity of 16" diameter. To test this, the plumb-line scale on the top surface of the mortar making the centre of the scale Coincided with the centre of the cavity and from the string of plumb-line try a stick equal to the radius of the cavity, 8" long, over the whole depth, Also, tally the side and the bottom of the cavity with the mason's square.

(6) With the help of a marking gauge draw a line along the wall of the cavity two inches below the top surface.

The top surface which is now in level should be scooped out leaving a sort of ridge along the edge 1½" high and

1½" broad and from this ridge the surface should be made to slope towards the centre by ½" which will bring the top of the wall of the cavity to the line that we have already drawn.

(7) The outer circumference of the mortar should now be bound by an iron band and where the unevenness of the log leaves any gaps between the band and the mortar, such gaps should be blocked up.

Note :—Before fixing the band the outer circumference of the log should be made as round as possible. However to do this, it is not necessary to remove the irregularities completely as such gaps as are left can be blocked up. In choosing the wood it should be kept in mind that these irregulatires do not extend to more than about two inches towards the centre.

2. The Pit (Ref. Sketch No. 2)

(a) *First Method*

(1) Select a log of wood about 17" in diameter seasoned, fairly straight, without knots and 18" long. Make it roughly round by removing the irregularities and with the help of a lathe make it into a perfect cylinder of 16" diameter.

(2) Saw it straight at both ends, reducing it to the same length as the depth of the cavity i. e. 17".

(3) Fix the centre of the top surface of one end and draw a circle of 7" radius and also any one diameter. At one end of the diameter take twe points 1½" away on its either side along the circumference and draw two radii passing through these points.

Saw the log vertically along the diameter and then saw both the parts vertically along the radii lines. This makes space for the third part, the key which has to be thurst in.

Note :—In order to make space for this key, it is necessary to cut 1½" from both the parts, for, if 3" are the cut from one part, the other part which is equal to half the pit will not allow any packing to be done behind it,

(4) On the flat surfaces of the two parts draw perpendicular bisectors. Put templet अबकडई (sketch 2) on the flat surfaces so that the perpendiculars and the straight line of the templet tally. Mark out the shape of Sketch No. 2 on the surfaces by putting the templet on either side of the perpendiculars. Draw two straight lines passing horizontally through ई and ड (sketch 2) respectively.

(5) First scoop out the portion of the part above the first horizontal line according to the shape just drawn and the circle drawn on the top surface (ref. article 3).

(6) With the help of the templet ईफ (sketch 2) dig out the line to the depth equal to the radius of the neck. This depth will be reached when the templet touches simultaneously the two points on the line.

(7) Similarly dig out the next horizontal line.

(8) With the help of the templet डकग (sketch 2) make the bottom slopes in both the parts.

(9) Finally both the parts should be tallied over the whole breadth with the templet अबकडई (sketch 2).

(10) The third part called the key which will complete the whole pit should have a head i. e. it should be about 2" longer and about 2" thicker at the top. This head has to be removed after thrusting the key in. This Key should be tight when placed along the two replaceable parts without any packing. It will fit in tightly after applying the lime plaster and gunny cloth.

The key is prepared thus. Shape it at the back having the same circumference as the two parts. Then place on its top surface the three inches wood which is cut from the whole cylinder and mark the slopes of its two sides Making allowance for the extra width necessary to fill up the gap, cut the sides 4f the key in the direction of the above slopes. Then keeping the head, shape it according to the two other parts.

(11) Now bore the drain in the manner illustrated in Sketch No. 1 after placing the replaceable part in the cavity.

The point ब should be in level with the top of the replaceable part whicoh is 4½″ below the top of the cavity. The augar should be kept at an angle of 45°. Point अ where the auger point should be placed while boring through the replaceable part, is 3″ away from the corner of the part. If there is any obstruction in putting the augar point exactly on space should be made near अ so as to remove the obstruction.

Note :—It is necssary that the replaceable part remains in its place while it is bored through. This can be done by fitting very tightly two wooden strips between the part and the cavity, one at the bottom being about 8½″ long and the other at the top being about 16″ long.

12) Just below the point at which the drain comes out a small wooden piece, with a semicircular channel carved along it, is fixed well within the mortar at an angle at which the iron placed in the drain will not be obstructed by this channel. Through this channal the oil will run down to the receptacle below.

(13) Plaster the cavity wall with lime and apply gunny cloth to it. Also put double gunny cloth between the two parts and fit them up by thrusting the key in after applying a little oil on its two sides.

Note:—To keep the bored part in its place while fitting up the key, insert the 1⅛″ iron rod into the drain from below allowing it to pass over the part.

(14) Insert small pegs in the bottom gap and make the surface smooth. Cut out the projecting gunny cloth on the wall of the pit and the head of the key.

(15) The cavity of the mortar is made $21\frac{1}{2}''$ deep (refer to article 5, Sketch 1). After making the ridge and the slope (refer to article 6, Sketch 1) the cavity remains $19\frac{1}{2}''$ deep. From this 17″ are taken up by the replaceable parts that are just fitted in. This leaves a margin $2\frac{1}{2}''$ high and 1″ wide over the replaceable parts. Scoop out the margin by an inch beyond the replaceable parts making it of 18″ diameter. This prepares the stirrer margin 2″ wide and $2\frac{1}{2}''$ high.

(16) As the oil receptacle is placed under ground, that part of the mortar is exposed and therefore, to give it support at this point the three sides of the pit for the vessel should be made firm with stones or wood.

(b) *Second Method*

If the log of wood of 17″ diameter is not available, four or five replaceable parts will have to be made for one pit.

(1) Select four seasoned babul or kusum logs of wood 18″ long and about 12" in diameter. Saw each log vertically along its diameter. Prepare the widest part of each piece to be fitted against the cavity.

(2) Fix a nail in the wall of the cavity at the part where the first replaceable part is to be fitted in to give it support and fixity.

(3) Place the replaceable part into the cavity and fix the plumb line scale on its top by cutting two notches at either end of the diameter of the cavity about 1″ x 1″ and extending to the level of the top surface of the replaceable part and make the centre of the scale coincide with that of the cavity. From the centre of the scale draw radii lines to meet the two top ends of the replaceable part touching the cavity wall. These lines will be the slopes of the sides of the replaceable part. Mend the sides in these slopes and make them straight and smooth with the help of a plane. Again, from the centre of the scale draw a 7″ radius circle on the top surface of the replaceable part.

(4) Prepare the part as explained in article 4 to 9 of the first method keeping it $\frac{1}{8}''$ broader at the bottom part than at the neck.

Note:—After preparing one replaceable part as shown above others are to be copied. They should be first fitted against the cavity wall and the sides of the complete parts and then pencil marked and shaped accordingly. Finally each replaceable part should be tallied with the templet अबकडइ sketch 2.

(5) Prepare the key as stated in article 10 of the first method.

(6) Before fitting up the replaceable parts, prepare the bottom filler 7″ in diameter with the help of the templet 'डकग' (sketch 2), making a hole in it in the direction of the drain as explained in article 11 of the first method. Then fit up the parts as explained in article 13 of the same method.

(7) Maintaining the position of the hole, fit up the bottom filler by inserting small pegs all round it and pack up the pit as stated in articles 13 and 14 and prepare the stirrer margin as stated in article 15 of the first method.

(c) *Third Method*

If the mortar wood is hard and solid, instead of making a cavity in it to fit up the replaceable parts for preparing the pit, the pit can be directly scooped out in the wood and used for a year or more and then changed into the cavity in which replaceable parts prepared either according to the first method or the second can be fitted up. This saves labour in the initial stage.

(1) Fix the centre of the top surface of the mortar and draw the neck circle, the fulcrum circle and the stirrer margin circle of $7\frac{1}{2}''$, 14″ and 18″ diameters respectively. First scoop out the neck circle to the depth of $14\frac{1}{2}''$ maintaining the same diameter. Prepare the top surface of the mortar as explained in article 6 of the first method.

(2) prepare the chest part making the necessary curvature in the chest wall from the fulcrum circle to the neck.

(3) Then prepare the socket part according to the measurements of the pit and tally the whole pit with the templet अबकडई (sketch 2) to see that the curvatures of the bottom, the socket wall and the chest wall are correct.

(4) Bore the drain as explained in article 11 of the first method.

(5) Scoop cut the stirrer margin.

3. The Pestle

(1) Remove the irregularities on the surface of the wood and try to make it as cylindrical as possible with a diameter of about 8″

(2) Saw the log straight at both ends.

Note:—Select that end which is the weaker of the two because of knots or other defects in the wood for the tapered end.

(3) On the bottom of the thicker end fix the centre and draw any diameter.

(4) Hold one end of the string on to the centre and take the string along the diameter towards the other end of the pestle. Let the string pass on the pestle in such a way that it leaves space on either side equal to half the required diameter of the pestle, which is $7\frac{1}{4}''$ upto 6″ from the bottom end and $5\frac{1}{2}''$ after that upto the fulcrum point. Measure this space upto about 2″ beyond the fulcrum point.

(5) Stretch the string straight and mark the line along the string passing through the bottom of the other end of the pestle.

(6) Turn the pestle over and take another diameter on the bottom of the thicker end at right angle to the one previously drawn.

(7) Holding the string along the second diameter pass it on to the other end as directed in article 4 above, leaving the necessary space on either side and mark the line as before along the string passing through the bottom of the other end.

(8) Locate the point of intersection of the two lines drawn. This point will form the centre of the top end of the pestle.

(9) Fix the pestle cylinder on a lathe, allowing it to rest on the two points of the lathe, from the two centres marked at its ends.

(10) Make the bottom section of 7½" diameter upto 4". From this point mark a spot 1¾" away and at that spot reduce the diameter to 5½". Connect the two diameters with a staight slope.

(11) Continue this diameter of 5½" to a distance of 12" and extend it 3" further where it is connected with the original size of the wood by a straight cut

(12) With the help of the templet डकग (sketch 2) bring about the slcp at the bottom,

(13) Make a rounded hollow space about 4" long, 1½" broad and ¾" deep on one side of the pestle at the neck part to allow oil to run down from the chest to the socket,

(14) To help in handling the pestle a small peg should be fixed about 8" above the fulcrum point.

(15) Make the other end of the pestle tapering from a distance of about 9" leaving the tapered end of about 1½" diameter passing through the centre which is allowed to rest on the lathe point.

4. The Stirrer (Ref. Sketch No. 3)

(1) Take babul or any other hard wood, 1½' long, 5" broad and 4" thick. Put templet No. 1 on the bottom of the wood along its breadth, mark out the outer and inner curvatures and shape the wood accordingly.

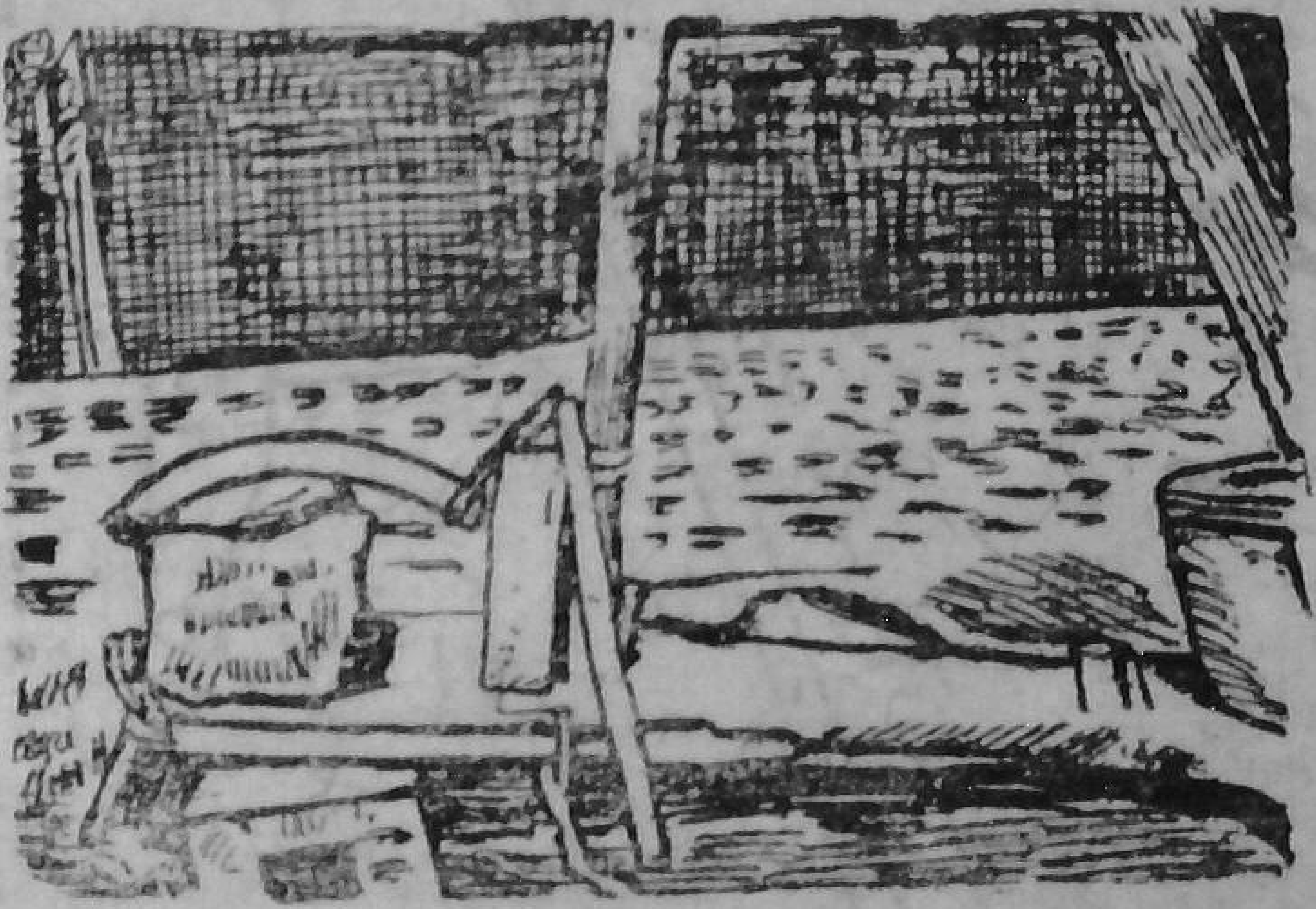


Fig. 12. The load beam—Ordinary Pattern.

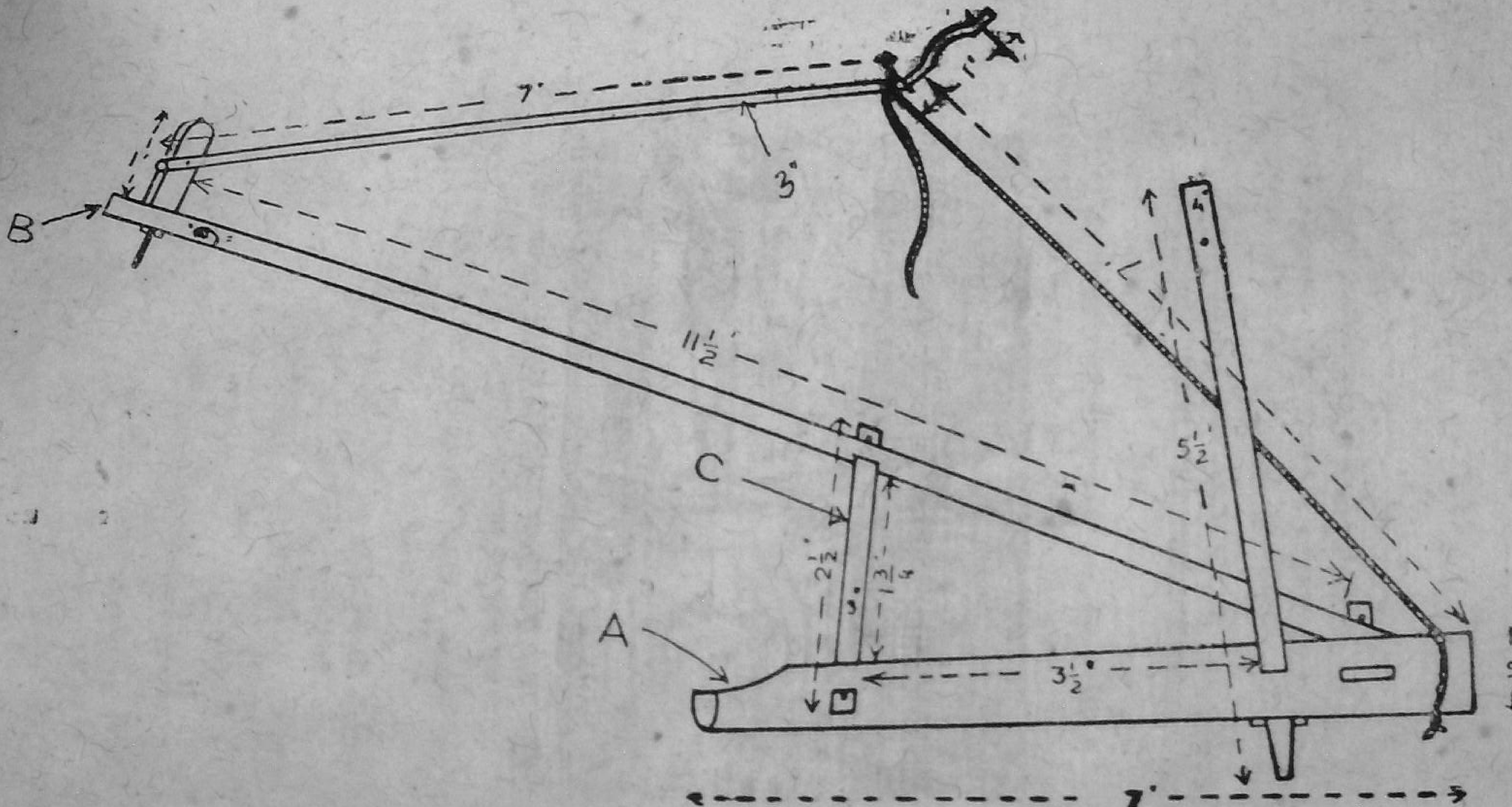


Fig. 11. The load beam—Gujarat Pattern—Page 57

(2) Put templet No. 3 vertically along the wall of the inner curvature, mark out its shape and prepare the wall accordingly.

(3) Put templet No. 2 on the top surface of the wood so that the inner curvature of the templet and the wood tally. Mark out the outer carvature and join it to the outer curvature at the bottom by making a straight slope.

(4) Join this face part of the stirrer to the long rod.

5. The Curved Wood

Select the wood as described in the list of equipment in Chapter 4 and make the hole for the top end of the peatle as explained and illustrated in Chapter 3.

6. The Load Beam

Sketches No. 4 and No. 5 as given on pages 57 and 58 are clear enough to guide the carpenter regarding the construction of the load beams of both the Gujarat and the ordinarry patterens.

The letters B,C,A, in Sketch No. 4 refer to the 'beam lever', the collar and the post beam respectively, The bean lever can be kept 8 feet long if 11½ feet is found too long. Consequently the rope will be reduced proportionately.

5. INSTALLATION AND REPAIRS OF THE GHANI

1, How to install the Ghani

(1) The mortar should be very firmly buried underground upto its waist, where a cut is made, leaving about two feet and three inches above the ground. It should be buried quite erect, and not slant on any side.

This can be tested by filling water in the ghani pit after corking its drainage hole with the help of a piece of cloth. If the level of the top of the replaceable parts tallies with the level of the water, the mortar can be taken to be erect.

(2) Below the pipe where the channel piece is fixed, a pit to contain the oil receptacle should be dug, This pit makes the support underground weak and to guard against it, stone slabs or planks of wood must be put as supports, two against the trunk where grooves for these are made and one as a support to these two.

(3) The load beam should move about the mortar, freely without causing much friction.

This can be brought about by adjusting the pegs that are inserted with the post.

(4) A load of about four and a half mounds should be put upon the load beam beyond the post. In the case of mustared seeds, if the eake is not formed in proper time, the load may be reduced till it is formed.

(5) When the charge is finished the load beam is allowed to rest on a stand. Between two charges the bullock should be given a little rest with the yoke removed from its neck.

(6) The rope connecting the yoke with the load beam should be seven feet long.

(7) The stirrer is to be hung at one end by a nail thrust in the beam post. The curved end of it is put above the pit margin, allowing its round edge to touch against the wall. A load of about ten seers is hung at the end near the post to give force in stirring the seeds.

(8) The iron rod should be inserted in the pipe to close the mouth of the pipe keeping it about $\frac{1}{8}$" bellow the level of the pit, and never allowing it to go inside the pit. To take out oil thrust this rod in twice or thrice to break the thin layer of cake which is formed at the mouth. Before thrusting this rod in, stop the motion of the bullock at a place which will bring the pestle on the side opposite to that of the drain so as to keep the drain mouth inside the pit open.

(9) Leaving about three feet of ground round the mortar a trench about one and a half feet deep and two and a half feet wide should be dug for the bullock's track.

(10) In order to keep dust away from the oil vessel, keep it covered with a wooden plank.

2. Ghani Repairs

Note:—In what follows, chest refers to the upper portion of the pit, neck to the narrow middle part and socket to the lower part.

(a) Defective functioning of the pestle

(1) The pestle revolving without resting on the fulcrum.

(2) The pestle being pushed out

(3) Loss of pressure on the chest wall of the pit

(4) The passage of oil from the chest to the socket being blocked

(5) The pestle breaking

(b) Formation of uneven cake

(c) The drain getting blocked

(b) The iron rod getting bent

(e) Lagging behind of the curved wood

(f) Defective functioning of the stirrer

(g) Defective working of the load beam

(h) Replacement of parts and pestle

(a) **Defective functioning of the pestle:**

1. *The pestle revolving without resting on the fulcrum*

1. If the pestle is broader at the bottom, it may not slant sufficiently to rest on the fulcrum in which case the pressure will be ineffective. Therefore the bottom end should be shaved off until the pestle rests on the fulcrum.

2. Due to the girth of the pestle at the fulcrum point being small either by construction or by wear it will revolve without contact at the fulcrum point. In such a case, either the pestle should be replaced or the ends of the same pestle be reversed.

3. If there is not the needed space at the chest wall or at the neck for the cake formation, the pestle will be cushioned up by the cake towards the centre. This may happen if the pestle is broder at that part or if the curve in the wall of the chest is less than necessary. A rough test is to see that the fingers can pass through the space between the pestle and the wall of the chest.

2. *The pestle being pushed out*

1. After being in use for some time, the socket gets widened and the pestle gets thinner. Hence greater space is left empty at the bottom where the seeds settle down and push up the pestle. In such a case either the pestle should be replaced or its ends reversed.

2. If the bottom surfaces of the socket and of the pestle in contact do not fit in exactly with each other there will be space left where the seeds will settle down and push up the pestle.

This happens when either the slope of the socket bottom is less or that of the pestle bottom is greater or uneven.

3. The pestle will come up if more than the required amount of water is poured into the socket. This extra water makes the cake very sticky which sticks to the bottom and pushes up the pestle.

3. *Loss of pressure on the chest wall of the pit*

If the pestle is too broad at the fulcrum point, there is much space left between the pestle and the chest wall. This may also happen if the curvature in that wall is too great. In either case the cake formed will be thick and the pressure will be ineffective.

4. *The passage of oil from the chest to the socket being blocked*

Sometimes the oil that is collected in the chest takes very long to run down below. This happens if the hollow space in the pestle is shallow or goes below the neck when the bottoms of the socket and the pestle wear out. If so the hollow space should be deepened a little and lengthened upwards so as to extend to about an inch over the neck.

5. *The pestle breaking*

If the pestle, instead of revolving uniformly, jerks, it will break from where there is a knot. Therefore, it is better to select pestles (wood) without knots.

The causes of jerks are as follows;—

1. While beginning the charge, when the load beam leaves its seat, it gives a great jerk to the pestle. Therefore, both the pestle and the beam post should be held up by hand at that time.

2. After most of the oil is extracted the cloth that is used for brushing the seeds or oil is placed below the pestle for pressing out oil from it. At this stage the cake is hard. If this piece of cloth is not spread out uniformly but is put in one lump it cushions up the pestle which rises and falls.

3. If the pestle is not straight i. e. its bottom end, its fulcrum point and its top end are not in alignment, it will make big jerks and break easily.

4. If the cut that is made in the pestle above the fulcrum point is not far enough then it rests on the pit

surface and does not allow the pestle to touch the pit wall. Hence when it revolves it slips off and makes big jerks, It presses the powderd seeds on the top surface of the pit and this has to be constantly removed, All this can be avoided by making the cut about four inches above the fulcrum point. This cut has to be renewed whenever the wear of the bottoms of the pestle and the pit calls for it.

5 If the water that is added from time to time is insufficient and the powder moves dry the pestle slips and jerks.

(b) Formation of uneven cake in the pit:

If the mortar is not fixed in level or sinks to a side afterwards, thicker cake will be formed on that side which bent and very thin on the opposite side. This can be set right by making the mortar erect.

(c) The drain getting blocked :

1. If water that is added is too much the cake sticks to the bottom and blocks the mouth of the drain.

2. If the head of the iron rod is smaller in proportion to the drain hole it does not allow oil to run down easily as the cake power blocks the passage.

(d) The iron rod getting bent :

The iron rod is to be thrust to break off the thin layer of the cake which gets formed on the drain mouth. This should only be done when the pestle is on the side opposite to that of the drain and only when the drain is open. Also the bullock should be stopped while thrusting the rod. If the pestle runs over the rod it will bend and then it is very difficult to take it out without damaging the drain.

(e) Lagging behind of the curved wood :

If the socket in the curved wood that rests on the pestle is made at the wrong place or angle and as long is it keeps rough and does not get smooth by use, the wood does not move freely with the pestle but is left behind.

1. In such a case a stick should be placed across opposite ends of the pegs of the curved wood and the beem post. The beam post exerts its force through the stick which makes the curved wood move along with the pestle.

2. The wrong angle ot the hole should be corrected.

(f) Defective functioning of the stirrer:

1. If the outer curvature of the stirrer is not made of the same circumference as the margin wall it will not move smoothly.

2. If the slopes in the curvature side and at the bottom of the stirrer are not properly made, space will be created and seeds will fill it up.

3. If the stirrer is tied to the post very high or very low it will not fit in the margin. Ordinarily, it remains about an inch high over the margin wall.

(g) Defective working of the load beam.

1. The place of the post in the beam is nearly (as allowance has to be made for the load on the beam) where the perpendicular dropped from the top end of the pestle falls on the beam. If the post comes nearer to, or goes away from the mortar the balance is lost and the beam goes up or comes down along the mortar. This can be made right by changing the position or angle of the post in the beam. The post should be taken towards or slanted towards the end of the beam which goes below the level. In other words, the peg that is inserted with the post should be thrust on the same side of the beam, the end of which side goes up. Thus, the rope will lift up the slanting post and so the beam end along with it.

2. The rope connecting the load beam and the yoke should be tied to the yoke as close to the bullock's neck as possible.

(h) Replacement of parts and pestle:

When there are signs of the working efficiency of the ghani getting decreased, such as the percentage of oil being reduced or the pestle being pushed up during the charge, they indicate the necessity for the replacement of the pit and the pestle. Ordinarily, these parts as designed at present last for about an year.

The parts of the pit can be easily taken out by breaking the key that is tightly fitted in.

6. OIL PRESSING

Importance of Adding Water to Seeds

The oil in the oilseeds exists in the form of minute particles or globules surrounded by tough membranes. The addition of water and the production of heat due to friction between the seeds and the wood during the process of pressing seeds form a sort of cooking the effect of which is to coagulate the membranes of the oil globules and to render them soft while at the same time the oil globules under the action of heat expand tearing assunder the already softened membranes.

In the process of pressing oil, addition of water to the seeds plays a very important part. The oilman must acquire the art of knowing exactly how much water to add and when to add it. Without this knowledge the pressing will be very defective, more time will be taken and the yield of oil will be less.

It is not easy to acquire this knack, for no hard and fast rules can be given for determining the proportion of water, which depends on many factors. The only safe way to find out whether the water is less or more or just enough, is to take out the cake and feel it in the same way as cooks take out a grain of rice and feel whether it is cooked or not. This is possible only after observation and experience, but primarily, the skill of the man is the main factor. Though difficult of achievement, it is as pleasant and profitable as it is difficult and herein lies the great value of handicrafts. Whereas, in the case of big machinery, the machine rules the man and gives no occasion to him for exercising his talent, in the case of handicrafts the man rules the machine and gets ample opportunity for the development of his skill.

The proportion of water to be added differs according to the variety af the seeds, their degree of ripeness, the time of the year and according as they are wet or dry. In the rainy season, there is moisture in the seeds and the water required will be less than in winter while in summer it is much more. In the case of some seeds the difference in this proportion is only about 5 to 7 tolas per charge, but all the same it is most important.

If the water is less than required the cake will be dry and will not give out all the oil. On the other hand if the water is more than required the cake will become sticky and then also it will not give out all the oil. Thus it is most essential to add the exact measure of water. A rough test of knowing whether the water is sufficient or not is to take out a little of the crushed seed and make it into a pill. If it forms itself into a pill, the water may be taken to be sufficient, if it crumbles, the water is not enough.

Besides the quantity the time when the water should be added must also be studied. As the water, besides helping to extract the oil, makes crushing easier, it should be added from the beginning and continued little by little as the powder becomes fine and dry. If too much water is added before the powder becomes fine the latter begins to stick and takes more time to be fully pulverised. On the other hand, if water is not added at the proper time, the dry powder will keep on rolling in the pit without forming into cake, in which case also, it will take longer to finish the charge. A certain amount of water should be poured into the lower part of the pit, for cake formation, for, unless this cake is formed first, the upper powder will keep on rolling and not become cake.

We have given here the details of pressing seeds for the bigger pit A (Sketch 2) alone. It receives 18 lbs. of gingely seeds per charge, while the smaller one receives 12 lbs. From this it will be possible to work out the quantity of different seeds to be put into the smaller pit per charge.

This quantity depends on the quantity of the cake that remains in the pit after the oil is extracted from it. The seeds which have a higher oil content will leave less cake in the pit and therefore will be received in greater quantity, while, the seeds which have a low oil content will leave more cake in the pit and therefore will be received in a smaller quantity. The test to know whether the seeds put in one charge are just sufficient and neither less nor more is too see that the cake formed in the chest and particularly below the fulcrum is ordinary medium size and neither too thin nor too thick.

The water that is added is hot. The measure of water given here should be taken to be approximate, and not exact, and allowance has to be made for the quality of seeds, the extent of moisture present in them, the proportion of the cake formed in the chest and the socket parts of the pit, the kind of wood, whether seasoned or green, and such other consideration.

Oilseeds

(a) Gingely (b) Groundnut (c) Coconut (d) Linseed (e) Mustard (f) Rape (g) Mahua (h) Castor

(a) Gingely

Capacity per charge	18 lbs.
Time ,, ,,	$1\frac{1}{4}$ to $1\frac{1}{2}$ hours
Oil Extraction	45 per cent

In winter and summer 60 tolas
In rainy season 40 to 50 tolas

First water

About 5 minutes after beginning the charge; 15 tolas in the chest and 10 tolas in the socket.

Second water

About 5 minutes after the first water; 35 tolas in the chest.

Details

In order that space may be left for the pestle to revolve in the pit about three fourths of the seeds that are put in one charge are allowed to be crushed first, keeping the remaining on the top of the mortar. After about 5 minutes, when seeds put in the lower part of the pit come up, the first water is added as stated above. In the rainy season the seeds become sticky and do not easily come up in which case they should be dug out once or twice before adding the water. To make sure that the water to be added into the socket is not retained in the chest but reaches the socket it should be added only after making space for it to go down, near the neck, with the hand stirrer.

If a sufficient quantity of water does not reach the socket, the cake in the chest becomes sticky and oil begins to appear before the powder becomes fine. The powder in the socket also does not form into cake and as in the circulation it goes up to the chest it does not allow the oil to get free from it for a long time. When the drain is opened the oil comes out mixed with powder. Thus, if there is more water in the chest than necessary oil begins to appear prematurely and if it is evenly distributed the powder is being crushed in a dry state. In rainy season only 5 tolas out of the first water should be added to the socket, because otherwise the pestle will be pushed up.

After the first water the stirrer should be brought into use and about 5 minutes afterwards the second water, 35 tolas and 15 to 20 tolas in the rainy season, should be added to the chest. While adding this second water if there are signs of insufficient water having reached in the socket, then about 3 tolas out of the second water should be poured into the socket after making space. After the second water the remaining seeds should be mixed with the powder which being compressed makes more space for the pestle to work at a slant. Thus the full quantity of water is added in the course of 15 minutes.

About 10 minutes after the second water when oil begins to appear, a little powder taken from the pit should be made into a pill. If this pill crumbles it means water is not sufficient. To rectify this about 5 tolas of water should be added to the chest. At this stage the cake should be turned over with a crowbar 5 or 6 times. This helps the power to get pressed along with the cake and makes the oil pure. Now the stirrer should be removed and the cake allowed to gather at the top. In about 5 minutes after this the drain should be opened and the oil allowed to run down. The collected oil should be strained, and the sediment should be put back into the pit. Off and on the drain should be cleared with the rod. All the oil is pressed in in about 1¼ hours. At the end 2 or 3 tolas of water should be sprinkled on the cake to soften it and loosen it from the pit. Then the bullock should be allowed to go 4 or 5 times round and the cake taken out. The charge is now finished.

(b) Groundnut

Capacity per charge	18 lbs
Time ,, ,,	1 hour
Oil Extraction	45 to 49 per cent
Water	60 totals in summer and winter, 30 to 35 totals in the rainy season

It is advisable to heat the seeds in an iron pan before putting them into the ghani. If unheated seeds are pressed the oil appears white like milk and is full of sediment. Heating helps pure oil to be extracted.

Details :

The process of pressing groundnut is almost the same as that of pressing gingely, except that about 5 tolas less of water should be added to the socket.

In the rainy season as the seeds become soft due to moisture less quantity of water is added, about 35 tolas, of which only 5 tolas should be added to the socket.

Experience has shown that crushing of groundnut seeds in shells is far more easier than crushing seeds without shells. It saves time and gives oil free from sediment. Even in the expeller mills it is found convenient to keep a certain portion of the seeds in shells along with the decorticated ones for crushing purposes. The cake is of course edible for eattle and is so used in some places like Khandesh.

It should however be noted that if the undecorticated seeds are to be pressed they must be washed clean of mud etc. in order that full extraction of oil becomes possible and pure cake is made available for cattle. Pressing of undecorticated seeds should better be restricted to those small varieties of seeds which yield higher extraction and whose shell are thin. If the bigger varieties are to be pressed only a portion of the seeds may be kept undecorticated. The pressing of the seeds in shells does not make much of a difference in the percentage of oil extraction and certainly facilitate the extraction of oil as stated above. It also saves the labour of decortication.

If however the cake is to be used for human consumption only decorticated seeds should be pressed.

(c) Cocoanut

Capacity per charge	20 lbs.
Time ,, ,,	$\frac{3}{4}$th of an hour
Oil Extrction	55 to 60 per cent
Water	30 to 35 tolas in summer and winter, 15 to 20 tolas in the rainy season

First Water :

In the beginning; 5 tolas in the chest.

Second Water :

After 10 minutes; 10 talas in the chest and 5 tolas in the socket.

Third Water :

10 minutes after the second water; 5 to 10 tolas in the thest.

Details :

After the first water, when the big pieces are pulverised the powder should be turned over once or twice with the crowbar. When it becomes dry, second water should be added as stated above. About 10 minutes after this when the powder keeps on rolling with the oil, the third water is added. This frees the oil from the powder which gets pressed with the rest of the cake. At this stage the cake should again be turned over once or twice.

(d) Linseed

Capacity per charge	12 lbs.
Time	1½ hours
Oil Extraction	32 to 35 per cent
Water	65 tolas in summer and winter; 50 tolas in rainy season.

First water :

In the beginning, 10 tolas in the chest.

Second water :

After 25 minutes, 15 tolas in the chest and 10 in the socket.

Third water :

15 minutes after the second water, 25 to 30 tolas in the chest.

Details :

All the seeds that are put into one charge are allowed to be crushed from the start. About 10 tolas of water is sprinkled to the chest. This water makes the hard and slippery linseed soft and thus checks the slipping of seeds.

About 25 minutes after the first water when the seeds are half crushed the second water should be added as shown above. This water makes the powder more soft and sticky which gets pressed and circulates speedily. At this stage the stirrer should be put into use.

About 10 minutes after the second water when the powder becomes dry, oil begins to appear and the circulation becomes slow, the third water should be added. This makes the powder again soft and sticky and increases its circulation. This time the powder becomes very fine and the oil is extracted in about 10 minutes. As the proportion of oil in linseed is comparatively low the oil that is extracted in the pit goes to the socket part if sufficient water has reached the socket. This makes us wonder if there is any oil at all. If the oil extracted remains in the chest it means that sufficient water has not reached the socket, and there is sediment rolling up instead of pure oil.

It is not very necessary to turn over the linseed cake, but when the old sediment that is strained from the stock of oil is mixed in the charge at a time the cake should be turned over 4 or 5 times.

When the oil becomes free from powder the stirrer should be removed. If the oil that is gathered in the chest does not go to the socket the drain should be opened and the sediment that comes out should be put back again with the cake.

No sprinkling of water to loosen the cake from the pit is necessary.

For other details of the process refer to the description given of pressing gingely. In the case of linseed, it is advisable to open the drain earlier than in the case of gingely.

(e) Mustard

Capacity per charge	15 lbs.
Time ,, ,,	1½ hours
Oil Extraction	30 per cent
Water	70 tolas, in summer and winter, 60 tolas in the rainy season

Details .

The process of pressing mustard is similar to that of press linseed.

(f) Rape (Sarsaon)

Capacity per charge	16 lbs.
Time ,, ,,	$1\frac{1}{4}$ to $1\frac{1}{2}$ hours
Gil Extraction	35 to 40 per cent
Water	60 to 65 tolas

Details :

The process is the same as that of pressing mustard seeds.

Note:—The alternative method of adding water to rape seed and mustard is to add about 15 tolas of water to the seeds in an iron pan by mixing them thoroughly so that the water is spread out uniformly and then to feed them to the charge. The remaining water is added to the seeds in the charge.

(g) Mahua Seeds

Capacity per charge	16 lbs.
Time ,, ,,	$\frac{3}{4}$ hour
Oil Extraction	35 per cent
Water	20 to 25 tolas

First water :

In the beginning, 5 tolas in the chest.

Second water :

After 20 minutes, 10 tolas in the chest and 5 tolas in the socket.

Third water :

10 minutes after the second water, 5 tolas in the socket

Details:

If the seeds are unripe, white and wet, no water is needed at all. The percentage of oil extraction from such seeds is also much less.

If the seeds are ripe, red and dry, water is needed. Ordinarily fresh seeds are available only in the beginning of the rainy season and so the seeds are wet and require comparatively less water to be added. Only fresh seeds are pressed well. It is very difficult to extract oil from old seeds without mixing the mahua flowers with them.

Only if the seeds are dry the first water should be added to the chest. The second and the third waters should be added as shown above.

The cake should be turned over twice or thrice.

(h) Castor Seeds

Capacity per charge	18 lbs. (with husks)
Time ,, ,,	1 hour
Oil Extraction	40 per cent
Water	Nil

Details :

The seeds are just heated into hot water and put into the pit after straining completely all water from it. This makes the seeds soft. Oil begins to appear in 10 to 15 minutes when the cack should be turned over twice or thrice, and the drain should be opened.

While putting the seeds into the pit even if only a little water is left with the seeds the cake becomes very sticky, the pestle is pushed out and no heat is produced. In such a case the seeds should be heated for a while by moving a burning torch in the pit.

This heat evaporates away the water, produces warmth in the pit and oil begins to be extracted.

'Vegetable Ghee Vs Fresh Ghani Oil'

The refining of vegetable oils and making them into hydrogenated vanaspati ghee is assuming such large proportions in India that instead of remaining as a side industry to oil crushing it has made the oil crushing industry subservient to it. Many oil crushing mills are regarded as suppliers of raw materials to the vegetable ghee concerns, the number of which is daily growing and promises to be very great under the impending postwar reconstruction plans of the Provincial Governments. As usual with any drive started by vested interests, this industry too has gathered a momentum of propaganda which is carried on ceaselessly by the paid scientists of the concerns. They present a partial truth which is dangerous. They exploit the masses and make them believe that the vagatable ghee is a wholesome product. They cannot scientifically lay claim to any greater nutritive value of this product than that of fresh oil. The only admissible quality will be the better keeping quality of vegatable ghee as compared with that of "rawoil".

Even here it is very important to remember that when the scientists talk of "raw oil" in this connection, they usually refer to mill pressed oil and not to the freshly pressed ghani oil. As it is there is a lot of difference between the two oils. The mill oil is bound to become rancid before it reaches the consumers. For, in the first place, mills crush huge quantities of seeds per day and it is difficult for them to sift out the decayed seeds or other dirt from the mass of seeds to be crushed. Then they stock decorticalted seeds which have a tendency to get rancid quicker than the undecorticated seeds. The mills do not find it possible to stock undecorticated seeds and get them decorticated from day to day. The storage arrangements are also far from being satisfactory. Thus there is an ideal situation for the seeds to become rancid before being crushed for oil extraction. Thus this oil which starts with some rancidity increases further while passing through the long channel of the distributing agencies of the mills.

If, therefore, the scientists recommend the use of refined and hydrogenated vegetable ghee in place of raw oil pressed by the mills, we cannot but agree. It is of course, better to use refined oil instead of rancid oil. But rancidity is not a constituent part of the oil itself. It is an acquired quality and is largely due to the mill process as indicated above. Rancidity is essentially a mill problem and the preparation of refined hydrogenated oils may be justified in order to solve this mill problem.

The scientists have nothing to adduce to commend the vegetable ghee as against fresh ghani oil which is free from all rancidity. It is quite possible to obtain fresh oil from the country ghanis.

The comparison does not end here. Raw mill oil is not regarded as fit for consumption. It has to be refined to be freed from all rancidity. The cost of refining oil should therefore invariably go into the total cost of the mill oil. In fact it is unjust to compare the prices of fresh ghani oil with those of raw mill oil. The rule should be to compare the prices of fresh ghani oil with those of the refined vegetable oil or the vegetable ghee. If this is done, the simple ghani will prove itself to be far more efficient and useful than the costly and complicated oil mills together with their attendant refining and hydrogenating plants. The comparison is not between the small tool, that the ghani is, and the big machine that the mill is. The comparison is between the two systems of organisations, one decentralised and the other centralised. This is an instance to show that one cannot always associate inefficiency with the decentralised method or efficiency with the centralised one, by merely comparing sections of an industry.

As an example of how the scientist suppress the unpalatable truths of the vegetable ghee industry from the public, let us take the theory of vitaminising vegetable ghee. In foreign countries the State enjoins such concerns to provide only vitaminised vegetable ghee. But in India there is no such obligation and it is highly doubtful how many of the concerns provide vitaminised vegetable ghee even after claiming credit for it. If they do, do they tell the public what are the agents they use for the purpose? If the public know that this vegetable ghee is vitaminised by adding fish liver oil to it, many of them may not touch the product at all. But this aspect of the question is hardly brought to the notice of the public.

Again vegetable ghee is no more suited for the addition of fish liver oil for vitamin purposes than fresh raw oil.

Thus fresh ghani oil and not raw mill oil should form the basis of comparison with vegatable ghee. Vegetable ghee can be said to be good only in its negative aspect in so far as it is made free from rancidity. It cannot be said to have established any superiority over fresh oil. It is of course, universally granted that vegetable ghee bears no comparison with animal ghee.

While in theory vegatable ghee favourably compares with raw mill oil and is intended to be used in place of such oil, in practice it tries to substitute the genuine animal ghee. It has become almost impossible to get pure animal ghee unadulterated with vegetable ghee. This situation has given the vegetable ghee concerns an argument to push their sales. They say why pay for genuine animal ghee and only get adulterated ghee? Why not straight away buy the vegatable ghee? This is nice tactics of course. First create a situation wherein adulteration can be practised and then ask for the purchase of their product. Not only this but they are against making the vegatable ghee of a colour which can be easily distinguished from the natural ghee. They are afraid of losing their customers in that way and therefore want to stick on to the form of the real ghee. If they recognise, as they seem to, the superiority of the natural ghee, over the vegetable ghee, they must not stand in the way of the customers of ghee getting the genuine product. This seems to be the sure way to stop adulteration. Government should be strict about this matter.

Odour : Just as refining removes the rancidity of the oil it also removes its odour. This second process called the deodourisation is acclaimed as a great success in that it removes any peculiar or pungent smell of the oil. Now removing the peculiar odour of a thing cannot be said to be a gain. What is a rose without its peculiar fragrance? Even in matters of food do we prefer smell less articles to those having peculiar smell? While buying rice people like rice having some good smell in it. The same is the case with oil. People rarely purchase oil without first ascertaining its peculiar smell. They are so accustomed to that very smell that they will not relish any other oil. Linced oil has a pungent smell and that of the rape seed oil is still more pungent. Those who are not used to these oils will feel a repulsion for them. But the usual consumers can't do without them. When this is the case it is useless to deodourise oil and still more useless to claim any value for it. But salesmen know how to turn their weak points to good account.

Let us just turn our attention to the nutritive aspect of the much advertised vanaspati ghee. Whatever information is available on this subject suggests that this vanaspati ghee becomes less digestible than raw fresh oil and is therefore of low nutrtive value. It is an artificial product unsuitable for human system and therefore much of it goes to waste. We can follow this better if we understand the following main changes brought about in the oil during hydrogenation.

1. The amount of stearic glyceride increases and consequently that of oleic glyceride falls.

2. A large amount of oleic acid is converted into its isomerisoleic acid which has a higher melting point (45°C) than oleic acid (melting point 14°C),

The effect of these two changes in the oil on the digestibility is as follows. The human stomach has less capacity to digeest a saturated glyceride like stearic acid glyceride than the unsaturated oleic glyceride. Hence the conversion of oleic acid glyceride to steoric acid glyceride makes it into a poor nutritive product. The converted compound acts as a burden to the digestive system and much of it passes out as undigested matter.

Iso-oleic acid is very much more difficult to digest than oleic acid on accotnt of its high melting point. Hence this conversion also during hydrogenation is injurious to the consumer.

Thus if the vanaspati ghee instead of being more nutritive is injurious to health or atleast it has no such positive claim to make, then all the investment and labour involved in the preparation of this product is so much loss to society. But as we have pointed out, the plan for refining oils and that of crushing oilseeds form part and parcel of one whole process and the two cannot be considered as separate units. Crushing oil seeds in a mill is only half the process. Oil supplied at this stage is only half processed oil in as much as it acquires rancidity as an inevitable consequence of the mill organisation.

There is always a talk of making use of the scientific progress for raising the standard of our life. Power driven machinery with labour saving devices invented by science are always put forth as the most efficent instruments of production. Giveing them up for the alleged harm they have done to society will tantamount to giving up the fruits of science. Let us pause and consider what science means. In the history of scientific progress mechanics preceed nutrition. For considerable time mechanics ruled the domain of science and its exploits were regarded as feats performee by the ingenuity of men. Later however other branches of science such as nutrition, hygine, biology etc. developed which have decried some of the mechanical feats, as injurious to human happiness; Mechanical skill produced huge rice polishing mills. But the science of nutrition condemns this performance. Numerous such examples can be cited, but here we may confine ourselves to the question of oil. The oil mill no doubt exhibits the high degree of mechanical skill but nutritively gives a poor product. It has again to erect equally huge plant namely oil refining plant to remove the bad qualities acquired by the product in the process and even after all this mountain of labour the rat produced is a tiny creature to the product of the simple country ghani. Now which science are we to follow? The mechanical or the nutritive science. If we follow the latter, can it be said that we give up the fruits of sciencitific progress? Simply because mechanical skill has invested certain machines does it mean that we are bound to use them even though they do not prove beneficial to us? And shall we only then be entitled to call ourselves scientific-minded? Let us pause a while and ponder over things so as to be able to separate the wheat from the chaff.

8 GENERAL

(1) Keeping qualities of oils

The water that is added to the seeds while pressing does not mix with the oil, but is sucked up by the cake. But if some cake powder is left in the oil, the powder retains a certain amount of water in it. This water as also the cake powder makes the oil rancid after a certain time. If the seeds are of an inferior quality, not properly stored or not fully cleaned before putting into the charge, then also the oil will get rancid.

The following are among the foreign bodies present in freshly extracted ghani oils.—

(1) Moisture (water)

(2) Albuminous of mucilaginous matter

(3) Suspended impurities like bits or oilcake, etc.

(4) Enzymatic bodies or minute organisms which are responsible for splitting up compounds

(5) Free fatty acids

(6) Colouring matter

(7) Characteristic odour

(6) and (7) are not lapses in so far as the edibility of oils are concerned. The nutty flavour (peculiar to the oils extracted in the ghanis) is probably the chief factor that accounts for the preference of the ghani oil to the mill product.

(1) to (5) are responsible for the general trouble associated with storage or keeping qualities of edible oils.

The two complaints brought to our notice regarding untreated ghani oils are:

(a) They turn rancid with storage and emit a foul odour which renders them non-edible, and

(b) They cause profuse frothing when a friable is introduced into them at high temperature.

Evidently the cure for both the defects consists in the removal of moisture, acidity, albuminoid and enzymatic bodies by coagulation. After the necessary treatment the oils can be stored for more than six months without their becoming rancid.

It is probable that most of the trouble comes from the use of damaged, broken and partly decomposed seeds that may have found their way into the raw material that is used for the extraction of the oil. If such objectionable matter be carefully removed there will probably be very little risk of rancidity developing at a rapid rate.

Care should also be taken to see that the oils are stored in clean vessels to which air and moisture have little or no access.

Investigations made in our laboratory with a view to eliminating the disturbing factors have led to conclusions which are summarised here.

(1) Til oil which has been very carefully filtered in the laboratory and kept away from air and moisture has not developed any rancidity even after six months whereas unfiltered oil showed first signs of rancidity after just a week and went difinitely bad after three weeks. The filtered oil which was exposed to atmospheric conditions kept well only for two months. What is said about til oil applies with necessary modifications to other oils.

(2) Treatment with powdered salt to the extent of a per-cent on the weight of the oil taken coagulated the albuminous bodies and preserved the oil from six to nine weeks. But care should be taken to see that soon after the treatment is completed which will be about 24 hours, the oil is separated from the salt on which the albuminous matter would have settled.

(3) The free fatty acid was removed by treatment with wood ashes which contained from 4 to 9% potash (the ordinary proportion being from 5.0 to 7.5%) and the oil was found to be preserved for over six weeks. In this treatment the oil (preferably treated with the soluble extract of the ashes and at high temperature) has to be filtered or decanted off from the accon-

panying soapy and coagulated impurities. Til oil which does not have much acidity requires only the above proportion of ash, where as there are oils with acid values as high as 20 for which comparatively larger amounts of ash are needed to neutralise the acids.

(4) A combination of the salt and ash treatments worked very well and retained the freshness of the oil for more than three months.

(5) In order to test if the practice of adding heated oil to the charge (to increase the yield) has any influence on rancidity, such oil was examined and the treatment was found to have no depreciative effect on the keeping quality of the oil.

(6) Till now we have eliminated moisture by using Plaster of Paris only, other infusorial earths having been found to be not very suitable. We have however found that if the salt-ash treatment is properly given the moisture singly does not do much to influence the rancidity.

(7) Regarding the occurrence of froth we have found that the same factors that cause rancidity are responsible for this phenomenon too. Treated oils do not froth unless, of course, the friable is introduced before the oil is not hot enough.

2. Cleanliness of the ghani

Generally, the surroundings in which the ghani is worked are dirty and we take this dirt as a matter of course and inevitable. But we must give up this attitude and learn to be intolerant of uncleanliness. If customers insist on cleanliness, the oil-man will be forced to observe it and as oil is an article of food, such insistance is all the more imperative.

To prevent uncleanliness, the following general suggestions should be carried out :—

(1) Dust is constantly raised by bullocks while walking and some of it has access to the oil vessel and the crushed seeds. To avoid this, the ground around the *ghani* should be kept very hard and the bullock's track should be kept about a foot

and a half lower in the form of a trench. Water should also be daily sprinkled over the space.

(2) The pit for the vessel which receives the oil should be protected from dust and urine by being always kept covered with a wooden plank made just to fit over the pit.

(3) The bullock hardly passes urine when he is in motion but does so, as a rule, when stopped. Therefore, he should be made to stand away from the pit where the vessel for oil is placed, so that the spray from the urine cannot reach the vessel.

(4) The oilman removes the dung with his hand and cleand it by rubbing it against the *ghani* or the bullock and stirs the seeds again with the hand thus half cleaned. This practice should be stopped and the dung should be always removed with a small, shovel.

(5) While working at the *ghani*, the oilman smokes and stirs the seeds with the same hand that touches his mouth. Smoking in the middle of work should be prohibited or the hands washed after smoking.

(6) The clothes of the oilman get dirty easily. Therefore he should keep two sets of clothes which can be washed every day alternately.

(7) The vessels for oil and water are very dirty generally. They should be kept away from the dust and should be cleaned every now and then.

(8) The water to be added to the seeds should be as pure as drinking water.

(9) The seeds should be well cleaned. In the rainy season many insects germinate in the stock of the seeds which, if possible, should be put in the sun and cleaned before use. In many places the *ghani* is not worked in the rainy season mainly because of the insects in the seeds.

(10) The bullocks should be washed every week. This will keep them clean and also reduce their fatigue. Swimming is an excellent antidote for the bullocks' fatigue.

Feed and Care of the *Ghani* Bullock

Selection :

The *ghani* bullock forms an important item in the economic management of the *ghani* as all the energy needed to drive the *ghani* comes from the bullock.

For the efficient running of the *ghani* we need an animal that can move in a circular direction with appreciable and steady speed and continuously drag a heavy load behind it. All these points are met in a type of animal which is of medium size, wellbuilt and long legged.

There are two methods of judging draught animals; first, by appearance and second by actual test. The characteristics of a good bullock can be summarised as follows :--.

The jaws should be strong and wide, lips thin and strong! nostrils wide and open with wide muzzles., forehead broad with big, bright, lustrous and clear eyes; the neck long and muscular; the legs strong and straight with heavy joints and clean bones; hoofs medium size, compact and round in shape; the chest should be broad with strong and well developed ribs, and the body tight and compact ; the loins wide and strong and the tail fine and tapering ; there should not be too much flesh ; a fat animal should be discarded; the bones should be strong, large and well developed.

Feeding:

A bullock engaged in work with the *ghani* will need for every 1000 pounds of live weight food according to the following table:

	Dry matter in lbs	Protein in lbs	Carbo-hydrate in lbs	Fat in lbs	Nutrition ratio in lbs
At rest	18	1	8	1	1 to 11.8
At heavy work	28	2.8	13	8	11 to 5.3

Cattle foods are generally divided into two main groups, (1) Ruffage and (2) Concentrates. Ruffage generally includes all kinnds of grasses, juwar and maize stock, wheat and rice straw ailage and threshings . They are generally rich in dry matter and crude fibre. For all practical purposes it is advisable to allow the bullock to eat as much of the stuff as he likes, the quantity varying from 12 to 20 pounds dry, preferably given in two or three lots.

Concentrates may be divided into three main sub-heads (1) Cereals and their products rich in carbohydrates such as bajri juwar, maize, ragi, wheat bran, rice bran etc. (2) Pulses and and their products rich in prtoteins and carbohydrates such as gram, red gram, green gram, black gram, cluster beans etc. (3) Oilseeds and oilcake very rich in prôteins and fat, such as cotton seed, and oilcakes like groumdnut cake, til cake, safflower cake, rape and mustard cake, linseed cake and cocoanut cake.

It is well known that individual proteins differ fron each other in many respects, and that in the formation of the animal body various kinds of prtoteins are required, So it is necessary that the proteins should not be only ample but must be of a varied character. A typical ration for a ghani bullock should contain enough of ruffage and about four to five pounds of concentrate mixture containing two to three parts of oilcake, one part of some pulse, one part of some grain and two ozs, of salt. Feeding exclusively on cake or too much of cake is in the end detrimental to the health of the animal.

Preparation of feed:

In order to facilitate digestion the feeds are treated in various ways before they are given to the animal. Long grasses and stalks are chopped into small pieces; the cakes, bran and broken pulses are soaked in water, and hard grains like juwar are sometimes cooked.

Care and Management:

A huge amount of water is needed to keep the circulatory system of the animal in order and to help digestion. It is, therefore, quite necessary to allow a liberal supply of pure drinking water. Generally it will be necessary to water the animal from three to five times a day according to the season of the year.

As the bullock has to work all the day indoors, it is necessary that bullock-shed be dry and well ventilated. The installation of a suitable manger will help in reducing the feed cost. The bullock is a ruminant animal and requires sufficient time to chew the cud. Therefore, the work of the animal should be so arranged that the bullock will have time, say at least an hour after the meal, to masticate food he takes. Feeding the bullock with cake at the time of work is not, therefore, advisable.

Grooming the animal after a day's hard work and occasional bath with warm water or a swim will help to keep the animal, in healthy condition. Nuisance from flies, ticks, lice etc. should be scrupulously prevented. In case of ill-health it is always advisable to clean the bowels of the animal by giving a dose of one lb. of oil with a handful of salt; the bullock be given complete rest and the nearest veterinary doctor consulted.

4 Oilcake as Human Food

Some of the oilcakes, such as the groundnut cake, the til seed cake and probably the linseed cake, can suitably be used as human food. Other cakes contain a very high percentage of fibre that is coarse which cannot be used for human consumption.

Oilcakes deserve a permanent place in our national dietary from the point of view of improving its quality. Our diet is said to be deficient in protein, which must be made good in every possible way. Oilcakes are very rich sources of proteins, that of groundnut containing as much as 48.6% that of tilseed 41.31% and that of linseed 35.70%. They also contain enough of fat and thus form a valuable item of food.

The quality of the proteins of the oilcakes is also fairly good. According to Sir Robert McCarrison the proteins of pulses are better than those of the cereals and the proteins of the nuts (of which oilcakes are the residue after oil is extracted out of of them) are better still. Dr. D. L.Sahasrabuddhe gives the following analysis of the proteins of the groundnut cake along with those of milk, the soyabeans and the gram.

Aminoacids	Grouunddnut	Miilk	Soyabeans	Gram
Argenine	13.26	4.84	5.12	11.85
Histidine	1.58	2.59	1.39	1.42
Lysine	4.69	5.95	2.71	7.42
Cystine	1.42	1.20	?	2.02
Tyrosine	4.80	4.50	1.86	2.95
Tryptophane	0.66	1.50	?	0.46

He observes,"Groundnut protein is characterised by its higher content of Tyrosine and Arginine—two of the most important essential aminoacids. Milk proteins are considered to be perfect and complete and it will seem that groundnut cake is nearer to milk than soyabean is".

Our people do occasionally eat groundnut and tilseed, but being very rich in fat they are hard to digest and therefore cannot be taken in any large quantity. The cake is comparatively easy to digest and can very well form an item of our regular diet. Looking to the high protein and fat value of the oilcakes they are availavle at much cheaper rates than pulses and hence even poor people can afford to eat them.

Such a practice will not be altogether new either. It is widspread in Andhra where til seeds are crushed after the outer layer which is blackish in colour is removed. The dirt is removed by soaking the til seeds with water in cloth or in a bucket. The oilcake which is whitish (Telaga pindi as it is called in Telugu) is used for preparing curries. We came across a village near Amraoti in which there is a custom of the oilman regularly supplying til seed cake to the village people who eat it by cooking it long with some vegetables.

If the oilcake is to be used for human consumption, the problem is that of cleaning the seeds completely from dust and sand. Groundnut seeds being of bigger size are easily cleaned. But smaller seeds like til or linseed are difficult to separate completely from sand of the same size. They should therefore be washed in plenty of water in which the dust will be washed away and the sand will settle at the bottom.

The best way of being sure of the cleanliness, as also of the freshness of the oilcake, is to get one's own seeds crushed in a ghani under supervision, after cleaning them properly.

The preparations can be varied to suit the tastes of the consumers. Good biscuits or sweetmeats can be made out of the cakes or they can be cooked along with vegetables or dals. The cakes keep well for a pretty long time if they are kept, after drying on fire, in closed tins or bottles.

5. Oilcake as Manure

Oilcakes are also verv valuable as manure. They are concentrated in form and are more readily available than farmyard and other bulky organic manures. They are generally valued for the amount of nitrogen they contain.

* Manural Composition of Some of the Oilcakes

No.	Name of Oilcake	Nitrogen Content Percent
1	Groundnut cake	7.69
2	Til cake	6.60
3	Safflower cake	6.34
4	Cotton Seed cake (undecorticated)	5.59
5	Rape and Mustard cake	5.54
6	Niger Seed cake	5.45
7	Linseed cake	5.30
8	Neem cake	5.04
9	Caster Seed cake	4.50
10	Coconut cake	3.67
11	Cotton Seed cake (deoorticated)	3.38
12	Mahua cake	2.72

* Analysed by Dr. D. L. Sahasrabudhe

APPENDIX A

Preparation of Cement Ghani Mortar

If it is difficult to obtain wood of the required dimensions for the mortar, it can be prepared of cement concrete with the rest of the parts being kept the same as in the wooden mortar.

1. *Have the following made ready as shown below:-*

   (a) The mould
   (b) The iron basket
   (c) The Kotha with the pipe fitted in
   (d) The stirrer ring

(*a*) *THE MOULD*

1. Take 38 wooden strips 2½ ft. long, ¾″ thick, and 2″ broad at one end and 2¾″ broad at the other.
2. With the help of four iron bands 1/8″ thick, and 1″ broad, two 4¼″ ft. long each, and two 3¼″ ft. long each, join the wooden strips so as to make two concaves having 2ft as the inside diameter at one end and 2¾″ ft. as the inside diameter at the other end.
3. The two concaves joined together with the help of nut-bolt screwed on the four iron bands, form the mould.
4. At any one point in the mould, cut out one wooden strip from the bottom to the height of about 5″ to allow the pipe to come out.

(*b*) *THE IRON BASKET*

1. Prepare three rings of 3/8″ thick bars, having 27″, 25″, and 23″ diameters respectively.
2. Prepare three more rings of 3/16″ thick bars, having 21″, 20″, and 19″ diameters respectively.
3. Prepare eight bars 5 ft. long and ⅜″ thick and hooked at both ends.
4. Prepare the basket by tying with a thin wire the rings with the bars as follows:

Tie the biggest and the smallest rings at the two ends. From the top, tie other rings in order of their diameters at a distance of 6" from each other. This forms the basket.

NOTE:—See that the basket is round and straight and the hooked bars at equal distances from each other. At the smallest ring they will be about 10" apart from each other and at the top about 13" apart.

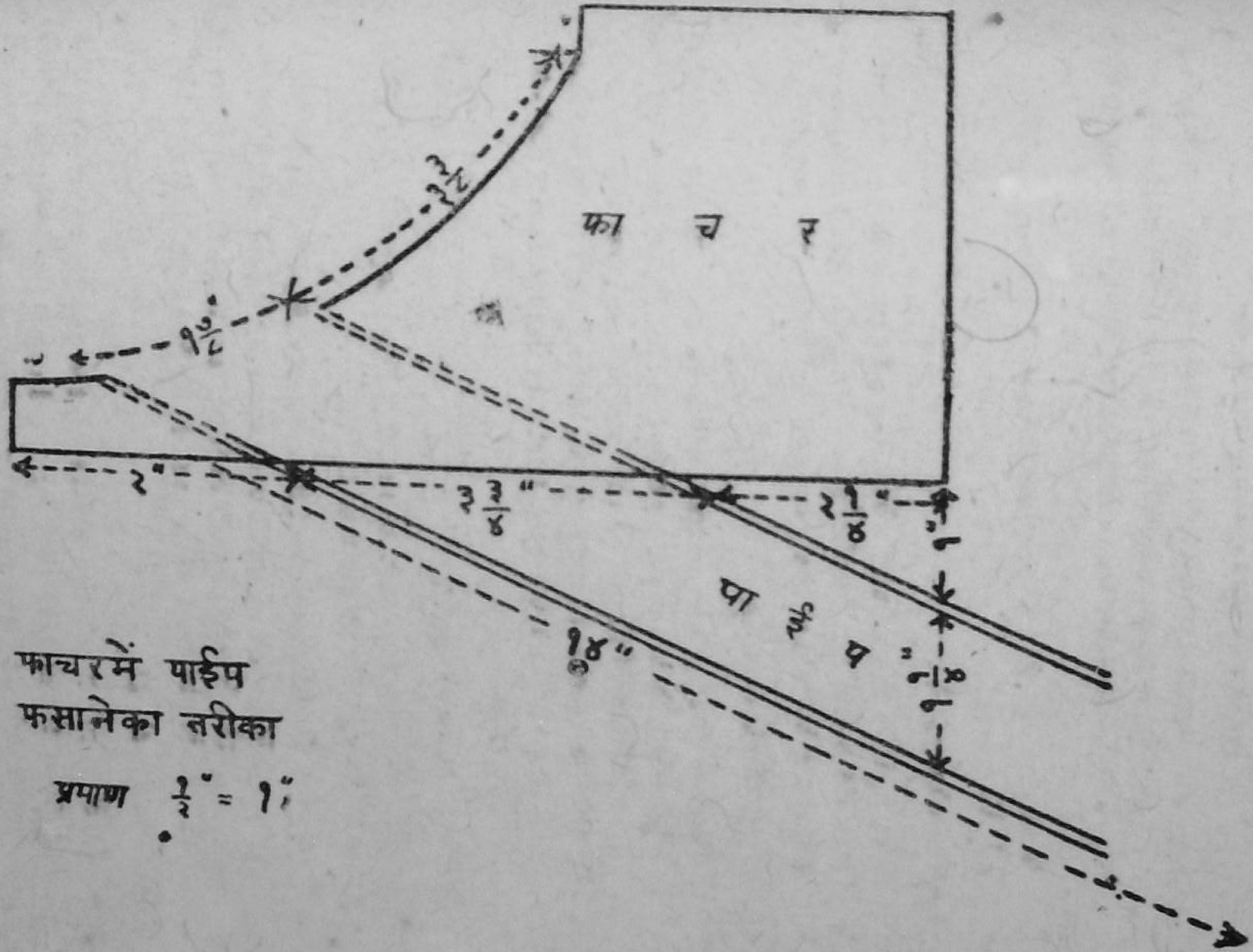
(c) *THE KOTHA WITH THE PIPE*

1. Take a pipe 14" long having 1¼" hole. At one end mark a point ¾" from the end and saw the pipe across making a slope up to the mark.
2. Make a hole in the bottom of the Kotha as shown in the sketch and fit the pipe in.

(d) *THE STIRRER RING*

1. Take four pieces of wood each 5½" broad and 3½" thick, and 1½ ft long. Make a square frame of it.
2. Inside this frame make the circle of 16" diameter.
3. Along the wall of this circle make a groove 1" broad and 2½" deep from the top. This groove will coincide with the top surface of the kotha and thus provide a margin for the stirrer 2" broad and 2½" high.

2. *Get the following tools and materials ready:*
   1. 3 iron pans
   2. 1 shovel
   3. 1 crowbar
   4. 1 mason's kaucha
   5. 1 level glass
   6. 3 bags of cement
   7. 7 bags of sand
   8. 12 bags of 1" jelly
   9. 2 water pots



फाचरमें पाईप फसानेका तरीका

प्रमाण १/२" = १"

10. 2 gunny bags

11. 3 pieces of oiled gunny cloth to be placed between the sides of the fachers making the kotha.

12. The iron rod which is inserted into the pipe to break the thin layer of the oilcake.

13. About 50 bricks, lime and two stone slabs, each about 1"x1"

14. Iron sheet 5" x 5" or stone slabs to prepare concrete on.

15 .Boulders.

3. *The Ground Pit.*

Dig a pit in the ground where the mortar is to be erected, 3 ft. deep and 2ft. in diameter. Prepare the foundation by filling the bottom of the pit up to one foot with boulders.

4. *First Grade Concrete.*

Prepare first grade cement concrete by mixing cement, sand and jelly in the proportion 1: 3 : 5. Put the iron basket in the middle of the pit on the boulders and ram this concrete with the crowbar round and inside the basket up to the level of the ground. Take care that the basket is not deflected by ramming.

5. *Second Grade Concrete*

Prepare second grade concrete by mixing cement, sand and jelly in the proportion 1: 2 : 3.

Note:—All the preparation of the concrete should be done on an iron sheet or stone slabs so that mud and earth do not get in. The sand and the jelly have to be throughlywashed in plenty of water so as to be free from dust and mud.

6. *Putting the Mould*

Now screw the two halves of the mould round the iron basket taking care that the mould and the basket are well concentric and the mould stands erect. Ram the second grade concrete between the mould and the basket and also inside the basket to the level of 8" above the ground.

7. *Putting the Kotha*

Now put over the concrete and inside the basket the kotha with the pipe fitted in and the oiled gunny cloth placed between its sides. See that it is put well in the centre and perfectly in level, testing the level with the level glass. In the level of the pipe about 3" away from it, insert a nail about 6" long allowing 3" of it to project outside the wall. Continue to ram the concrete round the kotha without upsetting the pipe and also round the basket to the level of one inch below the top of the kotha. Smoothen out the surface of the concrete round the kotha with cement mortar made of 1 part of cement and 2 parts of fine sand.

8. *Putting the Stirrer Ring*

Inside the iron basket, put the stirrer ring round the kotha so that the groove of the ring coincides with the top surface of the kotha. Fill up the mould with concrete till the top of the ring and make a wall along the inside of the mould 2" broad and 1½" high. From the wall to the ring make the surface having a slope of an inch.

9. *Removing the Mould*

Allow the concrete to harden within the mould for 24 hours. Then remove the mould and fill up the uneven surface of the concrete with cement mortar made of 1 part of cement and 2 parts of fine sand.

Next day polish the entire mortar by applying a paste of cement with water. Allow it to dry for about 4 hours and then fill it with water and put gunny bags over it.

Allow the mortar to harden completely by keeping it for three weeks under wet gunny bags. Never allow them to get quite dry.

10. *The Drain Pit*

Prepare the drain pit broad enough for the oil receptacle and long enough for the iron rod to be taken out and having a wall 9" high from the ground, with bricks and lime on the three sides and either stone slabs or bricks on the bottom.

11. *The Mud Platform*

Erect a mud platform 9" high and about 2 ft. wide round the ghani mortar. Bamboo or wooden pegs along the edge of the platform will help in keeping it in good condition.

APPENDIX B

Estimate of Income from Ghani

Monthly estimate of pressing red (Boria) gingelly seeds with a working unit of two Maganvadi Ghanis for an oilman at Wardha is given below. The rates for seeds, oil and cake are pre-war. Price of oil is calculated on the basis of retail rate of mill oil and that for cake on wholesale mill rate. Similarly, estimates for other seeds can be worked out on the basis of local rates with the help of the table given under Working Efficiency of the Maganvadi Ghani in chapter 2.

Capital required for:

	Rs.	As.	Ps.
(*a*) *Equipment and bullocks*			
Two ghanis	200	0	0
Two bullocks	400	0	0
Other accessories	150	0	0
	750	0	0
(*b*) *Seeds for the year* ..	12,000	0	0

(*c*) *Area of space required*

Shed for two ghanis	36'	× 16'	× 10'
Shed for storing seeds	20'	× 16'	× 10'
Shed for storing oil & cake	10'	× 16'	× 10'
Shed for shop	10'	× 16'	× 10'
Shed (separate) for bullocks	20'	× 10'	× 10'

Working day in a month 25. Working hours in a day 8, Charge on two ghanis in a day 10.

Receipts

Income from oil 1960 lbs @ 44% extraction and allowing for 25 lbs as wastage per month at Annas 10 per lb. is	1,225-0-0
Income from cake 2.520 lbs. at Rs 3-2-0 per maund of 80 lbs	97-10-6

Expenses

Cost of seeds 2½ khandies at the rate of Rs. 88-0-0 per khandi of 369 lbs. allowing 9 lbs. per khandi as refraction.	11,62—8 —0
Wages for cleaning seeds at 8 as- a khandi	6—4 —0
Assistant's wages	30—0 —9
Two bullocks' upkeep	60—0 —0
Repairs and depreciation of instruments and bullocks	10—0 —0
House rent	15—0 —0
Interest on capital at 6%	50—0 —0
General expenses	5—0 —0
	1,248—12—0
Net profit	83—14—6
	1.322—10—6

As part of the capital will be returned every month from the proceeds of sales, the interest paid in earlier months of the year will be more than in the later months. The interest shown above represents the average monthly interest in a year.

It may not be possible for oilmen to secure loans for stocking seeds at season time on such easy terms as 6% interest. In that case he will have to go on buying at current market rates. Generally, the season rates continue for about two months. For the rest of the year the rates rise by above Rs. 7 per khandi on an average. That means above Rs. 90 more per month on the price of gingelly, and taken as an average for the whole year it comes to about Rs. 80. From this deduct Rs 50 for interest on capital which is saved. Thus on the whole, the monthly profit will be reduced by about Rs. 30.

APPENDIX C

A scheme for an oil mill with power-driven ghanis and expellers, having a crushing capacity of 200 mds. of mustard seed per day (24 hours).

(Calculated on the basis of pre-war prices)

Equipment

1.	Bengal type power-driven ghanis 30 manufactured by Cawnpore works @ Rs. 120 each ..	Rs. 3.600
2.	Seed cleaning machine, rotary type manufactured by Cawnpore works	500
3.	Expeller, one, standard type, by any of the well-known makers. ..	6,000
4.	Cake breaking machine or disidtigrator No. 1½	350
5.	Filter press 2′ x 2′ with 12 plates. ..	1,200
6.	Storage tanks with capacity of storing about 1000 mds. of oil and pumps ..	1,350
7.	Weighing scales, two, for 20 mds. capacity	500
8.	Power plant 70 H. P. either steam, electric or oil in case of the electeic and oil units, a small boiler is necessary.	14,000
9.	Stanchions, shafting, belting, plummer blocks, pullies etc.	1,000
10.	Erection and unforeseen expenses ..	1,000
		Rs. 30,000

Working Expenses

Establishment :

1.	Head Mistry, one @ Rs. 75/-	Rs. 75/-
2.	Mechanics, two @ Rs. 30/- each	.. 60/-

3.	Line—men, six @ Rs. 20/- each	..120/-	
4.	Coolies, eight @ Rs. 12/- each	.. 96/-	
5.	Store clerk, one @ Rs. 40/-	.. 40/-	
6.	Chemist in—charge, one @ Rs. 100	..100/-	
7.	Miscellaneous expenses	.. 9/-	
			500/-

Coal and Stores

1.	Coal, its equivalent of oil or electric power ..	Rs. 800/-	
2.	Miscellaneous stores and renewals and replacements per month	.. 250/-	
			1,050/-

Interest and Depreciation :

On Rs. 30,000/-interest and depreciation @ 6% and 7½% respectively per annum works out per month	Rs.	340/-
	Total Rs.	1,890/-
		or say-
	Rs.	1,900/

The cost of building and land has not been taken into account. The interest and depreciation expenditure under that head may be added to this amount.

Output :

The mill will crush about 200 mds. of seeds per day and for 25 working days would crush about 5,000 mds. of seeds, giving an output of 35% oil amounting to 1,750 maunds. The crushing charges are, therefore, nearly Rs. 1/2- per maund of oil.

Income :

The income in the oil industry may be divided into two heads as uuder :-

(i) *Oil Crushing :—*

The usual calculation in always made for fixing the the price of oil and cake with crushing charges @ Rs. 1/4/-

per md. on oil. There is therefore, a saving of at least Rs.-/2/- per md. on oil under this item, which will amount to nearly Rs. 218/- or say Rs. 200/- when calculated on the monthly-production of 1,750 mds. of oil.

(ii) *Purchases of seed and sale of oil and cake :*

In this transaction there is a profit of Rs. -/4/- per md. on oil obtained after making allowance for interest @ 6% on the capital invested for running the factory. The income from this source will be approximetely Rs. 400/-.

In conclusion, with the expenditure of Rs. 30,000/- for machinery and Rs. 70,000/- for working expenses, there is possibility of an income of nearly Rs. 600/- after making allowance for interest and depreciation.

APPENDIX D

Preparation of Boiled Oil and Soap

1. Boiled Oil

The fact of India being the most important country in the world the production of oilseeds stamps the industries connected with the manufacture of consumable articles from the seeds is of great consequence in providing the artisans with gainful occupation. This gives a premier place to the oilpressing industry. How ever great an industry may be among village industries there are periods of slackness as most such industries are closely conneceted with the periodical ups and downs of agriculture. Therefore, it becomes imperative for us to provide subsidiary occupation to those engaged in village industries to take up the lag between seasons. It is from this approach that the following notes on boiled oil are drawn up and not for those who wish to follow these lines as their main occupation, and so these notes are chiefly intended to supplement the courses given in oilpressing by ghani at Maganvadi and are primarily addressed to such students. But for this approach the information may appear scanty.

Linseed oil is widely used in paint manufacture. It is also extensively used in the manufacture of certain oil varnishes, oil cloth linolium and soft soap. Linseed oil is called a drying oil as it rapidly absorbs oxygen from the air and forms a tough layer or film.

Linseed oil as used in various paint and varnish industries can be classed under four heads (1) Freshly expressed raw oil, (2) Matured oil (3) Refined oil and (4) Boiled oil.

Freshly expressed raw linseed oil dries very slowly and the dried film has many defects.

Matured oil is better than freshly expressed oil in that it is perfectly clear being free from suspended impurities. To get matured oil freshly expressed oil should be stored in an air-tight tin for about a year. This oil can be directly used for preparing boiled oil.

If matured oil is not available freshly expressed oil can be refined by mere heating. The oil is quicly heated to about 260°C and allowed to cool. This oil is allowed to settle for a week and the clear oil is then used for boiling.

The first three varieties of oil dry slowly. This defect is got over by adding certain driers and heationg the oil to about 200°C for 6 to 8 hours. The oil so prepared is called Boiled oil which acquires quick drying properties.

Preparation of Driers:

The driers used are rosinates of cobalt, lead and manganese. Oxides only of these metals can also be used as driers but are not as effective as rosinates. Rosinates disperse better in the oil than oxides and quicken the drying. Rosinates are prepared by mixing oxides of cobalt, lead and manganese with rosin in the following manner:—

Rosin is melted in an enamalled or brass basin by heating. When all the rosin is melted the oxide of one of the metals stated above is added in proportions as shown in the table below. The oxide and the melted rosin should be thoroughly rubbed till very little of the oxide remains over at the bottom of the vessel. This compound so formed is called a rosinate. Each type of rosinate has to be prepared separately.

Proportion of Rosin and Oxides:

Rosin	Cobalt Oxide	Lead Oxide or Litharge	Manganese dioxide
100	6	18	7

The quantity of these rosinates to be added to the oil during boiling is as follows:—

Oil	Cobalt Rosinate	Lead Rosinate	Manganese Rosinate
100	1	1	7

The Boiling Process:

The oil is boiled in any convenient vessel which should not be filled to more than about $\frac{2}{3}$ of its capacity. The vessel should

should not be covered during heating. The temperature is raised to 200°C and as soon as it is reached the driers are added and stirred. From this time onwards the temperature is maintained round about 200°C for about 7 hours. The oil is then allowed to cool a little, filtered through a cloth while hot, and stored in in an air-tight vessel. This oil is now termed boiled oil.

The oil is tested for its properties by ptainiong it on a plank and noting the time taken for the film to dry. A good oil dries in 12 to 24 hours. The dried film should be bright and sticky and if a finger is drawn over it, it should not leave a mark.

The oil prepared by using the above proportions of driers and heating it to 200°C obtains a pleasing light brown colour, a good flow and the film dries in 12 hours. Great care should be taken in maintaining the required temperature during the process. Heating at lower temperatures will give better results as regards colour and drying properties but the time of heating is inconveniently long. The temperature of the oil should be regulated by the constant use of thermometer which records up to 350° C.A margin of ten degrees is permissible but the temperature is better kept at the tower rather than at the higher limit. Precaution should be taken in not allowing the temperature to rise to300° C as at that degree there is every chance of the oil catching fire spontaneously and causing great damage to the building and danger to life. Further at that high temperature the oil begins to give off foul smelling fumes. As far as possible the shed where the oil is boiled should be fire-proof by having tin or zinc sheet roofing and mud walls.

2. Soap from Indigenous materials

Though soap is not commonly used in villages it has become an article of every day use in cities. At present it is either imported from outside or is manufactured locally in large scale factories out of oils or fats and caustic soda. It can also be made out of material available in villages. We produce vegetable oils in large quantities and caustic soda can be had by the action of lime on ordinary washing soda. We can get this carbonate of soda in large quantities in the shape of Sajjimatti, Sajjikhar or Papadkhar. All these contain sodium or potassium carbonates in varying proportions.

After the rains of layer of Sajjimatti appears on the surface of *usar* lands. This ordinary contains 5 to 20 percent of soda. Some times and at some places it contains as much as 60% of it. Ashes of some plants are called Sajjikhar. These contain from 15 to 25% of sodium or potassium carbonate. They are generally found in the Punjab and Sind. When certain low lying tanks and lakes dry up in summer a coating of Papadkhar is found on the soil there. This is plentiful in the Berar and Sind and generally contains 40 to 90% of soda.

By mixing lime in any of the above three necessary caustic soda or potassium for soap making is obtained.

We can prepare cheap washing soap on a small scale with the help of ordinary Kerosene oil tins, a ladle and a segree.

Soap can easily be made out of castor, cocoanut, groundnut, mahua and til oils. Castor oil gets converted into soap very quickly, but it is not good to be used alone. The other four oils no doubt make good soap but they require to be boiled for a long time. Even out of these, those of cocoanut, groundnut and gingelly have other uses and so they are rather costly and are not available in large quantities for soap making. Soap out of cocoanut oil alone wears away very soon. These oils can be used separately or mixed in any proportions for soap making.

Sajjimatti, Sajjikhar and Papadkhar at different places contain varying proportions of washing soda, so in order to be able to make caustic soda or potash out of these, it is necessary to determine the amount of soda present in a given lot. The easiest way to do this is as follows:-

Sajjimatti or its suluble chemical component in water-soda carbonate is an alkali. To determine the alkalinity of an alkali it is neutralized with a standard acid. The juice of fresh mature lime is such a standard acid. Then we want an indicator to show that just enough limejuice to neutralise the alkali has been added. Java flower (red) is an easily available indicator.

a. Press the juice out of a lime. This is our standerd acid.

b. Take $\frac{1}{4}$ of a tola of Sajjimatti in a pound bottle and add to it 25 tolas of boiling water. Shake the bottle repeatedly to ensure solution. This is our Sajjimatti alkaline solution.

c. Take an ounce of this mixture in an enamel cup.

d. Rub the blood red petals of Java on a piece of white blotting paper. The paper takes a purple colour and and it forms our test paper.

If we touch this test paper with a drop of the Sajjimatti solution it will turn green. But if the solution is neutralised by adding drops of lime juice it ceases to turn the paper green. If, however, the solution after neutralisati on is made acid by further addition of lime juice, a drop of it will stain the test paper pink. Take the lime juice in a minim glass and add it drop by drop to the solution and stir. Touch the test paper from time to time with the tip of the stirring rod with a drop of the liquid adhering to it. If green colour is produced, add more drops of lemon juice to the solution and again test. Go on adding drops of lemon juice till the test paper ceases to become green. This shows complete neuturalisation. But to be sure add a few more minims of the juice till the touch of the stirring rod produces a distinct pink tint. Read off from the minim glass how many minims of lime juice have been added. The extra drops added to produce the pink tint should of course be left out.

The number of minims required to neutralise the Sajji solution gives the percentage of alkali in the sample. If say, 30 minims have been used then the sample contains 30% of soda corbonate. It is to be noted that a minim is not a drop. A drop can be large or small, but a minim is a standard drop and has to be read off from the minim glass.

After the percentage of soda carbonate in Sajjimatti is determined it becomes easy to use its correct quantity for soap making.

Caustic lye is prepared by mixing 3 parts of soda (or enough Sajjimatti containing the required quantity of soda), 2 parts of slaked lime and 6 parts of water. The Sajjimatti is first dissolved in water and the mixture is boiled. Then lime is added in small quanties and the mixture is allowed to boil fcr about an hour. After that the mixture is allowed to settle and is strained and pressed through a piece of cloth. Some more hot water is added to the residue for washing out, then settled and strained. Add these two together and you get the caustic lye useful for making soap.

Inexpensive washing soap can be made at home with the following formula:-

Necessary material—6 lbs. of oil. 3 lbs. of soda and 2 lbs of caustic lye.

Process

Put the caustic lye in a considerably big vessel and allow it to boil. Then slowly add oil (this can be a mixture of til, mahua, castor and groundnut oils) to it and stir with a ladle or a stick. Continue boiling and stirring till the mass shows an indication to solidify on cooling. Then it should be cast into moulds and allowed to solidify. In a day or two the soap is ready to be taken out from the moulds. If the moulds are made of metal and if the soap has stuck to the sides, it should be separated by a sharp knife and the moulds inverted.Blocks of soap then fall out which may be cut into desired sizes.

APPENDIX E

THE MAGAN DIPA

1

The Problem

The use of vegetable oil for purposes of illumination raises several problems in devising a contrivance to burn it. Kerosene oil, being a thin oil, rises rapidly to the flame several inches above in the container through capillary action in the wick. Hence, the flame is fed as quickly as it burns, though the level in the container may fall appreciably with the consumption of the oil, As the flame is well above the container we can easily interpose a trimmer for the wick without any chance of leakage. The main consideration in a kerosene lamp is adequate ventilation with a well-regulated supply of a steady current of air to make the combustion complete, This is attained by the use of a chimney and a good burner. The question is not as simple as this if we wish to substitute vegetable oil.

Vegetable oils, being thicker than kerosene oil, do not rise up the wick easily much above the level of the oil in the container. Hence, the flame has to be as near to the level of the oil as possible. Formerly, an open flat vessel was used with the wick lying in the oil having one end just above the oil level to feed the flame, and as the level of the oil fell, the wick got burnt. There was no room for a trimmer or a chimney. The consequence was, we had an unsteady naked flame, with incomplete combustion smoking and flickering, ready to be put out by the first strong gust of wind. The light was dull and incapable of regulation.

To feed the flame satisfactorily, the oil will have to be gravity fed by keeping the oil container above the level of the flame or thinned by chemical means. The latter is not within the reach of villagers. If we attempt gravity feeding, this in itself raises several difficulties. The first is one of leakage at the burner unless we succeed in regulating the level of the oil and keeping it more or less constant, always just below the level of the flame. This we have been able to do in the Magan Dipa by resorting to the principle of "Hiros fountain" and by keeping the wick outside the oil container. Then, the ventilation of the burner has to be adjusted so as to let in enough air to make the combustion complete. The texture of the wick of the kerosene lantern is close woven. We may have to experiment with different texture wicks to see the results in the rate of conduction of the oil to the flame. Sjt. Satyan has been working on these problems for the last four years.

Thin sheets and other materials needed for the manufacture of the new lanterns on a large enough scale to cope with the demand are not available. Hence we have had to resort to adapting the Magan Dipa principle to apply to existing kerosene lamps for burning vegelable oils. This course, incidentally, will save the consumer much extra cost as he need not go in for new lamps but get his present ones converted. Adaptation of a kerosene lantern to burn vegetable oil by using the Magan Dipa parts will cost about as 12 for labour and 4 as. for material. Owing to shortage of trasport it is not posible to do the work of conversion in any one place for the whole country. Therefore, we are broadcasting the information with the hope that those who are willing to serve the public will take up this work in various parts of the country and supply the local needs by training and organising the local tinkers to remodel the existing kerosene lamps and also fit up the broken and discarded old ones. Those who are willing to carry on this work should get themselves recognised by the A.I.V.I.A. They can obtain an adapted working lantern and other Magan Dipa parts by sending in advance the price to cover cost, packing and postage, to the *Secretary A.I.V.I.A. Maganwadi Wardha, C.P.*

The present prices are as follows:-

Adapted lantern complete	Rs. 4-0-0
Magan Dipa attachment only	2-4-0
Bedroom lamp	1-4-0

The details of how to convert old lamps for this purpose are given in a pamphlet entitled Magan Dipa to be had from A.I.V.I.A, Wardha, C.P.

II

The Economics of The Magan Dipa

Kerosene oil is a mineral oil pumped out form the bowels of the earth. Man does not produce it but he merely extracts it from stock held by nature. Its economy belongs to the economy of predation and, its exploitation being in the hands of private enterprise today, its prices are determined under conditions of cut-throat competition, or by destructive, powerful combines, or by speculation. India consumes annually about 90 crores of seers of this product, worth about 20 crores of rupees. It brings practically no employment with it for the people,but it takes away Rs.20 crores of their produce and this also from the poorest of the poor and from the remotest villages. The story does not end there. To burn this oil we obtain lamps, mostly from foreign countries, costing about an equal amount. The supply of these lanterns also, like that of the oil, affords no employment to the masses. When consumption is based on local production, creation and distribution of wealth go hand in hand. But when articles produced elsewhere are consumed,it constitutes a drain on local production.The effect is much the same even when production is by one stratum of society and the consumption confined to another though in the same locality. Unless a reverse current is also in operation to establish equilibrium,the conditions described above will lead to increasing poverty. If we aim at avoiding such a contingency, we have to seek a way by which people can be made to supply their own primary needs. Illumination is a necessity and it will be contrary to our interest to depend on foreigners to obtain it.

India is an outstanding producer of oilseeds in the world. It exports over a million tons of castor, groundnut and linseed alone every year. Oil expressed from such seeds can well be used for illumination though, because of their many alternative uses it may prove expensive. There are, however other sources of oil like mahua, neem, karanjia, rayan, agara, polang, cashew nut etc. which are being used in villages for this purpose, and which can be made cheaper to use than kerosene oil,even commercially. The use of such oils, which man produces annually, places us on an economy of permanence, affording a perpetual source of employment, where the reservoir will not be exhausted upsetting our order,and where production and consumption will enrich the people.

The Magan Dipa burns about 20% less oil in a given time than a kerosene lamp with the same size of wick. On this basis we shall need 72 crores of seers of vegetable oil to replace the present consumption of kerosene oil. Without disturbing the other uses of oilseeds, if we stop our oilseed export, we can press that amount of seeds by using 1,50,000 bullock ghanis and obtain about 45 crores of seers of oil. This course, apart from providing work for 1,50,000 families of telis, bringing them an income of about 4½ crores of rupees, will yield 4 crores of rupees worth of oilcake for our ill-fed cattle and exhausted land. In addition 1,50,000 bullocks, which work the ghanis, will be better fed and employed. The oil produced will be worth about Rs.17 crores. Such stoppage of exports and the crushing of the seeds locally will add Rs.4½ crores to the wealth of the country. The balance of 27 crores of seers of cil needed can be obtained from the non-edible oils we have referred to above. This will give employment to another 1,00,000 ghanis, families and bullocks, and bring in about 3 crcres of rupess to the families engaged in this operation.

Besides benefitting the farmers and telis and providing fodder and manure, the lanterns themselves will be made by our tinkers, and the chimneys by the glassblowers. This will run into another Rs.20 crores of business, per annum and draw away from the over-crowded land a great many workers, relieving the pressure on the land and increasing the average income of the villager. This makes towards a better equilibrium amongst occupations, and creates skilled artisans, which in itself will provide scope for the development of the faculties of the people and on the material side, these considerations lead us to expect that switching over from kerosene to vegetable oils will add about 27½ crores of rupees of employment to the people.

Turning from the nation's economy to the interests of the individual who takes to the use of the Magan Dipa we have to see how he is affected. To begin with, it may be mentioned here that as the volatility of vegetable oils is lower than that of kerosene oil, the use of the former reduces considerably the chances of accidental fires. At present, the light from the Magan Dipa is about 15% less than the kerosene oil lamp of the same size; but as we have already stated, it burns 20% less by weight of oil. Burning for 7 hours, calculated on the basis of 5 as. per seer of non-edible vegetable oil, 6 as. per seer of edible vegetable oil and Rs.3-8-0 per tin of kerosene, the Magan Dipa uses 7½ ps. worth of ground-nut, mohuwn, karanjia, or neem oil, or 9 ps. worth of til, linseed or castor oil, while a similar lantern uses 7 ps. worth of kerosene oil for the same time. When groundnut or non-edible oils are used in the Magan Dipa both types of lamps can be said to be on a par as far as maintenance cost goes. But we have seen the tremendous advantages of the Magan Dipa from the point of view of the national economy which ought to make every person desiring the welfare of the people to strive hard to induce his neighbours to use vegetable oil in preference to kerosene.

(The above calaculations are based on pre-war prices)

APPENDIX F

Oil Press Questionnaire

(The questionnaire given here is meant to indicate lines along which further study may be made on the subject for which very scanty information is available at present. A careful and detailed enquiry on the subject will provide a very interesting data not only for students of economics but for those engaged in the work of national planning. It is from this point of view that those who can obtain first hand and reliable information bearing on all or any of the following questions are invited to send the same to the Supervisor, Ghani Dept., A. I. V. I. A., Wardha, C. P.)

1. Working Efficiency

(1) Capacity to receive seeds in pounds per charge.

(2) Time taken per charge.

(3) Oil percentage (completely free sediment).

(4) Average daily output of oil and cake.

Note :-Give the above information separately for different oilseeds pressed.

(5) If a spring balance is tied in the rope between the yoke and the load beam what is the pull shown in dragging the load

(6) What is the thickness of the cake formed ?

(7) Give sketches with measurements of the ghani pit and pestle, as given in sketch No. II.

(8) How much is the load in maunds put on the load beam to bring pressure on the pestle ?

(9) Is there a pipe to allow oil to run down or is it taken out from above ? If the latter, then what are the means adopted ?

2 Wood

(1) Out of what kinds of wood are ghanis made in the province ?

(2) Which kinds are scarce and which are abundant ? Where are they obtained from ?

(3) Which kind of wood is the best? Which kind does not crack or wear out easily ? Which kind becomes soft and rancid by being saturated with oil ? Which wood is immune from attacks by white ants and other insects ?

(4) What is the average life of a ghani of different kinds of wood ? What is the average price of wood for the mortar of the ghani of each kind ?

(5) What kinds of wood are used for the pestle and the liners (replaceable parts) of the mortar ?

Note :—Give the relevant information on the wood for these two purposes in the light of the above questions.

(6) Give the dimensions, length and width-of the ghani mortar and the pestle.

Note:—The length of the mortar is in a way related to the nature of the soil in regard to its softness or hardness and to its cracking nature. Therefore, say what part the soil has played in determining the length of the mortar.

(7) What is the total cost of the wood that is used for the ghani?

3. **Labour charges for preparing the ghani** :—

(1) What are the labour charges separately for the preparation of the principal parts of the ghani such as the mortar, the cavity, the pit made up of the liners (replaceable parts), the pestle and the load beam ?

(2) What are the carpenter's charges (including food charges, if any) for preparing a complete new ghani ? How are his charges fixed ? By contract or by daily wage system ?

(3) How many days are required for one carpenter to prepare a full ghani ? How many days for separate principal parts ?

(4) How many specialised ghani carpenters are there in the district ? Is the number enough to make them readily available when needed for repairs ? Is any repair work done by ordinary local carpenters ?

(5) What are the average annual repair charges for a ghani ?

Note :- In computing depreciation take into account the wear and tear of the wood and the carpenter's charges for repairs etc.

4. **The Draught Animal**

(1) Are the local bullocks strong or weak ?

(2) How many rounds on an average does the bullock make per minute?

(3) Is the ghani worked by a single bullock or by two?

(4) What is the price of an average sized bullock? What is the effective life of a ghani bullock?

(5) What is the daily cost of the bullock's upkeep?

(6) Is there any lateral curveture of the spine of the bullock while working at the ghani? Do the ropes fastening the yoke to the load beam rub against the sides of the bullock?

(7) What animals other than bullocks are yoked in the ghain? How do they compare with bullocks in point of cost, upkeep and efficiency ?

5. **The Oilman's Skill**

(1) How many persons are required to attend to a ghani ?

(2) How many kinds of oilseeds can he press? ,

(3) Describe the process he adopts in pressing various oilseeds. State when he adds water, how much he adds and whether hot or cold. Is the cake turned over while the. bullock is in motion ? How often? If the oil is drained through a channel, when is the channel opened?

(4) State what the oilmen knows about the following:-

(a) The factor of heat in the process of extraction of oil. What means, if any, are adopted to generate extra heat during the process?

(b) The circulation of the cake in the pit during the process as a time saving factor.

(c) The thickness of the cake that is formed in the pit depends both on the pressure exerted by the pestle and the space between the pestle and the wall of the pit. By judging the comparative thicknes of the cake it is possible to get an idea of the effectiveness of the pressure of the pestle. What light can the oilman throw on this?

(d) The measure of water to be added to different seeds and in different seasons in the year.

(5) Is the oilman capable of giving detailed directions to enable an ordinary carpenter to repair the ghani? If the ghani does not work properly can he locate the cause of the trouble?

(6) Does he know any side industry such as soap making or boiled oil making ?

6. **Oilseeds**

(1) What kinds of oilseeds are produced in the province? State the quantities produced. What are cultivated and what are gathered from natural growth?

(2) For each variety state how much is consumed locally and how much is exported. Are any seeds imported for crushing? What kind and quantity ?

(3) What oilseeds go waste without being pressed? Give their quantities.

(4) Which seeds are used for edible purposes and which for commercial ones ? Of the latter, state their uses.

(5) Is the province self-supporting as regards its requirements of oil or does it import it from outside ? From where, how much and why?

(6) What are the oil contents of different kinds of local oilseeds?

(7) What uses are made of the oilcakes? Are they exported? How much ? Where ?

7. **The Ghani, the rotary ghana and the mill**

(1) What is the crushing cost of one ton of oil by

(1) the bullock ghani, (2) the rotary power ghana and (3) power mill for various oils ?

(2) What is the percentage of oil extracted from the various oilseeds by the above three methods ? What percentage is left unextracted in the cakes ?

Note:- $1\frac{1}{2}$ lbs. of cake of each kind , well packed in a tin, should be sent for analysis to the Supervisor, Ghani Dept,, A.IV.IA. Wardha , C.P. The sample to be sent should consist of half a lb. of cake from each of the three parts of the pit, viz.(1) the lowest part (socket), (2) the middle (above the neck) and

(3) the top part and should be sepatately named according to these three divisions. Also state what fraction the cake sent from each of the above division bears to the cake formed in those divisions.

(3) How do the market prices of oils and cakes prduced by the the bullock ghani, the rotary power ghana and the power mill compare?

(4) How many bullock ghanis, rotary power ghanas and power mills are working in the province ? What is their respective total production of oil and cake in the year ? How many per-sonsoilman, carprnters, labourers and others, and bullocks are employed in the bullock ghanis that are working in the pro vince ?How many persons are employed in the rotary ghanas and how many in the power mills ? What is the proportion of the salaries and wages to the profit of the mill owners?

(5) Give the estimate of a production account of a bullock ghani oilman, showing his opening stock of seeds, purchases, expenses, depreciation and repairs on one side and sales of oils, cakes and the ending a stock on the other.

8. General

(1) How many different kinds of ghanis from the point of view of their construction and their methods of work are to be found in the province?

(2) Are there any hand presses working ? How do they compare with the bullock ghanis in respect of percentage of oil extracted ?

(3) What means have been adopted to ensure hygienic conditions in regard to the place of production?

(4) How is the oil freed from sediment ? For how long does the oil keep well ? What steps are taken to preserve it ?

(5) In the last ten years what is the decrease in the number of ghanis ? Give reasons of the decrease.

(6) Do the oilmen press their own seeds or do they press seeds on hire ? If the latter , give particulars. State what an oilman is paid per charge, how much oil and cake he returns to the customer etc.

(7) What suggestions have you to make for the improvement and revival of the bullock ghani?

(8) On acount of competition by large scale oil mills the number of bullock driven ghanis has dwindled away . Inspite of this cutthroat competition there are many other redeeming factors which have enabled the ghanis to survive. Out of the under-mentioned items which do you think have been helpful to the ghanis ? State how they can be availed of for the resuscitation of ghanis?

1. People may be prefering ghani oil to mill oil because it is more tasteful and nutritive.

(1) The oilman may be content to pull on with the least possible income.

3. Mill oil may not have hadaccess to all places till now.

4. For want of availability in sufficient quantities or for some other reasons many oilseeds may not be pressed by the mills but to meet local needs the ghanis may be pressing them .

5. People may have stocked oilseeds of their requirements and may be getting them pressed from time to time as needed.

6. Absence of other paying occupations and love for one's own calling .

7. The oilmen may be pressing oil as a sidebuiness to agriculture or some other major occupation.

8. Mill oil may have been altogether banned by the co-operation of the oilmen and consumers.

(9) Which of the following have been responsible for reducing the number of ghanis?

1. Inefficiency of the ghani i.e., less percentage of oil pressed small capacity, each charge taking more time, greater cost of repairs etc.
2. Want of foresight in oilmen in not selling scrupulously pure ghani oil.
3. Lack of capital with the oilmen for stocking oil seeds during the harvest.
4. Use of kerosene oil for lighting in place of vegetable oil.

(10) What is the proportion of villagers stocking oilseeds for their own use and getting them pressed on hire ? Is this oil cheaper than mill oil or dearer ? Are the oilmen as particular about extracting the same percentage of oil from seeds pressed on hire as they are about their own ?

(11) What is the difference in the prices of oilseeds during the season and off season? How does this affect the oilmen who are unable to stock them during the season and purchase them as and when necessary at the then prevailing market rates. Can you suggest any way out ?

(12) For how many months in the year and for how many days in the month does the oilman ply his ghani ? Why does he not ply it during the rest of the period? What is his daily output and what is the daily sale ? What is the proportion of mill oil to ghani oil in the total oil consumption of the village ?

(13) What are the chief edible oils? Which of them are mill pressed and which are ghani pressed? What is the difference in their retail prices ? How do these prices fluctuate during the year ?

(14) Are groundnuts pressed in ghanis? Can they compete with the mills as far as this oil is concerned? Are the people prepared to use this oil in place of other costly varieties ?

(15) How many families in a village can a full working ghani serve ?

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