THE CULTIVATION AND CURING OF CIGARETTE TOBACCO—*(Contd.)*

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FLUE-BARN

Special rooms are necessary for the curing of cigarette tobacco. These rooms are known as flue-barns because of the use of the flue pipes for heating the room.

Barns should be near the homestead in a tobacco field because it allows for the convenient supervision of the work. A supply of water should be handy. The building should be so placed that the prevailing winds do not blow through the furnaces.

SIZE OF BARN

The size of a flue-barn to be erected on a holding will depend on the area of tobacco usually grown each year in the scheme of rotation to be adopted. As the furnace used for flue-barns is of cast iron and the cost of casting depends on the weight to be cast the minimum size of furnace that could be economically cast will be 3 feet deep by $1\frac{1}{2}$ feet wide by $2\frac{1}{2}$ feet high. A furnace of these dimensions should serve to heat a barn 16 feet by 12 feet by 24 feet high. It is a mistake to have a barn too tall because the curing does not take place uniformly in all the tiers. A barn of the dimensions given above should serve to cure leaf from about $3\frac{1}{2}$ acres of tobacco at one time. Where the area is larger a larger barn is needed and for such a barn the furnace should be proportionately larger. The largest size of flue-barn which can be efficiently heated by a single furnace is 16 feet square by 24 feet high and the furnace should be 2 feet wide by 3 feet deep by $2\frac{1}{2}$ feet high. A barn of these dimensions could

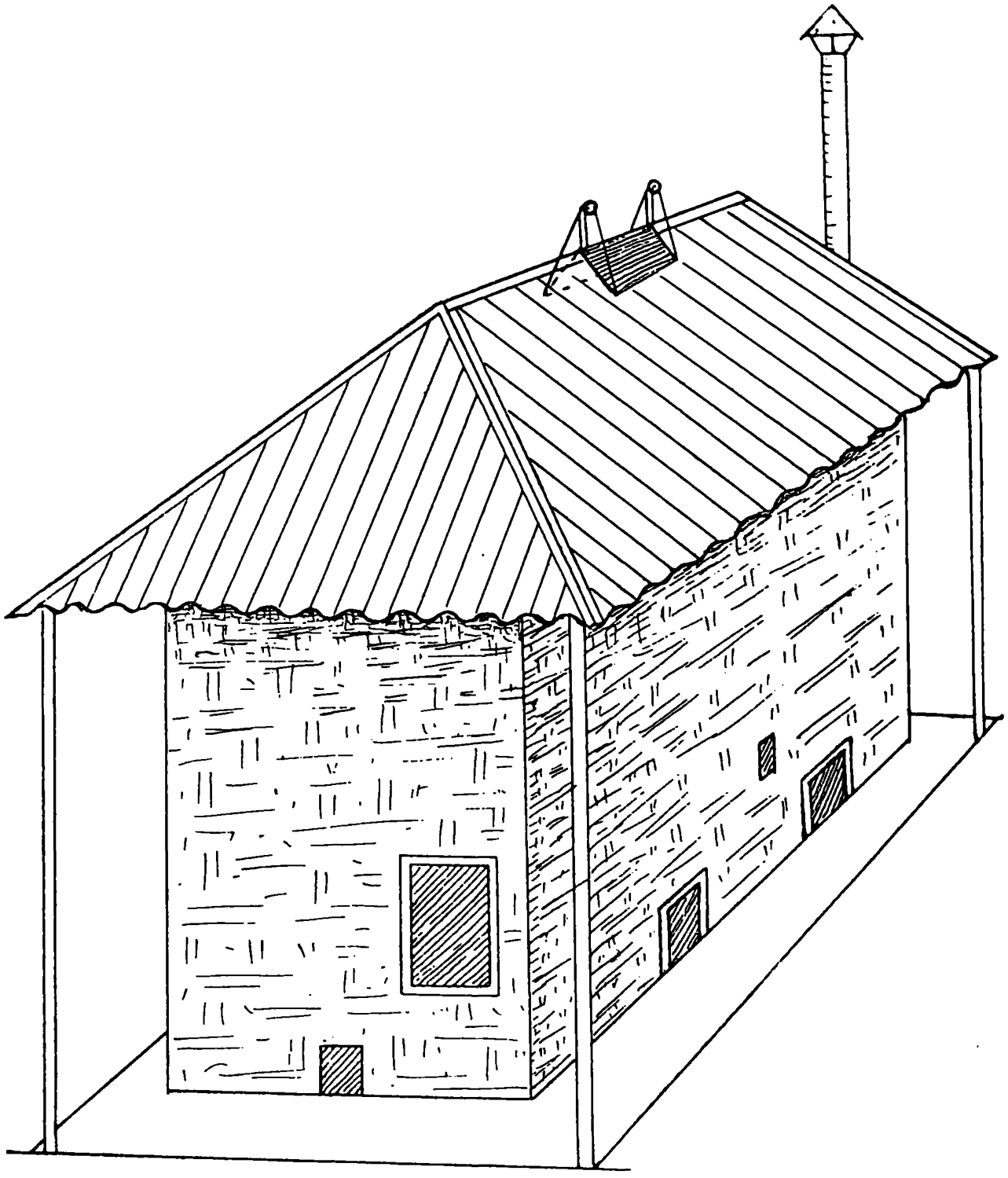

Plate I

A general view of a Flue-Barn. The door of the furnace is shewn at the base of the front wall and the door to the barn about three feet from the ground level. Note also the two ventilators on the side wall and the adjustable ridge ventilator on the roof.

hold at one time leaf from about 4½ acres. When larger areas of tobacco are grown it is more economical to build and manage a single barn of larger dimensions than to have several smaller barns. Large barns should, however, be provided with two furnaces. The largest size of barn which can be heated by two furnaces is 20 feet by 24 feet by 24 feet high. Each furnace should be 4 feet deep by 1½ feet wide by 2½ feet high. A barn of these dimensions can hold at one time leaf from eight acres.

CONSTRUCTION OF BARN

A building of wattle and daub walls and roof of corrugated sheets can be used for a flue-barn. A verandah all round the room is desirable and the roof should slope on all four sides so that rain may be kept off the walls of the barn. The thickness of the wall will depend on the diameter of the King posts which should not be less than nine inches. The mudding should be carried right up against the corrugated sheets of the roof, the idea being to have an airtight chamber, the movement of the air within being controlled by opening the ventilators described below.

A frame for a door 6 feet high by 3 feet wide should be built into the front wall of the barn on a side so that the threshold is about 3½ feet from the ground level. Each of the side walls is provided with two frameworks for ventilators placed at equal distances from the front and back walls. Each ventilator is about 30 inches long by 2 feet high and is placed at ground level. The ventilators can either be hinged on to or slide along the framework. A ventilator which has a Λ shape in section is also fitted on the ridge of the roof so that it can be raised or lowered at will. A glass window 18 in. by 9 in. is also built into any one of the four walls at a height of about 4 feet from the ground so that the reading of the thermometer and hygrometer can be taken out without opening the door.

Each barn should be provided with tier-poles for hanging the leaf for curing. A frame is built up by burying into the ground four stout poles each about 6 inches in diameter and reaching to the roof at the four corners of the room. Poles of smaller diameter but of the same height are erected vertically so that the room is thereby divided into coupes each 4 feet

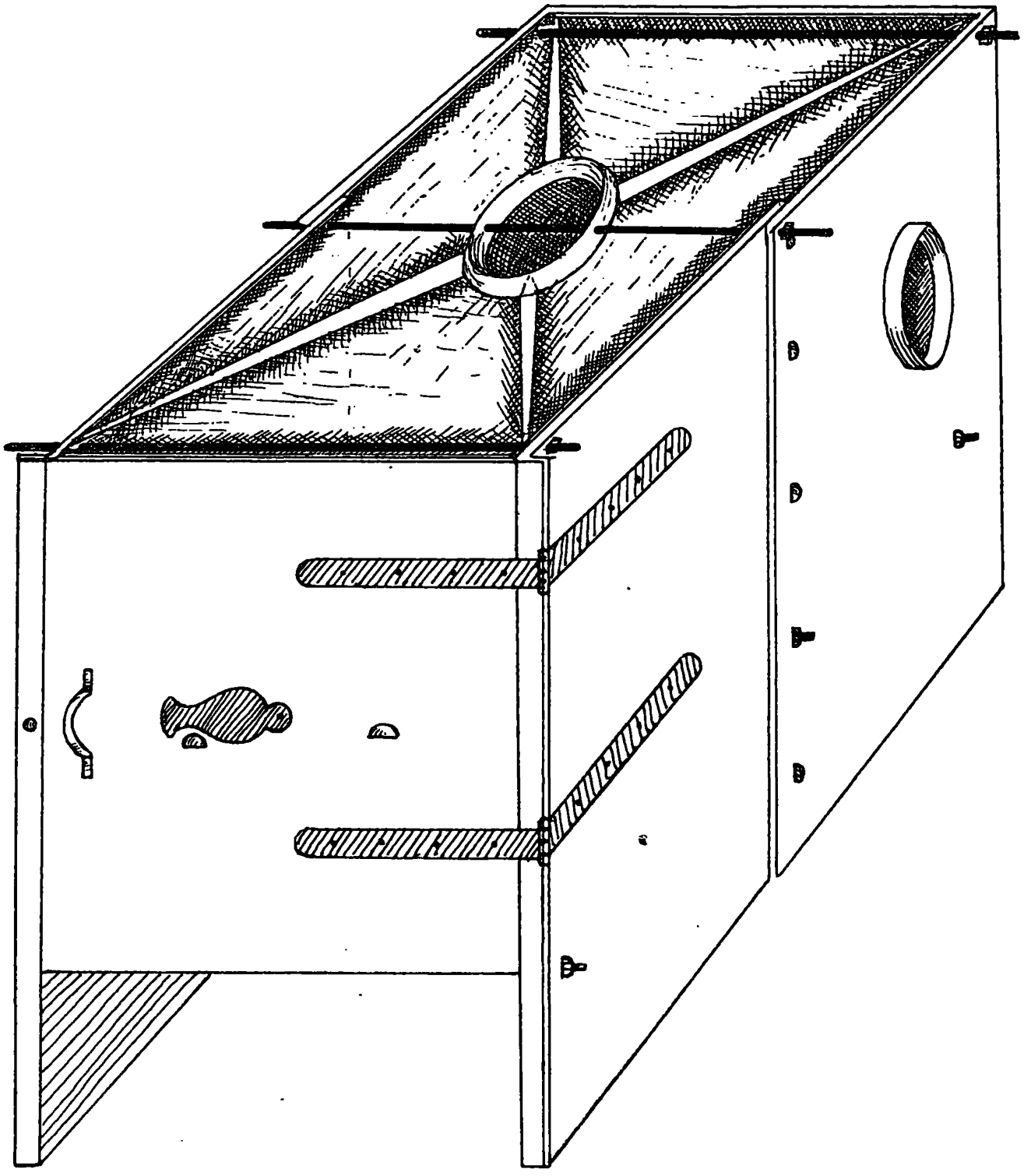

Plate II

A general view of a tobacco furnace. Note the roof reinforced against buckling and the three tier-rods above the roof holding the vertical side plates in position. The circular vent about ten inches in diameter is shown at the rear end of the side plate.

square. These vertical posts are joined together by horizontal ones so that the lower tier is about 7 feet from ground level and each successive tier is about 2 feet above the next lower one. On the framework thus formed are hung the sticks to which the tobacco leaves are strung. Each stick is 4 feet 6 inches long.

FURNACE

(Plate II)

Each furnace should have walls at least half an inch thick. The side walls may be cast in two pieces with either lap or butt-joints bolted together. At the further end of the side wall a circular vent about 10 inches in diameter with a flange 5 inches deep is provided. The flue pipes slide over this flange. The roof of the furnace may be cast in one piece and should be supported on lugs cast on the inside of the side walls of the furnace. Owing to its length the roof should be reinforced against buckling by ridges radiating to the four corners from a central circular flange, the whole being cast in one. The door which is provided with a peep-hole and sliding cover should be hinged to one side of the furnace. The whole when assembled is held together by six tier-rods with their ends threaded so that nuts can be screwed on as tightly as required to hold the side plates in a vertical position. Three tier-rods are fitted just above the roof, one at each end and one at the middle, while three others are similarly placed about nine inches from the base of the furnace. The furnace should be assembled on a level platform at the middle of the front wall of the barn so that its door when closed is flush with the outer surface of the front wall. Each furnace is provided with fourteen fire-bars each $\frac{3}{4}$ inch thick and of the same length as the furnace. The fore end of each fire-bar rests on a cast-iron bearer bar which is supported on lugs cast in the inside of the side walls. The rear end of the furnace is built up with bricks held together with fire clay. The space below the fire-bar serves as the ash-pit and this may be kept closed by bricks loosely assembled, so that they may be removed when the ash is to be cleaned out. A metal frame of flat iron rod 1 inch wide is built into the front wall nine inches from the edges of the furnace. To this frame is hinged shutters of iron sheet which open outwards and serve to regulate the rise of temperature in the barn. A second frame is constructed at the rear end of the furnace. These two frames serve to support sheets of galvanised iron which enclose the furnace on three sides forming a baffle to

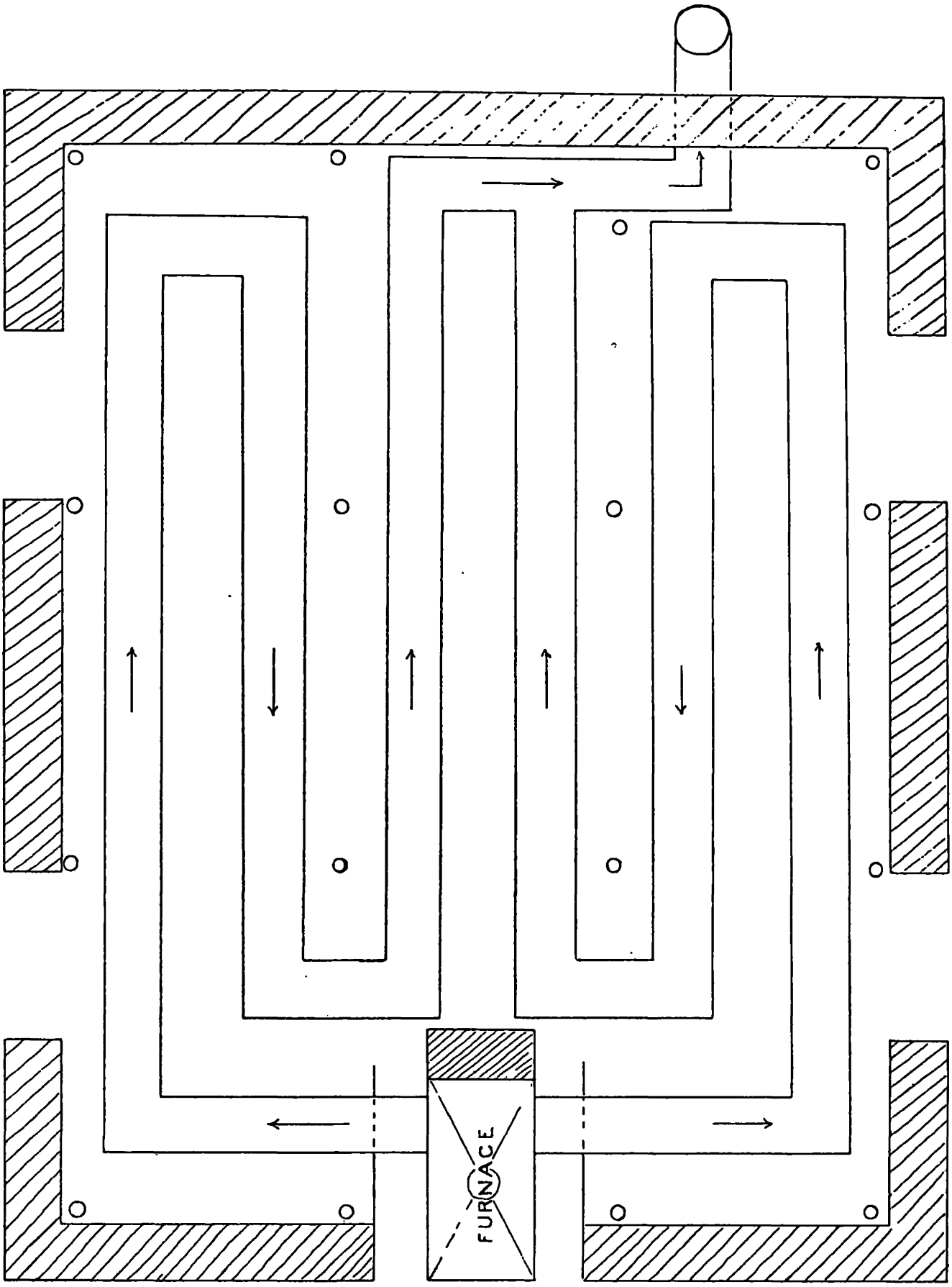

Plate III

A ground plan of a Flue-Barn. The walls are shewn hatched in, the breaks indicating where the ground ventilators are placed. The direction of the heat is shewn by arrows within the flue pipes. It will be noticed that the rear end of the furnace is not of cast iron but bricked in.

keep the direct heat of the furnace from the leaves cured and also serve as an outer chamber within which the heat can be regulated by the shutters referred to.

FLUE PIPES

The flue pipes which could be made of 22 gauge sheet-iron should have a diameter of at least 10 inches. The portion which fits into the flanges of the furnace should be carefully constructed so that a fire-proof joint is secured. The pipes should be arranged as shown in Plate III so that the room is uniformly heated. The fire stack leading the smoke from the flue pipes should be at least 28 feet high, so that a good draught is created.

CURING

Curing consists in the manipulation of the temperature and humidity of the barn when filled with leaf so that the yellowish-green colour of the leaf when harvested is gradually changed into a canary yellow colour and the moisture content of the leaf is considerably reduced. In curing, the composition of the leaf is subjected to a series of chemical changes.

No rule of thumb can be followed in flue-curing tobacco, for what is correct under one set of conditions may not be so under others. Soil, climate, cultural operations and degree of ripeness are factors which influence the duration of the several curing processes. The processes described below hold good only for conditions obtaining at Wariyapola. The duration of the processes for other localities is a matter for experiment.

There are three stages in the curing of tobacco for cigarette purposes.

a. Yellowing.

b. Fixing the colour.

c. Drying the leaf; both web and midrib.

Yellowing.—The barn is filled evenly, taking care that no large spaces occur between leaves or sticks. Should the quantity of leaf be insufficient to fill the barn completely the sticks should be evenly distributed over a fewer number of tiers. A thermometer and a hygrometer are hung just below the last tier of leaves somewhere away from the furnace, preferably in the middle of the room, so that readings can be conveniently taken

through the pane in the window provided. A small fire is started in the furnace and the temperature kept at 90°F.* The ventilators and the door are kept tightly shut during the yellowing stage so that as high a moisture content as possible is maintained in the room. If the leaf is at the right stage of ripeness and the weather conditions normal the moisture given out from the leaf should be sufficient to maintain the required humidity, which should never be allowed to fall below 85 per cent. during the yellowing stage. Should the humidity drop below this through any cause, artificial moisture should be introduced into the barn by placing wet bags over the flues or pouring water over the floor. This should, however, be avoided if possible specially at the later stages of yellowing because it leads to sponging of the leaf which greatly takes away from the value of the cured leaf.

As the temperature in the shade during the curing periods is about 82° it is necessary to raise the temperature to 90° before yellowing can be started in the flue-barn. Even if no artificial heat is used, the temperature inside the barn, when filled with leaf and with the door and ventilators closed, rises to about 90°. Yellowing can be induced and completed by this rise of temperature alone, but this takes about three days and the barn will not be ready for curing the next harvest which normally comes on about a week later.

The temperature is maintained at 90° till the edges and tips of the leaves show signs of yellowing, when the temperature is raised to 95° and kept at that till about 50 per cent. of the leaf surface is yellowed, when the temperature is again raised to 97° and held there until 75 per cent. of the leaf surface is yellowed when the fixing stage is begun. In a barn loaded with leaf of uniform ripeness there should be no difficulty in deciding when the fixing stage should be begun. There is, however, always difficulty because no two persons have the same standard for judging ripeness by colour. In case the yellowing of the leaf does not take place uniformly, it should be carried on until about 60 per cent. of the leaves are yellowed, and this should take place within 18 to 24 hours.

Fixing the Colour.—The last stage in the yellowing of the leaf is also the first stage in the fixing of the colour in the leaf. When about 75 per cent. of the leaf surface has yellowed and,

* Farenheit temperatures are given throughout this paper.

in a barn filled with leaves of uneven ripeness, when about 60 per cent of the leaves have reached this stage, the fixing is begun by raising the temperature to 100° and raising the ventilator over the ridge of the roof half the length of its travel. The raising of the ventilator reduces the humidity as the moisture would otherwise settle on the surface of the yellowed leaf causing it to turn a reddish-brown colour and this is known as "spongeing".

The temperature is maintained at 100° till the whole surface of the leaf is yellowed with only traces of green along the veins and mid-ribs, and the temperature is then raised to 102½° and the four bottom ventilators opened to a quarter of their travel. This stage is a matter for experience, and until one has gained enough experience it is wise to raise the temperature to 102½° while there is still a pronounced greenish tinge about the yellow. After the temperature has been held at 102½° for one hour the temperature is raised by 2½° every hour till 110° is reached and this will be the end of the fixing stage. At 105° the ridge ventilator is fully opened and the bottom ventilators half opened while at 107½° all ventilators are fully opened. The opening of the ventilators serves to regulate the moisture content of the barn and the appearance of "spongeing" or an indication on the hygrometer of a high moisture content in the barn should be a signal for opening the ventilators wider than is described above. Fixing the colour takes about 8 to 10 hours.

Drying the Leaf.—The drying of the leaf begins at 110° with all the ventilators fully open. As the most critical period in curing is when temperature of the leaf is between 110° and 120° care should be taken never to let the temperature drop, as is likely to happen at night or in rainy weather. The temperature is raised at the rate of 2½° per hour from 110° to 125°. In order to accustom the leaf to the high temperature keep it at 125° for three hours and then raise it to 130° and keep it at that till the web of the leaf is two-thirds dry. It usually takes about 4 to 6 hours before the temperature can be raised from 130°. The temperature is then raised at the rate of 5° per hour to 140° and kept at that till the web of the leaf is quite dry. The raising of the temperature from 110° to 140° and the complete drying of the web of the leaf take from 22 to 24 hours.

After the web of the leaf has been completely dried raise the temperature to 165° at the rate of 5° every two hours. This temperature is maintained until the midribs are quite dry. At the end of this stage the midribs should snap with a crack when bent between the fingers. The fires are then allowed to die down and the door and ventilators left open to let the cured leaf become flaccid enough for handling. At 155° the bottom ventilators may be partly closed to economise fuel. Under no circumstances should the temperature of the barn be allowed to go above 165° because the soft silkiness and bright colour of the leaf will be destroyed and the leaf will also become brittle.

SHINGLING

The leaf when pliable enough for handling is removed from the barn on the sticks and "shingled". In shingling the sticks are arranged one on top of the other so that the next upper stick overlaps the leaves of the lower by one-third of their length. Shingling should always be done on a clean dry floor. The shingled sticks form a heap about $4\frac{1}{2}$ feet square and the heap is covered over with some mats or clean gunnies. In favourable weather the leaves can be detached from the sticks the next day. If rains prevail the heap is left till dry weather comes on.

GRADING

Before grading, the cured leaf should be in the right condition for handling, *i.e.*, it should be slightly flaccid so that it will not break in handling. It should neither be wet nor too soft because it will then turn mouldy fast. A bundle of leaves when held by the butts, shaken out and held with the tips of the leaves upwards should, if in the right condition for handling, remain erect or only slightly drooping.

Grading is best done on the farm as it gives the grower a chance of seeing his tobacco at its worst and of knowing what return he may expect from the several grades.

Colour is the base for grading cigarette tobacco. Sub-grades are formed from leaves of the same colour but of different quality.

The following are usually recognised grades of cigarette-tobacco:

Grade i. Bright canary yellow coloured.

ii. Bright orange coloured of less clearness than Grade i. In this grade will be placed blotched or slightly sponged leaves.

iii. A fair amount of colour but insufficient for Grade ii.

iv. A greenish tinge free from blotching or spongeing. After six or eight weeks these leaves would have lost enough green to be included in Grade i or ii.

v. All leaves which cannot be included in the above 4 or the 6th Grade. This will include all sponged and dark leaves.

vi. This grade should not occur if harvesting and curing have been correctly done. All dark-brown and green leaves are included in this grade.

BULKING

Leaves of the different grades are bulked separately. About 25 leaves are bundled into a "hand" and tied together by a leaf of the same grade. The hands are heaped on platforms to a height of about 6 feet. The heaps are covered over with hessian or mats. A dark room is best for storing bulked tobacco. The heaps should be broken up once in 10 to 14 days and rebulked so that the upper hands will go to the bottom of the heap.

TRANSPORT

Prior to transport each grade is packed separately with the aid of a bailing press into bales of sizes suitable for handling. The hands must not be pressed too tight.

After completing harvest uproot and burn the stalk and trash within one month as a precaution against the spread of pests and diseases.

COSTS

The following cost per acre are approximate:

	R. c.
Nursery	5·00
Preparatory tillage	7·50
Levelling and draining land ...	10·00
Lining and pegging	1·50
Fertilising	15·00
Cost of fertilisers	50·00
Transplanting and supplying vacancies	10·00
Shading	5·00
Watering	25·00
Weeding	7·50
Removing shade	1·00
Intercultivating	10·00
Pests and diseases	4·00
Topping	1·00
Suckering	3·00
Harvesting	15·00
Stringing	5·00
Loading Barn	1·50
Curing	5·00
Shingling & bulking	1·50
Grading	20·00
Rebulking	5·00
Uprooting tobacco stumps ...	3·00
Depreciation on barn on a six-year life	100·00
Total cost.	311·50

YIELD

One acre of Harrison's Special tobacco if grown on ideal conditions of soil and climate should yield about 4 cwt. of first grade leaf.

PESTS AND DISEASES

The greatest handicap to the realisation of appreciable yields in tobacco cultivation is the occurrence of pests and diseases. The chief pests and diseases observed on tobacco are dealt with in this paper. The control measures and spray formulae are those recommended by Entomologist and Mycologist of the Department of Agriculture.

Attention should be given to plant sanitation by collecting and burning all dead and diseased plants or parts of plants which should never be left lying about in the field.

PESTS

Stem-borer (*Phthorimaea heliopa*).—This pest usually starts in the nursery where the moths lay eggs on either side of young leaves. When the eggs hatch in 4 to 6 days the larvae — tiny caterpillars—start boring inside the leaf. For the first day or two these larvae feed as leaf-miners and then proceed to the midribs of leaves and finally bore into the stems in about a week's time. The stems infested by the borer swell out and the growth of the plant is impeded, the leaves forming a rosette appearance.

Control Measures.—1. Cover the seed beds with crepe cloth. 2. Spray the nursery in the early stages regularly with an arsenical mixture. 3. Plants should be given a good start by avoiding overcrowding in the nurseries and growth stimulated by fertilising the seed beds. Should the pest be noticed in seedlings after they have been transplanted an incision is made in the swollen part of the stem with a sharp knife, the caterpillars removed and killed and the wound in the seedling filled in with a little clay. Such plants should in dry weather be watered liberally.*

Leaf Caterpillar (Prodenia litura).—This is a prolific breeder, one moth laying 300-400 eggs in one mass. The caterpillars cluster together and eat the under surface of the leaves which are thus reduced to skeletons.

These and other leaf-eating caterpillars are controlled in the young stages by spraying nursery beds either with an arsenical spray or with a solution of 1 lb. of soft soap in 8 gallons of water, or by hand picking. Overcrowding in nursery beds should be avoided.

DISEASES

Damping off.—This is caused in seed beds by *Rhizoctonia solani* and is easily avoided by having seed beds sufficiently raised to ensure proper drainage. Should damping off occur as is seen by the dying off of seedlings in patches, remove all the affected plants and water this patch freely with a solution of Jeye's Fluid — 1 oz. to 1 gallon of water. The usual watering should be stopped and the shade over the seed beds removed to hasten the drying of the seed bed.

Frog-eye.—This disease is caused by *Cercospora nicotianae* which attacks the plant at any stage of its growth and causes

* For fuller information on this pest see *The Tropical Agriculturist*, LXXXIII, No. 1, July 1934, pp. 64-66. Also obtainable in leaflet form.

irregular spotting over the leaf surface. It is not possible to completely eliminate this disease and the only hope is to reduce the incidence by adopting the following measures:

1. Soaking seeds in a solution of silver nitrate strength 1 to 1,000. The seeds are placed in a muslin bag and well shaken in this solution for 15 minutes, washed in several changes of water and dried out in the shade before sowing.

2. Spraying seed beds once a week with Bordeaux mixture 2-2-40.

3. Removal of diseased leaves as soon as they are noticed in the field. This cannot however be done to excess as the growth of the crop will be impeded.

Bacterial Wilt.—This disease is well known to tobacco growers in this Province and is the cause of much loss. The base of stem and main roots become partially rotted and discoloured. The leaves and the green shoots wither progressively and the whole plant puts on a wilted appearance. The stem shows dark brown streaks externally, while in section a brown colouring of the tissues is seen spreading upwards and extending from the pith to the cortex.

Plants with broken or wounded roots are most liable to infection by the bacteria which live in the soil. In transplanting care should be taken to avoid breaking roots or damaging the seedlings. In cases of severe attacks avoid growing tobacco at least five years on the same land. Crop rotation with the elimination of solanaceous crops (*e.g.*, tomato, chillies, brinjal) should be adopted.

Eelworm.—Plants attacked by this nematode show signs of wilting and the leaves yellow prematurely. When such plants are pulled out the presence of the eelworm is indicated by tuberculous swellings on the roots which in severe cases resemble a warted potato. A bare fallow in which the land is regularly ploughed up and kept free from all weeds followed by a cereal crop is the only form of control. All attacked plants should be uprooted, heaped up and burnt *in situ* to avoid conveying the the disease to other plants which are free. Legumes such as cowpea are very susceptible to eelworm attack, but there are immune varieties.

Mosaic is characterised by the mottling of the leaves which show dark veins when held against the light. There are several forms of this disease which is caused by an ultra-filterable virus. Collecting and destroying all plants attacked by this disease is the only form of control. Avoid handling healthy plants after touching diseased ones.