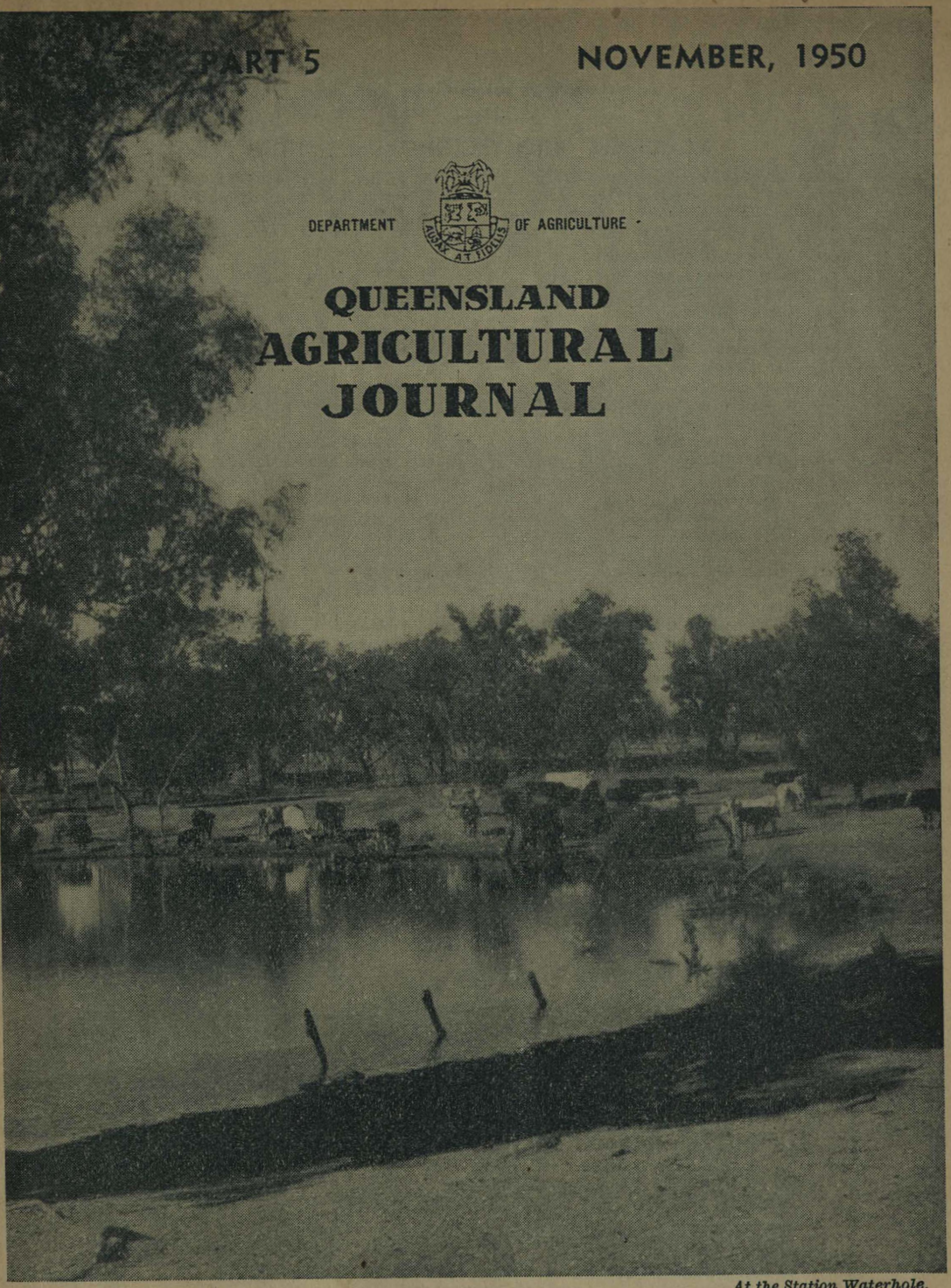
PART 5 NOVEMBER, 1950

DEPARTMENT OF AGRICULTURE

QUEENSLAND AGRICULTURAL JOURNAL



At the Station Waterhole.

LEADING FEATURES

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Contents

Queensland Certified Hybrid Maize.

Part 2. Notes for Growers on Procedure of Seed Production.

W. W. BRYAN, formerly Plant Breeder, Queensland Agricultural High School and College, Lawes.

IN Queensland, seed certification is under the control of the Seed Certification Committee, which is appointed by the Minister for Agriculture and Stock. This committee is advised by a Hybrid Maize Seed Certification Sub-committee of four members, also appointed by the Minister. Seed Certification Officers submit their reports to the Sub-committee and final decisions are returned by the Committee to the field officer and through him to the grower.

The objects of certification of hybrid maize seed are to—

(1) Give the purchaser reasonable assurance that the specific hybrid is approved on the basis of official and impartial performance tests, that the seed is true to label, and that it is in satisfactory condition for planting.

(2) Give the seed grower recognition and recommendation for hybrid seed properly produced.

(3) Provide unbiassed inspection of the technical operations of seed production, and assist in developing orderly and reliable methods of increasing hybrid maize seed.

The production of certified commercial hybrid maize seed—which is the final product—is achieved by firstly breeding inbred maize, then foundation hybrid maize, and finally certified commercial hybrid maize.

"Inbred maize" is produced by the Plant Breeder at the Agricultural College at Lawes only for use at that institution in the production of "foundation hybrid maize." The latter (foundation hybrid seed) is supplied by the Seed Certification Committee (through its agent, the Plant Breeder, Queensland Agricultural College, Lawes) to growers with registered areas for the production of certified commercial hybrid maize seed.

The essential features of certified commercial hybrid maize seed production by farmers are:—

(1) A probationary training period for seed growers.
(2) Registration of an area to produce certified seed.
(3) Proper isolation.
(4) Thorough detasselling.
(5) Correct and careful harvesting and shelling.
(6) Inspection and final sealing of shelled certified commercial hybrid seed.

PROBATIONARY TRAINING.

Before a grower can undertake seed production, he must serve a probationary training period of one season in order to learn the method of procedure. Essentially this consists of growing a small (¼ acre) crossing plot, for the conduct of which he is given all necessary advice and assistance by a fully trained seed certification officer. The seed grown on a probationary plot is to be used *only* by the grower and is on no account to be sold or even given away. It will not be certified.

Having succeeded in his probationary period, the grower is free *either* to engage in the commercial production of certified seed for his own use and for sale (under certification) and is known as a "Commercial Producer," *or* to produce only his own seed requirements (without certification), when he is known as a "Home Producer."

REGISTRATION OF AREA AND PLANTING.

Any grower who desires to grow certified hybrid maize should contact the nearest Adviser in Agriculture or the Plant Breeder, Queensland Agricultural College, Lawes, who will supply an application form (Form A.1.) and information as to the procedure.

The area to be planted shall conform to the isolation requirements, shall be free of all volunteer maize plants, and shall not have been planted to maize for at least one year prior to sowing the crossing plot.

After the application form has been completed by the grower, an inspection will be made and a report forwarded to the Standards Officer, Department of Agriculture and Stock, Brisbane.

When an application is approved by the Committee the seed necessary to sow the area will be supplied by the Plant Breeder.

PLANTING THE PLOT.

The two parental crossing stocks supplied will be designated "pollen" (male or tassel) parent and "ear" (female) parent. At least two pollen rows must be grown on each side of the crossing plot. Pollen parents must be sown in separate rows from ear parents and all pollen rows clearly marked by pegs at both ends of the field. A handful of cowpea or sunflower seeds to every few pounds of pollen parent seed also serves to aid in identification of the pollen rows. It should be noted that as the seed supplied for crossing plots will have come from inbred line parents, this seed will be small and irregular in shape. Five pounds of this seed covers the same planting area as 8 lb. of normal sized seed.

The recommended ratio of pollen rows to ear rows is 1:3 and probably the easiest plan to follow in planting is to plant

Parent: P. E. P. E. P. E. P. E. and so on.
(P = pollen, E = ear.)
No. of rows: 2 2 1 4 1 2 1 4 and so on.

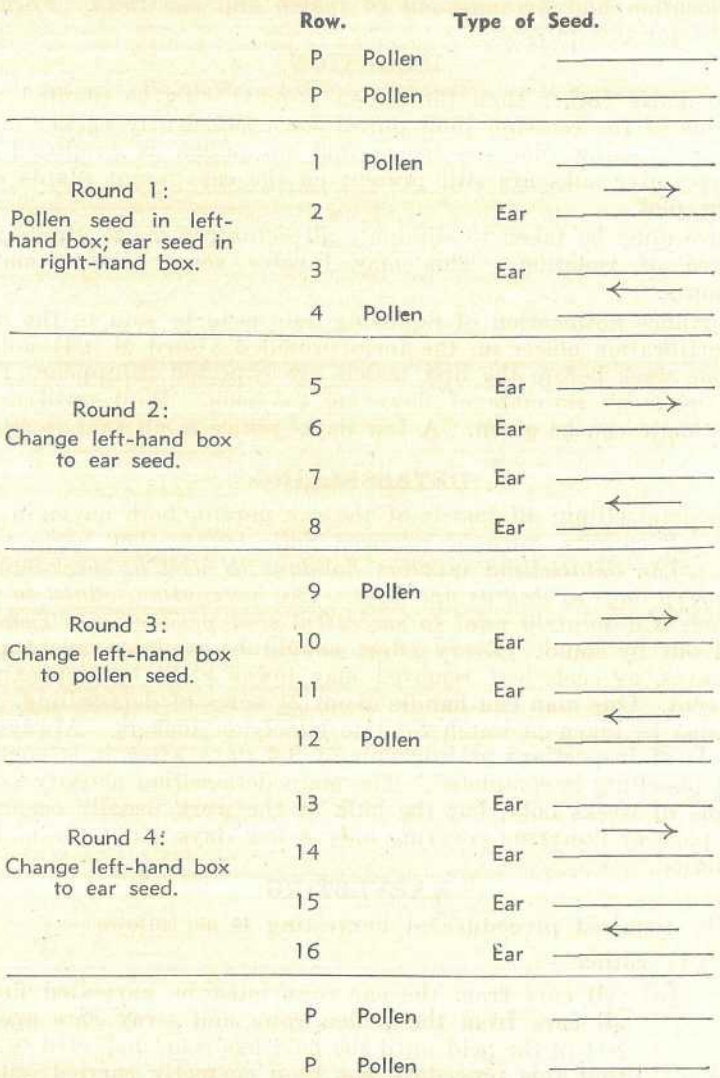
The 1:2:1:4 ratio is convenient to plant with either a 2- or 4-row planter. Fields that are more or less square, rather than long and narrow, ensure thorough crossing and proper pollination; the apprentice-grower plot is preferably planted therefore with rows not longer than 2½ to 3 chains.

PLANTING PLAN.

The method of planting a 20-row crossing plot with a 2-row maize planter is illustrated hereunder; arrows indicate direction of travel of the planter.

(*a*) Two pollen rows (P) are to be planted both before row 1 and after the last numbered row.

(*b*) When commencing to plant rows 1 and 2, the left-hand box of the planter must contain pollen seed, the right-hand box, ear seed. Then proceed as shown in the diagram.

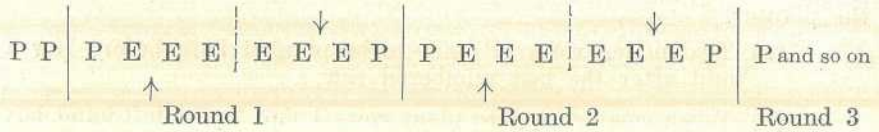


Alternatively, and for larger areas, the following plan is also satisfactory and lends itself well to ease of harvesting. It is designed for a 4-row planter, but can also be planted easily with a 2-row planter.

The plan is:—

P. E. P. E. P. E. P. and so on.
2 6 2 6 2 6 2 and so on.

For a 4-row planter this works as follows, no changing of seed in boxes being necessary.



Upon completion of planting the grower must notify the nearest seed certification officer of date of planting and furnish a plan showing exact location and arrangement of pollen and ear rows. Form 2 is provided for this purpose.

ISOLATION.

No maize (other than the pollen parent) may be planted within 20 chains of the crossing plot, unless sown sufficiently earlier or later than the crossing plot to ensure that no pollen is produced by it while receptive silks are still present on the ear parent plants of the crossing plot.

Care must be taken to eliminate all volunteer maize plants within the area of isolation. This may involve some co-operation with neighbours.

Advance notification of flowering date is to be sent to the nearest seed certification officer on the form provided (Card M.163) not more than one week before the first tassels are expected to appear. Do not try to make an estimate of flowering too soon. Wait until a fairly safe estimate can be given. A few days' notice is all that is required.

DETASSELLING.

In detasselling, *all* tassels of the ear parent, both on main plants and on all suckers, must be removed *daily* before they begin to shed pollen. *The detasselling involves holidays as well as week-days, wet or showery days as well as fine days. This precaution, added to proper isolation, is absolutely vital to successful seed production.* Tassels are jerked out by hand. Every effort should be made to avoid pulling any leaves, as each leaf removed may lower yield by approximately 3 per cent. One man can handle about 2½ acres of detasselling. Great care must be taken to watch for late tassels on suckers. Always make a couple of inspections at intervals of 3-4 days after it is considered that detasselling is completed. The main detasselling activity occupies a couple of weeks only, but the bulk of the work usually occurs in a sharp peak of flowering covering only a few days about the middle of this period.

HARVESTING.

The required procedure at harvesting is as follows:—

(1) Either—

(*a*) All ears from the ear rows must be harvested first and all ears from the pollen rows and stray ears are to be left in the field until the field has been inspected to ensure that this procedure has been correctly carried out;

or—

(*b*) At the discretion of the seed certification officer, all ears from the pollen rows and stray ears may be harvested first and isolated in accordance with the directions of the seed certification officer, so that all possibility of mixing shall be eliminated. The field is then inspected before the ears from ear rows may be harvested.

(2) The ears from the ear rows are to be culled so as to ensure that all kernels affected by dry rot or other diseases or by ear worm, weevil and other insects are rejected. Removal of butts and tips, unless damaged, is not imperative. Any off-type ears or ears from off-type plants should also be discarded.

(3) When culling is completed and the grower is ready to shell, notification of readiness to shell (Card M.164) is forwarded to the nearest seed certification officer. This officer will inspect the bulk of ears from the ear rows and also the sheller, and then allow shelling to commence. The bags of seed are sealed as they come from the sheller.

The seed from pollen rows and stray ears shall be used or sold as *feed grain only,* but not for sowing.

After shelling, store under conditions to protect adequately from rodents, insects, damp or other damaging influences. Information on protection of grain can be obtained from the Department of Agriculture and Stock, or the Queensland Agricultural College, Lawes.

Samples of seed offered for sale will be forwarded by the seed certification officer:—

(1) For purity and germination test, to the Seed Testing Station, Department of Agriculture and Stock, Brisbane, and

(2) For field trial to the Plant Breeder, Queensland Agricultural College; a 12-ear sample of each parent is also sent to the Plant Breeder for a check on identification.

SEALING.

As shelled, the bags will be sealed with an official seal, and marked with a temporary label. If germination, purity and type are satisfactory a certification label giving full details will later be supplied for each bag and sealed to it by a seed certification officer. Seed will be sealed in either ½ bushel, 1 bushel, or 3 bushel lots. The seed is available for sale only after final labelling and sealing, and until final labelling cannot be removed from the premises without permission of a seed certification officer.

The area for seed production, isolation, detasselling and the final seed product are all subject to inspection and approval by a seed certification officer, whose duty it is to carry out the objects of certification in an impartial manner.

No hybrid maize seed may be sold in Queensland unless it is certified. This is to protect the public from possible exploitation.

The only official charge involved in the production of certified commercial hybrid maize seed is the cost of foundation hybrid seed for sowing the crossing plot. At present there is no charge for the certification service.

Certified commercial hybrid maize seed is produced only on registered areas, and sold in unopened sealed containers, duly labelled, to any purchaser for the production of feed or grain.

Seed for sowing should not be harvested from the subsequent crop, as reduction in yield will result.

The sale or offering for sale of any hybrid maize seed as certified seed unless in *sealed, labelled and unopened* containers is an offence under the *Seeds Acts* and renders the seller liable to a penalty of £50.

Cucumbers, Rockmelons and Related Crops.

A. A. ROSS, Horticulturist.

THE vine crops of the cucurbit family most commonly grown commercially in Queensland are cucumber, rockmelon, pumpkin, squash, watermelon and choko. Other members of this family, such as gramma, gherkin and gourds, are planted only on a small scale. Most are tender annuals which are grown for their fruit. They require hot weather for their development and will not tolerate frost. Some are susceptible to leaf diseases, especially powdery and downy mildews during wet weather.

CUCUMBER AND ROCKMELON.

The cucumber is probably a native of Asia and Africa, and has been in cultivation for at least 3,000 years. The rockmelon also originated in Asia. These plants are closely related and in many respects the systems of culture of the two crops are similar.

Soils.

Where earliness is required, light textured soils such as sandy loams should be selected for the crop. However, cucumbers and rockmelons also grow well on heavier soils and high quality fruit is produced on loams and clay loams for an extended cropping period. Good drainage is essential, and provided this is satisfactory, soils 12 inches or more in depth can be expected to yield good crops.

Planting.

In the past, it was customary to plant cucumbers and rockmelons in "hills," that is, in groups of three or four plants spaced at distances of about six feet. The usual practice at the present time, especially where planting is done with a machine, is to sow the seed in drills from 4 ft. 6 in. to 6 ft. apart with about 12 in. between the plants. Later on the plants are thinned at the same time as the first chipping and spaced at approximately two feet. When planted in this way, about 3 lb. of seed will be required per acre.

Early crops are planted in late winter and spring according to prevailing temperatures in the district where they are grown. Young plants are easily damaged by frost but prices for early fruit are usually lucrative and growers are frequently prepared to risk winter planting in locations where frosts are normally light. In some districts

growers make two or three successive plantings at approximately weekly intervals so that even if the first is destroyed by frost, seedlings from the later sowings will escape injury. The best plants are then selected, the others being chipped out.

Fertilizers and Manures.

On all soils which are intensively farmed the regular addition of organic matter is essential. Where it is available, applications of farmyard manure are highly desirable. An annual green manure crop such as Poona pea which is turned into the soil when it matures is perhaps the best practical substitute for farmyard manure.

A complete fertilizer mixture containing nitrogen, phosphoric acid and potash, with an analysis of approximately 5 : 13 : 5, and applied at the rate of 10 cwt. per acre prior to sowing the seed, is recommended. This may be applied broadcast and worked into the soil during the later stages of land preparation for the crop. However, a better practice is to place the fertilizer in the drill beneath the seed. This can be achieved by opening a furrow with a mouldboard plough, distributing the fertilizer on the walls and bottom of the furrow at the rate of eight to ten pounds per chain, and finally covering in the furrow with a scuffler, which leaves a mark to indicate the position of the fertilizer row when the seed is planted.

A topdressing is usually required, especially in the lighter soils, at the time the vines have run about a foot. Either sulphate of ammonia at the rate of 1 oz. per plant (2 cwt. per acre) or, if the soil is fairly well supplied with nitrogen but is low in other plant foods, a complete fertilizer with an analysis of 10:6:10 or 10:8:7·5 at the rate of 1½ oz. per plant, would be suitable for this purpose.

Plate 184.

Young Cucumber Crop.—The pinés protect seedlings from wind and are removed when the cucumbers start to run.

Cultivation.

Cucumbers and rockmelon crops must be well worked early in the growing period, for once the vines start to run (Plate 184), they cover the ground quickly and machine cultivation becomes impossible. Inter-row cultivation can be performed by power implements but inter-plant cultivation must be done by hand hoe. Cultivation should be shallow and just deep enough to destroy weeds, otherwise root injury due to deep cultivation may give the crop a setback.

Irrigation.

All cucurbit crops need an ample supply of water, especially in the early stages of growth. However, with cucumbers and rockmelons a complicating factor to irrigation late in the season is their susceptibility to powdery and downy mildews. Over-watering, especially with overhead sprinklers, after the plants have met in the row tends to encourage these diseases. The object, then, is to apply water fairly frequently until the plants meet in the rows, and thereafter restrict irrigation to an early morning application when the crop shows symptoms of stress.

Harvesting.

When grown under good conditions, cucumber crops are ready for harvesting about 12 weeks after planting. The fruit should be picked while it is still green in colour and the seeds are soft. Fully mature, yellowish fruit is unsaleable. Fruit is picked into tins or baskets and packed into cases, usually of half or one bushel capacity.

The correct stage for picking rockmelons depends on variety, climatic conditions and distance from market. To develop its best flavour, a rockmelon must be left on the vine as late as possible, yet it must be marketed before it becomes soft. There is no definite external indication of approaching maturity, but with practice certain changes can be recognised in the netted varieties. The netting becomes more rounded and the colour showing through the netting gradually changes from dark-green to yellow. When the fruit is fully ripe, an abscission layer develops at the junction of the stem and fruit; this is known as the "full-slip" stage, for the fruit is then easily removed.

Varieties.

The most popular varieties of cucumber are Early Fortune and Kirby's Stay-green. Crystal Apple is a small fruited, pale coloured variety which at times meets a reasonable market demand.

The netted varieties of rockmelons are popular with Australian consumers, and for ease of handling and packing the small round types are preferred. Hales Best and Rocky Ford are the most commonly grown, and when mildew-resistant strains are available they should be used. Other varieties such as Californian Cream, Yellow Cantaloupe, Yates Surprise and Honey Dew are good quality melons, but their large size and unnetted character lower their market value.

WATERMELON.

The watermelon (Plate 185) is probably of American origin and was not well known prior to the sixteenth century.

Soils.

The watermelon will not tolerate poor drainage and prefers a light soil such as a sandy loam. An open structured soil to which organic matter has been added in the form of farmyard manure or green manure crops is therefore desirable.

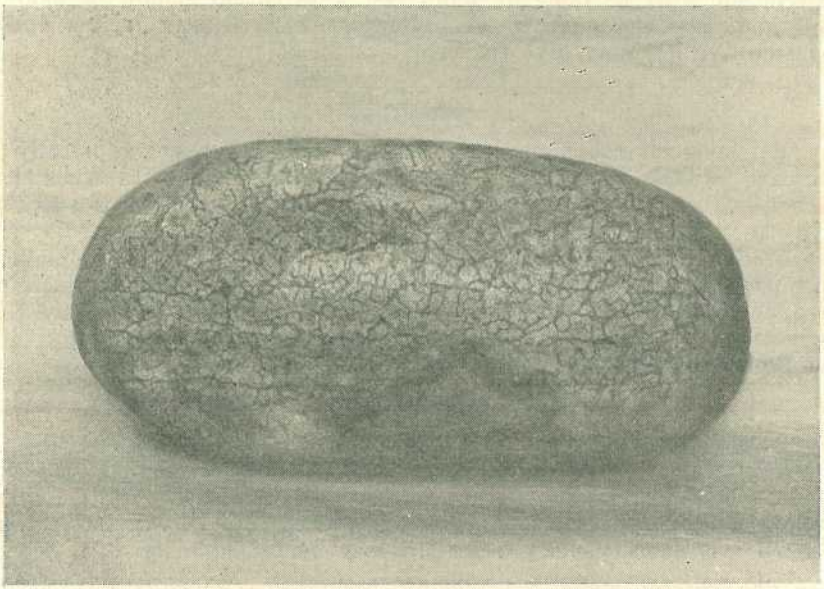


Plate 185.
Watermelon of the Variety Hawkesbury Wilt Resistant.

Planting.

Watermelons are usually established in "hills," which allow the field to be machine cultivated both ways. Spacings vary from 8 feet by 8 feet to 12 feet by 12 feet, the best results generally being obtained with the wider spacing. Several seeds are sown in each hill and the resultant plants are thinned to two or three. About 3 lb. of seed are required per acre.

Planting must be delayed until spring, when the frost risk has passed. The watermelon is slightly less tolerant to frost than the cucumber and requires a longer growing season. Very early crops can therefore be grown only in warm sheltered situations.

Fertilizers and Manures.

Where available, farmyard manure should be placed in and near the "hill" positions. Prior to planting, a basal application of a fertilizer with a composition of approximately 5 : 13 : 5 at the rate of 6-8 cwt. per acre is advisable. In most cases the crop would benefit from topdressing with a 10 :6 :10 or 10 :8 :7·5 mixture at the rate of 2 oz. per "hill" when the plants have run about 18 inches.

Cultivation.

Until the plants meet, cultivation should be frequent, thorough and just deep enough to destroy weeds.

Irrigation.

Watermelons are not as subject to leaf diseases as cucumbers and rockmelons and the irrigation programme need therefore not be so precise. The crop should be given a plentiful supply of water up to the time the melons are about three-quarters grown, after which irrigation is required only when the first signs of wilting are seen.

Harvesting.

It is difficult to pick a mature watermelon from external characters, as the skin colour does not change with advancing maturity and size gives no indication of ripeness. Experienced growers tap the fruit with the knuckles and listen for the "hollow" sound. This varies with the variety and it is therefore a wise precaution to cut a few melons after tapping to determine the significance of the sound as a test of maturity, and harvest accordingly. The fruit should be picked with a stem of about two inches attached in order to reduce injury from stem end rot. They are loaded singly into wagons and packed up to four layers deep. Watermelons are usually delivered to market in the grower's own vehicle.

Varieties.

The present trend is to plant a variety which exhibits some wilt resistance, for in many fields this disease has become very serious in recent years. Hawkesbury Wilt Resistant and Sugarstick Wilt Resistant are good quality melons with a crisp, bright-red flesh and a relatively thin rind. There are numerous varieties of watermelons available, but in addition to the wilt resistant strains, Kleckley Sweet, Tom Watson, Coles Early and Market Wonder are the most popular with commercial growers.

PUMPKIN, MARROW, AND SQUASH.

A great deal of confusion exists in the classification of these cucurbit crops, but they fall into three groups—pumpkins (Plates 186 and 187), marrows and squashes (Plate 188), and bugles, grammas and cushaws, which are better known in North Queensland than in other parts of the State.

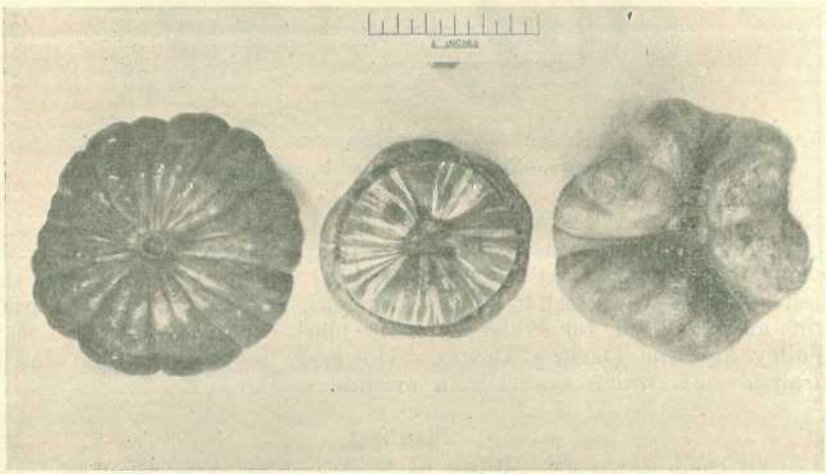


Plate 186.
Pumpkins of the Turban Group.—Left to right—Queensland Blue, Turk's Head and Triamble.

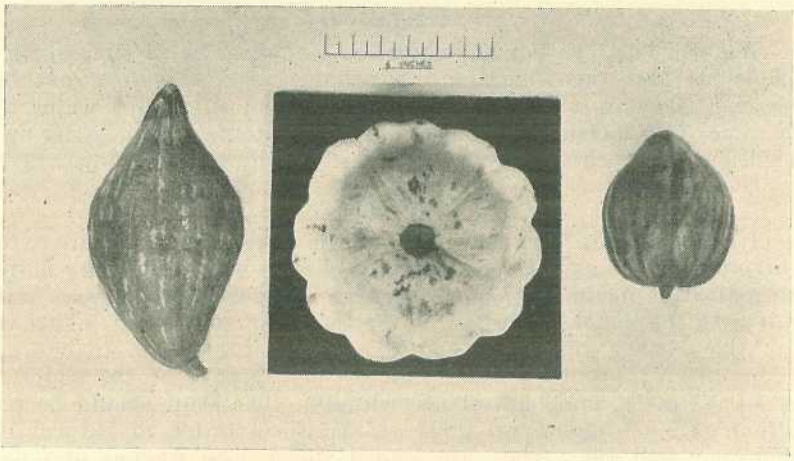


Plate 187.
Squashes.—Hubbard, White Custard and Table Queen.

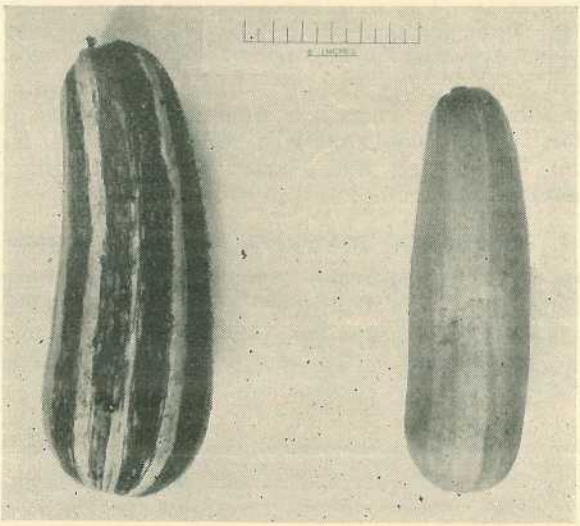


Plate 188.
Marrows.—Yellow Striped and Long Cream Bush.

Soils.

Pumpkins and related crops may be grown successfully on a wide range of soil types and generally do well on heavier soils than those best suited to watermelons and rockmelons. Excellent crops of pumpkins are produced, for example, on the black clay loams of the Lockyer Valley and the Darling Downs. However, they thrive best in well drained soils which are rich in organic matter.

Planting.

All these crops are subject to frost damage, and planting, except in frost-free districts, must be delayed until the spring when the risk of injury is slight. Planting usually extends from September to the end of December.

Pumpkins are usually planted in drills 10 to 12 feet apart, seed being dropped singly at intervals of 3-4 feet. Planting in "hills" is also satisfactory, two or three seeds being planted in groups at 6-8 feet spacings. Squashes and marrows, which produce smaller plants, are sown more closely, drills being spaced 4-5 feet, with plants 2 feet apart. Approximately 2 lb. of seed is sufficient to plant an acre of pumpkins and 4-5 lb. for those species which are planted more closely. At times, heavier sowings are made, to allow for seed or seedling losses caused by insect and other pests, any surplus plants being thinned out later.

Fertilizers and Manures.

It is the usual practice to grow pumpkins, marrows and squashes after a crop which has been heavily fertilized, the residue meeting the nutritional requirements of the cucurbit. However, on light soils fertilizer applications may be necessary. A pre-planting application of 6-8 cwt. per acre of a complete mixture with an analysis of about 5:13:5 should prove satisfactory. Except in very fertile heavy soils it is advantageous to topdress the crop with a complete fertilizer mixture of a 10:6:10 or 10:8:7·5 formula at the rate of 2 oz. per vine when the plant has run about 12 to 18 inches.

Cultivation.

Early cultivation should be frequent in order to get weeds under control before the plant spread prevents the use of machines. Hand chipping between plants is important in the early stages of growth. As with other cucurbit crops, cultivation should be shallow.

Irrigation.

The water requirements of these plants are high and lack of water at critical periods causes shedding of the partly formed fruit. In excessively wet seasons, mildews cause much damage to the leaves and water should therefore be used sparingly towards the onset of the normal period for summer rains.

Harvesting.

Crops of the pumpkin type are usually allowed to mature in the field, where they frequently remain until the vine dies or is frosted. A short length of stalk should be left attached when the fruit is picked to lessen the risk of stem end rot. Late crops store very well in a dry, cool building such as a well ventilated barn, but they should be kept either on racks or in a single layer, as wastage is apt to occur in heaped pumpkins.

The vegetable marrows and the scallops should be harvested before they are fully developed; if they are allowed to mature on the plant, the flesh becomes soft and the fruit loses flavour. Marrows are normally despatched loose to local markets and packed in sacks or 1½ bushel cases for more distant centres.

Varieties.

Within each of the three cultivated species in the genus Cucurbita, there are several distinct groups of varieties, clearly

distinguishable by fruit shape. Plants of the pumpkin type are divided into the following groups:—

(1) *Hubbard.*—Fruit oval in shape but always pointed at the blossom end. Surface varies from smooth to strongly warted. Colour ranges from deep green to orange. This group includes the varieties Golden Hubbard and Green Hubbard.

(2) *Turban.*—Fruits are turban shaped, usually with a button at the blossom end. The thick, hard shell gives a long storage life to varieties in this group. The varieties include the Queensland or Beaudesert Blue—a very popular table pumpkin—Triamble, Ideal, Ironbark and Crown. Unfortunately, strains of all these varieties are somewhat variable.

(3) *Mammoth.*—Huge fruit often used for stock food. They usually have large seed cavities and a coarse, pale soft flesh. Varieties include Mammoth Cattle, Mammoth Yellow and Mammoth Chili, but again strains are considerably mixed.

(4) *Banana.*—Somewhat similar to the hubbards in shape, but usually more elongate. They are generally greyish-green in colour but have a softer rind than the hubbards. They are reputed to be of excellent flavour but are not grown to any extent in Queensland. Chief varieties are Banana and Plymouth Rock.

Varietal groupings for the plants of the marrow and squash type include:—

(1) *Patty Pan.*—Flat fruits with scalloped edge, plants being of bushy habit. Varieties belonging to this group are:—Early White Bush Scallop, Early Yellow Bush Scallop and Golden Custard.

(2) *Vegetable Marrow.*—Oblong fruit with smooth hard rind ranging in colour from white to dark green. Plants are both bush and twining in habit. Varieties include Long White Bush, Long Creamy Marrow, Long Cream Bush and Zucchini.

(3) *Crookneck, Fordhook and Connecticut Field,* which are not grown commercially in Queensland, would not be expected to meet a ready demand on local markets.

CHOKO.

The choko (Plate 190) is a popular fruit on Queensland markets and differs somewhat from other cucurbit crops in that it is perennial in habit, contains only one seed per fruit and is usually grown on trellises or frames. It is reported to be a native of Mexico, Central America and the West Indies.

Soils.

Because of the perennial habit of the choko, it is wise to select a relatively deep, well drained soil, preferably with a sandy loam texture. The plant will also do well on heavier soils if good cultural practices are adopted.

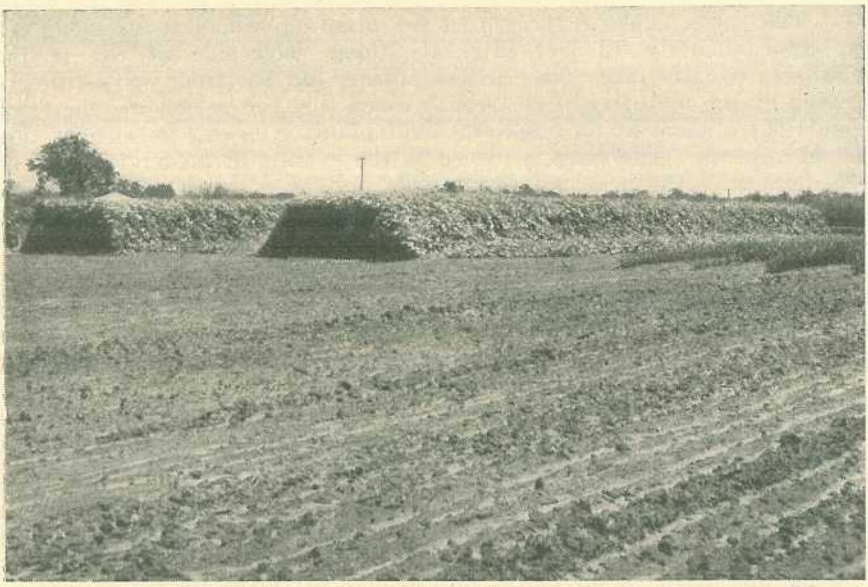


Plate 189.
Trellised Choko Bowers at Sunnybank.

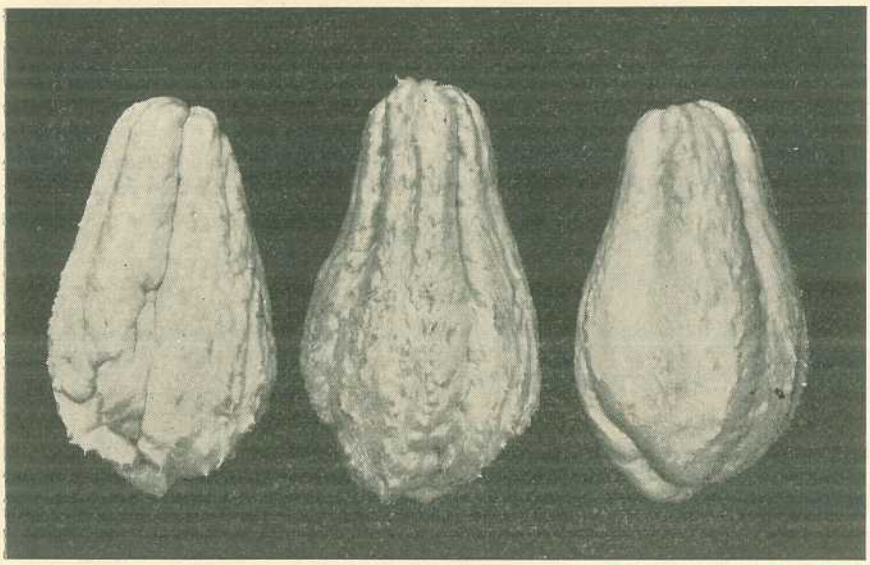


Plate 190.
Fruit of the Choko Variety, Cream.

Planting.

Before planting, substantial trellises (Plate 189) capable of standing for several years should be erected. These are usually constructed in the form of an arch about 6 feet high, 15 feet wide at the top and 22 feet wide at the bottom. Wires are stretched along the sides and top of the trellis at intervals of approximately 15 inches.

The entire choko fruit is used for planting, whole fruits being set at approximately 12 feet intervals along each side of the trellis. Planting usually takes place in the spring, but the time will be determined by the maturity of the seed. When the seed is mature, the fruit sends out a shoot at its basal end, and planting begins as soon as this shoot appears. The fruit is placed in the ground at an angle of about 45 degrees, with the shoot downwards and at a depth of 3-4 inches. The apical end of the fruit is then at ground level or slightly exposed.

Fertilizers and Manures.

Careful preparation of the soil should precede planting and all available farmyard manure should be applied to the approximate sites for the plants. Pre-planting applications of fertilizers may be necessary to provide a suitable medium for growth, especially in the lighter types of soils. The nature and rate of this application will depend to a certain extent on the previous cropping history of the soil, but the fertilizer used should contain a fairly high proportion of nitrogen.

Topdressings are an important means of supplying nutrients to the plant. Two topdressings should be made during the season, one in midsummer when the main crop is setting and the other in early spring just as the plant moves into growth after the winter dormancy. According to the type of soil, an 8:10:5-5, 5:13:5 or similar complete fertilizer mixture would be suitable for the spring dressing, 8-10 lb. per plant being applied. In midsummer, 2-3 lb. per plant of a 5:14:5 mixture should be used. The topdressing should be spread evenly around the plant over a circular area having a radius of approximately five feet.

Cultivation should be shallow, and frequent enough to keep weeds in control. In cold locations it may be necessary to protect the roots and base of the plant during winter. When growth has ceased in the winter, the vine may be cut back and the soil mulched to avoid frost damage. In the spring, the tuberous root will throw out new shoots and the vine will recommence cropping.

Irrigation.

Soil moisture must not be allowed to become deficient at any time during active growth, and as the plant has a high water requirement frequent irrigation is necessary.

Harvesting.

When the plant has become well established, two crops will be produced each season, a light crop in late spring and early summer and the main crop in autumn. A small number of fruit will also mature during the summer. Chokos should be harvested when fully developed yet should not be allowed to become old and seedy. They are frequently marketed loose for the local market, but for distant markets they should be packed in cases.

Varieties.

There are two varieties, the green and the cream. The green is the more popular type but the market requires reasonably large fruit free of spines. The cream variety is sometimes favoured by home gardeners.

PLANT PROTECTION

Brown Rot Control Experiments in the Stanthorpe District, 1948-49 and 1949-50.

W. PONT, Assistant Pathologist, Science Branch.

BROWN rot, caused by the fungus *Sclerotinia fructicola*, is a major cause of loss in stone fruits throughout Australia. At a conference of Australian plant pathologists held in 1949, it was agreed than an average loss in stone fruit production of 10-15 per cent. per annum due to this disease would be a conservative figure.

During recent years in Queensland, the 1947-48 and 1949-50 seasons have seen large scale market condemnations of stone fruit consignments due to brown rot infection. In this State heavy losses occur when rainfall during the late spring and summer is above average, but epidemic outbreaks of the disease do not seem to be dependent on this factor alone. In some seasons in which rainfall for the season as a whole has been above average, brown rot incidence has been slight. Heavy rains early in the season appear to play an important part in causing epidemics of the disease. For example, in both 1947 and 1949 October was characterised by abnormally high rainfall and number of wet days, while in 1948 the opposite was the case. It was observed in 1949 that the prolonged wet conditions in October caused a build-up of the fungus on apricots, which, due to their sensitivity to sulphur and copper compounds, receive no fungicidal treatment subsequent to a sulphur or copper application at petal fall. Once the material for infection was built up, the incidence of the disease fluctuated with rainfall and very severe losses occurred in fruit which experienced fairly consistent rain or overcast conditions immediately prior to harvest.

Incidence of brown rot in the case cannot be divorced from incidence in the orchard. Preventive measures must originate in the orchard and should consist of efficient orchard sanitation, to prevent overwintering of the fungus, plus the use of a spray programme designed to keep a protective cover of fungicide on the fruit throughout its development. The problem with brown rot is to obtain a fungicide which is toxic to the fungus spores but which is not toxic to the tree and which does not leave a noticeable residue on the fruit. This last point is important so long as a pre-harvest spray remains necessary.

Sulphur sprays of various types have been proved over a number of years, in countries where brown rot is a problem, to reduce the amount of infection. In Queensland, lime sulphur, because of considerations of cheapness, ease of preparation and proved toxicity to the brown rot fungus in the laboratory, has for some time been recommended as a preventive spray for brown rot control. In view of the losses from the disease which still occur, experiments were carried out during the seasons 1948-49 and 1949-50 to further test the efficiency of lime sulphur under orchard conditions in Queensland. In two of the experiments a second sulphur compound, a wettable sulphur, was included.

Experimental Procedure and Results.

During the 1948-49 season, experimental spraying was carried out on Goldmine nectarines at Glen Aplin. Forty-eight trees were included in the experiment. These were divided into four blocks of twelve trees each. Spray treatments used involved lime sulphur and a wettable sulphur each used in two schedules, thus giving four treatments. These treatments were applied separately to plots of two trees within each of the four blocks. For the purpose of gauging brown rot incidence within the experimental area, four trees were left unsprayed in each block. The two schedules mentioned above were a long and a short schedule respectively. The long schedule consisted of fortnightly spray applications commenced in mid-November and carried through to harvest. The short schedule consisted of similar fortnightly applications commenced in mid-December.

Lime sulphur was used at a strength of 1-80 during November, but because of the possibility of spray damage to the trees during the warmer months the strength was reduced to 1-120 in December and January. Agral 2 spreader was used with the lime sulphur at the rate recommended by the manufacturer. Wettable sulphur was used at a strength of 1 lb. to 20 gallons throughout.

This experiment was repeated in the 1949-50 season on the same trees. Treatment schedules and the amount of brown rot infected fruit in each for the respective seasons are given in Table 1.

Additional experiments were laid down in the 1949-50 season, one on plums and two on peaches. Forty trees were included in each experiment. These were divided into four blocks of ten trees each. Spray treatments consisted of lime sulphur used in long and short schedules and in two strengths as follows:—

(1) 1-80 in November; 1-100 in December and January;

(2) 1-100 in November; 1-120 in December and January.

In the trial with plums, in order to avoid burning, the second November application was reduced to 1 in 100 and 1 in 120 respectively.

Four spray treatments were thus involved. These treatments were applied separately to plots of two trees within each of the four blocks. One plot of two trees in each block was left unsprayed. Table 2 details the treatments and shows the amount of brown rot in each.

TABLE 1.

SPRAYING TRIALS WITH NECTARINES (GOLDMINE).

(Harvest Dates: 12th January, 1949; 7th January, 1950.)

Treatment.	Applications.				Infected Fruit.	
	Mid-Nov.	End-Nov.	Mid-Dec.	End-Dec.	1948–49.	1949–50.
					Per cent.	Per cent.
A. Lime sulphur ..	1–80	1–80	1–120	1–120	1·2*	6·0*
B. Lime sulphur ..	..	..	1–120	1–120	10·0	26·5
C. Wettable sulphur	1–20	1–20	1–20	1–20	6·8	21·4
D. Wettable sulphur	..	..	1–20	1–20	8·7	10·3
E. No spray ..	..	..	..	..	13·4	42·5

* Significantly better than no spray.

The figures given for percentage infected fruit in the tables were obtained from plot samples harvested from the various experimental blocks, wrapped to prevent spread from fruit to fruit in the container and stored at room temperature. They were examined and picked over at intervals until the soft ripe stage and the figures therefore represent total loss rather than loss at time of marketing.

TABLE 2.

SPRAYING TRIALS WITH PLUM AND PEACH.

Treatment.	Number of Sprays.			Infected Fruit.		
	Pond's Seedling Plum. (Harvested 26-1-50.)	Late Crawford Peach. (Harvested 31-1-50.)	Golden Queen Peach. (Harvested 22-2-50.)	Pond's Seedling Plum.	Late Crawford Peach.	Golden Queen Peach.
				Per cent.	Per cent.	Per cent.
A. Long schedule, strong.. ..	6	6	7	10·6*	13·1	62·5
B. Short schedule, strong.. ..	4	4	5	16·7	18·6	55·6
C. Long schedule, weak	6	6	7	17·5	12·1	60·8
D. Short schedule, weak	4	4	5	19·0	12·3	72·0
E. No spray ..	..	..	..	26·5	29·7	67·0

* Significantly better than no spary.

Discussion.

In the 1948-49 and 1949-50 seasons' experiments on nectarines, worthwhile control of the disease was obtained with long schedule lime sulphur (Treatment A). The low percentage brown rot infection for Treatment D in the 1949-50 experiment should be disregarded, as black mould rot (*Rhizopus nigricans*) was particularly prevalent in plot samples of this treatment and masked the true incidence of brown rot.

In the experimental work on Pond's seedling plums, long schedule strong lime sulphur (Treatment A) gave a decrease in infection of approximately 60 per cent. in comparison with unsprayed (Treatment E). The other treatments were less effective.

The figures obtained from the spray experiments on peaches are variable and difficult to interpret. No statistically significant reductions in percentage infections were obtained with any of the treatments in either experiment. The fact that the final spray on the Golden Queen peaches was applied 13 days before harvest at a time when the weather was exceptionally wet may have influenced the severity of the disease in this experiment. The reduced effect of the November sprays in the plum and peach experiments may have been related to the younger age of the fruit of these varieties at the time as compared with nectarines.

Spray residue did not present any difficulties except in the case of plums, and even here it is thought that use of more powerful and more efficient spray equipment would have eliminated the trouble.

These experiments have shown that until a more suitable fungicide for brown rot control has been found, little change can be made in the recommendations for control of this disease.

Orchard sanitation should be a primary consideration and this should comprise end-of-season removal and destruction of mummified fruit, and elimination, by pruning, of infected laterals. The lime sulphur 1-15 or Bordeaux 6-4-40 spray usually applied at bud movement for the control of rust and peach leaf curl should be supplemented by a schedule corresponding to Treatment A in the experiments described above.

The pre-harvest spray is considered important, especially if weather conditions are favourable for brown rot. This spray should be applied as close as is possible to the date of harvest. If continuous rain is experienced preceding harvest, the grower should still attempt to apply a protective spray when the weather lifts and before the fruit is harvested.

Acknowledgments.

These experiments were located on the orchards of Messrs. Lyons Bros., I. Martin and N. A. Collins and Son, all of Glen Aplin, and Mr. S. J. McLucas, Severnlea. The assistance rendered by these orchardists is greatly appreciated.

Butter Defects—Their Causes And Prevention.

V. J. BRIMBLECOMBE and E. B. RICE, Division of Dairying.

BUTTER defects may be divided into three classes:—(1) Flavour and aroma defects; (2) body and texture defects; and (3) colour defects.

FLAVOUR AND AROMA DEFECTS.

The best quality Australian butter has a full, sweet, nutty flavour and a pronounced butter aroma. However, provided the butter has a clean, neutral fat flavour it is classed as choice grade. Any taint of weed, bacterial, chemical, or other origin is regarded as a defect which will cause the butter to be placed below choice grade, the actual grade assigned being dependent on the nature and intensity of the defect.

Flavour and aroma defects are mainly due to "off" flavours in the cream from which the butter was made, although they may become accentuated in the butter. However, some flavour defects are due to faulty factory practice, or conditions of holding. The Department's leaflet entitled "Cream Defects—Probable Causes and Prevention" should be consulted for fuller information on taints in cream which may be transmitted to the resultant butter.

(*a*) Flat Flavour.

The butter is flat and slightly insipid to the taste and devoid of a sweet nutty flavour and pleasant aroma. This is caused by the churning of cream from cows in poor condition, excessive dilution of the cream with water prior to churning, over-washing the butter in the churn, or neutralising cream to too low acidity.

Remedy. Avoid excessive use of dilution or wash waters and over-neutralisation of cream.

(*b*) Bitter Flavour.

This defect may be caused by a predominance of cream from cows advanced in lactation, contamination of the cream by certain yeasts, the use of unrefined salt, or the leakage of brine from the refrigeration system into the cream.

Remedy. Dry off cows for six weeks before freshening; an overhaul of shed methods is indicated on farms supplying yeasty cream; use a good refined salt; avoid brine leaks.

(*c*) **Yeasty Flavour.**

This is caused by cream produced under insanitary conditions and held at high temperatures.

The remedy is obvious.

(*d*) **Sour Flavour and Aroma.**

This defect may be caused by the churning of cream which has not been properly neutralised before pasteurisation, or contamination after pasteurisation. Overchurning of the cream yielding large butter granules is also suspected to favour sourness.

Remedy: See that neutralisation is carefully carried out; churn to the correct size grain (wheat size).

(*e*) **Stale Flavour.**

Stale flavour in butter is generally caused by stale cream, and is often noticed when cream deliveries are infrequent in winter months. Stale butter and cream remnants in improperly washed churns, vats, pipelines, &c., many be contributory causes.

Remedy. Clean methods of cream production and frequent deliveries to the factory, allied with factory hygiene.

(*f*) **Unclean Flavour and Aroma.**

This defect in butter is usually caused by cream of inferior quality. Blending of cream below choice grade with choice grade cream gives a slight unclean flavour to butter. Improper care of factory equipment and defective churns may also cause an unclean flavour.

Remedy. Clean dairy shed methods, proper cleaning and maintenance of factory equipment, and efficient grading of cream are indicated.

(*g*) **Absorbed Flavour.**

This may be due to absorbed flavours in cream, or storage of butter near odoriferous material.

The remedy is obvious.

(*h*) **Oily, Metallic, and Tallowy Flavours.**

These defects are dealt with collectively as the causes are similar, and they often (though not always) represent a sequence of flavour changes. The butter has a distinct taste and odour resembling oil, metals or tallow. Tallowy butter is usually bleached in colour. The defects are usually due to oxidation of the butterfat, which can be promoted by minute traces of copper and/or iron compounds derived from faulty cream cans or factory equipment. Direct sunlight shining on cream may cause tallowiness, the taint carrying through into the butter.

Remedy. See that factory equipment is well tinned or replaced by stainless steel equipment; re-tin or renew rusty cans, or cans from which any part of the tinning has worn; protect cream and butter from direct rays of the sun.

(*i*) **Rancid Flavour.**

This defect is due to decomposition of the fat and is characteristic of carelessly produced cream or very old butter. Certain fat-splitting bacteria, acidity, age and high temperatures are the causative agents.

Remedy. On any farm producing rancid cream a complete overhaul of farm hygiene is necessary. Efficiently pasteurise cream to destroy fat-splitting micro-organisms; maintain a high standard of factory hygiene; use low storage temperatures to prevent heating and breakdown of fat.

(*j*) **Cheesy Flavour.**

This defect, which is self-descriptive, is mainly caused by the manufacture of butter from cream produced under insanitary conditions and allowed to become sour and curdy or over-ripe.

Remedy. An overhaul of farm production methods is indicated.

(*k*) **Musty or Mouldy Flavour.**

Butter which becomes wet during transport or storage is likely to become mouldy. The fault may also be due to cream stored in a musty or mouldy place or cows eating musty or mouldy fodder.

(*l*) **Fishy Flavour.**

This defect was common in Australian butter some years ago before lower neutralisation was adopted. Factors favouring its development are high acidity, traces of metallic salts, salt and overworking. Fishy flavour rarely occurs in present-day, low-acid butter.

(*m*) **Feedy or Weedy Flavour.**

Taints in milk and cream caused by weeds or feeds eaten by the cows are carried through into the butter. The intensity of the defect is dependent on the stage of growth at which the tainting feed or weed is eaten, the amount consumed, the season of the year, and the manner in which the cows are grazed. Most feed taints (for example, lucerne) are removed from cream by modern vacuum pasteurisation, but some weed taints persist and, in fact, are intensified. The most common cream tainting weeds are lesser swine cress (*Coronopus didymus*), peppercress (*Lepidium* spp.) and turnip weed (*Rapistrum rugosum*).

Remedy. If practicable, where milk tainting plants are present, graze cows immediately after milking, taking them off such feed five to six hours before the next milking; avoid overstocking of farms and adopt good pasture management.

(*n*) **Cooked Flavour.**

This is a pronounced scorched flavour caused by excessive heating of the cream during pasteurisation, or keeping cream at a high temperature for a prolonged period. A slightly cooked flavour in butter usually disappears after the butter is held in cold storage.

Remedy. Avoid excessive exposure of cream to high pasteurisation temperatures.

(*o*) **Alkali or Over-neutralised Flavour.**

This is caused by the addition of too much neutralising agent to the cream, or by washing factory equipment with strong soda solutions and not rinsing prior to the treatment of cream. Over-neutralised cream may acquire a soapy flavour because of saponification of the fat by the neutraliser.

Remedy. Pay carfeul attention to acidity testing and neutralisation of cream; rinse all factory equipment with clean boiling water after cleansing.

(*p*) **Harsh Flavour.**

This is a term used to denote a defect in butter caused by the addition of too much salt, its imperfect incorporation, or the use of unrefined salt.

Remedy. Avoid over-salting of the butter, salt evenly, and thoroughly work the butter.

(*q*) **Rabbito.**

The butter has a putrid taint, suggestive of protein decomposition, often claimed to be like decomposing rabbits; hence the name commonly used in Australia to describe the defect. It is known in other countries as surface taint and sectional contamination, due to its often being first noticeable on the surface of the butter, or characterised by variations in a core taken from a box of butter. It is generally considered to be caused by protein-digesting bacteria, primarily of water origin, although they become established in churns and other equipment, which are thus often a more serious source of their contamination of the cream and butter than the primary source. Faulty neutralistation of cream and poor-textured, under-worked butter favour the growth of the organisms.

Remedy. Chlorinate or filter any factory water supply suspected of harbouring the causative bacteria; rigorously clean and sterilize equipment. As soon as the defect appears in butter, the cream should be neutralised to not below ·08 per cent. acidity, the salting increased and the butter thoroughly worked pending effective control by treatment of the water supply and factory sanitation.

(*r*) **Hammy Flavour.**

This is a flavour defect in butter resembling the taste of cooked ham. It is caused by the use of impure water—for example, untreated water and unfiltered surface water, such as dam water. When this water is used in boilers the steam, during vacreation, transmits the flavour to the cream. Hammy flavour may also be caused by faulty operation of the vacreator, when impure condenser water happens to come in contact with the treated cream during the processing. Pollution of the water takes place when cream passes over into the vacreator condenser water.

Remedy. Use the proper treatment for and filter surface water for boiler-feed water; efficiently operate the vacreator to prevent contact of condenser water with cream and cream with condenser water.

BODY AND TEXTURE DEFECTS.

In the butter industry, the term "body" refers to the firmness and standing-up property and spreadability of butter. Texture may be defined as the character of the structure and grain of the butter.

Butter should have a firm, solid body, capable of standing up to unfavourable temperature, and a close, waxy texture. Variations in the composition of the butterfat, due chiefly to seasonal conditions, and workmanship during manufacture, largely govern the body and texture of butter.

The major defects of body and texture are as follows.

(*a*) **Weak Body.**

Weak bodied butter lacks the desired firmness and standing-up property when subjected to slightly unfavourable or ordinary temperatures. It is due mainly to churning to too large a grain, or insufficient

cooling of the cream prior to churning. The cream either is not cooled to a temperature low enough, or is not held at the correct cooling temperature long enough to obtain complete chilling of the fat.

Remedy. Cool cream to the correct temperature prior to churning and hold it at that temperature sufficiently long for complete and uniform chilling of the fat—at least 12 hours. Churn to a correct and uniform size of grain (about the size of a wheat grain).

(*b*) **Open Texture.**

The butter has not the desirable close, waxy texture. The defect is frequently due to underworking of the butter and is often associated with other defects which arise from the same cause, such as mottles and streak.

The remedy is obvious.

(*c*) **Greasy Texture.**

Weak-bodied butter worked excessively may acquire a greasy texture. Butter churned from cream with a very high fat content, or washed with water at too high a temperature, may also have a greasy texture.

Remedy. Use the correct temperatures for churning and wash-water and churn to grain of correct size.

(*d*) **Sticky and Ravelly Texture.**

This refers to butter which will not cut cleanly with a knife, or clings to the butter trier; also it is rag-like and tends to tear during the working process, finally sticking to the sides of the churn and butter workers. Too high a churning temperature will cause sticky butter. It is often associated with cream from cows which are drying off and so is aggravated by the dry paddock feed in late autumn and early winter or with cream produced from under-nourished cows during drought. Even slight overworking of butter made from such cream tends to accentuate the defect. Overworking of butter during any season can also cause stickiness.

Remedy. Churn at the correct temperature and to normal size of grain and avoid overworking.

(*e*) **Leaky Body and Texture.**

Under this heading free moisture will also be dealt with. The butter has a wet appearance, and when cut beads of brine or moisture can be seen. Under storage conditions, or when cut into pats, this type of butter will leak moisture and lose weight rapidly. Its flavour will also soon deteriorate.

Leaky body and free moisture are brought about by underworking. The churning of fresh cream without proper chilling, over-churning to too large a grain, washing at too high a temperature, and failing to adjust manufacturing temperatures under flush season conditions when fats are soft, are conducive to leaky butter, as they prevent the thorough working of the butter without risk of overmoisture.

Remedy. Allow freshly pasteurised cream to chill for at least three hours before churning, and churn at a lower temperature than normal; adjust churning and washing temperatures to suit the climatic conditions and season of the year; churn to the correct size grain; work the butter to a close, waxy texture.

(*f*) **Mealy Texture.**

Mealy butter lacks the smooth, waxy texture of well-made butter, and when tasted gives the impression of a mealy sawdust-like character. This defect is caused by an accumulation of hardened casein particles (from low-testing, curdy cream), or by prolonged heating of cream sometimes occasioned by a stoppage or breakdown during pasteurisation. This causes an oiling-off of the fat, which, when cooled, presents a mealy condition.

Remedy. Strain the cream into the churn and prevent the oiling-off of fat during heating.

(*g*) **Salvy Texture.**

The butter has a salvy consistency resembling lard or tallow. It is caused mainly by an abnormal, hardened condition of the fat during dry winter conditions, or by excessive dilution of the cream with water. Such cream requires prolonged agitation to bring the grain to the required size, and the granules are usually hard, round pellets of a salvy bleached nature. This type of grain requires prolonged working, which tends to aggravate the condition.

Remedy.—Adjust the cooling, churning and working temperatures to suit seasonal conditions and avoid excessive dilution of cream with water during standardisation.

(*h*) **Gritty Texture.**

The defect is usually caused by the presence of undissolved salt. If the cream is churned at too high a temperature or over-churned the salt cannot be completely dissolved during working without exceeding the permissible maximum moisture percentage. The use of a coarse salt, too much salt, or adding salt after working has commenced, may be other causes. Gritty butter may also be brought about by loosened milkstone or casein deposits from factory equipment.

Remedy.—Use correct churning temperatures and fine dairy salt; keep milkstone scale down to a minimum.

(*i*) **Crumbly Texture.**

The butter has a dry brittle condition. This is brought about mainly during cold winter weather when high melting point fats predominate. The cream, when very cold, may become solidified, causing a short hard grain. Such cream has to be steamed out of cans, which may cause oiling out of the fat. Shock cooling of cream after vacreation is prone to favour this defect in butter made during the winter, when hard fats predominate.

Remedy.—Cool pasteurised cream to, and churn at, a slightly higher temperature than normal and to a fine grain, and use low-temperature wash water; work butter sufficiently to obtain a tough waxy texture when finished. If winter vacreated cream can be partly cooled in a vat, the defect is minimised.

COLOUR DEFECTS.

The colour of Queensland butter varies from a pale straw to a golden yellow, the ideal being a bright straw. The natural colour of butter is due to yellow pigmented substances, carotene and xanthophyll, derived from pastures and green foods, and which are dissolved in

butterfat. During the flush season the plentiful green feeds contain their maximum amount of the pigments mentioned and the butter has a bright golden-yellow hue; when the paddock feed is dry the colour of butter becomes pale and, during droughts, almost bleached because of the decline in the natural pigments in the food consumed.

Salt affects the colour of butter; hence salted butter is deeper in colour than unsalted. When salt is added it dissolves in the moisture to form brine droplets. Owing to capillary attraction there follows a movement of liquid to make fewer and larger drops of water in the butter. The fewer and larger the drops of water the more yellow the butter becomes. As working continues and the droplets become smaller, the yellow colour decreases in intensity.

(*a*) Mottled Butter.

This is manifested by dappled spots of deeper shades of yellow throughout the butter resulting from an uneven distribution of the salt. Mottling is a serious commercial defect, as affected butter is always degraded.

The water in butter is present in the form of very numerous microscopic droplets. In freshly worked, salted butter these droplets are fairly even in size and distribution. However, if the salt is unevenly distributed, water is attracted to the spots of high salt concentration and the droplets in these spots increase in size. As shown above, the fewer larger droplets in such spots will cause a deepening of the yellow colour and so give the typical mottled appearance. The formation of larger droplets at areas of high salt concentration in this way is a fairly slow process and this is the reason why mottle is seldom seen until two or three days after manufacture of the butter.

Mottling is brought about by faulty cooling, churning and washing temperatures, which give a soft, weak-bodied butter incapable of being thoroughly worked to incorporate the salt; over-churning to too large a grain or uneven size of the butter grains; uneven distribution of the salt; using too coarse salt which dissolves too slowly; insufficient working of the butter; overloading of churns or mechanical defects which prevent the churn rollers from evenly working the butter.

Remedy.—Pay strict attention to cooling, churning and washing temperatures to suit the seasonal conditions; churn to a fine, even grain (about the size of wheat); spread salt evenly over the butter in the churn; if salt is coarse, crush it, or resort to damp salting, that is, wetting the salt with water after spreading in the churn; before engaging workers revolve the churn for a short time in low gear to help distribute the salt; work the butter until a compact, waxy texture is obtained; avoid overloading the churn, and keep it in sound mechanical condition.

(*b*) Streaky or Wavy Butter.

Instead of being a uniformly even colour, the butter is marred in appearance by waves and streaks of different colours throughout its mass. The defect is caused by uneven working of portions of the butter in an overloaded churn, faulty churn rollers, churn barrel not being level, or uneven moisture distribution. Remnants of butter from different churnings put together, the surface of butter becoming greasy while awaiting packing in hot weather, and reworking of over-moisture butter, are other causes.

Remedy.—Avoid overloading the churn; see that the churn is maintained in good mechanical condition and the rollers properly adjusted; avoid the packing of butter remnants from one churn with butter from another churn.

Pack butter as quickly as possible. In hot climates a temperature-controlled packing room is recommended. Do not handle butter with the bare hands. Take care in moisture control to avoid the necessity of reworking the butter.

(*c*) **Dull Colour.**

The butter lacks the desired bright straw colour. This defect is caused by drought conditions and dry feed, or excessive dilution of cream with water prior to churning.

Remedy.—If necessary, add a little artificial butter colouring to the cream prior to churning; avoid excessive dilution of cream with water.

(*d*) **Speckled Butter.**

White specks in butter may be due to small pieces of coagulated casein. By straining all cream into the churn from the holding vats this may be avoided.

Yellow specks may arise from over-chilling of soft butter grains by cold wash water running on to one spot in the churn. The remedy is to use wash water not more than 4 deg. F. lower than the churning temperature and to spray the water over the whole surface of the butter.

BUILDING NOTES.

Many farmers will be interested in a series of "Notes on the Science of Building," issued free by the Building Research Liaison Service, P.O. Box 2807AA, Melbourne.

These notes are in the form of a two-page leaflet, well illustrated with photographs and diagrams. Titles of numbers so far issued are:—

1. Design for climate.
2. Footings for small masonry buildings on sand, gravel, or rock.
3. Roofs—ventilation and insulation.
4. Reinforced brickwork lintels.
5. Mortars for brickwork.
6. Footings for small masonry buildings on plastic soils.
7. Attic exhaust fans for summer cooling.
8. No-fines concrete.

DEHORNING OF CATTLE—CORRECTION.

A sentence inserted by error in the article on dehorning of cattle which appeared in the October issue made it appear that pliers were recommended for stopping bleeding from an artery. Artery forceps are used for grasping a cut artery for tying off.

Cobalt Deficiency of Sheep In Queensland.

G. R. MOULE and R. B. YOUNG, Sheep and Wool Branch.

RESEARCH work carried out in South Australia and New Zealand during the last few years demonstrated that cobalt is essential to sheep for their normal growth and wellbeing.

Cobalt is a metal closely related to zinc, manganese and nickel, all of which are well known for their commercial uses. The cobalt in the soil is taken up by plants, or it contaminates the pastures as part of the dust which blows about so freely during average seasons in the pastoral country. On being consumed by grazing sheep, cobalt is used by some of the bacteria in the paunch, which make compounds essential to the formation of red blood cells. When sheep suffer from cobalt deficiency, they are unable to make sufficient red blood cells and as a result their growth rate is decreased. In extreme cases affected sheep lose condition, and quite heavy mortality may occur if the flock is left untreated.

Cobalt deficiency was diagnosed amongst sheep in Queensland for the first time during the winter of 1950. The factors which led to its sudden appearance are not clear. The abnormally heavy rain promoted rapid growth of pasture plants, but may have decreased the rate at which they absorbed cobalt from the soil. In addition, the continued wet weather and heavy ground cover probably prevented contamination of the grass with dust.

SYMPTOMS OF COBALT DEFICIENCY.

Weaner sheep are most commonly affected by cobalt deficiency, and as far as is known its occurrence during 1950 was restricted to sheep of this class, although a detailed examination was not made of older animals for evidence of the complaint.

The symptoms of cobalt deficiency might be classified as mild or serious, depending upon the time the deficiency lasts or on its severity.

Decreased growth rate of weaners is the most important symptom of mild cobalt deficiency. In the majority of cases it is manifest as a transitory check, which may remain unnoticed.

Should the deficiency be maintained for four or five months and be severe, mortality may occur, and a large proportion of the weaner flock will show evidence of extreme malnutrition, despite ample feed.

By keeping a careful check on the liveweight of young sheep, it has been found that weaners suffering from cobalt deficiency may lose ¾ to 1 pound a week, whereas unaffected animals may gain a comparable amount in the same time.

As the disease progresses, the affected sheep become very thin and listless (Plate 191); they are incapable of travelling and are disinclined to eat. They assume a typical stance with backs arched and heads lowered. Ears are drooped, and the sheep appear to be completely disinterested in their surroundings, as the upper eyelids remain half

Plate 191.
Sheep Affected by Cobalt Deficiency.—Note the loss of condition and the dejected appearance.

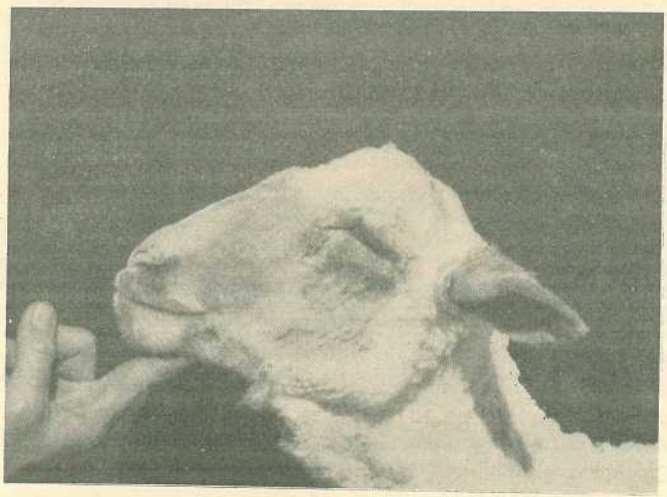


Plate 192.
Head of Sheep Suffering From Cobalt Deficiency.—Note the dull eye and watery discharge matting the wool on the side of the face.

closed. The eyes are dull and lifeless and there is often a watery discharge from each eye (Plate 192), although there is no sign of inflammation. In some animals, this discharge is so profuse that it mats the hair on the side of the face, and as there is a copious flow of tears down the duct leading from the inner corner of the eye to the nose, a clear fluid sometimes drips persistently from the nostrils.

The skin is pale and lifeless and the fleece tender. In extreme cases, the skin is fragile and may tear away when a staple of wool is suddenly plucked.

Very little is to be seen on post-mortem examination. The carcase is thin and wasted and contains comparatively little blood. Sometimes the marrow in the shank bones is redder and more jelly-like than usual, but generally speaking there are very few characteristic changes.

OVERCOMING COBALT DEFICIENCY.

Before taking steps to overcome cobalt deficiency affecting sheep, it is essential to make certain as to the cause of the symptoms which are exhibited.

The symptoms of cobalt deficiency are quite like those manifest by sheep affected with moderate infestations of round worms, or which are on drought rations, or which are suffering from copper deficiency. In these circumstances, care should be taken in making a correct diagnosis before attempting treatment, and wool growers who suspect cobalt deficiency amongst their sheep would be well advised to seek the assistance of the technical services offered by the Department of Agriculture and Stock.

Cobalt deficiency is easily overcome by arranging a small regular intake of cobalt. In areas where drenching is practised it is a simple matter to add a cobalt salt, such as cobalt chloride or cobalt sulphate, to the drench. However, as the cobalt is not stored it is necessary to drench the sheep every week, and this may mean a considerable amount of work.

In areas where salt licks are fed, the cobalt salt can be incorporated in the lick at the rate of 2 oz. per 1,000 sheep per week. The easiest way of getting an even distribution of cobalt is to dissolve it in a small quantity of water, which can be sprayed over the salt lick during mixing.

The disadvantages of using a cobaltised lick are:—

(1) Expense and labour are involved.

(2) The cobalt intake of the whole flock is erratic and some sheep will not take licks. This is particularly likely to occur during good seasons, when cobalt deficiency may be more prevalent.

In districts where neither of these methods is practicable, it is possible to give the sheep cobalt through the drinking water. To be successful, this method must allow for a fairly continuous supply of cobalt in the water. This may be attained by adding the cobalt salt to the supply tank. Alternatively, it may be placed in a small metal cylinder (Plate 193) about 18 inches long and 1½ inches in diameter, with one end closed and a hole about 3/64 of an inch in diameter drilled about 1 inch from the closed end. A small piece of metal gauze is placed in the bottom of the cylinder, so that it extends to above the level

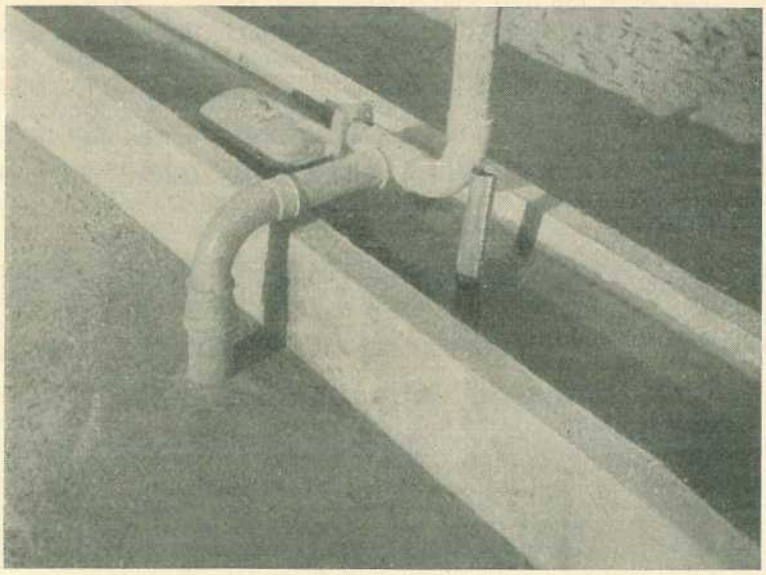


Plate 193.
Cylinder For Feeding Cobalt Salt Into Drinking Water.

of the small hole. The cylinder is supported in the trough near the float valve, and the requisite amount of cobalt to supply the sheep in the paddock for one week, calculated at the rate of 2 oz. per 1,000 sheep, is added to the cylinder. The water, which enters the cylinder through the small hole, becomes saturated with cobalt and gradually finds its way out of the hole. Additional cobalt is added each week. The preferable method is to have duplicate cylinders for each trough. The weekly amount of cobalt to be given to the sheep in any one paddock is weighed out and placed in the spare funnel. When the troughs are visited as part of the routine inspection, the funnel containing the cobalt can be placed in the trough and the empty cylinder withdrawn and recharged for use again during the ensuing week.

Cobalt salt can be added slowly to a running bore drain instead of to the supply tank or trough, and while this method is more expensive because of greater quantities of material used, it can be quite effective. In either case, it is as well to seek the opinion of the Department as to the suitability of the water for the addition of cobalt.

The disadvantage of supplementation through water is that when alternative sources of surface water are available the sheep will often prefer them and not return to the troughs until forced to by dry or hot weather.

The fourth method of overcoming cobalt deficiency is spraying the pasture with a finely atomised solution of a cobalt salt. The sheep should be yarded overnight and in the morning shepherded on the sprayed areas.

In the event of this method being used, wool growers would be well advised to discuss the details with Departmental officers.

ANIMAL HEALTH

Brucellosis (Contagious Abortion) In Cattle.

A. L. CLAY, Assistant Director, Division of Animal Industry.

DEFINITION AND CAUSE.

THE term "brucellosis" confuses many people. To add to the confusion many American writers refer to contagious abortion of cattle as "Bang's disease," a name derived from that of the man who discovered the cause of the disease in 1896. It is well, therefore, to know the derivation of the term brucellosis and why it is preferred to the older name, contagious abortion.

The term brucellosis comes from the name given to a group of micro-organisms of a rather special type, which cause disease in man, cattle, pigs, goats and horses. The first man to discover one of these organisms was David Bruce. He made the discovery in 1887 when investigating a disease of human beings known as Malta or Mediterranean fever, and called the organism *Micrococcus melitensis*. Some 30 years later (in 1918) the relationship of this disease to contagious abortion of cattle was revealed. Since that time the organism causing Malta fever has been named *Brucella melitensis* in honour of the discoverer, and the organism which causes contagious abortion of cattle, previously known as *Bacillus abortus,* has beeen renamed *Brucella abortus.*

Brucellosis simply means "disease due to *Brucella* organisms." It is a specific disease which can occur only in the presence of these organisms. The term can be used to describe the disease whether it occurs in man, cattle, pigs, goats or horses, and when it is used no room is left for confusion because it can mean only one thing, that is, disease due to *Brucella* organisms. No other term has this advantage.

Additional reasons why the term brucellosis is to be preferred are as follows:—

(1) There is more than one kind of abortion in cattle which is of a contagious nature, so that when different people speak of "contagious abortion" they may be speaking of quite different diseases.

(2) Some cows affected with brucellosis do not abort at all; and many, though they abort once, carry subsequent calves to full time.

(3) There are other important consequences of brucellosis in cattle quite apart from abortion. Such are sterility, difficulty in rearing calves, and lowered production.

ECONOMIC IMPORTANCE.

Losses caused by brucellosis in cattle are often very considerable, so much so that individual farmers have sometimes been virtually forced to give up dairying because of the ravages of the disease. No reliable estimate is available of the loss to the dairy industry in Queensland or the other Australian States, but there can be no doubt that it is huge.

The losses in affected herds are largely the result of lowered milk production. It is universally accepted that production in an infected herd compares unfavourably with that in a "free" herd, all other things being equal. The lower milk production in infected herds is due to calving taking place before full term, delay or even complete failure of cows to prove in calf, and the prolonged ill-health which is sometimes the aftermath of an abortion, especially if accompanied by retention of the afterbirth.

A very large number of cows is disposed of each year as "tinners" because of sterility consequent upon brucellosis.

The serious position created in stud herds by the birth of dead calves or of weak calves which are difficult to rear is obvious.

Finally, the presence of brucellosis may lead to quarantine restrictions, direct or indirect, on farms, districts, or even whole States. No cattle can be imported into Australia unless they are free from brucellosis. Within Queensland, because of the prevalence of the disease, quarantine is imposed only in exceptional circumstances.

DISTRIBUTION AND INCIDENCE.

Brucellosis is world wide in its distribution. In Queensland it occurs in all the recognised dairying districts and for the most part must be considered as prevalent.

The disease occurs in beef cattle but is not of comparable importance to the disease in dairy cattle. There are exceptions, especially in stud beef herds, where the degree of contact between the animals therein approaches more closely that found in dairy herds.

HOW COWS BECOME INFECTED.

For the most part brucellosis is brought into a herd with purchased cattle. Buying replacement cattle at a saleyard is attended with the risk of purchasing infected animals; it should be avoided if at all possible. There is also some risk when making purchases at "clearing sales," as it may perhaps be that the "clearing out" process is in some measure the consequence of the ravages of brucellosis.

Straying cattle may introduce the disease. Sending cattle to other farms (as for service) or taking them to Shows and then returning to the home farm may introduce the disease. Dogs, foxes, and perhaps crows may act as mechanical conveyors of infective material.

Drainage from adjacent infected farms may be responsible for introducing infection.

Brucella microbes are frequently present in the milk of affected cows. This infection may occasionally be transmitted on the hands of milkers, especially to cows with abrasions on the teats.

Experimentally, cows have been infected through the eye and the skin, but these are not considered common ways of infection under natural conditions. It can, however, be noted that infection by way of the eye is easily effected and is the method of choice when it is desired to set up infection deliberately, as when testing the efficacy of vaccines. This permits of speculation as to whether flies act as mechanical conveyors of the disease, but so far proof is lacking.

There can be no question, however, that introducing and maintaining infected animals in a herd is by far the most important source of infection.

Pasture Contamination.

Whether they abort or carry their calves to full term, infected cows discharge from the breeding passage, for some weeks, large numbers of micro-organisms, which contaminate the hindquarters, pasture, water supply, &c. Since most cows are infected by way of the mouth, contaminated pasture represents the most common source of infection.

The droppings from calves fed on infected milk may contaminate pastures, the microbes passing right through the calves' digestive tracts without being destroyed.

The survival of *Brucella* microbes on pasture is obviously a matter of great importance. Survival is longer in winter than in summer, and at any time of the year is longer in a situation protected from the direct rays of the sun.

The longest survival time noted under experimental conditions in Australia was between 90 and 100 days. The survival time was consistently longer for microbes in the afterbirth itself as compared with microbes in discharges.

Pastures are probably quite safe three months after the removal of infected stock in summer and four months in winter.

Infection from the Bull.

The part played by the bull in infecting cows has been the subject of much misunderstanding. It was originally thought that service by infected bulls was a common source of infection. Later investigations suggested very strongly that infected bulls did not transmit the disease in the act of service, except perhaps in rare instances. Recently, however, Danish veterinarians have shown that some bulls can transmit the disease with some degree of regularity during service, more especially when their semen is used for artificial insemination.

Though many infected bulls fail to transmit brucellosis by service it has now to be recognized that some may do so and the use of such bulls may cause rapid spread of infection in a herd.

Infection from Other Animals.

Brucellosis of pigs requires some consideration in relation to mode of infection of cattle. The causal microbe in swine is known as *Brucella suis*, and though similar to *Brucella abortus* is not quite the same thing. Cattle are susceptible to *Brucella suis* but infection is not common. When it does occur it is a serious matter from the public health standpoint.

Fistulous withers in horses is sometimes due to *Brucella abortus*, or at all events the latter is present in the lesion. Horses with fistulous withers, especially if the lesion is discharging, are therefore a potential danger to cattle.

SUSCEPTIBILITY OF DIFFERENT CLASSES OF CATTLE.

Some cows are much more susceptible to infection than others. In herds that have been blood-tested annually without removing reactors it has been noted that some animals remain negative to the test year after year despite the presence of many infected animals in the herd. These negative animals have certainly been exposed to infection on numerous occasions but the infective agent does not become established in the

cow. Such cows have a natural resistance to brucellosis. They constitute a varying percentage of the cows in different herds—usually 20 to 30 per cent. but sometimes considerably less.

Calves are rather a special case. Nearly all calves have a high resistance to infection, at all events until six months old. This is so whether the infection is natural or artificial (for example, by inoculation with living vaccines). From six months onwards the resistance decreases but is often evident even at 12 months of age. Resistance in calves is considered by some authorities to be connected with the lack of development of the sexual organs. Once these attain full development—that is, when the calf becomes capable of breeding—then susceptibility to infection increases very markedly.

The in-calf cow is more susceptible to infection, or at all events to the ill-effects of infection, than the not-in-calf cow. Abortion is much more likely to follow if infection occurs during pregnancy, except that if infection occurs after the seventh month there may not always be sufficient time for the *Brucella* microbes to cause enough damage in the uterus to bring on an abortion. Infection taking place while a cow is "empty," or during the very early stages of pregnancy, is quite often followed by an apparently normal calving.

It will be seen that infection with *Brucella* microbes need not necessarily result in the calf being aborted.

PERIOD OF INCUBATION.

This is subject to a great deal of variation. There is now some evidence to show that in the case of the in-calf cow it varies inversely as the stage of development of the foetus at the time of infection; that is, the younger the foetus at the time of infection the longer is the incubation period. This explains why few brucella abortions occur before the fifth or sixth month of pregnancy.

It is also necessary to remember that the size of the dose of infective material has a bearing on the length of the period of incubation. Large doses tend to shorten and small doses to lengthen the period.

The period of incubation may exceed six months.

SYMPTOMS.

The most obvious symptom is the failure of cows to carry their calves to full term, the calf being aborted usually at about the fifth month of pregnancy, though sometimes earlier. However, calves may be carried to full or nearly full term and be born dead, or, if born alive, be small and weak. Further, in these cases there is often retention of the placenta (that is, failure of the cows to get rid of the afterbirth).

Sterility is a matter of very real concern in the great majority of heavily infected herds and is due to the abnormal uterus (womb) which prevents conception. Brucellosis would be less serious than it is if, following abortion, the uterus always returned to its normal healthy state and so allowed of another pregnancy being got under way. Unfortunately, such is often not the case, cows being left with a chronic inflammation of the womb. The condition is very difficult to treat because the organ is so inaccessible.

Calves born of affected dams are prone to scours and pneumonia.

A less frequent indication of the disease is the presence of swellings on various parts of the body. Sometimes these swellings are associated with joints, the knee joint being the one most commonly affected. On

the other hand, the swellings may have no association with a joint; in these cases they occur commonly on the sides of the neck, on the withers, in the flank or over the hip. The swellings in the neck regions may be very large and contain a gallon or more of fluid.

In the bull there may be swelling of one (usually) or both (sometimes) testicles, but such is not necessarily the case.

None of the symptoms described can be regarded as enabling certain diagnosis of brucellosis. This can be done only after use has been made of the "blood test."

As has already been noted, once cows abort as the result of brucellosis they will in most cases carry subsequent calves to full term, always provided they remain capable of breeding. It is important to recognize that such cows remain infected. This is of great importance in assessing the results obtained from the administration of "cures" or "remedies."

POST-MORTEM CHANGES.

The disease does not cause death of the dam, but if the animal is killed and examined, the only sign found is an inflammation of the uterus. Even this is not constant.

The afterbirth which is shed following the delivery of a dead calf usually (but not always) shows some abnormalities. The cotyledons are a dirty-yellow colour and gelatinous in consistency. The membranes as a whole may be infiltrated with a yellow gelatinous material. Most suggestive of all is the presence of areas in the membranes which can be described as leathery in texture.

DIAGNOSIS BY BLOOD TESTING.

One can suspect the presence of brucellosis in a herd but there is only one way of making certain, and that is to submit blood samples from suspected cattle to a laboratory for test. The test is correctly referred to as an agglutination test, but is commonly spoken of as a "blood test." The test is done on the serum—that is, the clear yellowish fluid which separates out from blood after it has clotted. The serum is mixed with a suspension of *Brucella* microbes in a series of small glass tubes. The mixture which results is cloudy. The tubes are then placed in an incubator for 48 hours, after which time the test is read (Plate 194).

The test works by reason of the presence of certain "antibody" substances in the blood of infected animals. When these substances in the blood serum come into contact with the *Brucella* microbes in the tube, they cause them to clump together or agglutinate (hence the name agglutination test). Having done so they are no longer capable of remaining suspended in the liquid, and sink to the bottom of the tube, leaving a clear fluid above.

The test is reliable to an extraordinarily high degree, but it is not infallible.

A disadvantage is that the development of anti-bodies in the blood (consequent upon infection) is occasionally a very slow process. Added to this is the fact that the period between the demonstration of anti-bodies and the occurrence of abortion is sometimes very short, and in some cases abortion may actually precede the appearance of anti-bodies. The situation sometimes arises therefore where an eradication programme is believed completed and testing suspended only to have an animal abort and start a fresh cycle of infection.

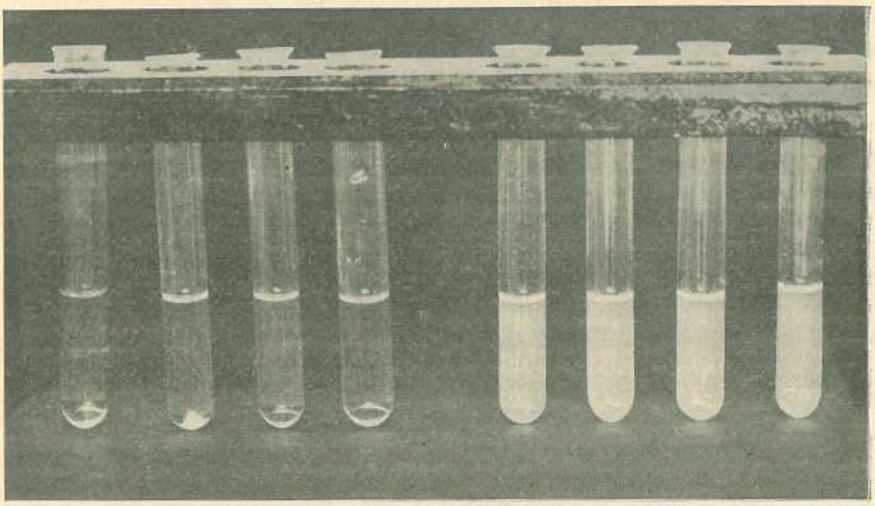


Plate 194.

Agglutination Tests.—Left, positive tests; right, negative tests. In a postive test the mixture in the tube becomes quite clear and the microbes which were responsible for the cloudy appearance settle on the bottom of the tube as a distinct deposit or sediment. In a negative test the cloudy appearance remains and no deposit forms at the bottom of the tube.

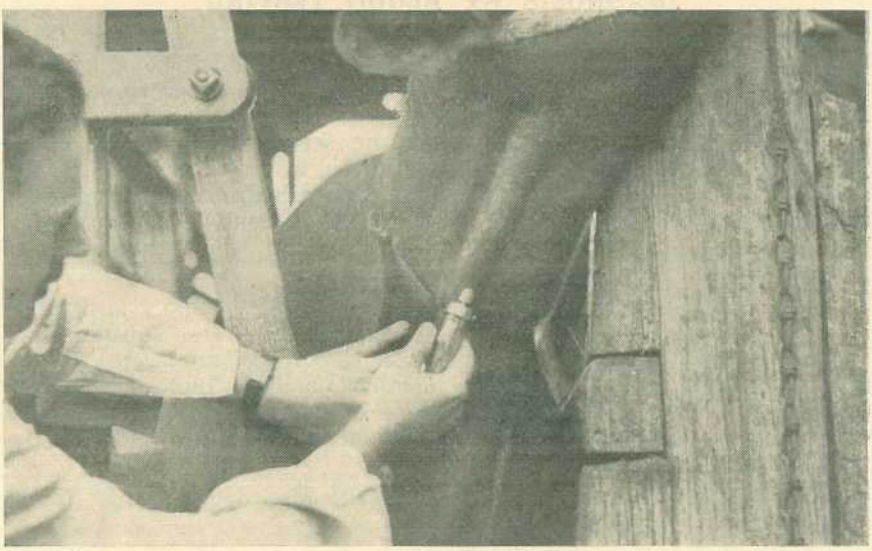


Plate 195.

Collecting a Blood Sample.—Note tourniquet or bleeding strap applied so as to cause distension of the jugular vein. The needle is inserted into the vein with a quick thrust; then, the sample having been collected, the tourniquet is loosened **before** the needle is withdrawn from the vein.

A small percentage of reactors do eventually cease to react, but it is not possible to say with certainty that they cease to be carriers of infection. All reactors should be regarded as permanently infected.

Taking Samples for Testing.

Blood samples may be obtained from the ear, the tail or the jugular vein. The jugular vein is by far the most satisfactory (see Plate 195). A stout hypodermic needle about three inches long is required, and a device known as a King bleeder to hold both the needle and the bottle into which the sample is drawn greatly facilitates the procedure.

The cow's head should be secured firmly to a rail or post. A strap or cord is then looped round the animal's neck and pulled taut. This results in the jugular vein becoming prominent, whereupon the needle is inserted with a quick thrust and the sample collected. The strap is then loosened and the needle withdrawn from the vein.

A sword-type bail is very useful for bleeding cattle and can be installed at the exit end of a crush.

GENERAL FARM PRECAUTIONS.

In the absence of an attempt to eradicate the disease altogether, there are certain general precautions which should be taken.

(1) Isolate all cows that abort or have premature calves, such isolation to continue until all traces of discharge have disappeared. During the isolation period (especially the early part) syringe out the cow with a reliable antiseptic solution to minimize the output of live *Brucella* microbes. "Dettol" and "Lysol" (1 fluid oz. to 1 gallon of lukewarm water) are examples of suitable fluids. About one quart should suffice for each cow unless the amount of discharge is exceptionally large.

The person carrying out this work should wear gum boots and either remove them just prior to leaving the isolation paddock or else disinfect them thoroughly.

(2) Do not use a known infected bull if it can be avoided. Do not put cows mentioned in (1) to a non-infected bull for at least six weeks after they have aborted or calved.

(3) Locate the foetus and the afterbirth (if not retained) and burn them and fire the grass in the immediate vicinity. If this is too much of a fire risk, then disinfect as efficiently as possible. The foetus and afterbirth are the main source of infection.

(4) Keep the tail and buttocks of all cows free from matted discharge. This material may be teeming with *Brucella* microbes. Warm soapy water will make the task an easy one.

(5) Watch cows carefully for signs of impending abortion with a view to getting them into isolation before the event takes place.

(6) Rear all herd replacements on the property, but if purchases must be made, then buy only from herds which are beyond reproach, or if your herd is already infected buy animals which have been vaccinated as calves.

(7) As a general rule it is best to dispose of infected cattle in the late spring or early summer, for the reason that residual infection on pasture will die out quicker at that time of the year.

(8) Send to slaughter cows known to be infected and which fail to prove in calf after a reasonable period.

In the absence of precautions as outlined, a certain "balance" eventually comes about in an infected herd and a farmer perhaps comes to think that brucellosis is after all not a matter of any great account. Now, though it is well recognized that brucellosis is self-limiting, the disease leaves many cows sterile. The average number of services by the bull per live calf may rise as high as five, the calf crop itself may come down to 50 per cent. of the cows annually, production comes down, and wastage through having to cull barren cows is heavy. In such herds the percentage of heifers that abort is often very high indeed; moreover, as the abortion takes place while the animals are still growing the ill-effects are accentuated.

TEST-AND-SLAUGHTER METHOD OF CONTROL.

For many years test and slaughter has been an important means of control. Until comparatively recent times it was the only worthwhile method available.

The blood test enables the animals in a herd (as at the date of test) to be catalogued as infected, possibly infected, and not infected. They are referred to as positive, suspicious, and negative, respectively. Obviously, if all the infected animals—and to be on the safe side, the possibly infected ones also—are removed, the remaining herd is composed exclusively of non-infected animals. However, the infection present on the pastures grazed by the infected cattle will remain for about three months and during that time some of the non-infected animals may become infected through grazing on those pastures. It must also be recognized that there may still be animals in the herd which though actually infected have not arrived at the stage where they react to the blood test. To counter this situation, what remains of the herd is retested at 30-day intervals until a "clean" test is obtained. After the second and each subsequent test the positive reactors are eliminated, but suspicious reactors are often held until the next test and, as it were, given another chance.

It is necessary to get two "clean" tests at an interval of not less than 90 days before a herd can be accepted as free from the disease. The number of tests that has to be applied before this requirement is met varies greatly and there is no way of forecasting it. The number of cattle that has to be liquidated also varies greatly; it is again difficult to forecast. The procedure meets with earlier success on some farms than others, but the reasons are not always apparent.

The cost of this method may be considerable and there are many farms on which it cannot be justified in the light of present-day knowledge. It does have attractive features if a man has two farms, on one of which he can run all the reactors (infected cattle) and on the other the "clean" (non-infected) cattle.

Having "freed" a herd from brucellosis it has often happened that the disease is re-introduced at a later date despite all practicable precautions having been taken. This is a most serious drawback to the method. If in the process of obtaining a "free" herd a "resistant" herd were acquired, then the method would be much more attractive. It has become usual in Queensland to advise against attempts at eradication of brucellosis if infected cattle detected at the first test exceed 15 per cent. of the herd. Nevertheless, on some farms the test-and-slaughter method of control has been used to the complete satisfaction of all concerned even when the initial infection in the herd has been comparatively high.

It is much more attractive when testing is being carried out on an area basis—that is to say, testing is carried out on a group of adjacent farms at one and the same time. This largely eliminates the risk of re-infection.

In deciding on whether to control brucellosis by test and slaughter the following considerations must be kept in mind—

(1) Danger of re-infection after the herd has been "freed" from the disease.

(2) Economic value of the animals in the herd, including a consideration of their value as meat.

(3) Percentage of animals found infected on the occasion of the first test of the herd.

(4) Is the herd self-contained?

In general it can be stated that stud herds with a low initial infection are the most suitable herds in which to use the test-and-slaughter method. Grade herds that are not self-contained present difficulties which are not easy to overcome.

CONTROL BY VACCINATION.

Control by vaccination has been attempted ever since the bacterial nature of brucellosis was first discovered 50 years ago. It was early evident that dead vaccines had no immunizing effect against the disease and that living vaccines must be used. It was also evident that the virulence (power to produce disease) of the microbes in the vaccine must not be reduced in any way otherwise the immunizing power would be correspondingly reduced. The use of such fully virulent live vaccines had serious disadvantages. Abortions were prevented but the disease itself was perpetuated; the infection became established in the vaccinated animals and was shed in the afterbirth and milk, thus exposing other animals as well as man to the risk of infection.

In Australia the use of fully virulent live vaccines has at all times been prohibited.

Strain 19.

In 1925 Buck, working in the United States of America on an attempt to improve vaccination against brucellosis in cattle, came across a strain of *Brucella abortus* (since known as Strain 19) which was of considerably less virulence than is usual with this organism. Later Buck tested this strain as a vaccine and concluded that, notwithstanding its lower virulence, it was capable of producing a serviceable immunity. Buck's findings have been confirmed by many later investigators and Strain 19 vaccine is being used extensively in many countries.

Advantages and Disadvantages.

The chief advantage of Strain 19 is that it does not become established in the vaccinated animal other than in exceptional circumstances; and it never does when its use is confined to calves. Moreover, it does not become localised in the udder and hence is not shed in the milk.

It does not spread disease from vaccinated to unvaccinated animals. Vaccinated calves are no danger to unvaccinated cattle and do not require to be isolated for any period following inoculation.

When properly applied, Strain 19, apart from some local swelling at the site of inoculation, is not harmful to the animal in any way whatsoever.

The main disadvantage of Strain 19 is that the immunity conferred by it is not absolute. If the degree of exposure to infection is high enough, then the vaccinated animal will in many instances contract brucellosis. There is also a difference of opinion as to how long the immunity lasts. This is quite understandable because a number of factors enter into the matter, as, for example, the extent and severity of exposure to infection and the response of the individual calf to vaccination. These are all subject to great variation. Immunity is at its highest a few weeks after vaccination and then falls very gradually. Experimental evidence indicates immunity is of quite long duration.

The important thing is whether Strain 19 vaccine helps to bring brucellosis under control. There can no longer be any doubt on this point; its use is certain to effect improvement when intelligently applied. Abortions are not eliminated altogether but they are reduced to a point where they cease to be of any great consequence. Accompanying this is a decided improvement in the fertility level in the herd, easier rearing of calves, and increased production generally.

It is of great importance to realise that, although Strain 19 vaccine has proved itself on the farm as well as in the research centres, it must not be looked upon as a substitute for good sanitation and herd management. To do so is to invite disappointment.

There is no truth in the suggestion that Strain 19 leaves many heifers unable to breed. The experimental evidence in this regard is very clear; no difference can be discerned between the breeding capacity of vaccinated and unvaccinated heifers.

Precautions to be Observed.

In Queensland the use of Strain 19 vaccine is subject to permit, firstly because it consists of living organisms to some extent dangerous to man, secondly because it must be used under special conditions. For these reasons its use is confined to approved persons—that is, veterinary surgeons and certain officers of the Department of Agriculture and Stock.

All who carry out vaccinations are required to undertake to observe the following conditions:—

(1) No male cattle to be vaccinated.

(2) No pregnant animal, irrespective of age, to be vaccinated.

(3) No animal over 12 months to be vaccinated.

(4) As far as possible vaccination to be confined to calves between the ages of 4–8 months.

(5) Records of all calves vaccinated to be kept.

Calves under four months of age are not vaccinated for the reason that many of them fail to "take" and little or no immunity results.

No bull calves are accepted for the reason that bulls are normally more resistant to infection than females. Vaccinal reactions are also more persistent in males than in females.

Vaccination of adult cattle is not permitted in Queensland for the following reasons:—

(1) Permanent infections may be set up.

(2) Long-lasting positive reactions to the "blood test" are set up in nearly all cases.

(3) The local reaction to vaccination is very often severe and a permanent lump may remain at the site of inoculation.

(4) Milk flow is often seriously depressed for 2-3 weeks following inoculation with the vaccine.

(5) As vaccination of adult cows (even if practised) must be carried out when cows are "empty," a series of visits must be made to each farm before all the cows can be inoculated. The problem involved here is considerable, and in combination with the other disadvantages has brought vaccination of adult cows into disfavour.

(6) Vaccination of adult cattle which are already infected is in any event useless.

Abortions in Heifers Vaccinated as Calves.

In this State, as in other States of the Commonwealth, there have been some reports of abortions in vaccinated heifers. This is in accordance with what has been reported from other parts of the world. Strain 19 vaccine does not give absolute protection. It is, however, now becoming evident that some of these abortions are not due to *Brucella* abortion at all but to infection with other types of micro-organisms known as *Vibrios* and *Trichomonads*. This is not altogether surprising, as the protection afforded by Strain 19 vaccine against *Brucella* abortions was bound to bring these other types of abortion into greater prominence.

Vaccine Supply and Costs.

The vaccine is put up in bottles containing 100 c.c., or sufficient for 20 calves, the dose being 5 c.c. As the vaccine is comparatively costly, waste should be avoided. It is desirable that groups of farmers get together to ensure that as near as possible to 20 or multiples of 20 calves are available in the one locality for inoculation on any one day.

The charges made for inoculation by private veterinary surgeons will naturally have some relation to the number of calves and the distance travelled. The Department of Agriculture and Stock charges 2s. per calf as a flat rate, but it is only reasonable to expect that as the distance travelled increases so should the number of calves.

Indications for Vaccination.

Vaccination is especially suited to those herds which are already heavily infected. There is, however, a case for vaccination in any herd whenever the danger of infection or of re-infection exists. In all heavily infected herds all the calves should be vaccinated, and in fact in any herd where the danger of infection or re-infection exists vaccination is clearly indicated.

Vaccination and Blood Testing.

Vaccination and the use of the blood test may be combined to advantage. Vaccinations must be restricted to heifer calves not older than eight months. This is for the reason that vaccination with Strain 19 is followed by the development in the blood of those anti-body substances which are responsible for a positive reaction to the "blood test." This is to be expected and in fact is looked for as evidence that the vaccine has "taken." This positive reaction in vaccinated calves has quite a different significance from that given by animals which have contracted the natural disease. In the former case it indicates only a

temporary infection with no danger of organisms being shed by the animal; in the latter case it indicates a permanent infection with every prospect of organisms being shed by the animal.

The positive reaction due to vaccination gradually fades; but the older the calf at the time of vaccination, the longer the reaction lasts. Once the vaccinated calf reaches the age when a natural infection becomes a possibility, confusion and doubt as to the significance of the positive reaction become inescapable. The reason for this is that the "blood test" does not enable us to distinguish between a reaction due to vaccination and one due to natural infection. If careful records are kept of the animals vaccinated as calves there is less room for doubt but it cannot be removed altogether.

It is for the reasons stated that, when combining vaccination with the use of the "blood test," the age of the calves which are vaccinated must be kept lower than would otherwise be the case. Even so, in order to retain a "negative" herd it may still be necessary to dispose of a small percentage of vaccinated calves because they fail to return to a "negative" state.

Quite recently certain modifications of the "blood test" have been evolved which give hope of enabling us to distinguish between the two types of reaction. If this eventuates it will be a notable advance.

The main advantage of combining vaccination with the "blood test" is that an owner can look forward to having a "resistant" as well as a disease free herd and thus help materially to eliminate the possibility of re-infection.

In the early stages of an eradication programme the combination also enables the financial loss to be spread by disposing of reactors over a longer period. There is not the same pressing urgency about disposing

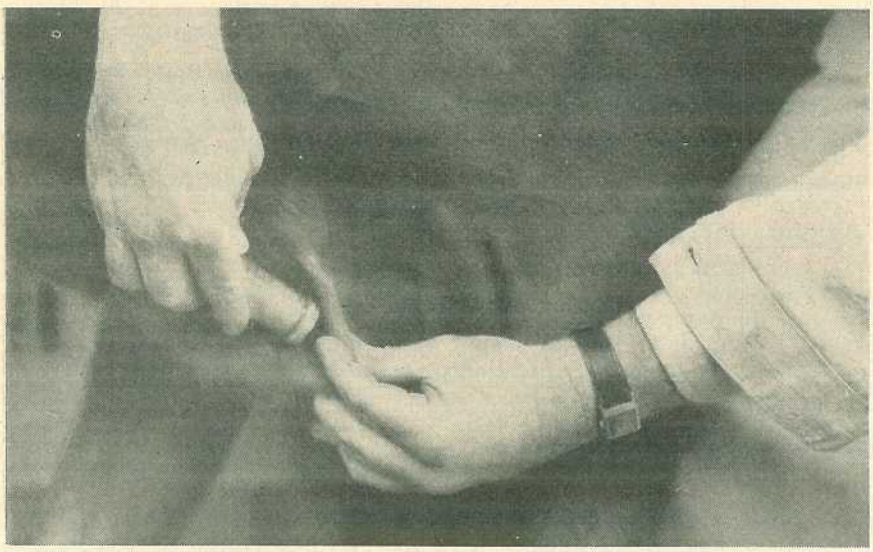


Plate 196.

Inoculation with Strain 19 Vaccine.—The injection is made low down on the side of the neck almost over the brisket. Note the loose skin, which makes the injection easier and safer for the operator and allows ample room for local swelling caused by the vaccine without detriment to the calf.

of all infected cattle, as the young stock are protected (by vaccination) before they reach a susceptible age. This is especially attractive to owners of stud herds in which a medium to high initial incidence of infection exists. Eradication can come four or five years later when the herd is composed largely of animals that have been vaccinated as calves.

Vaccination as an adjunct to "test and slaughter" should be seriously considered whenever the risk of re-infection of a "free" herd can be regarded as real. The consequences of this latter can be extremely serious.

Time to Start Vaccination.

Calfhood vaccination with Strain 19 is a long-term project, no matter what the circumstances in which it is used. It takes at least two years to obtain useful results in even small measure, and 4–6 years must elapse before a herd can be obtained which is composed entirely of vaccinated animals. It is very necessary to realize this and not postpone vaccination until the disease strikes. The time to start vaccination is NOW.

USE OF DRUGS.

The cure of brucellosis by the injection of various chemical substances has in the past been the subject of many claims by different people. A very popular "cure" was a weak solution of carbolic acid administered as a hypodermic injection. This in common with many others has been shown to be useless.

With the advent of the sulpha drugs high hopes were held, but these too proved useless. Even penicillin and streptomycin have been found wanting.

A more recent product known as aureomycin holds promise, but is not yet in the realm of practical farm use, being very expensive as well as not readily available for veterinary purposes.

Douching or syringing the vagina with antiseptic fluids helps to reduce the amount of infective material dispersed by affected animals but is not a cure of the disease itself.

RELATION OF BRUCELLOSIS TO VAGINITIS AND MASTITIS.

All three conditions are often seen in a herd at the same time but they are quite unrelated. Vaginitis is often seen in herds that have been proved by "blood test" to be free from brucellosis. Treatment of vaginitis will have no influence on brucellosis should the latter be present in the animal.

With regard to mastitis, it is necessary to note that *Brucella abortus* is found in the udder of infected cows. Its presence does not, however, cause any inflammation of the udder and is not considered to have any bearing on whether the cow will or will not become affected with mastitis.

RELATION TO HUMAN DISEASES.

Both *Brucella abortus* and *Brucella suis* can cause undulant fever (brucellosis) in man.

The disease due to *Brucella abortus* is very similar to Malta fever (due to *Brucella melitensis*). It is usually contracted from close contact with cattle and hence occurs chiefly in farmers, veterinarians, cattle

buyers and other people closely associated with cattle. There is also the possibility of infection occurring through drinking unpasteurized milk from infected herds. The risk in this latter regard is greatly heightened in those rare cases where cattle become infected with *Brucella suis*.

The disease in humans may be serious, especially as treatment is reported to present some difficulty.

Cases of undulant fever have not been common in Australia up to the present time, but there can be no certainty that this state of affairs will continue. They are in fact now being recognised somewhat more frequently.

It is clear that brucellosis in cattle has features which are of interest to the community as a whole as well as to the owner of the affected cattle.

TUBERCULOSIS-FREE CATTLE HERDS (AS AT 18th OCTOBER, 1950).

Breed.	Owner's Name and Address of Stud.
Aberdeen Angus ..	The Scottish Australian Company Ltd., Texas Station, Texas
A.I.S.	F. B. Sullivan, " Fermagh," Pittsworth D. Sullivan, Rossvale, *via* Pittsworth W. Henschell, Yarranlea Con. O'Sullivan, " Navillus Stud," Greenmount H. V. Littleton, " Wongalee Stud," Hillview, Crow's Nest J. Phillips and Sons, " Sunny View," Kingaroy
Ayrshire	L. Holmes, " Bencecula," Yarranlea
Friesian	C. H. Naumann, " Yarrabine Stud," Yarraman J. F. Dudley, Yarraman
Jersey	W. E. O. Meier, " Kingsford Stud," Rosevale, *via* Rosewood J. S. McCarthy, " Glen Erin Jersey Stud," Greenmount J. F. Lau, " Rosallen Jersey Stud," Goombungee G. Harley, Hopewell, Childers Toowoomba Mental Hospital, Willowburn Farm Home for Boys, Westbrook F. J. Cox and Sons, Crawford, Kingaroy Line R. J. Browne, Hill 60, Yangan

APPLIED BOTANY

Hemlock Declared a Noxious Weed.

S. L. EVERIST, Botanist, Science Branch.

HEMLOCK or poison hemlock (*Conium maculatum*) has been declared noxious throughout the State. The following notes are issued to enable those interested to identify this plant.

Description.

Erect annual or biennial herb 3-5 ft. high, with a strong mousy smell when crushed; root white, parsnip-like; stems stout, hollow, shining green outside, often with purple spots or patches, repeatedly branched; leaves alternate, sometimes opposite on upper part of stems, 4-12 inches long, deeply divided into narrow segments like a carrot leaf; smaller and less divided near top of plant; flowers very small, white, in clusters (umbels) at the ends of stiff, slender rays ¾-1 inch long; rays 8-15 in number, spreading out from the top of a stalk 1-2 inches long; 5 small green bracts beneath the ray clusters; fruits ("seeds") numerous, about one-sixth of an inch long, nearly globular but somewhat flattened with thick ribs.

Distribution.

Hemlock is a native of Europe and Asia, now naturalised in most temperate regions of the world. It is common in parts of New South Wales, Victoria and South Australia. In Queensland it is sometimes grown in gardens under the name "carrot fern" and in appearance resembles the "meadow sweet" or "bishop's weed." Lately it has become plentiful in a few localities in southern Queensland, and in every case the source of infestation has been traced to plants thrown out from gardens.

Seasonal Occurrence.

In Queensland, the plant makes its best growth in seasons with wet winter and spring months. It comes up in autumn or winter and persists through the spring until the beginning of summer. Seeds are usually produced between August and November.

Poisonous Properties.

For many centuries, hemlock has been known to be poisonous to man. Cases are on record of poisoning in cattle, horses, sheep, pigs and goats. It causes gradual weakening of muscular power and paralysis of the lungs, sometimes with loss of eyesight. All parts of the plant are poisonous. In Europe, the leaves and stems are reputed to be most dangerous before flowering and the young fruits to be very poisonous.

Plate 197.

Drawing of Various Parts of the Hemlock Plant.

In man, cases of poisoning have occurred when seeds have been used in mistake for aniseed, and the roots for parsnips. There are even cases on record where people have been poisoned by blowing whistles made from the hollow stems.

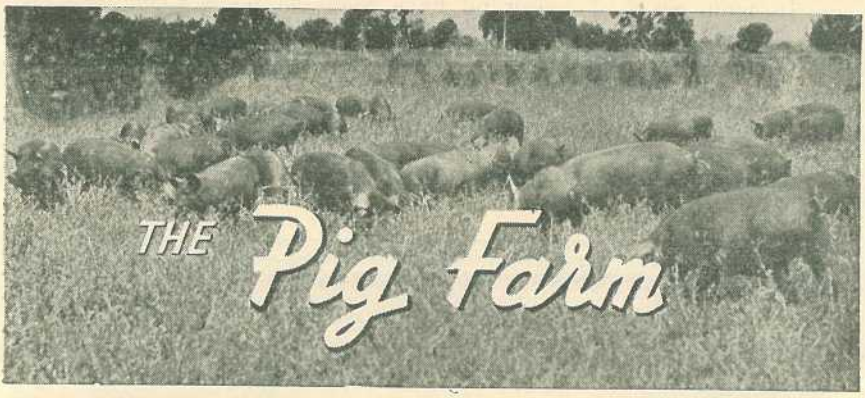
Because of its strong mousy odour, the plant is distasteful to most animals. Recently there have been cases where cattle have died after eating the young plants mixed with grass.

Plate 198.
A Single Plant of Hemlock.

Eradication.

Experiments conducted by the Department of Public Lands show that the plant can be destroyed by spraying thoroughly with hormone weedkillers. Young plants can be destroyed with 0·1 per cent. solutions and older plants with solutions double that strength. To get a 0·1 per cent. solution, 1 gallon of a liquid preparation containing 10 per cent. active ingredient should be added to 100 gallons of water. If the liquid preparation contains 50 per cent. active ingredient, 1 gallon should be mixed with 500 gallons water. With powders, 1 lb. should be added to 70 gallons water where the original preparation contains 70 per cent. of active ingredient, 1 lb. to 80 gallons where the powder contains 80 per cent. active ingredient, and so on. The percentage of active ingredient is given on the label.

To make a 0·2 per cent. solution, use half the amount of water.



Bacon Curing on the Farm.

F. Bostock, Officer in Charge, Pig Branch.

BACON curing on the farm is entirely different from factory curing and the following notes are designed for the guidance of farmers situated where there is no factory to which pigs may be sent to be cured. The home product, provided it is properly handled and the necessary attention given to important details, can be just as satisfactory as any the farmer can buy.

On the farm, curing should be conducted during the winter months, during frosty weather and in a moist atmosphere, as in a cellar, rather than in a dry atmosphere. Extremes of temperature are unfavourable.

The pigs selected for slaughter should be free from disease and in a healthy condition, gaining and not losing weight. They should be properly finished and free from bruises, cuts, sun-scald, etc. The live-weight should be about 175 lb. at approximately six months old, giving a dressed weight of about 125 lb., which is a desirable weight to produce first-class bacon. Some prefer pigs of much heavier weights for farm use, but excessively fat carcasses are not desirable.

The breeding of animals plays an important part in producing suitable carcasses, and the use of purebred sires of outstanding type and quality is necessary to produce ideal bacon pigs (Plate 199). Selection, careful handling, and intelligent feeding are also necessary.

PRE-SLAUGHTER CARE.

As with other animals, pigs should be kept off their food for about 24 hours before slaughter and allowed all the water they will drink. Should an animal be particularly restless, it is desirable to allow a small quantity of food. A well rested and fasted animal will give a better carcass, as the muscle is in good condition and the blood stream will not be gorged with nutrient substances from the digestive system. It is also claimed that the intestinal wall of a fatigued animal is less resistant to the passage of bacteria. In ordinary circumstances, most of the contamination that takes place at slaughter is of intestinal origin, and for this reason the intestinal content should be reduced to a minimum. Careful handling of the pig prior to slaughter is essential to the production of good bacon.

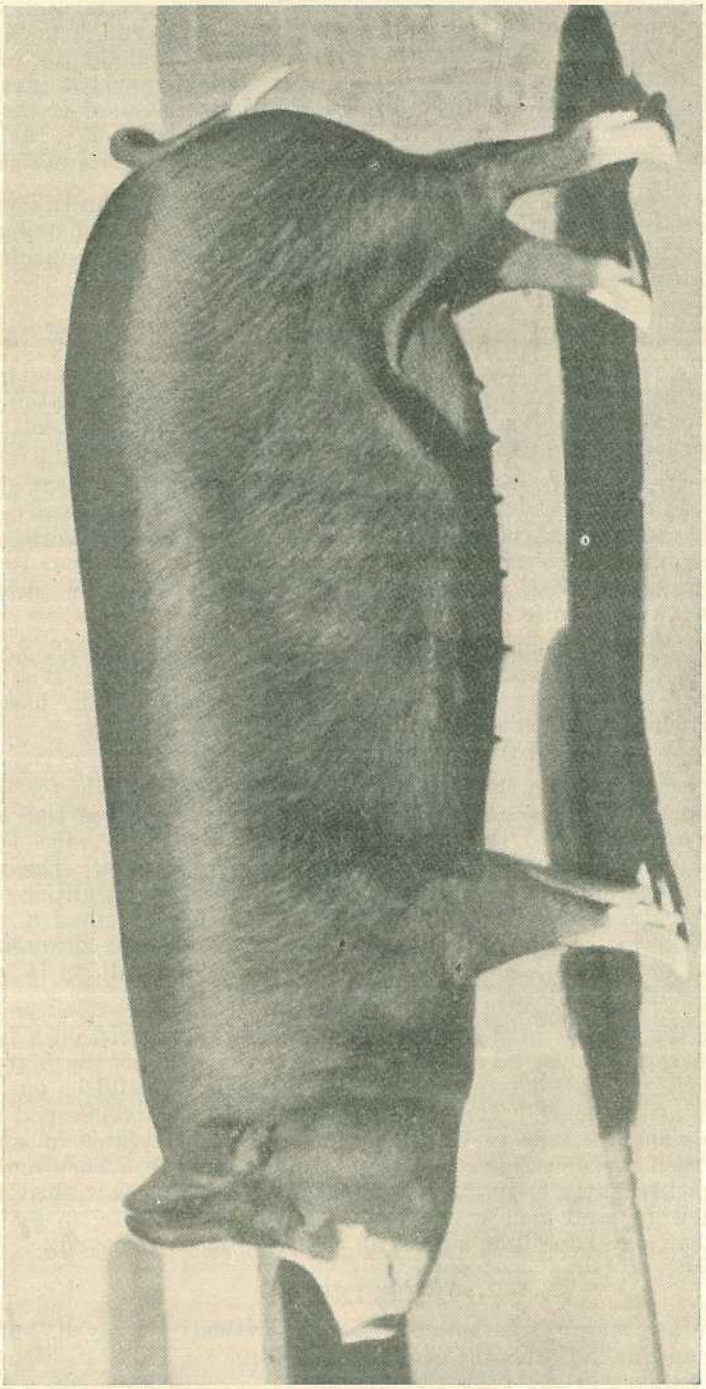


Plate 199.
Baconer Pig of Correct Type.

SLAUGHTERING.

Every care should be taken to avoid excitement and bruising at slaughter. Ordinarily, it is not necessary to stun or shoot the pig before sticking; although it is sometimes done, this method may not give the best results in bleeding. More thorough bleeding is assured if the pig is hung up by the hind leg for sticking, but care must be taken that the pig is held properly so that bruising or shoulder sticking does not occur.

Blood provides an ideal medium for the growth and multiplication of putrefactive organisms and it supplies a vehicle for their distribution throughout the animal. Thorough bleeding therefore has a profound influence on the keeping quality of a carcass.

Sticking without stunning, which is the common commercial practice, is not considered to be more cruel than other methods. However, for the beginner it may be a wise practice to stun the pig and get it into the proper position for sticking. This is on its back, and the man holding should stand astride the pig with feet against the shoulders, and take a firm hold of the front legs.

The man doing the sticking takes a position squarely in front of the pig, holds down the snout and opens the skin for a distance of about three inches in front of the breast bone. He then inserts the knife, edge upwards, taking a line with the base of the tail, for about four or five inches, lowers the wrist, which brings the point of the knife upwards, and withdraws the knife.

Care should be taken to hold the pig squarely on its back and to keep the knife in the centre so as not to stick the shoulder. It is both difficult and unwise to stick the heart. Let it pump out the blood as long as possible.

SCALDING AND DEHAIRING.

Soon after sticking, the pig is ready for scalding, in either a barrel or a tub large enough for the purpose. The temperature of the water for a pig of about 175 lb. liveweight should be 140° to 145° F., or approximately two parts of boiling water to one of cold. The work should be carried out in a sheltered place, as weather conditions will affect the scald. A slow scald is better and much safer than a quick scald. While in the water, the pig may be held by a hook through the snout, and the carcass should be kept moving, so that all parts get a uniform scald and a clean white skin is produced.

After the pig has been lifted from the scald and placed on a bench or table, scraping must be done as quickly as possible, as the hair will again adhere if allowed to cool. All tools necessary should be on hand before a start is made. The hind legs should be firmly grasped with both hands and the hair twisted off; the forelegs are treated in similar manner; then the dew claws and hoofs pulled off with a hook and the hair scraped from the body. After scraping, the carcass is washed down with cold water and gone over again, using a sharp knife, to see that all hair that may have been missed in the scalding is removed.

DRESSING.

There are many variations of dressing methods employed, but the following outline indicates the general procedure.

The tendons of the hind legs should be exposed by making a cut down the trotter between the foot and the hock. The gambrel is inserted in each leg and the carcass hung ready for dressing.

Stand at the back of the carcass and grasp the tail, then cut around the pelvic arch to loosen the bung, care being taken to keep the point of the knife against the pelvic bones.

With the belly facing the operator, make a shallow cut from between the back legs to the throat; cut deep to the bone between the back legs and open the abdominal cavity, care being taken not to puncture the bladder; insert the left hand and keep back the intestines and stomach and continue the cut through to the breast bone; the knife may be pointed downwards and inserted into the chest cavity in order to continue the cut through the centre of the breast bone and throat.

Now pull the bung through the pelvic cavity and ease the intestines down by severing the attachments to the backbone; cut around the skirt or diaphragm and pull out the lungs and heart; cut through just below the gullet.

The carcass is then thoroughly washed both inside and out, a short stick being inserted to keep the ribs apart, while a stone or potato is placed in the mouth to keep it open to allow drainage and more rapid cooling. To assist in cooling, the carcass may be backed down while hot—that is, cut into the backbone from the butt of the tail to the head. The kidneys and leaf fat are also removed and the carcass left neat and trim, then allowed to cool thoroughly.

Before proceeding further all animal heat must have left the carcass.

Cleanliness in all these operations is of the utmost importance.

INSPECTION OF CARCASS.

Although legal requirements apply only where meat is offered for sale or intended for sale for human consumption, it is strongly recommended that the carcasses of pigs killed for farm consumption be examined, if possible, by a qualified meat inspector to ensure that they are fit for human consumption. However, this may not be possible, and it is desirable that the person handling such products should be familiar with the normal and healthy tissues. This knowledge can only be acquired by experience and observation, but the following brief outline may prove a guide to the main points to look for.

The lymphatic system ramifies throughout the body somewhat like veins, and at intervals there are enlargements which are termed lymphatic glands, sometimes referred to by butchers as "kernels." They can be considered as filters which serve to prevent bacteria, etc., from penetrating further into the animal body. Most people are familiar with a swollen gland under the armpit arising from a poisoned hand, or sore throat causing an enlargement of the glands in the neck. Thus the meat inspector can usually find evidence of disease in an enlarged, discoloured gland more easily than in the tissues which have been primarily infected. A knowledge of the position and normal appearance of these glands is therefore of utmost importance in meat inspection.

Their size varies considerably, some of the glands being as small as a millet seed while others may be as large as a walnut. The outer wall of the gland consists of a strong fibrous coat, and in the gland proper two regions can be recognised—an inner portion somewhat pink in colour, and a lighter outer part. Some glands, particularly those to be found in the intestinal organs, may have a somewhat greyish colour.

As mentioned, glands act as filters to remove germs from the general circulation; they are, however, very sensitive and are found to be inflamed should there be inflammation in the region they drain.

In the case of tuberculosis, the changes that take place in infected glands (the most important of which are the submaxillary and cervical in the neck, and the precrural in the flank) may be observed in one of the following forms:—(1) swelling; (2) small cloudy spots; (3) formation of larger tubercles; (4) caseation (cheesy formation); (5) calcification (gritty formation). In the pig, tuberculosis is generally contracted by ingestion, and consequently the digestive system and its glands will usually be involved. Should the disease become generalized, the lungs, liver, spleen, and kidneys are usually affected.

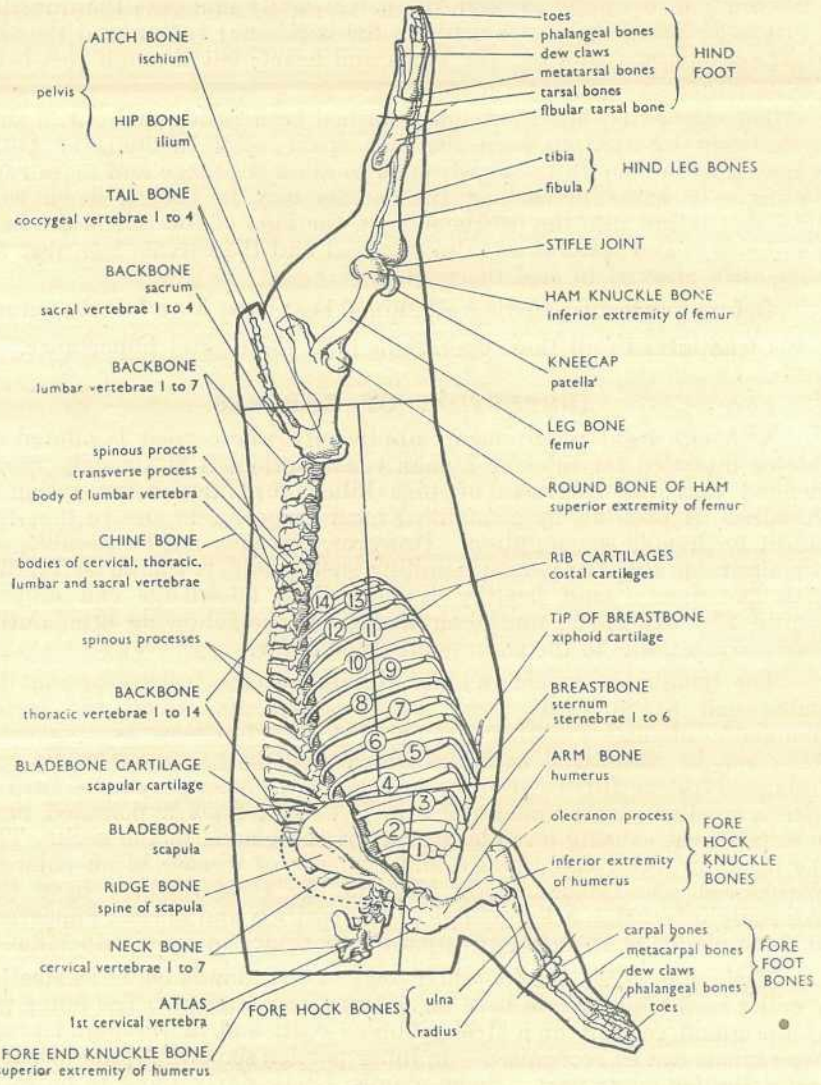


Plate 200.

Location of Bones and Cuts in a Side.

(From a Bulletin of the Ministry of Agriculture and Fisheries.)

Plate 201.
A Cutting Room in a Bacon Factory.

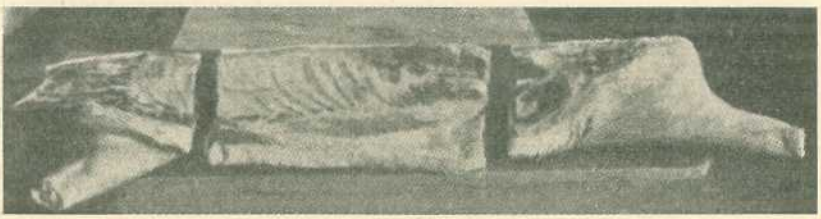


Plate 202.
Side Divided into Shoulder, Middle, and Ham.
(From a Leaflet of the New South Wales Department of Agriculture.)

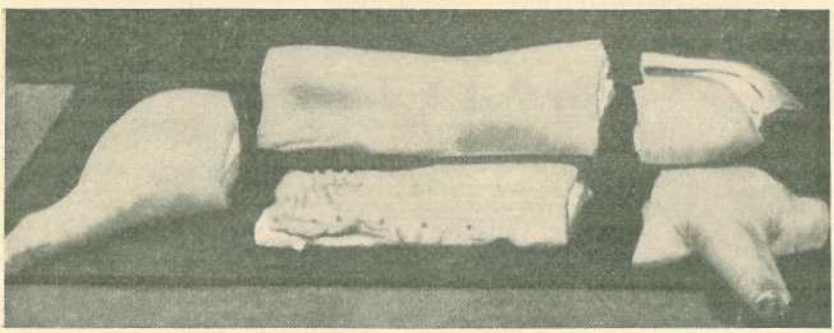


Plate 203.
Right Side as Cut to a Standard English Method.
(From a Bulletin of the Ministry of Agriculture and Fisheries.)

CUTTING UP.

There are various methods of cutting up, but a good plan is to remove the head and front feet, then split the carcass down the centre of the backbone, making two full sides. The backbone is then taken out in two pieces, and used with other trimmings for the making of pies, &c. Each side is now divided into shoulder, middle and ham; or the full side may be cured; or again the ham may be taken off, leaving the shoulders and middle together (called the flitch).

All parts are neatly trimmed and any scrap pieces taken off. A sharp pointed knife is used to release the joint oil in the ham and shoulder joints. Strong string is put in convenient places on the hams, flitches, &c., to enable the pieces to be easily handled and hung up.

CURING.

The curing of bacon should be conducted in a somewhat moist atmosphere with a regular temperature of from 40° to 45° F.—or during winter weather on farms. The curing room should be perfectly clean and as far removed as possible from any source of contamination, such as drains, heaps of manure, rubbish, dust, &c. There should be efficient ventilation, so that the carcass or pieces may be exposed only to pure air, and the floor of the room must be such (concrete for preference) that it can be readily cleaned.

Curing may take the form of dry salting or pickling, or a combination of the two methods, although for the farmer dry salting is the more convenient, and possibly less troublesome. The carcass must be thoroughly cooled and drained of blood before any attempt is made to cure the meat, otherwise it may decompose in parts and give objectionable flavours or taints.

Combined Method of Pickling and Dry Curing.

Although the dry cure method later described is recommended for farm use, there are numerous pickling mixtures to select from, as used in bacon factories, where the brine is tested by means of a salinometer and is used at a standard density of 95°, but the following formula will be found useful. For each pound of meat use—

Water	1/14 gal.
Salt (lb.)	No. of gallons of water × 3·2
Sugar (lb.) ..	1/10 of salt
Saltpetre (lb.) ..	1/10 of salt
Flavouring—allspice (lb.)	1/10 of saltpetre

Therefore pickle or brine for 280 lb. of meat would be—

Water	20 gal.
Salt	64 lb.
Sugar	6·4 lb.
Saltpetre	6.4 lb.
Flavouring (allspice)	0.64 lb.

Should saltpetre not be available, 7·5 lb. sodium nitrate could be used.

Always use the best brands of ingredients, and dissolve them through cheesecloth or a fine sieve. The use of sugar in a pickle or brine is a matter for the discretion of the curer; it may cause slime or set up a fermentation and not produce the mild flavour anticipated. The meat should be placed in a tub or cask, flesh side up, and care taken that it is well covered with brine.

The meat is left in the brine from four to six days, and then removed, salted, and stacked on a table or bench flesh side up for seven days. Use approximately 1½ lb. of salt per side. The pieces are then re-salted, using ¾ to 1 lb. per side, and if desired 10% sugar added. They are then stacked for a further seven days flesh side up. The changing of the stacking at seven days is to reverse the pieces in order to get an even distribution of the curing mixture. The pieces are soaked for 8 to 12 hours in clean water, which is drained off, and then washed in clean water at about 110° F. When the pieces are clean, they are hung up to dry. If possible, this should be done in the smoke house at a temperature of 85° to 90° F.; proper drying will take from 8 to 10 hours, after which they may be smoked (taking approximately 12 to 14 hours depending on the colour desired, usually a light tan), then rubbed lightly with olive oil after smoking.

Pickling.

If pickling only is desired, the following recipes are suggested:—

(1) For 125 lb. of meat.

Water	15 gal.
Salt	50 lb.
Saltpetre	1½ lb. (or 2lb. sodium nitrate)

The meat is placed in a cask and well covered with the pickle. It remains in the cask for 21 days, and is then taken out, washed, dried, and smoked.

(2) For 500 lb. of meat.

Clean rain water	20 gal.
Fine dairy salt	50 lb.
Brown sugar	5 lb.
Saltpetre	2 lb.
Allspice	½ lb.

Dissolve the salt, sugar and saltpetre in the water and immerse the allspice, tied in a calico bag. Boil for one hour and skim off any frothy matter rising to the surface while boiling. Allow the solution to come down to the temperature of the curing room before placing in the pickling tub.

The meat should be rubbed with salt and stacked for two days before being immersed in the pickle. If it is necessary to place weights on the meat in order to keep it immersed, see that clean pieces of hardwood are used, and soak them well in waste pickle before use. The time the meat is in pickle will be determined by the size of the pieces, but is usually three weeks.

Dry Curing.

When dry curing is practised, as is usually the case on farms to save possible trouble with brine, there are many different curing mixtures that may be used, but the following, using the best brands of salt, sugar and saltpetre available, will give good results.

For every 125 lb. of meat, use—

9 lb. salt
5 lb. sugar
¼ lb. ground allspice
½ lb. ground saltpetre or sodium nitrate.

After the carcass has been cut and trimmed into the desired pieces and the joint oil has been released from the ham and shoulder joints with a sharp pointed knife, the pieces are placed flesh side up and sprinkled with two parts of salt to one part of saltpetre (finely ground) or sodium nitrate and allowed to stand for 24 hours; this will draw off the surface blood and help retain the colour of the meat. The pieces are then turned and allowed to drain before applying the curing mixture.

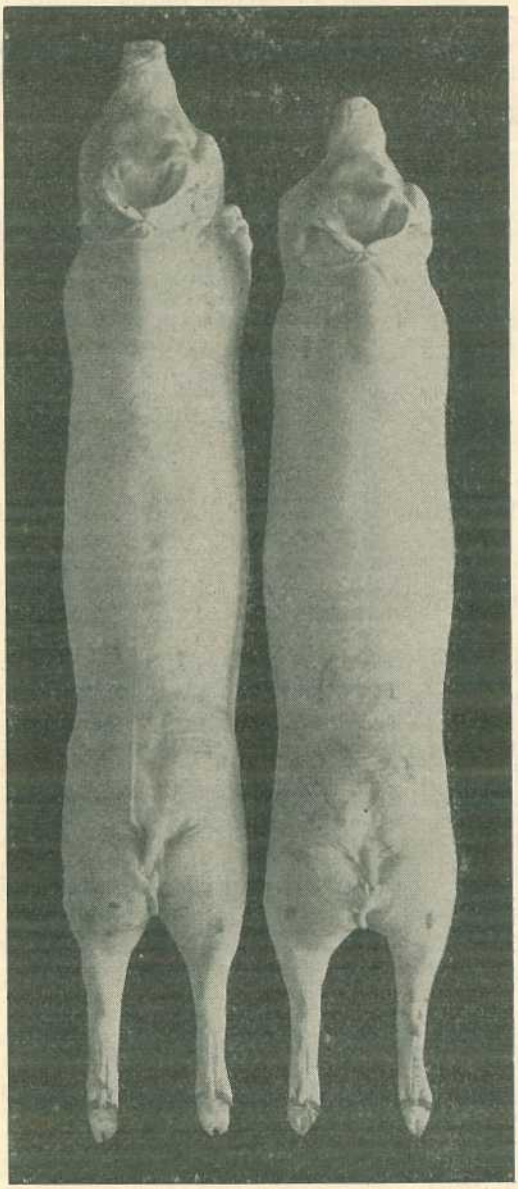


Plate 204.
Comparison in Carcass Length.

Curing by this method takes approximately three to four weeks according to the size of the pieces. The pieces are placed on a clean table or concrete floor, flesh side up, for the application of the mixture, and are then stacked. They are re-stacked differently every second

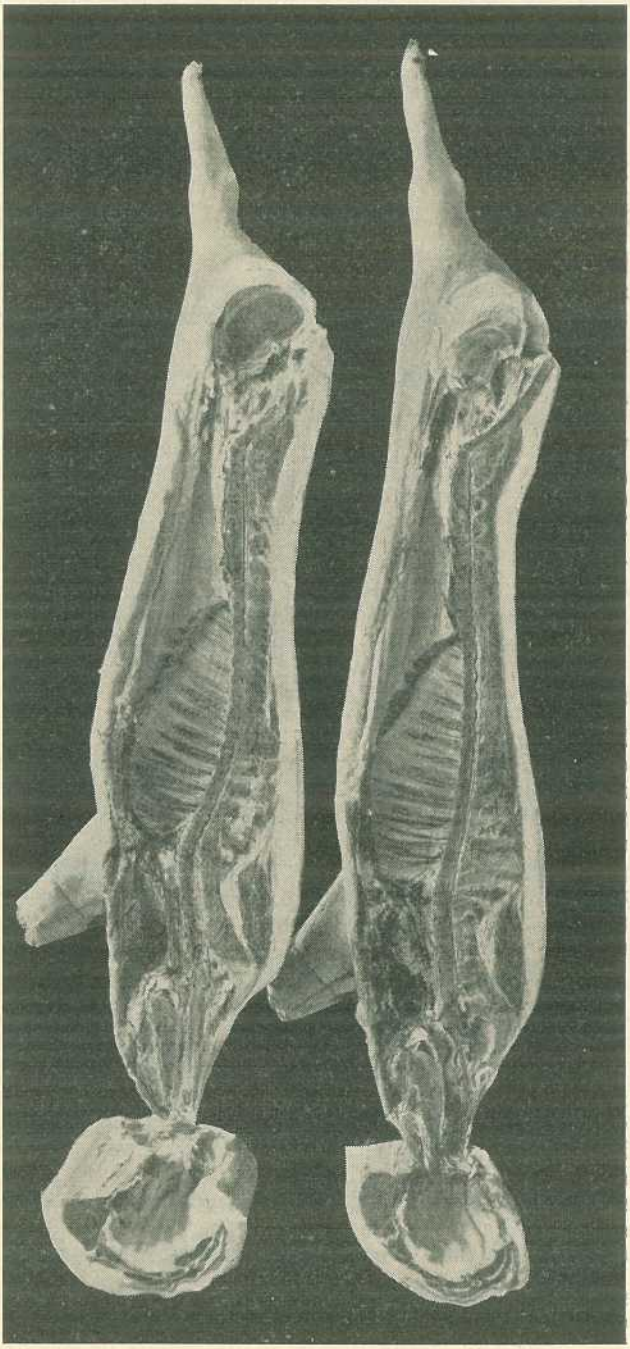


Plate 205.
Comparison of Fat Development.

day for two weeks, and then once a week for the balance of the time; the changing of the stacking is necessary to ensure an even distribution of the curing mixture. Extra salt should be placed along the bones and thick parts of hams and shoulders.

The pieces are next washed in water at a temperature between 100°F. and 110°F., dried, and smoked.

Much farm cured bacon becomes rancid through being hung in places where the temperature is variable, and bacon may be attacked by flies unless some preventive measures are taken. The pieces of bacon can be dusted over with pepper and then placed in a calico or flour bag, but should be kept in a dry place and examined periodically.

Smoking.

In addition to having a drying and preserving action on meat, smoking imparts a flavour which adds to the value of the bacon. It has been ascertained that in smoking bacon there is no loss of nutriment and the finished product is as digestible as fresh meat. The smoke has a distinct antiseptic or preservative action and provides a protecting cover which checks the action and growth of putrefactive organisms and their processes and retards decomposition. The effect of all is nullified if the meat has not been properly dried before being placed in the smoke house. The aim is to surround the bacon pieces with a dense smoke at a comparatively low temperature, which should never exceed 90°F. during the period of smoking.

Construction of a properly designed brick or iron smoke house may be worth while in some cases, but where a farmer only wishes to smoke one or two pigs at a time an old galvanised iron tank (say 600 or 800 gallons) would meet his requirements. The top of the tank is cut out, battens on which to hang the bacon pieces placed across the top, and the whole covered with bags or tarpaulin.

A well-spread sawdust fire about three inches deep is made in the bottom of the tank or smoke house. Many methods of creating smoke are applicable; sawdust (dried) with a few corncobs will answer to kindle the fire, with a good development of smoke without too much heat. Direct heat should be prevented from reaching any bacon that is hanging over the fire by having a sheet of galvanised iron placed on a column of loose bricks or stones. The smoke must be conveyed to the bacon cool, for if direct heat reaches the bacon the fat will melt and run and may cause loss of flavour, or fire.

Colour.

In deciding the length of time to leave the bacon in the smoke house, the colour desired must be considered. This is usually light brown or tan, and to obtain it smoking may occupy any period from one to two days. The character of the flesh, its thickness, &c., require to be estimated in order to obtain perfection in colour and flavour. When the desired colour is obtained, the tank should be uncovered or the door of the smoke house opened and the meat allowed to cool down before handling; from this time onwards the meat should be handled as little as possible, as the "bloom" may be rubbed off.

Smoked bacon will hang well in a smoke house until required, provided reasonable care is taken to exclude insects and keep the place very dry, dark and cool. Any degree of dampness or moisture in the atmosphere in which bacon hangs will result in the development of mould.

ASTRONOMICAL DATA FOR QUEENSLAND.

DECEMBER.

Supplied by W. J. Newell, Hon. Secretary of the Astronomical Society of Queensland.

TIMES OF SUNRISE AND SUNSET.

At Brisbane.			MINUTES LATER THAN BRISBANE AT OTHER PLACES.					
Day.	Rise.	Set.	Place.	Rise.	Set.	Place.	Rise.	Set.
	a.m.	p.m.						
1	4.45	6.28	Cairns	51	7	Longreach	44	26
6	4.46	6.32	Charleville ..	30	24	Quilpie	33	37
11	4.47	6.35	Cloncurry	65	35	Rockhampton ..	19	0
16	4.49	6.38	Cunnamulla ..	27	32	Roma	19	15
21	4.51	6.41	Dirranbandi ..	16	22	Townsville ..	42	8
26	4.54	6.43	Emerald	28	11	Winton	52	29
31	4.56	6.46	Hughenden ..	49	21	Warwick	2	6

TIMES OF MOONRISE AND MOONSET.

At Brisbane.		
Day.	Rise.	Set.
	p.m.	a.m.
1	11.37	9.58
2	..	10.56
	a.m.	
3	12.09	11.55
		p.m.
4	12.40	12.54
5	1.11	1.56
6	1.45	3.01
7	2.23	4.11
8	3·07	5.24
9	3.59	6.38
10	5.00	7.47
11	6.08	8.49
12	7.19	9.41
13	8.29	10.24
14	9.34	11.00
15	10.35	11.32
16	11.33	..
	p.m.	a.m.
17	12.28	12.01
18	1.22	12.30
19	2.15	12.59
20	3.10	1.29
21	4.06	2.02
22	5.02	2.39
23	5.58	3.21
24	6.50	4.08
25	7.39	5.00
26	8.24	5.57
27	9.03	6.54
28	9.38	7·53
29	10.11	8.51
30	10.41	9.48
31	11.11	10.46

MINUTES LATER THAN BRISBANE (SOUTHERN DISTRICTS).

Charleville 27; Cunnamulla 29; Dirranbandi 19;
Quilpie 35; Roma 17; Warwick 4.

MINUTES LATER THAN BRISBANE (CENTRAL DISTRICTS).

Day.	Emerald.		Longreach.		Rockhampton.		Winton.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	14	26	29	42	4	17	33	49
6	23	14	39	29	14	4	45	33
11	30	9	46	24	21	0	54	26
16	20	19	36	35	11	10	42	40
21	11	27	26	43	0	18	29	51
26	10	30	26	45	0	21	28	53
31	19	19	35	36	10	10	41	41

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	16	45	41	60	26	46	14	37
3	20	35	44	55	29	40	18	30
5	32	24	52	46	36	31	26	21
7	43	10	60	37	45	23	36	10
9	54	2	67	32	51	17	44	3
11	56	3	68	32	52	18	46	4
13	48	12	63	38	48	24	40	12
15	38	23	56	45	41	30	32	20
17	27	29	49	50	33	35	23	25
19	17	38	41	57	26	42	15	33
21	8	48	36	62	21	48	8	40
23	2	55	33	67	17	52	3	45
25	3	56	34	67	18	53	4	46
27	10	51	37	64	22	50	9	43
29	20	41	43	58	28	44	17	35
31	30	31	51	51	35	36	25	26

Phases of the Moon.—Last Quarter, 3rd December, 2.22 a.m.; New Moon, 9th December, 7.28 p.m.; First Quarter, 16th December, 3.56 p.m.; Full Moon, 24th December, 8.23 p.m.

On 22nd December at 8 p.m. the Sun will reach its greatest angle south of the Equator and will then rise about 25 degrees south of true east and true west respectively. On 4th, 17th and 31st December the Moon will rise approximately at true east and set close to true west.

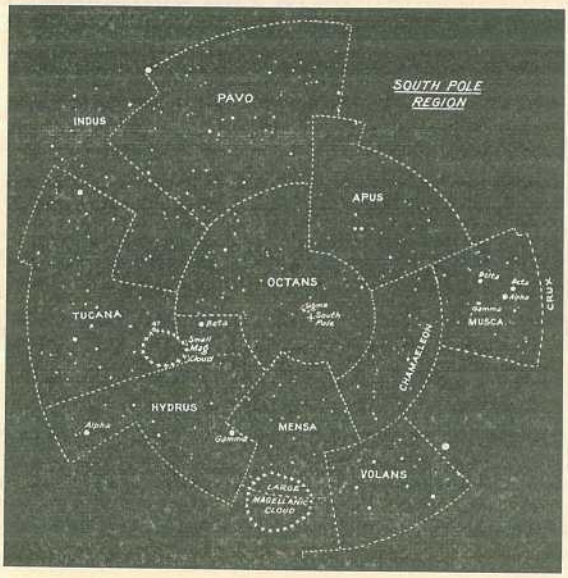
Mercury.—An evening object all this month, setting 1 hour 15 minutes after the Sun on the 1st, when it will be in the constellation of Ophiuchus. On 15th December it will reach an angle of 20 degrees east of the Sun, when it will set 1 hour 20 minutes after sunset, and by the end of the month, in the constellation of Sagittarius, it will set only 10 minutes after the Sun.

Venus.—Too close to the Sun for observation at the beginning of the month, but may be observed low in the west at sunset at the end of the month, when it will set about one hour after the Sun.

Mars.—At the beginning of the month, in the constellation of Sagittarius, will set between 9.15 p.m. and 10.30 p.m., while at the end of the month, in the constellation of Capricornus, will set between 8.55 p.m. and 10.15 p.m.

Jupiter—The dominating object of the evening sky now, is almost overhead at nightfall at the beginning of the month, when it will set about midnight. By the end of December it will set between 10 p.m. and 11.15 p.m.

Saturn.—Will rise just after midnight at the beginning of the month and by the end of the month will rise just before midnight. On the morning of 1st January the Moon will pass close to Saturn.



THE CONSTELLATIONS.

South Pole Regions.

The grouping of constellations in this area of the sky is of comparatively recent date—within the last 300 years or so—and these did not receive names at the same time as groups in the more northern areas because these stars never rose above the horizons of early areas of civilisation, which were situated north of the Equator.

The constellation surrounding the South Celestial Pole is Octans, named by Hadley. It is rather an inconspicuous group and unlike the constellation surrounding the North Pole, none of its stars are bright enough to be used as a guide, as is the Pole Star of the Northern Hemisphere, though two of its stars (Sigma, a fifth magnitude star, just out of the range of normal vision, and another star of seventh magnitude) are very much closer to the Pole than the North Pole star.

The constellations adjoining Octans are shown in the accompanying diagram. These include:—*Hydrus*, the Water Snake, which is on the meridian about 8 p.m. towards the end of December. Beta, a 2.9 magnitude star, is the nearest bright star to the South Pole and is 12 degrees away. There are three other serpents in the sky—Draco, near the North Pole, Hydra, and one held by Ophiuchus. The stars Alpha, Beta and Gamma are quite easily seen and form a large triangle.

Musca, a small constellation situated at the foot of the cross, Alpha, a third magnitude star, Beta, a double star, Gamma and Delta are all easily detected. The region around Alpha and Beta is very rich in small stars when viewed through field glasses.

Chamaeleon lies between Carina of Argo and the South Pole. It contains no stars greater than fourth magnitude, but they are a replica of the Little Bear of the Northern Hemisphere and the constellation was named The Little Dipper by early navigators and Chinese.

Pavo, The Peacock. The fourteen stars in the region representing the tail are as glorious as the bird's tail in real life.

Indus, The Indian, joins Pavo and is on the meridian about 8 p.m. in the middle of October, while Apus, The Bird of Paradise, is seen from April to November during the evening.

Toucanus, The American Goose, Volans, The Flying Fish, and Mensa, The Southern Fly, complete the circle around the South Pole.