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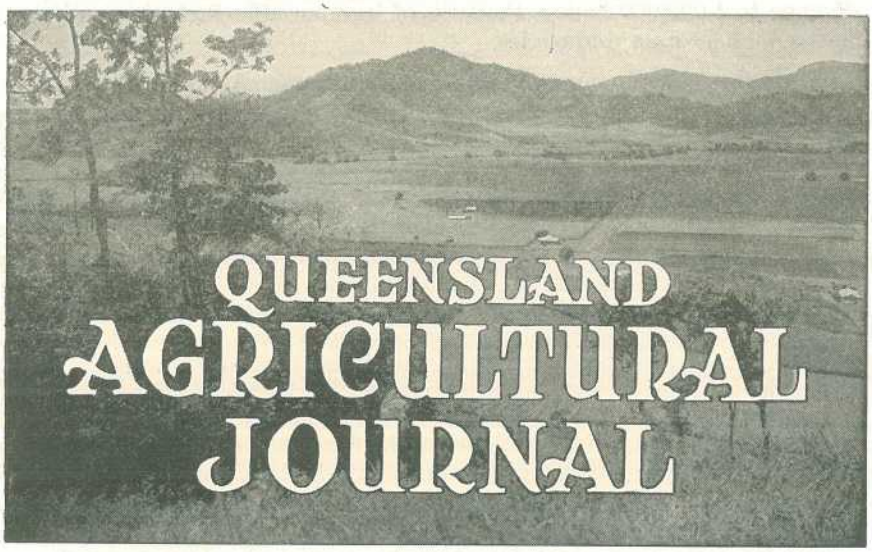

QUEENSLAND AGRICULTURAL JOURNAL

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Event and Comment.

Food for Britain.

DURING the war, Britain's enemies did their worst to starve her out, but she met the challenge by doubling her pre-war production. Behind that simple fact is the story of a great endeavour, of an extraordinary gift for improvisation and of commonsense co-operation among food producers and skilled administrators inspired by a lively practical patriotism. Remarkable success in the handling of wartime food production was a natural corollary. In the biggest crisis of her history Britain was able to rise to the emergency and work out a plan which saved her people from hunger, although it was done on a strictly rationed diet. Within the scope of that plan came, of course, food supplies from the Dominions.

During the six long years of blitz, blackout, blast, and blockade, the people of Britain lived on a skimpy dietary scale, restricted both in quantity and variety. All that time they had to do with less than the lowest amount of rationed food that any other English-speaking community had been called upon to accept. On top of that, to feed her famine-stricken neighbours Britain, with characteristic generosity, drew on her own security food reserves, so soon to become a diminishing quantity and which had been accumulated by foresight, prudent management, and self denial.

For over two years Britain, aided by the Dominions, fought the greatest war in history alone; and while the war lasted the whole of

her population was virtually in the front line. It cost her hundreds of thousands of lives, thousands of millions in money, the destruction of or damage to 4,000,000 homes, the ruin of innumerable factories, and great havoc to her other industries.

At the end Britain was financially exhausted, but not in spirit. She is now fighting her way back to recovery gradually by self-sacrifice and toil, beset by tremendous difficulties. A wet autumn, a succession of winter blizzards followed by disastrous flooding of millions of acres of her best farming lands have made her food position more precarious than ever. The loss of crops and livestock at this stage is a shattering blow to a people who, even had their last harvest been normal, would still have to continue on their monotonous meals based on a scanty scale of rationing. Entitled when victory came to look forward to fuller meals and some luxuries, they are now existing on even shorter commons than they had to take during the blackest war period.

Britain's hope is in the capacity and courage of her people. Of their possession of those qualities and, above all, of an unconquerable spirit there, happily, can be no doubt. With sleeves rolled up they are already on the job of all-out production, with consequent long hours of unceasing strain on brawn and brain; but to keep going for any length of time they must be properly nourished. Large supplies of nutritious food are needed for their sustenance so that increased production in all industries, so essential to complete economic recovery, may be achieved.

When Britain fought alone she used her accumulated savings of a century, a vast amount which vanished during the dark days of 1940-42. In the later years of war, with all her credits gone astronomical debits piled up and when V-Day dawned she did not have a penny in her purse. Huge loans had to be raised and with their credits Britain has been able to buy wheat, meat, and other essential foods, as well as the new factory equipment required for the rebuilding of her industries. Despite the hard times through which she is passing, Britain is determined to recover and keep her place as a leader in world affairs.

Australia and the other Dominions of the British Commonwealth are rallying to the assistance of the Mother Country. Throughout this continent there is a definite desire to help in such a way that the people of Britain may not be called upon to make further sacrifice. It is recognized that the need is theirs, the obligation ours, and the call to honour it is immediate.

Britain wants our wheat, meat, butter, cheese and other necessities to help her through. Every extra ton will be welcomed. Food and more food must be sent quickly. Contributions made through various Food for Britain appeals have aided in relieving the position, but a much greater effort is needed now to increase our shipments of essential commodities.

It is expected, therefore, that exports to Britain will rapidly increase and will be promptly despatched; and that private organizations and individuals who can, from their abundance, send food will redouble their endeavours.

A Grape Variety Trial at Charters Towers.

S. E. STEPHENS, Horticulturist, and F. L. JARDINE, Adviser in Horticulture.

THE Charters Towers district, the chief grape-growing area of tropical Queensland, is situated 80 miles inland in a direct line from the coast at an elevation of 1,000 feet above sea level. Weather conditions are hot and dry in the early summer with a short wet season in January and February, and frosts occur each winter. The average annual rainfall is 24½ inches.

Land under horticultural crops is largely alluvial flats and pockets along the tributaries of the Burdekin River. The soil is of sandy loam to loam. Cultivation also extends to the lower slopes of the adjacent rises, where the soil is reddish brown, with gravelly texture and fair clay content. All crops are grown under irrigation.

Grape production in the area has been built up round the Royal Ascot variety, which thrives and crops well, is hardy, and matures its crop sufficiently early to escape the wet weather except when the wet season occurs abnormally early. The variety is not a first-class commercial one, however, and it was considered that if an expansion in the grape industry was to take place it should be based on better varieties than the Ascot. In an endeavour to find other varieties suitable to the conditions obtaining in the district a trial was laid down in July, 1940.

The soil selected for the trial was of the red-brown gravelly type on a low slope bordering an alluvial flat. The soil analysis, as supplied by the Agricultural Chemist, indicated that available nitrogen and phosphate were very low but potash fair; the soil was alkaline in reaction.

The land was prepared according to the usual method followed by the grower; that is, the rows were trenched and broken up to a depth of 15-18 inches, and then thoroughly irrigated during the week before planting.

Varieties.

The following 13 varieties were selected for trial:—Belas Blanco, Black Malaga, Black Prince, Chaouch, Doradillo, Gros Colman, Henab Turki, Ohanez, Purple Cornichon. Red Malaga, Servant, Waltham Cross, and White Wax. The vines were secured from Stanthorpe as rooted cuttings. Six plants of each variety were included in the plot, which was planted in July, 1940. Plants were set six feet apart in the rows and the rows were 10 feet apart, so that the plot occupied an area of approximately one-ninth of an acre.

Training Method.

Waltham Cross and Purple Cornichon were trained on the Bordelaise espalier system and all other varieties on the unilateral cordon system. In addition to the regular winter pruning, a moderate amount of summer pruning was given where necessary to keep the vines within reasonable bounds.

Fertilizer Treatment.

An initial fertilizer dressing of ½ lb. per vine was applied, after the vines had become established in February, 1941, a complete mixture of 8:8:8 formula being used. Subsequent treatments of 1 lb. of the same mixture per vine were given in early spring of each year, except 1942. In that year the treatment was 1½ lb. of dried blood and meatworks mixture (7% N., 10% P_2O_5) in August, followed by ½ lb. sulphate of ammonia in September and again in November.

Observations.

Observations on habit, yield, disease resistance and so on are summarised in the accompanying table.

Variety.	Yields in Pounds.					Remarks.
	1942–3.	1943–4.	1944–5.	1945–6.	Average per vine.	
Belas Blanco .. (6 vines)	16	10½	9	6	1¾	Weak-moderate habit; foliage sparse; leaves suffer from marginal scorch; fruit affected by sunscald; fruit poor quality. Generally unsatisfactory.
Black Malaga .. (6 vines)	..	..	..	..	..	Weak habit; subject to black spot; no crop set. Generally unsatisfactory.
Black Prince .. (6 vines)	2½	3	17	3	1	Moderate habit; fairly resistant to black spot; unfruitful with spur pruning but improving with long pruning; fruit ripens in latter half of December.
Chaouch.. .. (5 vines)	..	25*	40*	64*	5½	Vigorous habit; very early variety; crops well if short pruned; high resistance to black spot; bitter rot destroys most of the fruit each season. Unsatisfactory.
Doradillo .. (6 vines)	..	..	..	..	..	Very weak habit; subject to black spot. Generally unsatisfactory, but some doubt as to variety.
Gros Colman .. (6 vines)	16½	22*	44*	35* (5 vines)	5¼	Very vigorous habit; sturdy variety and good cropper; resistant to black spot; fruit ripens unevenly; half crop lost by bird attack. Unsatisfactory.
Henab Turki .. (5 vines)	19½	14*	4	8 (4 vines)	2½	Moderate habit; subject to black spot and marginal leaf scorch; should be more fruitful with long pruning; crops in December-January.

* Estimated yield if no loss from bitter rot and birds had occurred.

Variety.	Yields in Pounds.					Remarks.
	1942–3.	1943–4.	1944–5.	1945–6.	Average per vine.	
Ohanez .. .. (6 vines)	15	20*	26*	**	2½	Moderate habit; subject to black spot and bird attack; good carrying variety; crops best when long pruned; late ripening. A promising variety.
Purple Cornichon	7	**	4	..	½	Weak habit; sparse foliage; fruit subject to sunscald. Generally unsatisfactory.
Red Malaga .. (4 vines)	1½	..	..	.. (3 vines)	⅛	Weak-moderate habit; small bunches; poor fruit. Generally unsatisfactory.
Servant .. .. (6 vines)	39	68*	84	50* (4 vines)	11½	Vigorous habit; subject to bird attack; late ripening; fruiting excellent. Most satisfactory variety in trial.
Waltham Cross.. (5 vines)	9½	5½	2	..	¾	Weak habit; poor bunches. Generally unsatisfactory.
White Wax .. (5 vines)	11	8½	18	21	3	Vigorous habit; early variety; subject to black spot; crops best when long pruned. A promising variety.

	1941	1942	1943	1944	1945	Average.
Royal Ascot in vineyard ..	12	14	11	11	12	12

* Estimated yield if no loss from bitter rot and birds had occurred.

** Crop totally destroyed by birds.

Summary.

Of the 13 *Vitis vinifera* varieties selected for trial in the Charters Towers district, only three varieties show promise as to vigour and cropping habits. These are Servant, White Wax and Ohanez in that order. Probably the last two would improve in cropping with long pruning.

It will be noted from the remarks concerning the behaviour of each variety that the following six varieties are totally unsuitable:—

Belas Blanco, Black Malaga, Doradillo, Purple Cornichon, Red Malaga, and Waltham Cross.

The damage caused by birds and bitter rot* has been so extensive that Gros Colman and Chaouch, which made good growth and cropped reasonably well, cannot be regarded as satisfactory varieties until the trouble in each case can be overcome.

Black Prince and Henab Turki did not display any particularly good qualities when pruned on the short spur method. However, in one season an appreciable increase in yield followed when a few vines were long pruned to the Casanave Cordon system. Further field records would be necessary to ascertain whether these varieties maintain their cropping habits and remain vigorous with long pruning.

* *Melanconium fuligineum.*

Conclusions.

The climate of the Charters Towers district is not ideally suited to grape-growing generally.

A few varieties thrive and yield profitable crops of fruit but their lives are greatly shortened by the mild winters, which do not permit the vines a normal period of dormancy; furthermore, the ravages of termites seriously undermine the constitution of the vines.

Strong-growing varieties which thrive and crop best under the existing conditions are therefore recommended for planting in this area.

Results of the variety trial plot indicate that Servant is the most reliable variety which can be recommended for future planting.

White Wax and Ohanez are the next most promising but, until further data is collected as to their bearing qualities with long pruning, plantings should be made with caution.

Black Prince and Henab Turki require close observation under long pruning for at least another two seasons. This can be carried out under normal field conditions.

Gros Colman and Chaouch can be regarded as unsuitable until bird attack and bitter rot can be overcome.

Acknowledgment.

Thanks are due to Mr. A. H. Richardson, on whose Sellheim property these trials were carried out.

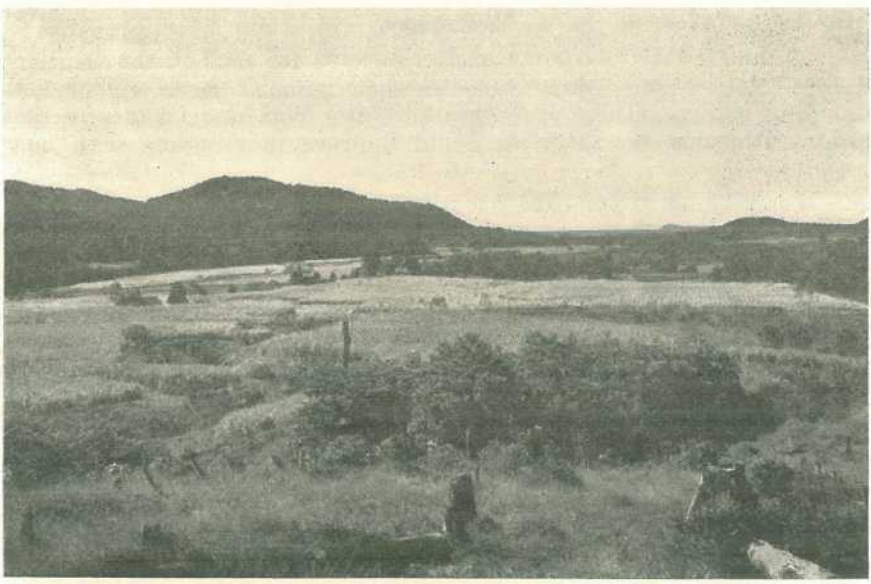

Plate 85.
NEAR JAPOON, NORTH QUEENSLAND.

PLANT PROTECTION

Stored Products Pests.

N. E. H. CALDWELL, M.Agr.Sc., Horticulturist.*

INSECT and related pests which feed on the wide range of commodities usually referred to as stored products are responsible for considerable losses in this State. Such commodities include grain and grain products, dried fruits and vegetables, nuts and nut meats, and products of animal origin such as ham and cheese as well as the numerous foods for both human and stock consumption which are prepared from one or more of these main classes of raw materials. The majority of the pests involved are either beetles or moths; the remainder make up a miscellaneous group which includes flies, psocids, and mites.

The beetles include several weevils but most of them are not true weevils, though they are commonly referred to as such. They are nearly all rather small, hard-bodied insects. Both the adults and larvae of these species feed in the infested material throughout their life and thus are usually found together. The adults of several species are very long-lived, some surviving for at least three years.

The adults of moth pests, on the other hand, do not feed on stored products and thus cause no direct injury in this stage of their life. Their mature larvae usually either leave the infested material before pupating or they pupate in such a position that the moths on emerging from the pupae may readily escape into the open. Thus the moths of these stored products pests are commonly found resting on the containers of the infested material, or on the walls of—or flying round—the building in which the goods are stored. In this stage, too, they live for only a week or two. The larvae of these moths characteristically spin silken threads wherever they go and also construct silken cocoons, this habit distinguishing them quite definitely from beetle larvae.

Pests in the miscellaneous group have no general characteristics in common. Psocids and mites are very small, the latter being scarcely visible to the naked eye. As is the case with beetles, all stages of psocids and mites are found together in the infested material. The adults of fly pests, on the other hand, are usually seen resting on or flying round the material in which their larvae are feeding.

A number of pests of different classes of stored products are discussed briefly in the following pages. As the measures adopted for controlling all these species are broadly similar, they are dealt with in a final section of this article following the discussion of the individual species.

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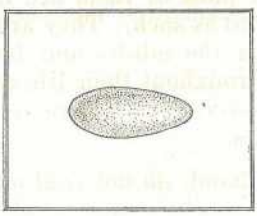
* Formerly Entomologist, Science Branch.

A.—Pests of Stored Cereals and Other Seeds.

The more important pests of stored cereals and other seeds are rice weevil, lesser grain borer, Angoumois grain moth, and pea and bean bruchids. The status, life history and habits of these species are discussed in this section.

RICE WEEVIL.

First recorded as a pest of rice, from which its common name is derived, the rice weevil* is a widespread enemy of stored maize, wheat, sorghum, rice, and other grains as well as of certain processed foodstuffs such as macaroni. Both the adults and larvae of this species feed on the grain or other foodstuff, but the bulk of the damage is done by the larvae. Grains may be completely hollowed out and the whole mass reduced to a heap of husks and debris by the feeding of successive generations of this pest. Grain with a high moisture content is very susceptible to attack by the rice weevil, but fortunately much of Queensland's wheat is very dry when harvested and, provided it is stored under suitable conditions, wastage in this case is slight. The moisture content of maize, on the other hand, is normally high and favourable for rapid breeding; the incidence of the pest in this cereal is thus usually serious. It is also characteristic of the rice weevil that it requires a solid medium in which to breed. Finely-milled products, such as flour are, therefore, not attacked and the occurrence of the insect in them is only accidental.



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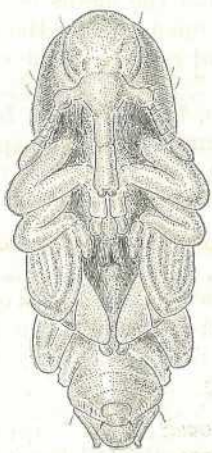

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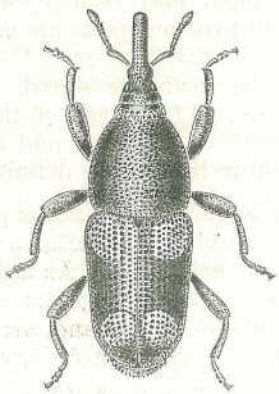

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[*Drawings by William Manley.*

Plate 86.

RICE WEEVIL.—Fig. 1, Egg × 30; Fig. 2, Larva × 12½; Fig. 3, Pupa × 15; Fig. 4, Adult × 12½.

* *Calandra oryzae* L.

Life History and Habits.

The adult rice weevil (Plate 86; fig. 4) is a small, dark-brown insect measuring about one-sixth of an inch in length, with two lighter coloured, irregular marks on each of the two wing covers. It has the typical elongate snout of the weevil family, which in this case is turned downwards at right angles to the body. The weevil may live for from four to five months and during that time the female lays up to 400 eggs. Each egg (Plate 86; fig. 1) is placed in a small cavity bored by the female into the grain or other material in which the larva feeds. The white, legless larva (Plate 86; fig. 2) hatches in a few days and burrows into the grain, where it feeds for two or more weeks. When full-grown, it pupates (Plate 86; fig. 3) in the material in which it has been feeding and the adult emerges about a week later. The life cycle thus may be completed in less than a month in mid-summer, though a considerably longer time is required for the completion of development during the colder months. In coastal Queensland there are probably six or seven generations annually.

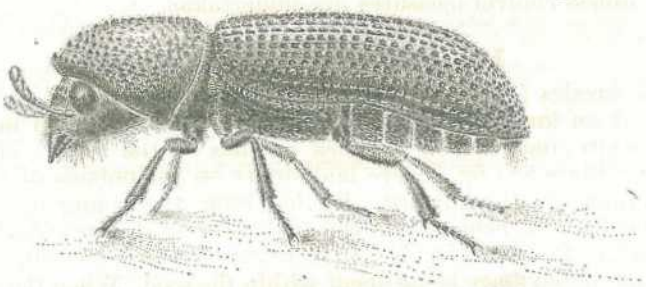
The closely-related granary weevil*—a very common pest in more temperate climates—which has habits very similar to those of the rice weevil, is unimportant in Queensland.

LESSER GRAIN BORER.

The lesser grain borer† is primarily a pest of whole grain. In wheat and maize it may at times be very destructive though it is not so general in its occurrence in Queensland as the rice weevil. Stock foods derived from cereals, particularly those containing crushed grain, may also be heavily infested by it. Foodstuffs for human consumption, such as barley, oatmeal, wheatmeal, and wholemeal flour are also commonly attacked but the presence of this pest in the more highly refined products such as white flour is rather unusual. The beetle of this species is equipped with powerful jaws which enable it to bore directly into sound grain. The combined activities of both adults and larvae, therefore, can be very destructive. The species will thrive in grain with a somewhat lower moisture content than that required for the development of the rice weevil.

Life History and Habits.

The shiny, dark-brown or black lesser grain borer beetle (Plate 87) is very small, being only about one-tenth of an inch in length, and can readily be distinguished from other grain beetles by its slender, cylindrical form. The female may produce from 300 to 500 eggs and these are



[*Drawing by William Manley.*

Plate 87.

LESSER GRAIN BORER.—Adult × 25.

* *Calandra granaria* L.

† *Rhizopertha dominica* F.

laid singly or in clusters on the grain. They hatch in a few days and the small, whitish grubs emerging from them crawl actively about through the foodstuffs. They may then bore directly into slightly damaged grain and there complete their development. The period elapsing from egg to adult may be of about a month's duration in summer.

ANGOUMOIS GRAIN MOTH.

The Angoumois grain moth* is a cosmopolitan species, the larvae of which feed on cereals. Overseas this species is considered a very important pest of stored grain, but in Queensland it can hardly be regarded as being in that category.

Life History and Habits.

The adult of this species is a very small moth measuring approximately half an inch across the outstretched wings and is yellowish-brown to buff in colour. On account of its small size and pointed, fringed wings it is not likely to be confused with other moths infesting grain. Its eggs may be laid either on the ripening ears of grain in the field or directly on the grain in storage. As many as several hundred eggs may be laid by one moth of this species though the average is less than one hundred. The egg is white when first laid but it soon changes to a reddish colour. On hatching, the young larva bores into a grain kernel and there completes its development, the full-grown larva, which is white in colour, being about one-quarter of an inch in length. Pupation takes place in a silken cocoon spun just beneath the surface of the seed after the larva has prepared for the exit of the moth by partly cutting a circular hole through the seed coat. After emerging from the pupa the moth pushes its way out through this hole and escapes from the grain kernel. The period which elapses from the laying of the egg to the emergence of the adult may be of five weeks' duration under very favourable conditions but generally is considerably longer.

PEA AND BEAN BRUCHIDS.

The pea and bean bruchids† are small, weevil-like insects which attack the seeds of peas and beans. Infestation frequently takes place in the field before the seed is harvested and generation after generation of the beetles may breed in the stored seed, eventually completing its destruction unless control measures are undertaken.

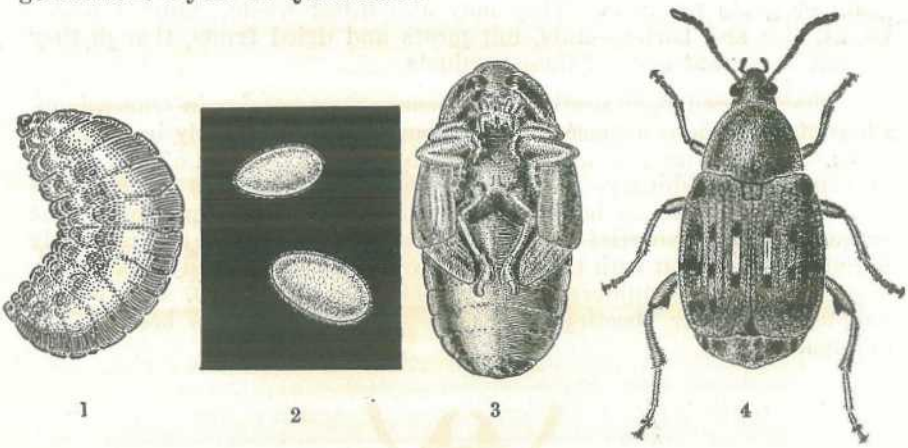
Life History and Habits.

Bruchid beetles (Plate 88; fig. 4) are stoutly-built, about one-eighth to one-fifth of an inch in length, and brown or reddish-brown in colour with grey, white, dark-brown or black patches on the back. The oval, whitish eggs (Plate 88; fig. 2) are laid singly on the outside of the seed and firmly glued to the surface. On hatching, the young larva bores directly into the seed beneath the egg and there feeds voraciously until it is full grown (Plate 88; fig. 1). It then transforms to the pupa (Plate 88; fig. 3), the pupal stage being spent within the seed. When the adult is ready to emerge, it cuts a clean, circular hole in the seed coat, which

* *Sitotroga cerealella* Oliv.

† Family *Bruchidae*.

gives a characteristic appearance to infested seeds from which the adults have escaped. Development is rapid and there are probably several generations a year in Queensland.



[*Drawings by William Manley.*

Plate 88.

BEAN BRUCHID.—Fig. 1, Larva × 10; Fig. 2, Egg × 25; Fig. 3, Pupa × 10; Fig. 4, Adult × 10.

MINOR PESTS OF STORED CEREALS AND OTHER SEEDS.

Many other species of lesser importance may be found in association with stored cereals and other seeds. Among them are flour beetles, saw-toothed grain beetle, cadelle beetle, flat grain beetle*, rice moth, Indian meal moth, meal moth†, psocids, and mites.

Control.

Control measures for the pests of stored cereals and other seeds, which are discussed at length at the end of this article, include:—(*a*) sanitation in storage premises, (*b*) the use of sprays in storage premises, (*c*) fumigation of storage premises, (*d*) fumigation of infested products in fumigation chambers, tanks, or other suitable containers, under tarpaulins, &c., and (*e*) storage with paradichlorobenzene and/or naphthalene.

B.—Pests of Flour and Other Milled Cereal Products.

Flour and other milled cereal products pests of importance which are discussed in this section are flour beetles, Mediterranean flour moth, cadelle beetle, biscuit beetle, rice moth, psocids, and mites.

FLOUR BEETLES.

Flour beetles are a group of small insects commonly found—as their name would indicate—in flour and related products though some species also feed on many other foodstuffs and are amongst the most widely distributed of all stored products pests. They are frequently referred to by other common names, such as flour weevils, bran bugs, or—in the milling industry—as scavenger beetles or brownies.

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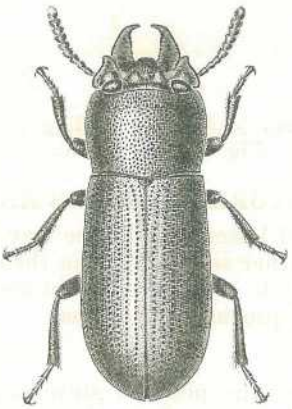
* *Laemophloeus minutus* Oliv.

† *Pyralis farinalis* L.

Commodities in which these beetles may be found—frequently in very large numbers—include flour of all types, bran, pollard, wheatmeal, oatmeal and practically any other human or stock foods containing grain or grain products. They may also infest whole grains—such as wheat, rice and barley—nuts, nut meats and dried fruits, though they are not important pests of these products.

The rust-red flour beetle* is the commonest species in Queensland, where it is a serious menace to stored foodstuffs, particularly in northern areas. The confused flour beetle† is the dominant species of this group in flour mill machinery. However, it occurs in all parts of the State and occasionally it may be very numerous in some stored products. The broad-horned flour beetle‡ (Plate 89) is equally widespread and is usually found in association with the more important species already mentioned, though in smaller numbers. Other species of the group, such as the long-headed flour beetle§ and the depressed flour beetle¶ are unimportant.



[*Drawing by William Manley.*

Plate 89.

BROAD-HORNED FLOUR BEETLE.—Adult × 12½.

Life History and Habits.

The rust-red flour beetle—which may be regarded as being typical of the flour beetles—is an active, shining, reddish-brown, elongate insect (Plate 90; fig. 1) measuring about one-eighth of an inch in length. The female beetle of this species may lay several hundred very small white eggs, which are deposited indiscriminately in the infested material. They may hatch in as short a time as three days under extremely favourable conditions but more usually the incubation period lasts for a week or more. From the eggs emerge slender, cylindrical, worm-like larvae which are normally brownish-yellow in colour and somewhat leathery in appearance. These larvae feed for three weeks or more before they become full-grown, at which stage they measure one-sixth of an inch in

* *Tribolium castaneum* Herbst.

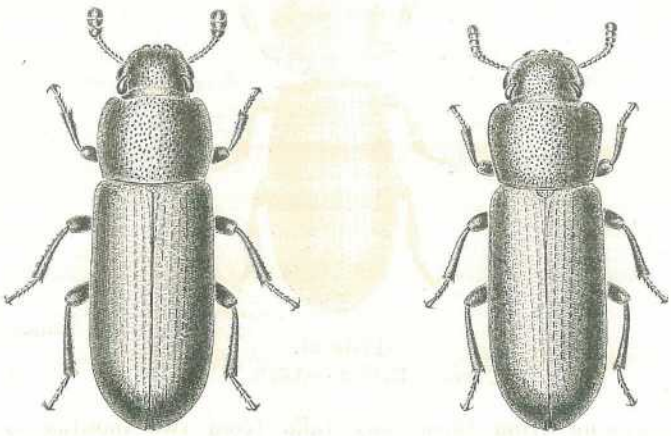
† *Tribolium confusum* J. du V.

‡ *Gnathocerus cornutus* F.

§ *Latheticus oryzae* Waterh.

¶ *Palorus subdepressus* Woll.

length. They then pupate anywhere in the foodstuff in which they have been feeding. On emergence from the pupal stage the adults are noticeably pale but their colour deepens to the characteristic reddish-brown in a day or two. The life cycle is sometimes completed in about five weeks but may be of much longer duration if the temperature is low or the foodstuff is not particularly suitable for the species.



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[*Drawings by William Manley.*

Plate 90.

FLOUR BEETLES.—Fig. 1, Rust-red flour beetle, Adult × 15; Fig. 2, Confused flour beetle, Adult × 15.

The other flour beetles in Queensland are very similar to the rust-red flour beetle in appearance, and in life history and habits. The adults of all species are very long-lived; the confused flour beetle (Plate 90; fig. 2) may survive for over three years and the rust-red flour beetle for more than two years.

CADELLE BEETLE.

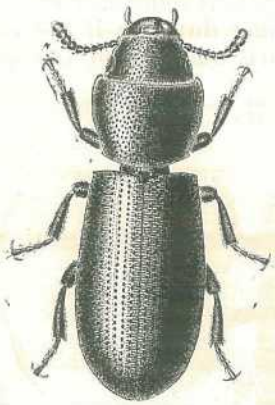
The cadelle beetle* is another widely distributed species which attacks almost any type of grain or grain product. It is commonly found in flour and other wheat products and is a well-known pest of flour mills, where it is sometimes erroneously referred to as the click beetle. In whole grain, damage may be confined to the germ but in other foodstuffs feeding seems to be indiscriminate. The boring habits of the full-grown larvae frequently result in much damage to woodwork in flour mills and to grain silos and other containers. Extensive damage is also sometimes caused in flour mills by the larvae cutting holes in the silk cloth of sifting machines. Holes in the containers of many packaged foodstuffs, which are frequently due to the presence of this pest, permit the entry of other species which could not otherwise gain access to them.

Life History and Habits.

The adult cadelles are elongate, flattened beetles (Plate 91) measuring about one-third of an inch in length and are thus much larger than the majority of beetles found in stored products. They are long-lived, many surviving for from one to two years. The females lay eggs for the

* *Tenebroides mauritanicus* L.

greater part of their life and may deposit up to one thousand during that period. The white, elongate eggs are comparatively large and may hatch in as short a period as seven days in warm weather. The



[*Drawing by William Manley.*

Plate 91.
CADELLE BEETLE.—Adult × 7½.

larvae emerging from them may take from two months to over a year to complete their development, by which time they have attained a length of about three-quarters of an inch. They are greyish-white in colour, with the head, the adjacent segment, and the two horny points at the end of the body, black or dark-brown in colour. They may be distinguished from the larvae of other beetles infesting stored products by their large size and fleshy appearance, and from the larvae of moths—many of which are of approximately the same size—by the black, horny points at the end of the body and, of course, by the fact that they do not spin silk. Pupation takes place in cells formed in the foodstuff or in holes bored into adjacent woodwork by the full-grown larvae. Both adults and larvae may live for long periods without food, sheltering in secluded places in bins and other containers, from which they emerge to infest fresh stocks of grain or other commodities.

BISCUIT BEETLE.

The biscuit beetle*, which is sometimes called the drugstore beetle because of its habit of attacking dried herbs and other dried plant products used by pharmacists, also infests a great variety of stored foods, seeds, and other materials. In Queensland it is commonly found in crushed grains, pre-cooked breakfast foods, biscuits, and some condiments such as Cayenne papper.

Life History and Habits.

The adult of the biscuit beetle is a rather oval, reddish-brown insect, measuring about one-tenth of an inch in length, and is very like the better-known tobacco beetle in appearance, with which it is sometimes confused. Its larvae are white in colour and its life cycle is much the same as that of the tobacco beetle, being completed under favourable conditions in less than two months. Breeding will take place in almost any substance attacked by the adults.

* *Stegobium paniceum* L.

MEDITERRANEAN FLOUR MOTH.

The Mediterranean flour moth* is a very well-known insect with a world-wide distribution. In Queensland, as elsewhere, it is primarily a pest in flour mills but occasionally flour, and especially wholemeal flour, stored away from the mill may be infested. It is also frequently found in other premises where cereals are ground or otherwise processed. Like all moth larvæ infesting stored products, those of this species spin silken threads wherever they go and construct loose silken tunnels in which they live. Thus particles of the material in which they are feeding become matted together, with small pellets of excrement conspicuously attached to the webbing. In flour mills the webbing produced may be so dense as to clog up the machinery completely.

[*Drawing by William Manley.*

Plate 92.
MEDITERRANEAN FLOUR MOTH.—Adult × 2½.

Life History and Habits.

The adult of the Mediterranean flour moth (Plate 92) is predominantly grey in colour, with wavy, transverse black lines across the forewings, which, when outstretched, are a little less than an inch across. When the moth is in the normal resting position with the wings folded it is about half an inch in length. The small, white eggs are laid in crevices or scattered about in the mill machinery or in accumulations of flour and other grain products. Under some conditions the eggs hatch in less than a week and the larvæ complete their development in about six weeks. At maturity the larvæ are rather more than half an inch in length and are white or pinkish-white in colour. They then spin silken cocoons in which pupation takes place and from which the adults may emerge in about a week. In warm weather the life cycle may thus be completed in eight weeks or a little longer.

RICE MOTH.

The rice moth† is an extremely important pest, particularly in the coastal and sub-coastal areas north of the Tropic of Capricorn. There the larvae infest a wide range of commodities and may be present in very large numbers. Grain products of all kinds may be seriously infested and appear to constitute the favoured foodstuff of the species, but it also occurs in whole grains such as wheat, maize, and rice, cotton seed, nuts and nut meats, dried legume seeds, dried fruits, and all kinds of processed commodities containing some or all of these ingredients.

* *Ephestia kuehniella* Zell.

† *Corcyra cephalonica* Staint.

Rice moth larvæ have also been found on uncooked ham and later reared to maturity on this foodstuff. The larvae spin copious quantities of silken threads and construct dense silken tubes during their feeding. These tubes are usually attached to the inside of flour sacks and other containers and may form a dense mat which can be peeled off in large quantities when the infestation is serious. Some webbing, together with pellets of excreta, may be pushed out through the mesh of hessian sacks, giving a somewhat characteristic appearance known in the trade as cobweb or weeping.

Life History and Habits.

The rice moth adult is fawny-grey in colour, with a few, slightly darker streaks on the forewings (Plate 93). Though rather variable in size, it is usually larger and somewhat stouter in build than other warehouse moths, being approximately half an inch in length and about seven-eighths of an inch across the expanded wings. The female is generally larger than the male. The small, whitish eggs are laid singly

[Drawing by William Manley.

Plate 93.

RICE MOTH.—Adult × 3.

and are attached securely to rough surfaces such as walls and sacks, each female laying from 100 to 200 eggs. The whitish larvae may hatch from the eggs in less than a week and reach maturity under favourable conditions in as few as five weeks, though this period may be much longer under other conditions. When full-grown, the larvae usually exceed half an inch in length and are dirty-white in colour, sometimes with a grey or slightly bluish tinge. The pupal stage, which is spent within a tightly woven cocoon, occupies little more than a week. During the summer in North Queensland the life cycle may be completed in six to seven weeks.

PSOCIDS.

Psocids or booklice are minute insects frequently found in association with grain and grain products or other dried vegetable matter. Sometimes they are present in enormous numbers, swarming over the surface of the infested material. They may also be found living in small accumulations of spilled goods and dust-like deposits of flour. Their presence in any numbers is usually an indication that the infested material has been held in stock too long or that it is stored under

insanitary conditions. The common species* of booklice in Queensland is yellowish-white in colour and not more than one twenty-fifth of an inch in length.

MITES.

Mites† associated with stored products are microscopic in size, soft-bodied, and usually pale in colour. On account of their small size they are seldom seen, pale species being especially difficult to detect in substances such as flour. When present in large numbers, the movement of the very small creatures on the surface gives a characteristic appearance to materials such as flour. They also impart to it a well-recognized musty odour. Flour is one of the commonest commodities to be affected in Queensland, especially if stored for an unduly long period, but grain and grain products generally, dried fruits, cheese, dried meats, and other types of food may be attacked. Serious infestation by these pests is, however, usually a sign of over-long storage. Mites multiply extremely rapidly, are capable of withstanding very adverse conditions, and generally are very difficult to control.

MINOR PESTS OF FLOUR AND OTHER MILLED CEREAL PRODUCTS.

Additional pests of flour and other milled cereal products include lesser grain borer, saw-toothed grain beetle, flat grain beetle, corn sap beetle, yellow meal worms‡, black fungus beetle§, spider beetles¶, tobacco beetle, Indian meal moth, meat moth, and fig moth.

Control.

Control measures for these pests of flour and other milled cereal products are discussed in the final section of this article. They consist of:—(*a*) sanitation in manufacturing, packing or storage premises, (*b*) the use of sprays in such premises, (*c*) fumigation of such premises, (*d*) the use of high temperatures, (*e*) the use of low temperatures, and (*f*) fumigation of infested products in fumigation chambers, tanks, or other suitable containers, under tarpaulins, &c.

C.—Pests of Dried Fruits, Nuts, and Nut Foods.

Dried fruits, nuts, and nut food pests discussed in this section are saw-toothed grain beetle, corn sap beetle, fig moth, and Indian meal moth.

SAW-TOOTHED GRAIN BEETLE.

Despite its common name, the saw-toothed grain beetle‖ is best known in this State—in which it is widely distributed—as a pest of dried fruits. However, it also infests a wide range of other stored products, including wheat, stock foods containing wheat or other grain

* *Troctes divinatorius* Müll.

† *Thyreophagus entomophagus* Lob. and other species.

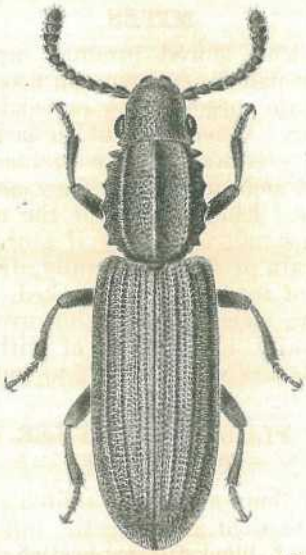
‡ *Tenebrio molitor* L.

§ *Alphitobius piceus* Oliv.

¶ *Gibbium psylloides* Czemp. and other species.

‖ *Oryzaephilus surinamensis* L.

products, rice, barley, flour, and other cereal foodstuffs such as wheatmeal, peanuts and other nuts, nut meats, and processed foodstuffs such as biscuits, breakfast foods, and chocolate.



[*Drawing by William Manley.*

Plate 94.

SAW-TOOTHED GRAIN BEETLE.—Adult × 25.

Life History and Habits.

The adult of this species is a very active, slender, dark-brown beetle (Plate 94), measuring about one-tenth of an inch in length. The sides of the thorax bear six tooth-like projections which give the species its common name and which serve to distinguish it from other beetles found in stored products. The adults normally live from six to ten months but some may even survive for as long a period as three years. The small, white, elongate eggs, of which the female has been known to produce nearly 300, are laid anywhere in the foodstuff and usually hatch in less than a week. The larvae, which are also white, move actively through the material in which they are feeding and become full-grown in about two weeks under favourable conditions. They then pupate in fragile cells made by binding together fragments of the infested foodstuff, the pupal stage lasting about a week. The life cycle may thus be completed in less than a month though it usually extends over a longer period.

CORN SAP BEETLE.

The corn sap beetle* normally feeds on decaying fruit and vegetables or on sap exuding from injured plant tissue, but it is frequently found also in association with various types of stored products. Very heavy infestations have been observed in stored peanuts, while rice, pearl barley, flour of various types, and other grain products may also be attacked. At times, the larvæ swarm in large numbers over infested premises.

* *Carpophilus dimidiatus* F.

Life History and Habits.

The adult insect is a small, dark-brown to black beetle whose wing covers are rather lighter in colour than the rest of the body. These covers do not reach the full length of the insect's abdomen, the tip of which is therefore exposed, thus giving this beetle, and several closely related species, a characteristic appearance amongst stored product pests. The corn sap beetle measures about one-tenth, or slightly more, of an inch in length. The larvae hatching from the eggs laid by it are white in colour and fairly active in their movements.

FIG MOTH.

The fig moth* is closely related to the Mediterranean flour moth, but in Queensland it is very widely distributed and much more important than the latter species—except in the flour milling industry. Though perhaps best known as a pest of dried fruits, peanuts, other nuts, nut meats and processed foods containing these materials, this species is an important pest of flour, bran, pollard, and other grain products, and dried vegetables such as peas. Infestation of whole grain such as maize has also been observed. Like the larvae of other moth species, those of the fig moth spin silken threads wherever they go, matting together the particles of the foodstuff as well as their excrement.

Life History and Habits.

The adult of the fig moth is somewhat smaller than its relative, the Mediterranean flour moth, being about three-eighths of an inch in length with the wings folded and not more than three-quarters of an inch across with the wings outstretched. It is predominantly grey in colour, sometimes with a slightly fawny tinge, with a distinctly darker grey, straight band across the middle of the forewings. The eggs are laid anywhere in the foodstuff and the larvae hatching from them wander freely through it as they feed. The full-grown larvae are dirty-white in colour and measure about half an inch or slightly more in length. In late summer and autumn the life cycle of this species may be completed in six to seven weeks.

INDIAN MEAL MOTH.

The Indian meal moth† is another well-known and widely-distributed species which is an important pest of dried fruits, nuts, and nut meats. It may also infest milled cereal products such as flour, bran, and pollard and is perhaps the pest most commonly found in highly processed breakfast foods, though these products are not usually severely infested unless held in stock for unduly long periods or stored under extremely unhygienic conditions.

Life History and Habits.

The adult of the Indian meal moth (Plate 95) has a wing expanse of rather less than three-quarters of an inch and is about three-eighths of an inch in length when the wings are folded. The basal third of the forewings in this species is whitish-grey in colour, whereas the remainder of the surface of the forewings is reddish-brown with a coppery sheen.

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* *Ephestia cautella* Walk.

† *Plodia interpunctella* Hbn.

The possession of such a definite wing pattern serves to readily separate the Indian meal moth from other moth species infesting stored products in this State. The female moth may lay anything from one hundred to three hundred eggs which hatch in a few days into small, whitish larvæ. When full-grown, these larvæ measure about half an inch in length, and are dirty white in colour, sometimes tinged with green or pink. They spin silken cocoons in which they transform into the light-brown pupæ from which, in turn, the adult moths emerge.

[*Drawing by William Manley.*

Plate 95.

INDIAN MEAL MOTH.—Adult × 3.

MINOR PESTS OF DRIED FRUITS, NUTS, AND NUT FOODS.

Other less important pests of dried fruits, nuts, and nut foods are some of the flour beetles, tobacco beetle, rice moth, psocids, and mites.

Control.

Control measures for pests of dried fruits, nuts, and nut foods are discussed in detail later, but may be summarised under the following headings:—(*a*) sanitation in packing and storage premises, (*b*) the use of sprays in these premises, (*c*) fumigation of such premises, (*d*) the use of low temperatures, (*e*) fumigation of infested products in fumigation chambers, tanks, or other suitable containers, and (*f*) fumigation of infested products by the injection of ethyl formate into the packages in which they are enclosed.

D.—Pests of Stored Tobacco.

Brief reference is made in this section to two pests which, in addition to attacking tobacco, will also infest other stored products. They are tobacco beetle and tobacco moth.

TOBACCO BEETLE.

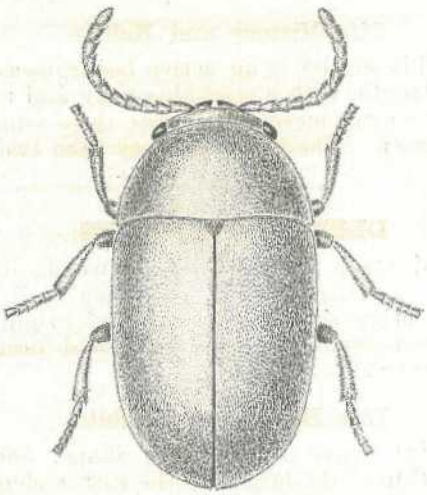
The tobacco beetle* is, as its name implies, a pest of dried tobacco leaf and processed tobacco of all kinds. In Queensland it is of greatest importance as a pest of bulked tobacco on farms. It is also a minor pest of flour and other grain products, and of nut meats.

Life History and Habits.

The adult of this species is a light-brown, oval-shaped beetle (Plate 96) measuring from about one-sixteenth to one-tenth of an inch in length. Each female beetle may lay approximately one hundred very small, white

* *Lasioderma serricorne* F.

eggs, each egg being deposited singly in the infested material. The larvæ which hatch from these eggs—after an incubation period of about a week—are white in colour except for their light-brown heads and are fairly densely clothed with brownish hairs. They become full-grown in from four to ten weeks and they are then one-tenth of an inch in length. The pupal stage is spent within a distinct cell composed of fragments of the infested material; in bulked tobacco these cells are usually located along the midribs or in folds of the leaf. The pupal stage in this species lasts for about a week and the life cycle thus may be completed in some six weeks.



[*Drawing by William Manley.*

Plate 96.

TOBACCO BEETLE.—Adult × 25.

TOBACCO MOTH.

The tobacco moth* is a widely-distributed relative of the Mediterranean flour moth and the fig moth but it is apparently far less common than either of these species in Queensland. As its name suggests, it will attack tobacco and, in many countries, it is a pest of considerable importance in tobacco warehouses. However, like related species, it will also infest a wide range of other materials.

Life History and Habits.

The adult of the tobacco moth is very similar in appearance to the fig moth. Its general colouration, however, is more uniformly grey, the conspicuous transverse marking on the forewings of the latter being either absent or very faint.

Control.

On farms, satisfactory control of these two pests in tobacco can be achieved by strict attention to sanitation and to the fumigation of the bulking sheds.

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* *Ephestia elutella* Hbn.

E.—Pests of Commodities of Animal Origin.

This section is devoted to a brief consideration of three pests of commodities of animal origin. These are red-legged ham beetle, dermestid beetles, and cheese skipper, all capable of inflicting serious losses in the commodities which they may infest.

RED-LEGGED HAM BEETLE.

The red-legged ham beetle* is a scavenger species which normally feeds on dead animal matter and thus sometimes attacks cured meats in storage. It may also do considerable damage to stored hides.

Life History and Habits.

The adult of this species is an active beetle measuring about one-fifth of an inch in length, with a steel-blue body and reddish legs, while the larvæ is a white grub measuring about three-tenths of an inch in length when full-grown. The life cycle may take two months or more for completion.

DERMESTID BEETLES.

The dermestids† are a group of beetles which, for the most part, feed on dried animal matter. Thus, not unnaturally, some are pests of hides, furs, and other substances of animal origin. A few species attack cereal products and some are household pests which damage carpets and other furnishings.

Life History and Habits.

There is a wide range in the size, shape, and appearance of dermestid beetles. One of the largest is the rather elongate hide beetle‡ which measures about one-third of an inch in length, the body colour on the back being dark-brown or black whereas the under surface is white. A much smaller species is the varied carpet beetle§, often referred to as the museum beetle. This species is oval in shape, mottled fawn and grey in colour, and measures about one-tenth of an inch in length. The hairy larvæ of the several species of dermestids are very active, and the life cycle of most species is rather long, extending, under unfavourable conditions, over two or three years.

CHEESE SKIPPER.

The cheese skipper is the name given to the larva of a black fly¶ (Plate 97; fig. 1) which is about the size of a small house fly. The larvæ (Plate 97; fig. 2) of this species may infest hams, bacon, and cured fish as well as cheese and are white, legless maggots which derive their name from the habit of propelling themselves by bending into an arc and then straightening out suddenly. They may also crawl about when undisturbed. The life cycle of this species may be fairly brief, being completed in as little as three weeks under some conditions.

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* *Necrobia rufipes* Deg.

† Family *Dermestidae*.

‡ *Dermestes maculatus* Deg.

§ *Anthrenus verbasci* L.

¶ *Piophila casei* L.

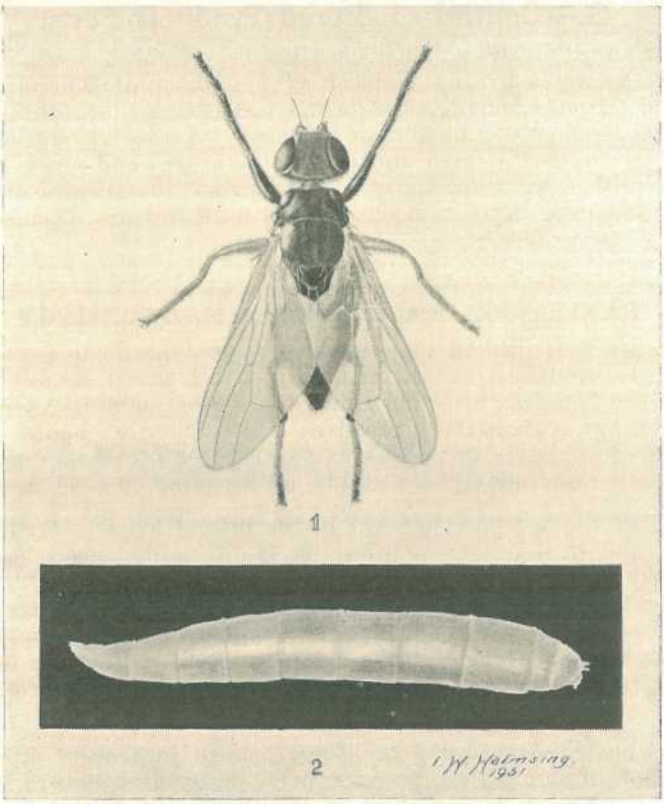


Plate 97.
CHEESE SKIPPER.—Fig. 1, Adult × 9; Fig. 2, Larva × 9.

MINOR PESTS OF COMMODITIES OF ANIMAL ORIGIN.

Mites and psocids may also attack products of animal origin while larvæ of the rice moth have been known to feed on hams.

Control.

Pests attacking commodities of animal origin can usually be satisfactorily dealt with by strict attention to sanitation and by the use of low temperature storage.

F.—Pests of Miscellaneous Materials.

Many other stored products which cannot readily be classified in any broad, general scheme are subject to insect attack. The species involved are, for the most part, those with varied tastes described in previous sections. They include flour beetles, saw-toothed grain beetle, tobacco beetle, biscuit beetle, dermestid beetles, fig moth, Indian meal moth, rice moth, psocids, and mites. The control of these species may involve any of the known methods of treatment, depending on the nature of the commodity infested.

G.—Control of Stored Products Pests.

Merchants, farmers, and housewives may combat insect infestation of stored products by the adoption of a number of control measures. First and foremost among these is strict attention to sanitation in, and to the management of, the storage premises. Actual infestation may be reduced by the use of high and low temperatures and much good may be accomplished by spraying with appropriate insecticides and by the use of fumigants. These various control measures are discussed in the following paragraphs.

SANITATION AND GENERAL MANAGEMENT.

The first essential in the control of stored products pests is strict attention to sanitation in all premises in which goods subject to attack by them are handled; all other control measures should be regarded as supplementary. Sanitation involves not only the maintenance of scrupulous cleanliness but also certain features of management aimed at eliminating, as quickly as possible, all breeding sites of the pests.

Most of the insects concerned in the infestation of stored products can live, and in many cases breed freely, in spilled goods and debris which may accumulate in cracks and crevices, in inaccessible corners, and under floors. Regular and thorough cleaning of the storage premises therefore is the basis of the control programme. If this is not attended to, contamination of fresh stocks begins as soon as they are taken into storage. In addition, the efficiency of other control measures, such as spraying and fumigation, is seriously impaired.

The construction of the buildings has an important influence on the question of sanitation. In a properly-designed structure the maintenance of the required standard of cleanliness is relatively simple; in a badly-designed building it becomes a difficult, if not an impossible, task. A good warehouse or store should have no dark, damp, inaccessible corners, and floors and walls should be free from cracks and ledges where debris may lodge. For this reason a smooth-finished concrete is the best type of construction. Any cracks in the structure should be filled with plastic bitumen or some comparable product, particular attention being paid to the junction between walls and floor. Regular applications of paint are helpful in sealing cracks in wooden walls and should be made with a spray gun, preferably after one of the periodical cleanings of the premises.

Walls, beams, and ledges should all be swept as well as the floors. Vacuum cleaners are particularly useful in cleaning corners and cracks and should be used in storage premises wherever practicable. Sweepings should be removed from the buildings at once and destroyed, preferably by burning. On no account should they be swept into a corner or under the steps or bagged and held on the premises for disposal later.

Certain commodities, such as bran, pollard and other stock foods, are more prone to heavy insect infestation than are highly processed goods. The risk of cross-infestation from the former is, therefore, great and accordingly stock foods should never be housed in the same premises as goods for human consumption. In the same way, even amongst the latter type of commodities, those particularly susceptible to insect attack, such as wholemeal flour, should, as far as possible, be isolated from other goods.

The correct rotation of stocks is an important phase of pest control work both in the home and in places where stored products are handled on a bulk scale. As a general rule, the oldest stocks on hand should be used first. Therefore, it is essential that a systematic method of stacking should be employed so that the oldest stocks are always readily accessible. All stocks, however, should be checked at frequent intervals and any which are unfit either for immediate consumption or for reconditioning should be removed at once and destroyed.

Since warm, moist conditions are usually favourable for the development of stored products pests, any measures designed to keep stocks cool and dry are worthwhile. In addition to the proper design and construction of buildings, such measures include the installation of fans, the use of dunnage under stacks to allow air circulation beneath them and a stack layout which permits maximum ventilation. Passageways should always be left betweeen walls and adjacent stacks and between the several stacks. These passages should preferably be wide enough to permit a man to walk along them.

CONTROL BY HEAT TREATMENT.

Heat can be used to control some insect pests and may, in certain cases, be applied easily and cheaply for this purpose. A high degree of heat is not required because most insects are killed if they are exposed to a temperature of about 125°F. for a few minutes. The chief difficulty in the application of this control measure lies in ensuring that the whole of the infested environment reaches the desired temperature, special provision being necessary to achieve this result. Even entire buildings may be heat-treated satisfactorily, especially in hot weather, provided they are well-built and specially equipped with a network of steam pipes for raising the temperature.

Heat is used to kill insects in a wide range of processed foodstuffs for which purpose specially constructed rooms are employed. These are fitted with controls to give a constant temperature of about 130°F. and the goods can be held in them until a uniform temperature is attained throughout each package.

In the home, small quantities of foodstuffs can be heated in ovens by spreading the material on trays in layers not more than two inches deep. By the time the surface temperature has reached about 170°F. the centre of the layer should be about 125°F. In gas ovens, this can usually be attained by keeping the flame as low as possible, turning off the gas when the temperature reaches 180°F. and then leaving the material in the oven with the door closed for half an hour. With the aid of a thermometer this treatment can be simply managed in any type of oven but, even in the absence of such an instrument, much can be done by the exercise of a little care. With flour a temperature above about 170°F. should be avoided, as the baking quality may be seriously impaired by higher temperatures. With most other products it is usually sufficient to ensure that charring does not take place. Frequent stirring will greatly assist uniform heating and reduce the risk of scorching.

LOW TEMPERATURE CONTROL.

Cold also may be employed at times as a pest control measure. At moderately low temperatures—40°F to 55°F.—most foodstuff pests lie dormant and damage in infested goods may be arrested by storage at

these temperatures. Several weeks of storage under such conditions will kill many insects. Comparatively short exposures to temperatures below freezing point are also fatal to many species.

CONTROL BY SPRAY APPLICATIONS.

Sprays of various kinds find a place in the control programme for stored products pests. Most of the commoner sprays employed for this purpose must come in contact with the insects to be controlled and good results can be obtained from their use only if the premises in which the goods are stored are kept clean. Accumulations of spilled stock and debris will frequently protect any insects in them from the effects of the sprays and thus impair the efficiency of the whole operation. Due precautions also must be taken to ensure that flour and other susceptible commodities are not tainted by the odour of the spray used.

A fuel oil such as dieselene or some similar product may be sprayed liberally on floors and walls, particularly in grain sheds or other buildings where grains and stock foods are stored. Dunnage also should be treated after being taken up and brushed down. No commodities liable to absorb odours should be allowed to remain in the sprayed section while treatment is in progress and the whole building should be thoroughly aired for at least 24 hours before goods are stacked on the treated area. Liberal treatment with such an oil or even a cruder product is also advisable beneath steps and landing stages, and in other places outside the building where debris accumulates.

Sprays containing a pyrethrum extract and D.D.T. in an oil base, with or without other organic insecticides, are a valuable aid in suppressing stored products pests, notably moths, though they also have a considerable effect on beetles and some other species. Normally these sprays are available as proprietary fly mixtures. They depend for their action not only on their ability to kill many insects when sprayed directly on them but also on the fact that some species, principally moths, are killed if they come in contact with adequately-sprayed surfaces, such as walls of rooms and outsides of cases, even some considerable time after treatment.

Sprays must be applied in an atomised form. All walls and outside surfaces of containers—where accessible—should be sprayed at weekly intervals. When stacks of cases, for instance, are broken during the ordinary working of the store and fresh surfaces exposed, those surfaces should be treated on the same day. Small hand atomisers are satisfactory for domestic use but for the adequate treatment of warehouses and their contents a power-operated, compressed-air plant operating a gun of the paint-spray type is necessary.

Many fly sprays have a kerosene base and hence are liable to cause tainting of certain commodities. Where the oil base is odourless the risk of tainting is completely eliminated. Unless it is known that an oil of the latter type has been employed in their manufacture, sprays should not be applied directly to the outside of absorbent containers such as sacks.

FUMIGATION CONTROL MEASURES.

The use of fumigants in the control of pests of stored products may be discussed conveniently from three aspects, namely (1) fumigation of buildings, (2) fumigation of products in stores and (3)

fumigation of products on the farm. In connection with fumigation of stored products, whether in a warehouse or on a farm, it must be remembered that, while efficient fumigation may destroy all insects present at the time of treatment, it will not prevent reinfestation. Fumigated products therefore must be stored in insect-proof containers or on premises as free from infestation as possible. The latter point emphasises once more the importance of sanitation.

Fumigation of Buildings.

The treatment of buildings by fumigants is usually a rather difficult and costly operation and should be undertaken only when simpler measures have failed to keep insect pests in check. Fumigation is not a substitute for routine hygienic measures and, as with spraying, it should always be preceded by a thorough cleaning of the whole premises. Successful treatment is possible only when the buildings can be made reasonably airtight. This is usually difficult to achieve and in poorly-constructed buildings may be almost impossible. The whole operation of fumigation of buildings should be undertaken only by thoroughly trained and experienced persons and is best done by firms which specialise in this type of work. The fumigant most commonly used in the treatment of buildings is hydrocyanic acid gas, which is very poisonous to human beings and animals and must be handled with the greatest care.

Fumigation of Products in Stores.

Stored products may be fumigated in several ways, depending on the type and quantity of material to be treated and on the facilities which are available.

Vacuum chamber fumigation represents the most highly specialised method of treatment but the facilities required for its adoption are rather elaborate and are not generally available. It necessitates the provision of a specially-constructed steel chamber or vault which is capable of withstanding external atmospheric pressure when exhausted of air. After the chamber has been filled with the commodities to be treated, much of the air which it contains is pumped out and replaced by the fumigant. Vacuum fumigation has the three-fold advantage of high efficiency, rapidity of treatment, and economical use of the fumigant. As compared with the 24-36 hours required for treatment by other methods, vacuum fumigation of some commodities may be carried out in as short a period as 90 minutes. Much less fumigant is used than is required normally for treatment by any other method. Vacuum fumigation is particularly valuable for the treatment of tightly-packed goods such as flour and cased dried fruits, which are difficult to deal with by other methods, and also for perishable commodities which must be handled quickly. The fumigants commonly employed in vacuum chamber treatment are ethylene oxide and ethylene dichloride.

Atmospheric chamber fumigation, in which treatment is carried out at normal atmospheric pressure in air-tight buildings or rooms, is used extensively with many types of commodities. A suitable chamber may be constructed fairly cheaply using a non-porous material, though considerable care must be taken to ensure that it is as gas-tight as possible.

Provision should be made in such a chamber for the circulation of the gas during fumigation and for removing it after treatment and fittings should be provided for the introduction of the fumigant. In atmospheric chamber fumigation the materials generally used are hydrocyanic acid gas, carbon bisulphide, methyl bromide, ethylene dichlorides and, for some special purposes, ethyl formate.

Fumigation of Products on the Farm.

Bin fumigation is the method most suitable for use on the farm. It involves the treatment of commodities, usually in comparatively small quantities, in some suitable container such as a tank, drum, or well-constructed box which is reasonably air-tight. The goods to be fumigated are placed in the container, the fumigant—which must be of the heavier-than-air type—is then introduced, and the top of the bin is closed with a tight-fitting lid or with a thick layer of canvas or sacking.

Grain, either loose or in sacks, can be fairly satisfactorily treated with a heavier-than-air fumigant under a tarpaulin or other type of covering weighted down at ground level. Rubberized sheets, if procurable, are the best type of covering, but any closely-woven fabric may be used. Success with this method will be achieved only if the floor on which the grain is resting is solid and thus reasonably gas proof.

Carbon bisulphide, one of the oldest fumigants, is still the most suitable for use on the farm and satisfactory results can be obtained with it in bin fumigation, or fumigation under tarpaulins or other coverings. This substance is a heavy liquid with an unpleasant odour. It is highly inflammable and should not be exposed near naked lights, electric switch gear, or hot pipes. When fumigating with it the liquid is poured into shallow containers or on to several layers of bagging on top of the material being treated. The liquid vaporises and the gas, being heavier than air, sinks towards the bottom of the container, which should be left undisturbed for 36 hours, except in the case of certain seeds, such as cowpeas and related varieties, when only 24 hours' exposure is considered desirable. At the end of the necessary period, the container is opened and the contents aired thoroughly.

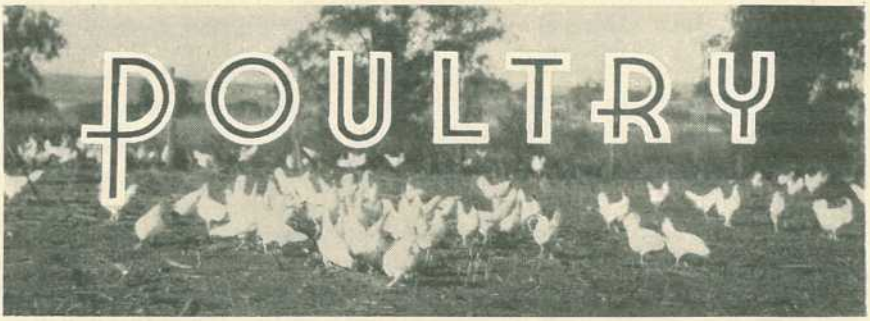
The dosage rate in carbon bisulphide fumigation depends on the degree of air-tightness of the container being used. In thoroughly gas-tight tanks and drums, 4 to 5 lb. of carbon bisulphide to every 1,000 cubic feet of container is sufficient. Thus a box measuring 4 feet by 3 feet by 2 feet—24 cubic feet—would require 2 oz. of fumigant if used at the rate of 5 lb. per 1,000 cubic feet. With less gas-tight containers the dosage must be increased until, for treatment under tarpaulins, it should be as high as 15 lb. per 1,000 cubic feet. Best results are obtained at high temperatures and, where possible, fumigation with carbon bisulphide should be avoided when the temperature drops below 70°F.

The risk of tainting foodstuffs with this fumigant is small, except perhaps with some of the more oily products such as nut meats, and airing after treatment is normally sufficient to dissipate any residual odour of the fumigant.

For the present, it appears that carbon bisulphide will continue to fulfil farmers' fumigation requirements. It may be, however, that as they become available in a suitable form, other materials will also be used on the farm for the control of stored products pests.

One other method of treating small quantities of seeds may be used by farmers when these cannot be stored in insect-proof containers and when facilities for fumigation with carbon bisulphide are not available. This method involves adding a mixture of naphthalene and paradichlorobenzene to the bags of seeds. Both these substances are white, crystalline solids, each with a characteristic odour, which vaporise on exposure to the air. The mixture is both toxic and repellent to insects; it kills those already present in the seed and gives a considerable degree of protection against reinfestation for some months. Equal parts by weight of the two substances are thoroughly mixed and then added to the seed at the rate of one to one and a half pounds to each bushel of the material to be protected. The paradichlorobenzene and naphthalene may either be mixed with the seed or distributed evenly through it in small cloth bags, each containing about one half pound of the mixture. As paradichlorobenzene vaporises much more rapidly than naphthalene, any residual crystals will probably be pure naphthalene. These are available for further use if the cloth bag method of distribution has been employed but the necessary amount of paradichlorobenzene, of course, must be added. Grain treated with this mixture retains a characteristic taint and should not be fed to stock.

Plate 98.
STORE BULLOCKS IN THE YARD AT KINGPAH, WEST MORETON, THE PROPERTY OF MR. J. FAULKNER.



Incidence of Disease in Poultry.

P. RUMBALL, Officer in Charge, Poultry Branch.

THE incidence of disease in the poultry flocks of the State could only be ascertained by a very careful survey, or from an examination of accurate returns furnished by a cross section of those engaged in the industry. Neither has yet been possible.

Many specimens of diseased birds are submitted to the Poultry Branch by farmers for opinions. These specimens are invariably forwarded to the Animal Health Station, Yeerongpilly, for diagnosis or confirmation of diagnosis. The accompanying graph has been prepared from cases dealt with in this manner for the year ending 30th June, 1946. It is not claimed that it represents the incidence of disease within the industry as a whole, but it does give some indication of the disease problems that have to be faced by those farmers situated in areas close to Brisbane, and it is probably fairly representative of the State as a whole.

The graph deals with losses of poultry of all ages. Mortalities from diseases such as pullorum are in the main confined to young chickens and coccidiosis to growing stock from five to eight weeks of age, though serious losses from coccidiosis have come under notice in pullets as old as 12 weeks. The mortalities that were due to nutrition also occurred in poultry up to the age of about 16 weeks. Adult stock also feel the effects of nutritional deficiences. Deficiencies are responsible for production being curtailed, and mortalities also occur. The only case of mortality in adult poultry to which the accompanying graph refers was that of tick fever. Consequently, the graph can be taken as one dealing with poultry that had not, or had just, reached the production stage.

NUTRITIONAL OR DEFICIENCY DISEASES.

The extent of nutritional deficiencies was no doubt largely due to war conditions, and may never again reach the proportions indicated in the graph. In pre-war days there were isolated cases of deficiency disease, and as nutrition plays such an important part in economic production it is as well to indicate what some of these deficiencies were.

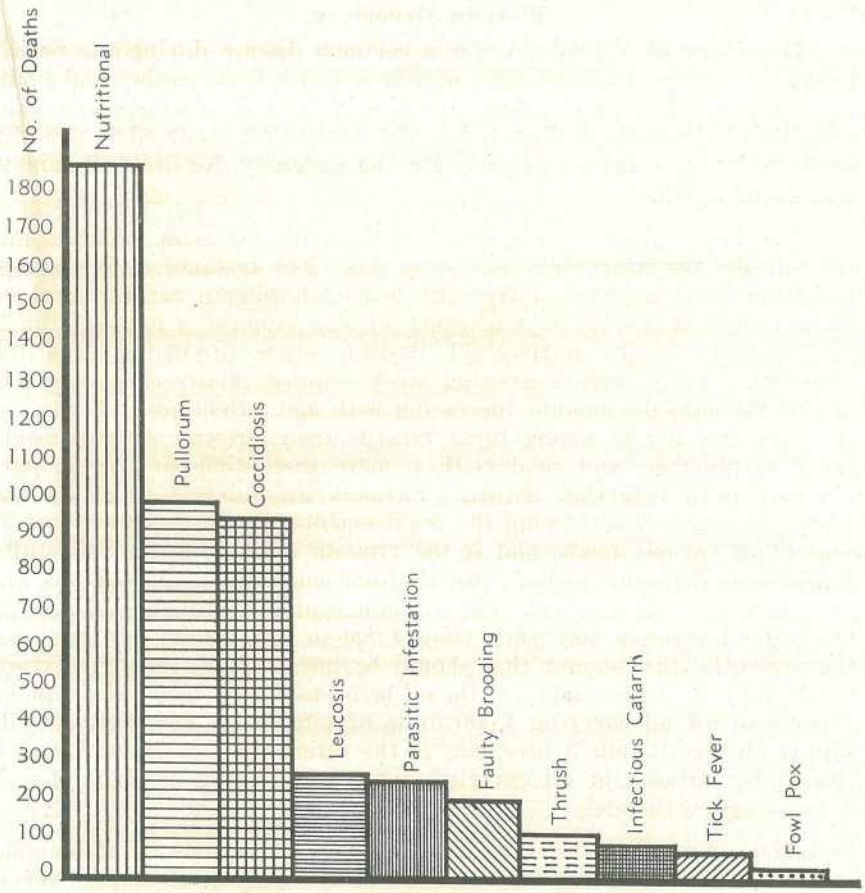


Plate 99.

GRAPH SHOWING NUMBER OF DEATHS FROM VARIOUS DISEASES.—Compiled from details of specimens submitted through the Poultry Branch to the Animal Health Station, Yeerongpilly.

Protein Deficiency.

One deficiency that had never occurred in pre-war days was that of protein, particularly of animal origin. The expansion that had taken place in the poultry industry and the more extensive use of protein of animal origin by other livestock industries made a demand upon meatworks by-products that could not be filled, with the result that a large percentage of poultry mashes had to be used that were deficient in protein and did not contain any protein of animal origin.

Experiment has demonstrated that, for chickens during their early life, mashes should contain from 18 to 20 per cent. of crude protein, and for laying stock about 17 per cent., and that at least 25 per cent. of this protein should be of animal origin. Meat-meal, liver-meal, and milk powders supply this form of protein, and a percentage should be incorporated in all poultry mash mixtures.

Vitamin Deficiency.

Deficiency of Vitamin A was a common disease during the period under review, due to the absence of yellow maize from mashes and grain rations, shortage of green feed, and the inability of farmers to obtain supplies of vitaminised oils. It is a deficiency that occurred in pre-war days, and unless farmers appreciate the necessity for this vitamin it will occur again.

The requirement of vitamin A varies with the class of stock and the purpose for which they are being fed. For instance, it is possible to obtain good production from rations containing a certain level of vitamin A, but almost twice as much of this vitamin is necessary in a ration used for the purpose of feeding fowls producing eggs for hatching. Again, young growing stock require relatively high levels of this vitamin, the amount increasing with age. Deficiency of vitamin A in rations fed to young birds retards their growth, is responsible for poor plumage, and renders them more susceptible to disease, particularly of a catarrhal nature. Farmers are advised to study the accompanying tables showing the requirements of vitamins and vitamin content of various foods, and if the vitamin content of the foodstuffs available is deficient, to make up the deficiency. Vitaminised oils are not all of the one quality. The vitamin content of those available to Queensland farmers may vary from 1,000 to 5,000 units per gramme. Consequently, the amount that should be incorporated in any mixture would vary with the quality of the oil being used. For general purposes 1 per cent. of oil carrying 1,000 units of vitamin A per gramme will supply all the vitamin A necessary in the ration short of vitamin A-rich foodstuffs. Grades of oil carrying a greater number of units should be used proportionately.

Green feed is one of the cheapest forms of vitamin A obtainable, and farmers should endeavour to have a good supply at all times. When green feed is not available they should use vitaminised oil. Young chickens cannot consume sufficient green feed to obtain their requirements, and consequently vitaminised oil should always be used in chicken rations.

Vitamin B2 or riboflavin is another vitamin the shortage of which was responsible for trouble in chickens, bringing about a characteristic "curled toe" condition.

Requirements of Vitamin A and B2 (Riboflavin).—The most recent recommendations with respect to vitamin A and riboflavin requirements per lb. of feed consumed by poultry are as follows:—

Chickens.	Laying and Breeding Hens.
Vitamin A 2,000 Int. units	3,300 Int. units
Riboflavin 1,600 microgms.	1,300 microgms.
Poults.	**Breeding Turkeys.**
Vitamin A 2,500 Int. units	4,000 Int. units
Riboflavin 2,000 microgms.	1,800 microgms.

From the following table it will be possible for poultry raisers to examine the ration fed and correct any apparent weaknesses:—

Food.	Vitamin A per Lb. Inter. Unit.	Vitamin B2 (Riboflavin) Microgrammes per Lb.
Barley	400	400
Maize (Yellow)	3,180	450
Maize (White)	0	450
Cowpeas	1,360	350
Milo	250	400
Oats	80	400
Peanut Meal	250	1,200
Wheat	140	400
Wheat Bran	150	1,000
Wheat Germ Meal	1,900	1,800
Wheat Middlings, near Pollard	120	900
Cottonseed Meal	600	300
Linseed Meal	200	900
Buttermilk, Dried	200	9,000
Cod Liver Oil	340,190	0
Liver Meal	*	18,500
Meat Scrap	*	2,700
Skim Milk, Liquid	15	1,000
Green Lucerne	63,560	2,000
Lucerne Leaf-Meal	32,000	7,000
Cabbage	200	100
Molasses	*	2,000
Kale	181,400	2,240
Lucerne Meal	13,000	5,000

* Information on the vitamin content is lacking.

PULLORUM DISEASE.

This is a disease that is transmitted in the first instance through an infected egg from parent to offspring. It is a disease readily spread during incubation when infected eggs are hatched with others, as the fluff and excreta from the chickens hatched from infected eggs are a most fruitful means of distributing the organism responsible for the disease.

Healthy chickens can contract the disease from infected containers, brooders, and premises, and the disease has been known to be spread from infection on feed sacks. It is a disease readily conveyed from infected adult stock to the brooder house on the feet of the person attending to the general farm practices.

The germ responsible for the disease has been known to maintain its virulence on dry cloth for a period of four months, and in the excreta and litter of a fowl house for up to fourteen months.

Treatment.—There is no treatment for the disease beyond the destruction of those visibly sick and the frequent cleansing and disinfection of brooders, feed and drinking vessels, and brooder pens.

Control.—The disease is one that is readily controlled by eliminating carrier hens from the flock and infection from the premises. Blood testing is the means of detecting the carrier. As the organism will live in the soil and in the fowl pens, poultry as tested should be placed in clean pens that have been disinfected. One test is not sufficient.

To eradicate the disease from the parent stock it is desirable to test all birds four months of age and over at intervals of from four to six weeks until two consecutive tests are conducted and no reactors found. When this stage is reached an annual test should be sufficient. After testing the birds, however, it is essential to make sure that the eggs will not be incubated with eggs from flocks that have not been tested, and to avoid every possible source of infection.

The object of the registration of hatcheries is to reduce the incidence of pullorum disease; although outbreaks have occurred among chickens that are purchased from registered hatcheries, the responsibility for the outbreak does not always rest with the hatchery owner, as he has invariably taken every opportunity to assure that nothing but healthy chickens will be distributed from his hatchery.

Blood Testing.—The services of officers for the purpose of blood testing poultry are available to all poultry raisers.

COCCIDIOSIS.

Coccidiosis is a parasitic infection of poultry caused by the entry into the body of an organism, microscopic in size, belonging to the class "Protozoa"—the lowest form of animal life.

The organism has a specific life-cycle, part of which is spent inside the body of the fowl and the remainder outside. It is only at a certain stage in this cycle that it becomes infective. If the bird swallows material containing coccidia which have not completed their stage of existence outside the body of the bird the organism will not multiply and will be passed through the body. But if it has been outside the body of the bird for more than a day before being swallowed, upon re-entry rapid multiplication frequently takes place with disastrous results.

Two main types of the organism are met with: (1) the caecal type which attacks the caeca or blind gut, frequently giving rise to the condition known as "bloody diarrhoea," and, (2) the intestinal type, which, although not usually as severe as the caecal type, may be just as disastrous.

Coccidiosis occurs mainly in chickens from as early as 3 weeks of age up to 10 weeks. Owing to the rapidity with which the organism develops within the body (one parasite giving rise to up to 4,000 within a very short period of time, most of which are passed out in the droppings to be picked up by other chickens), it can be seen that as time increases the infection becomes proportionately greater. It must be stressed that, as the parasite develops more rapidly in moist litter than in dry, it is of the utmost importance that all litter be kept as dry as possible.

Treatment and Control: The most satisfactory method is, by strict sanitation, to remove the cause. As the organism requires at least 24 hours outside the host to become infective, daily cleaning of the pens and the removal of the droppings is essential until the disease is brought under control. The placing of food in hoppers and the water in vessels where the risk of contamination from droppings is eliminated is essential. Prevent droppings from infected pens being carried to other pens.

Some of the sulpha drugs in more recent years have appeared to have been used with very satisfactory results.

Good nutrition is very necessary, as the disease appears to be more severe when such is not the case. Rations should not be deficient in vitamins A and B. Vitaminized fish-oil should be used for A and milk products for B.

LEUCOSIS.

The general term leucosis embraces a variety of diseases which are caused by the same organism and which are named according to the seat of infection. If paralysis of wing, leg, and/or wing were the only symptoms displayed in this disease, it would be a relatively easy matter for the farmer to determine if it had appeared among his flock. Whereas in many other diseases, for example, coccidiosis, the onset of the disease is sudden and the mortality rate heavy over short periods, in leucosis the daily losses may be small, but the collective annual loss can be ruinous to the commercial farmer.

The seriousness of the disease is best illustrated by citing one or two cases that have come under the notice of the Department in recent months. One Brisbane flock of 1,000 head in a period of eight months was reduced to 472 and upon culling a further 69 showed symptoms of leucosis in its following forms: 6 were blind, 34 had distorted pupils, 10 had typically pearly eyes, 1 had paralysis of the wing, 7 had distended abdomens and 6 were wasting and had diarrhoea.

On another small farm with a pullet population of 310, mortality from February to July was 113. Weekly cullings of birds showing symptoms of leucosis were made on this farm from July to October, resulting in a reduction of the pullet section of the flock by another 113.

Ten years ago this disease was unknown in Queensland but today few flocks are free. These are not isolated cases. Numerous outbreaks have been reported during the last few months, two of which are more severe than the above.

Cause: Considerable research work has been carried out in relation to this disease, and there is little doubt that it is caused by an ultra-microscopic or filter-passing virus which attacks the nervous system and various organs. This wide variety of attack gives many external and internal symptoms which may be overlooked when culling for the disease. The typical external symptoms of leucosis are—

1. Paralysis of legs and/or wings.
2. Grey or pearl eye.
3. Distorted pupil.
4. Anaemia.
5. Wasted appearance.
6. Diarrhoea.

The need for close examination is apparent. A farmer may cull for the very obvious symptoms of leg and/or wing paralysis and miss those less readily discernible.

Internal examination often reveals gross pathological changes in the viscera, for example, enlarged liver and tumours involving the ovary, spleen, kidneys, testes, lungs and the membranes connecting and lining these organs. These tumours are greyish-pink or yellowish in colour, and those visible vary in size from a small nodule to a mass as large as a tennis ball.

Control Measures: There is no known cure for the disease. Treatment of affected birds is useless. A few cases of recovery have been noted, but these birds may still be a potential source of danger as "carriers." The only method of attack is by adopting strict control measures such as—

1. *Culling*: Constant observation for symptoms of leucosis with drastic culling of infected birds is advised.

2. *Rearing of Chickens*: It has been shown that direct or indirect contact of chickens with infected birds is a common method of spread. It is considered by some authorities that the incubation period, that is, the time between infection taking place and symptoms occurring, may vary as widely as from 4 to 5 weeks to a year and that most of the infection takes place during the first four to six weeks of the life of the chicken.

It has been shown that, when chickens have been reared in isolation from possible infection, the incidence from disease has been greatly reduced.

In view of the above it will be seen that the chickens must be reared in isolation from the adults. Clean ground is essential for rearing, and if this is not available intensive methods of rearing should be adopted. Even under these circumstances the brooder house should be well apart from where adult fowls are housed and if possible a separate attendant should look after the chickens until six or eight weeks of age. If such is not practicable the attendant should guard against the introduction of the disease per medium of his boots and clothing.

3. *Breeding Resistant Stock*: Transmission from parent to offspring through the egg is considered by many as a method of spread of this disease and breeding for resistance must play a large part in its control. In breeding practice the use of birds which are infected but show no clinical symptoms will sometimes be made unwittingly. Such a bird will be a probable source of infection. This probability therefore cannot be eliminated from any system of breeding. The incidence of disease can be lessened by breeding from older stock which have proven their resistance to leucosis. The practice of haphazard breeding from pullets cannot be too strongly condemned as the birds have not shown themselves resistant to diseases. Again, the incubation period varying from four to five weeks to a year is another factor which makes breeding from pullets most undesirable. It is obvious, therefore, that the only means available to build up a resistant flock is by progeny testing.

GENERAL.

The other causes of mortality indicated in the graph have been dealt with extensively in previous articles.

The graph does not show the incidence of leucosis to be of a much greater significance than parasitical infestation, and little more than that due to faulty brooding. Mortality from leucosis among poultry does not end with that occurring in growing stock, but persists and continues among the adult. It is for this reason that the importance of taking methods for the controlling of the disease has been stressed.

ANIMAL HEALTH

The Control and Treatment of Mastitis in Dairy Cows.

R. D. CHESTER, Veterinary Officer.

MASTITIS (mammitis) means any inflammatory condition of the udder. It may be caused by a number of different agents, but the common type of infectious mastitis of dairy cattle in Queensland is due to a specific organism, *Streptococcus agalactiae*.

Types of Mastitis.

Mastitis may be classified into three broad types: (*a*) Subclinical, (*b*) Acute, (*c*) Chronic.

Subclinical Cases.—These are, strictly speaking, those cases where the causal organism is present in the udder without causing any change in the appearance of either milk or the udder tissues. However, for all practical purposes they may be regarded as those in which there is no change in the appearance of the udder, but the presence of small clots in the fore-milk may be detected when it is drawn into a strip cup. Thus the regular use of the strip cup is essential to any plan of control.

Strip cup diagnosis should be checked by the submission of properly collected milk samples for laboratory examination.

These cases can be cured by the application of the correct treatment.

Acute Cases.—These are usually indicated by a sudden flare-up of intense inflammation. The onset of an acute attack is frequently a break-down of a subclinical or chronic case. Occasionally the inflammatory condition in the quarter is associated with fever. The cow may be disinclined to follow the herd; she will not eat. Milk secretion is greatly reduced and the milk may vary in appearance from a thin, watery, blood-tinged fluid to a thick, yellow, custard-like material. Usually there are many clots.

These cases will respond quite well to correct treatment.

Chronic Cases.—These are the result of long-standing infection which has produced udder damage. There is no painful inflammation, though usually there is destruction of glandular tissue, with either shrinkage of the quarter or enlargement due to scar tissue formation (fibrosis). Milk secretion is reduced.

The milk is sometimes thick and custard-like; more often it is apparently normal except for a few clots which will be noticed in the strip cup.

No treatment can replace secretory tissue which has been destroyed. However, the bacteria infecting the quarter can be killed and further fibrosis prevented.

Predisposing Causes of Mastitis.

A thorough understanding of the conditions likely to predispose cattle to infection is essential before the farmer can embark on any programme of control. These predisposing conditions may be grouped under (i) those which lower the resistance of the udder and (ii) those which increase the chances of pathogenic organisms coming in contact with the glandular tissue.

Those conditions lowering the resistance of the udder are:—

(*a*) Bad milking methods.
(*b*) Bad herd management.
(*c*) Unhealthy cattle.
(*d*) Hereditary susceptibility.

Those favouring contamination by bacteria are:—

(*a*) Dirty hand or machine milking.
(*b*) Injury to udders.
(*c*) Contamination of bails and utensils.
(*d*) Dirty udders.
(*e*) Dusty yards.
(*f*) Fly population in bails.

Measures to Prevent the Spread of Disease.

Bearing in mind the predisposing causes set out above, the farmer must try to develop a routine which will overcome these faults.

Milking Routine.—Work in the milking shed should be carried out according to a strict plan. Cows will quickly become accustomed to such a routine and react accordingly. They should work through the bails in a definite order, smoothly and without bustle, but rapidly. A fast, efficient milking technique is of great importance.

Hand-stripping after machine milking should be avoided.

Machines should be run at a maximum pressure of 15 lb. per square inch; less is desirable. High milking machine pressure tends to damage the delicate secretory cells of the udder.

Teat cups should never be left on a cow longer than is necessary. Much damage will result if teat cups are left attached to empty udders.

Most milking machine manufacturers issue instructions concerning the operation of the machine. These instructions should be followed carefully and the pressure gauge checked periodically by a Departmental Dairy Officer.

Preparation of the Udder.—Immediately before applying the teat cup, or commencing hand milking, wash the udder in warm soapy water, drying off excess moisture; then draw a few streams of milk into the strip cup and examine for the presence of abnormalities. Should the milk in the strip cup be normal the teats should be dipped in a tin containing clean fresh chlorine type solution (1 part free chlorine in 800 parts water) and the milking commenced immediately. A delay of more than one minute between preparation of the udder and the commencement of milking is undesirable.

Preparation of Machines.—Immediately prior to each milking run one gallon of chlorine-type disinfectant through each unit. At the completion of each milking the machines must be thoroughly washed by running the following solutions through each unit:

One gallon of cold water.

One gallon of boiling water containing caustic soda (1 tablespoonful for each 4 gallons).

One gallon of boiling water; or, if steam is available, draw steam through each unit.

The teat cups must be disinfected between each cow during the milking process. This can be accomplished by dipping them in clean caustic soda solution followed by chlorine solution immediately prior to attaching to the udder.

Preparation of the Hands.—The hands must be washed between each cow. Wash in warm soapy water and follow with a rinse in chlorine solution.

Stripping.—Do not hand-strip after removing the machines. Inexpert stripping causes considerable injury to the udder.

Drying-off.—Do not dry off by leaving some milk in the udder at each milking; avoid milking once a day. The drying-off process should be quick, the food should be cut down and the cow turned out of the milking herd.

Herd Management.—A great deal of mastitis is avoided by the farmer who takes a little extra care in the management of his herd. Overcrowding in yards and feeding troughs should be avoided. The provision of shelter against extremes of weather and the proper care of sick animals will result in a healthier herd. All chronically diseased animals must be culled from the herd.

Cows known to be susceptible to infection should not be used as breeders. It is known that some strains of cattle are more easily infected than others.

Elimination of Dust.—Dust from yards carries bacteria which will contaminate udders and utensils. Small forcing yards can be swept daily and when water is available they should be hosed.

Control of Flies.—Rails, walls and ceilings about the dairy should be sprayed regularly with a 4 per cent. solution of DDT in order to reduce the fly population.

Management of Infected Cows.—All cows known to be infected must be milked after the healthy cows have passed through the bails.

Infected milk must be drawn into a special container and destroyed. Never milk infected quarters on to a bail floor and never feed milk from infected cows to calves.

Treatment should be carried out immediately a positive diagnosis is made, as early treatment is essential if good results are to be obtained.

Management of Calves.—All calves should be dehorned soon after birth. Dehorned cattle are much more contented in the milking herd and injury to udders is considerably reduced.

Calves should be kept away from the herd and milking yards. Milk from infected cows must never be fed to calves.

Treatment.

New drugs for the treatment of mastitis by udder irrigation have materially increased the chances of curing infected quarters. However, it is essential for satisfactory control that the measures outlined above be practised in conjunction with treatment. Success or failure in handling outbreaks of mastitis will depend upon the thoroughness with which these control measures are carried out.

Treatment by Vaccination.—Although some measure of success has been attained, the use of vaccines is not recommended where udder infusion can be practised.

Treatment by Udder Infusion.—This method has proved very effective. Many different drugs have given promising results but sluphanilamide and penicillin have been most efficient under experimental conditions.

Sulphanilamide in Oil.—A preparation of this type has been placed on the Queensland market under the name of "Europa." A special injector is also available. The preparation has the advantage of being non-irritant and therefore it may be allowed to remain in the udder after injection.

Treatment should be carried out immediately mastitis is diagnosed. The quarter is completely stripped out and the udder washed with hypochlorite solution (1 part free chlorine in 800 parts of water). A sterile teat syphon is then inserted into the quarter by way of the teat canal. The teat syphon is connected with the injector by a short piece of rubber tubing and from 30 to 60 c.c. (according to capacity of udder) of the preparation injected. Three injections at intervals of 24 hours are necessary.

Recovery should be complete after one week. If recovery does not take place it is advisable to submit milk samples for laboratory examination so that the type of infection can be checked.

Dry cows can be treated in exactly the same way as those in milk.

It is most important that all apparatus be sterilized by boiling immediately before commencing treatment. Although more than one quarter can be treated at the one time without sterilizing the injector, it is absolutely essential that a fresh sterile teat siphon be used for each individual quarter.

It is advisable to consult your Veterinary Officer or Stock Inspector and have him demonstrate this method before undertaking routine treatment.

Penicillin.—This drug is now available for the treatment of mastitis; like sulphanilamide in oil it is non-irritant and is therefore left in the udder after injection. Its efficiency depends on the type of organism responsible for the infection and the degree of udder damage present at the time of treatment.

The penicillin is sold as a yellow solid in ampoules containing 100,000 units. Each is sufficient for four treatments. The preparation is only stable if kept refrigerated.

To make a solution for treatment take 10 c.c. of boiled sterile water in a boiled syringe and inject it through the rubber cap of the ampoule. The penicillin, which is very soluble, quickly dissolves. It may then be withdrawn into the syringe and transferred to 400 c.c. of boiled sterile water in a graduated bottle from which it can be gravitated into the quarter. Each 100 c.c. of the solution so prepared contains 25,000 units of penicillin, which is sufficient for a single treatment.

Once dissolved in water penicillin must be used immediately.

The apparatus for injection consists of a bottle to contain 400 c.c. graduated at each 100 c.c., a rubber stopper through which two glass tubes are passed and a length of rubber tubing.

The quarter is stripped out and the udder washed as for sulphanilamide treatment and the sterile teat syphon inserted. The teat syphon is then connected with the bottle containing penicillin solution, which is held upside down at a height above the udder and 100 c.c. of solution is gravitated into the quarter.

The whole apparatus must be sterilized by boiling after each 400 c.c. of solution is used and a separate sterile teat syphon must be used for each quarter.

Treatment is repeated 24 and 48 hours after the initial treatment.

Cases which do not respond should be checked up by sending milk samples to the laboratory.

Farmers wishing to use penicillin should consult their Veterinary Officer or Stock Inspector. The use of penicillin is controlled, and is only available to veterinarians subject to a certificate stating that the penicillin is required for the treatment of mastitis in cattle.

Collection of Milk Samples.

For complete and satisfactory examination of milk samples it is essential that they are collected correctly. Following is the method recommended by this Department:—

(1) The udder and teats should be thoroughly washed with a solution of hypochlorite (1 part chlorine in 800 parts water) and excess disinfectant allowed to drain off.

(2) The ends of the teats should be vigorously swabbed with methylated spirit.

(3) Discard the first jet of milk.

(4) Draw straight into a sterile bottle held at an angle to exclude falling hair and dust.

(5) Cork or cap immediately after taking sample.

These additional points should also be observed:—

(1) Only samples from individual quarters should be submitted.

(2) If more than one quarter is sampled, the teats must be swabbed in the correct sequence, namely, left fore, left hind, right hind, right fore and the samples drawn off in the reverse order.

(3) Do not collect specimens into bottles previously filled with disinfectant.

(4) Sterile bottles will be supplied free by the Animal Health Station, Yeerongpilly, if requested. If the bottle cannot be obtained from Yeerongpilly, a clean bottle should be sterilized by either of two methods:—

(*a*) Put the lid (or cork) and bottle separately into a saucepan of water and boil for 15 minutes. When cool, shake off excess water and assemble. Do not touch the inside of the bottle or the lid, or open the bottle until it is used.

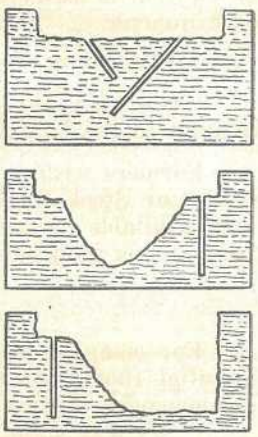
(*b*) Cork or cap bottle and heat in a hot oven for one hour. Do not open until used.

(5) Label all samples with:—

(*a*) Name (or number) of the cow and the quarter from which the milk was taken.

(*b*) Name and address of person submitting specimen.

USEFUL HINTS ON SINKING WELLS.



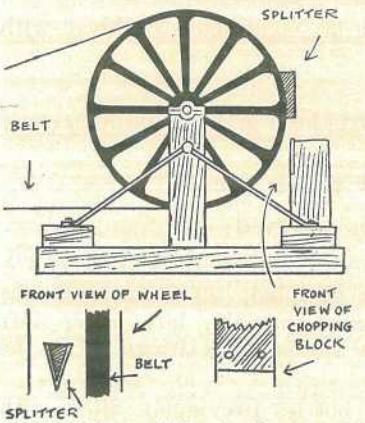
These few notes are based on the successful experience of one man sinking a 5 x 3 well which had reached solid rock. In such cases, it is usually hard to keep the corners straight, and to know how the holes should be drilled to obtain best results.

Two holes were put down, as shown in figure 1, one being about 18 in. in depth and the other 2 ft. 6 in., the charge in the short hole being fired first.

After the second charge has been fired, there should be a conical shaped hole as shown in fig. 2 and the next task will be to put down a hole parallel with the wall at one side, so that it leaves a "bench" which is afterwards removed by another parallel charge.

These are, of course, only general instructions, as the type of country makes it hard to apply any hard and fast rule. Naturally the charge will leave the hole in a rough condition, and the corners will have to be made, and the walls trimmed. However, by working a series of "benches," it should be possible to accomplish the task with little difficulty.

A HOME-MADE WOOD SPLITTER.



This useful type wood splitter devised by one man has done good service and saved much time and labour. He got a pulley from an elevator which had a 12 in. face. To the rim on one side is riveted a wedge, faced with two leaves of an old car spring, brought to a sharp edge in front.

The splitting block is made as shown, with a notched iron plate The belt from a 3½ h.p. engine runs on the other side of the wheel. The stick of wood is held on its side and pushed in so that the wedge shaped splitter comes down on it. If the splitter sticks, it simply throws the belt and no harm is done. As fast as a man can feed the blocks to the machine it will split them. The idea itself might be of value to many even if another type of wheel has to be used.

—*From "Handy Farm and Home Devices and How to Make Them."* (*J. V. Bartlett for War Blinded Association, Adelaide, S.A.*), 1946.

Submission of Specimens when Poisoning is Suspected.

W. R. WINKS, Chemist (Toxicologist).

SUDDEN deaths often occur among animals in good health and poisoning is naturally suspected. The question then arises as to what material should be submitted for chemical analysis and how it should be selected.

The nature of the specimen will depend to some extent on the symptoms preceding death and on the general history of the case.

Specimens from Cattle, Sheep and Goats.

Cattle, sheep and goats are ruminants—that is, cud-chewers—and have what are commonly called four stomachs. The first and second stomachs are mainly food reservoirs, and the main digestive action taking place in them is bacterial fermentation. The fourth stomach is the true stomach.

In the case of poisons taken by mouth, after a quantity sufficient to cause death has been absorbed, most of the remainder will be found in the first and second stomachs. As animals which have died suddenly have usually consumed quantities of poisons far in excess of the fatal dose, comparatively large amounts are found in the first stomach.

The remains of poisons actually digested or being digested are found chiefly in the fourth stomach.

It is therefore necessary in the case of suspected poisoning of ruminants to submit specimens of the contents of the first stomach (or paunch) and also of the fourth stomach.

These specimens must be kept in separate containers and distinctly labelled with the nature of the specimen and the name and address of the owner.

The amount of specimen to be sent is also of importance. The paunch of cattle usually contains between 50 and 60 pounds of material and it is obviously not advisable to send this amount. The paunch contents should be thoroughly mixed and about 2 pounds taken as a sample. The whole of the contents of the fourth stomach should constitute one sample. If animals have had access to materials containing arsenic, such as dipping fluids, or pastures poisoned with arsenical weed-killers, confirmation of this fact is all that is necessary, and the specimens suggested above are sufficient.

Poison residues, however, are stored in the liver and kidney and in the case of death after a somewhat prolonged illness about one pound of liver and at least one kidney should be selected and each placed in a separate container suitably labelled.

In the case of poison absorbed through the skin, such as from an over-strong dip, the liver and kidneys should always constitute part of the specimen, as absorbed poisons are seldom found in any of the stomachs. It is not necessary to wait for the death of an animal, as

traces of some poisons, particularly arsenic, can readily be picked up in the dung, a sample taken directly from the lower bowel with the hand being preferable to one that has been passed on to the ground.

As an antidote for arsenical poisoning, the common photographic hypo (2 ozs. as a drench repeated in 3-4 hours) is quite harmless, and no time should be lost in drenching the animal. A specimen of the dung could be submitted to confirm the presence of the suspected poison.

Horses, Pigs and Other Animals.

The distribution of poison in the organs of animals which have only one stomach is somewhat different from that in ruminants and different specimens are needed for examination.

In the case of horses, about two pounds of the well-mixed stomach contents is sufficient for chemical examination, and where the symptoms indicate chronic poisoning portion of the liver and the whole of one kidney should be sent.

For pigs, about two pounds of the stomach content will suffice for analytical purposes, with liver and kidney required if the illness has been prolonged.

The whole stomach of a dog should be taken, as well as any vomit which may be available.

For fowls, the crop and gizzard in separate containers are usually sufficient. If a number of fowls have died several crops and gizzards can be used as samples, the crops being kept together in one bottle and the gizzards in another.

Preservatives.

Most animals begin to decay and offensive odours arise soon after death. To ensure the arrival of the specimen in the least objectionable condition, the sender is often tempted to add preservative.

Preservatives of any kind add to the difficulties of analysis and may themselves contain traces of poisons and so should be used as little as possible.

No preservative is necessary in the case of stomach content of cattle, sheep, or goats (that is, grass or plant-eating animals), and if the containers are not overfilled preservatives should not be necessary for pig or dog stomachs or bird specimens.

If liver and kidney specimens have to be sent any distance, a small quantity of coarse salt may be added but, if added, a small packet of the same salt should accompany the specimen.

Formalin should never be used, as it destroys or partially destroys some poisons and is most objectionable to the analyst.

Methylated spirits would be the best preservative, but the materials used for denaturing it introduce complications in the analysis, and it therefore should not be used.

Additional Specimens.

Any substance or material suspected of causing the death of an animal should also be sent; but if the animal has died, specimens from the animal should always come with the suspected substance. A piece

of meat containing strychnine does not necessarily indicate that the animal died of strychnine poisoning. The presence of strychnine in the stomach of the animal and in the meat would, however, be strong presumptive evidence of death from this cause.

All specimens should be forwarded to the Director, Animal Health Station, Yeerongpilly. A letter, also addressed to the Director, should be sent at the same time as the specimens. This should give particulars of number and class of stock affected, number sick, number dead, course of the disease, post mortem, pasture, poison suspected and why, and specimens submitted.

Suspected Plants.

Many plants dangerous to stock grow abundantly in Queensland, but their active principle (i.e., the poison) has not yet been isolated. In these cases it is not possible for the analyst to verify plant poisoning as the cause of death. However, in all cases of suspected poisoning by plants, specimens of the plants should be sent along with the samples for identification. If possible plants or pieces of plant with either flowers or fruit or both should be selected as botanical specimens.

Summary.

For ruminants: (1) Send about 2 lb. well-mixed paunch content and the whole of fourth stomach content; (2) send liver and kidney in case of protracted illness.

For horses: Send about 2 lb. well-mixed stomach content, and liver and kidney in protracted sickness.

For dogs: Stomach content, also vomit, and liver and kidney after protracted sickness.

For fowls and other birds. Send crop and gizzard.

Specimens should be in separate containers and distinctly labelled. A covering letter should be despatched along with the specimens. Containers should be scrupulously clean. Do not use any tin or bottle labelled "POISON," even if certain that it has been thoroughly cleaned.

Do not use preservative except in special cases.

A further article covering the selection of specimens where a lawsuit is probable will appear later.

It must be recognised that the analyst can only analyse the specimen he receives. See that it is representative.

Agricultural Chemistry

Why Cattle Chew Bones.

R. H. MATHAMS, Analyst, Chemical Laboratory.

BONE chewing or depraved appetite (pica) in cattle is the result of an instinctive effort by the beast to replace certain elements deficient in its diet. These are usually mineral substances and may be (*a*) phosphorus (phosphate), (*b*) calcium (lime), (*c*) a combination of both, or (*d*) certain "trace" elements, e.g., iron, copper and cobalt.

It should not be overlooked, however, that a heavy infestation of intestinal parasites—such as worms—may also cause similar symptoms. The immediate effect of such a heavy infestation is to induce malnutrition and digestive upsets which may, in their turn, result in a depraved appetite.

Phosphate and lime deficiencies are, more often than not, companion deficiencies and hence their cause and treatment will be discussed together.

Phosphate Deficiency.

This is common in many parts of coastal Queensland and the Peninsula where natural pastures represent virtually the whole of the grazing. Deficiency in the phosphate content of the soil is reflected in phosphate-deficient pastures.

Symptoms.

Affected cattle chew and eat bones and other foreign material, such as wood, hair, putrid flesh, earth, stones, leather and even tin cans. As the deficiency progresses they exhibit loss of appetite, emaciation, lowered efficiency, weak bones, stiff joints, spastic gait ("wobbles"), decreased milk flow, small calf drop and a general unthrifty and haggard appearance.

Analysis of blood from affected animals shows a marked decrease in inorganic phosphate. Fodder analysis also shows a low phosphate figure.

Calcium (Lime) Deficiency.

Uncomplicated calcium deficiency is rather rare, especially when cattle are receiving liberal amounts of roughage, but may occur in dairy cattle during heavy continuous milk production. This is particularly the case with cattle in which a large proportion of the ration consists of industrial waste products, e.g. brewers' grain or milling by-products.

Symptoms.

Frequent bone fractures, lowered milk production and incapacity to reproduce through failure of the fœtus to develop are the most apparent effects. The condition is difficult to determine in its early stages as the animal remains in generally good condition—there is none of the lethargy and stiffness associated with phosphate deficiency.

Because the animal draws readily on its bones to keep up the calcium content of its blood, an analysis of the blood will often show, in adult animals, only a slight decrease and sometimes even an increase. Younger animals are more prone to calcium deficiency and blood analysis will show a greater decrease.

Cause of Ailments.

The bones of the body are the storehouses in which are kept reserve supplies of lime and phosphate. Normally, any demand by the body over and above that provided by the food can be met, but when a decreased food intake is prolonged the demand becomes too great and, in addition to the other symptoms described above, the bone structure is affected. Phosphate deficiency is much more prevalent than lime deficiency, although oftentimes the two are combined.

Danger Points in Lime-Prosphate Deficiency.

In growth, when the bones are being formed and the young body developing, there is a heavy demand for phosphorus and calcium minerals and a deficiency can cause rickets, stunted growth, and the development of a "runt" or "poor doer."

Dairy cows, in the first months of a heavy lactation, excrete through the milk more calcium and phosphate than they obtain in their fodder and, therefore, draw on their bone structure for the necessary minerals. These need to be replaced later when milk production declines or during the succeeding "dry" season.

Drought and—more frequently—overstocking can so reduce the food intake that stock become mineral-starved with consequent obvious results.

It should always be remembered that heavy-in-calf and lactating cows and young animals are much more susceptible than dry stock, males or mature animals, for the obvious reason that they are in greater need of the minerals.

Prevention and Treatment of Lime-Phosphate Deficiencies.

The obvious answer to the problem is to supply the minerals for which the bone-chewer craves. This can be done in several ways:—(*a*) by introducing mineral-rich foods into the animal's diet; (*b*) by supplementing the normal diet with lime- and phosphate-rich mineral supplements; and (*c*) by increasing the mineral content of the pasture by fertilizing the soil on which it is grown.

The following foods provide a selection of phosphate-rich supplements which could be added to the diet—legume hays and chaff (e.g. lucerne), bran, animal protein concentrate (such as meatmeal or even meatworks fertilizer), seed cakes (such as linseed, cottonseed and peanut) and cereal grains. Of these, the legumes and meatmeal are also rich in lime.

Mineral supplements should be finely powdered so as to be quickly and easily utilized by the body and made palatable by mixing with salt as a lick, or mixed with the supplementary feed.

Sterilized bone meal, degelatinated bone and dicalcium phosphate are the more common lime phosphate supplements. Rock phosphate or "super," though reasonable sources of lime and phosphate, may be dangerous as they often contain sufficient fluoride or arsenic to cause ill effects and they are not readily eaten by stock.

Such finely powdered mixtures (especially bone meal), if fed in the open paddock, are liable to contamination, to spoilage from rain or heavy dew, and to wastage from the wind. It is therefore better to put the trough under cover and, if necessary, bind the mixture together with molasses diluted at the rate of one pint to one gallon of water. One gallon of this liquid will bind about 50 lb. of lick.

The topdressing of pasture depends on a number of factors—the soil type, the topography, climate, composition of the soil and the type of pasture grown. No general advice can, therefore, be safely given. Help should therefore be sought from the nearest Agricultural Adviser before commencing any pasture improvement.

Milking cows, to be kept at efficient production, need special attention. In many parts of the coastal dairying areas of Queensland the soil has been shown to be mineral deficient. Cattle should therefore be provided with a mineral supplement, e.g. a mixture of equal parts of common salt and sterilized bone meal, added to the fodder at the rate of 1–2 lb. per 100 lb. of fodder. For grazing animals a similar mixture used as a lick should be readily available. Where the water is brackish the lick may have the salt reduced or even eliminated and a small amount of cereal meal used to make it attractive.

For straight-out calcium deficiency, powdered limestone or powdered shell, such as oystershell, is the cheapest source of lime. It may be fed as a lick if some appetizer is added.

The practice of feeding smashed "green" bones is not recommended, as a sharp sliver of bone may cause puncture which would result in internal hæmorrhage. Further, the organism which causes botulism may have infected the bones or the meat scraps on them.

Deficiency of "Trace" Minerals.

This is also known as nutritional anaemia or anaemia, in America as "salt lick," in Scotland, as "pine," in New Zealand, as "bush sickness," in Australia as "wasting disease" and under various local names in the highlands of South America and Central Africa and in Asia.

Symptoms.

Cattle may show many and varied symptoms, depending on which trace mineral or combination of minerals is deficient. Depraved appetite is sometimes, but not always, associated with the more common signs of loss of appetite, weakness, diarrhoea or severe constipation, listlessness, a rough coat of hair and a scaly skin. Young cattle fail to grow, sexual maturity is delayed, and reproduction and lactation are unsatisfactory. Occasionally (but especially in copper deficiency) the hair coat of the animals becomes bleached.

The blood becomes very pale and deficiencies may be determined by chemical analysis and a microscopic examination of the blood. If death occurs, analysis of liver and spleen are also useful. It must be remembered, however, that only minute amounts of these trace minerals are present in the blood—one ounce of it will contain about one-millionth part of an ounce of copper—and so extreme care is needed, when taking the samples, to ensure that there is no contamination with metal instruments which may contain copper.

Cause.

A lack of these trace minerals in the diet causes, eventually, a reduction in the size of the red cells in the blood plus too little haemoglobin (the red colouring matter in the blood). This causes a lessening in the efficiency of the blood in its normal work with resultant ill effects to the body.

Danger Points.

Young cattle over six months and heifers calving for the first time seem to be more susceptible than others to nutritional anaemia, though cattle of all ages and both sexes may be affected if being run on country that is deficient in all or any of these trace minerals.

Prevention and Treatment.

Similar recommendations to those given for lime and phosphate are here again generally applicable. Amounts needed for treatment are so small, however, that perhaps the best method is the addition of small amounts of the minerals to either a salt lick or to the drinking water. A suitable lick can be made of a mixture of 100 lb. common salt, 25 lb. red oxide of iron, 1 lb. of powdered copper sulphate (bluestone) and 1 oz. of cobalt nitrate or sulphate. Twenty pounds of this mixture will supply an adequate amount of these trace elements to 50 head of cattle for one month. The cobalt salt can be evenly spread through the mass by dissolving it in water and spraying it over the mixture with a fly sprayer.

Parasitic Infection.

A heavy infestation of worms can have the same effect as slow starvation and hence cause many of the symptoms already described. Unthriftiness, a dull and rough coat, a haggard or "tucked-up" appearance and some interference with normal digestion shown by diarrhoea or constipation are the usual symptoms.

Control measures and treatment for such infestations have been the subject of previous articles in this Journal and any detailed explanation would be out of place here. In general, a specific drench for the kind of worm found is administered, and strict decontamination and rotation of paddocks practised. This is followed by a well-balanced ration to bring the animal back to good health and efficient production.

Conclusion.

Where cases of bone-chewing or depraved appetite are noted, it is well to examine the cattle for companion symptoms. If worms are suspected, carry out the necessary drenching and routine control measures. If mineral deficiency is suspected then an analysis of (i) the food, (ii) the soil on which the pasture is grown and (iii) blood samples, and samples of liver and spleen, if possible, will generally indicate what mineral (or minerals) is lacking and hence what supplement to use. Remember that samples for analysis should be carefully taken so as to be truly representative, and should be well packed and quickly consigned to the laboratory so that a reasonably accurate result may be obtained. Remember also that the provision of a lick or the supplementation of a ration are, though effective, not the *only* answers. Pasture improvement, where at all possible, is perhaps the best answer to this problem.

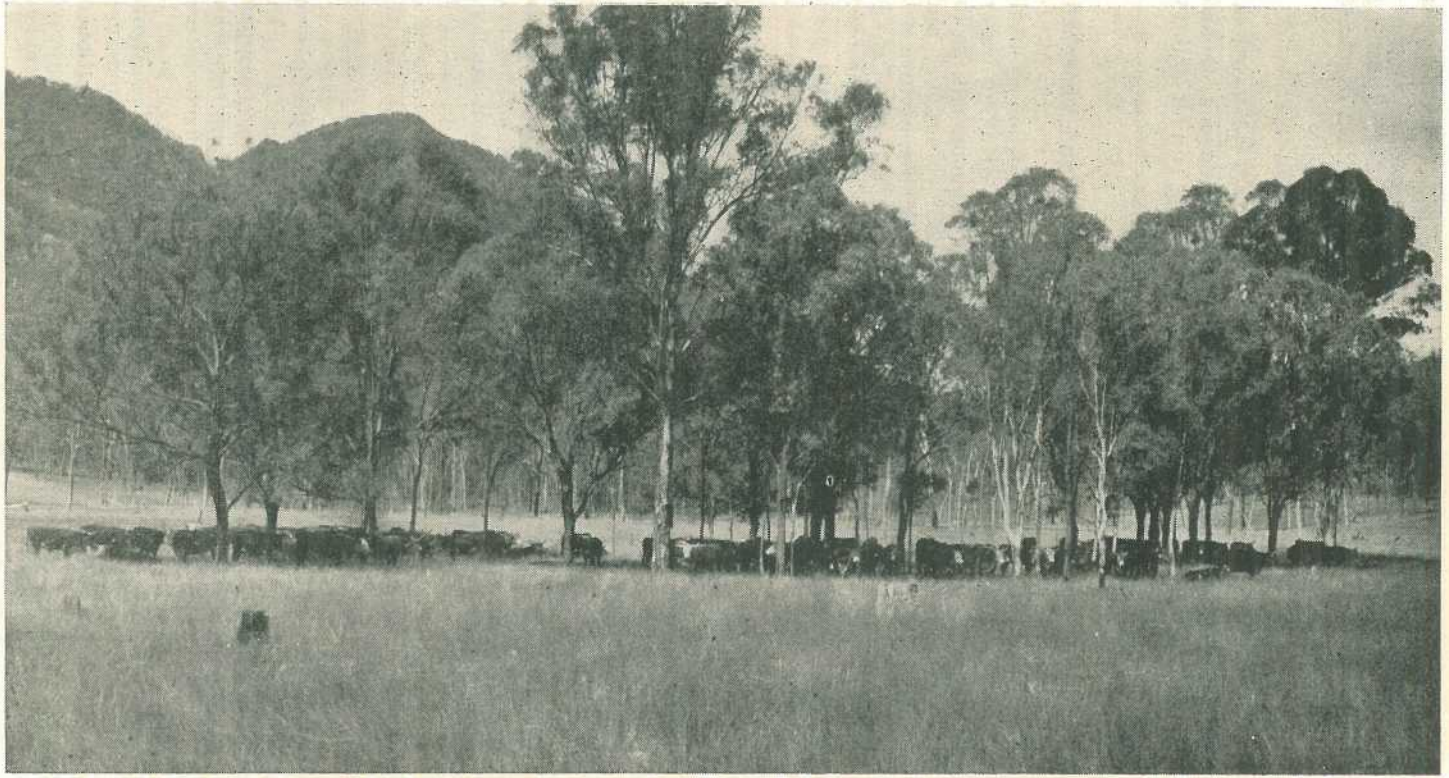


Plate 100.
A CATTLE CAMP ON KINGPAH, WEST MORETON—The property of Mr. J. Faulkner.

MARKETING

Crop Forecasting Service.

C. H. DEFRIES.

THREE hundred thousand farmers in the United States of America regularly keep their Department of Agriculture informed as to the production prospects of crops and livestock products in their particular localities. These reports from honorary crop correspondents, as they are called, form the basis of surveys by the United States Department of Agriculture which give comprehensive information as to acreage planted, growing conditions, and anticipated production of crops. These surveys are issued at frequent intervals and provide valuable information which can be used by primary producers to plan the operations on their farms.

These forecasts are also distributed to machinery and fertilizer firms, transport and storage agencies, banks, and firms which sell farmers' requirements such as produce merchants, grain brokers, seedsmen, case mills, bag manufacturers, and so on, all of whom find forecasts of this nature of great value in the organization of their business.

A similar service is provided in New South Wales and reports are regularly issued by the Department of Agriculture in that State giving a detailed analysis of growing conditions of various crops in all of the important production centres of the State.

The need for a similar system in Queensland has long been recognized and provision was made for the inauguration of a crop forecasting service when the Department was reorganised two years ago. The service will be administered by the Marketing Division of the Department, and now that the pressure of work arising from wartime controls is easing, it is proposed to establish a limited service which it is expected will be extended as time goes on.

The initial objective of a crop forecasting service in this State would be to provide in respect of important agricultural crops authoritative information which would include—

1. Details of the acreage farmers intend to plant to the particular crop.
2. As soon as practicable after planting, details of the acreage sown and the planting conditions.
3. Information concerning the progress of the crop and an estimate of the expected production therefrom.

Great reliance will be placed on honorary crop correspondents and field officers of the Department of Agriculture and Stock for the information necessary to compile these reports. The co-operation will be sought of Commodity Marketing Boards set up under "*The Primary*

Producers' Organisation and Marketing Acts, 1926 to 1945," and also of any other agencies which may be in a position to advise of crop conditions.

As already mentioned, an important feature of this service will be the reports to be submitted by honorary crop correspondents. In the main, these will be practical farmers who have been recommended by local field officers of the Department of Agriculture. At appropriate times during the growing period of the crop to be dealt with, a form will be posted to correspondents which, when completed, will provide the information needed for the compilation of the crop forecast. A stamped addressed envelope will be provided in each case, so that correspondents shall not be put to any expense in this regard. The details required will primarily be concerned with information such as the changes in acreage on the correspondent's own farm and in his immediate locality; estimates of the yield per acre on his farm and in his immediate locality; together with brief comments on weather conditions, planting conditions, growing conditions, the abandonment of crops, or the diversion of crops to other uses.

One very important consideration which cannot be neglected in forecasting is the possibility of sudden changes which may occur in crop prospects as the result of hail, frost, flood, or other natural phenomena, which may change the picture overnight. Continued drought or heat at critical periods may also render forecasting difficult. However, every effort will be made to provide an up-to-date picture of crop conditions as at the time of the issue of the report; and correspondents will be asked to extend their co-operation to the end that in the event of any untoward influences being encountered early information as to the effect on crops will be available.

It is proposed to commence this service with the autumn potato crop and action has been taken to appoint, in the main potato-growing districts, crop correspondents who have been asked to report as already outlined.

FARMERS MADE MONEY.

American farmers are sitting behind a lot of money to-day—money made during the war, Mr. A. K. Gardiner, Progressive Farmer Competition winner, said on his return to Sydney from his U.S.A. tour. Many of these men, he added, were anxious to visit Australia instead of Europe, which was too unsettled.

As an instance of the steep rise in land values, Mr. Gardiner cited the case of a government official whom he met. Just before the war this man gave 10,000 dollars for a house and 6-acre block at San Matao. Recently he refused 40,000 dollars for the property, but leased it for 5,000 dollars per year instead.

Throughout the States the price of farm land was so steep that there was practically no soldier settlement, he said. The Government, too, did not appear anxious to encourage soldier settlement as the risk of over production was very great.

Incidentally, butter was anything up to 5s. per lb. in America when Mr. Gardiner was there.

Droves of U.S.A. people were ready to take tourist trips to Australia since returning servicemen had told them about this country, Mr. Gardiner continued.

But, he added, Australia would need to provide much better accommodation than exists to-day, for the American, he said, was used to the best service in the world and was prepared to pay for it. Money spent in this direction was no consideration, but the American tourist expected value in return, and would spend money like water to get it.

Marketing and Economic Notes for April.

Empire Preference.

To meet a prevailing demand, stimulated by the current International Trade Conference at Geneva, for information concerning Empire Preferences and the influence they have had upon the export trade in Queensland's rural products, a brochure has been prepared by Officers of the Division of Marketing, and will shortly be made available for distribution.

Farm Machinery.

Of particular interest to wheat and cane farmers and others in Queensland who depend to a large degree on mechanisation is a report in the November 1946 edition of "The Agricultural Situation" issued by the United States' Department of Agriculture. This emphasises the acceleration of the trend towards mechanisation occasioned by the war and indicates that the production of farm machinery has not yet caught up with the demand by American farmers. Moreover, prices continue to rise, and continued material shortages are expected to influence adversely the volume of production this year. It is stated that the one and a-quarter million tractors on farms in 1940 will probably increase to over two and a-half million in 1947. It is therefore apparent that farmers here can expect no substantial relief from the United States until something approaching equilibrium between demand and supply is attained in that country.

Production Trends.

Dairy cattle are in thriving condition and prospects for the winter appear bright, as paddock feed is plentiful and large areas of green fodder crops are available.

With favourable conditions the maize crop on the Atherton Tableland may reach 19,000 tons. The South Burnett district has experienced favourable conditions, and yields of late crops will be satisfactory.

It is estimated that 1,000,000 bushels of grain sorghum are still to be harvested from the Darling Downs. Good yields from late planted crops in the South Burnett are now assured.

A good rate of growth was maintained throughout all sugar areas. Crop prospects are good in the Lower Burdekin, but only fair at Mackay and in the far northern district. The overall yield in the southern districts should be much better than last year.

Tobacco curing operations are almost complete in the South-west and grading is in progress on all farms. Grading of cured leaf from irrigated crops in North Queensland has been completed.

STORAGE OF PUMPKINS.

Pumpkins for storage should be selected preferably from early-sown crops as they have longer to ripen off than those from the later crops. The fruit should not be harvested until thoroughly ripe, as immature specimens tend to develop mould. Maturity is indicated when it is difficult to pierce the rind with the thumbnail. The pumpkin should then be cut from the vine, leaving several inches of the stem attached to the fruit. Care should be taken to avoid bruising the skin, as injuries of any type permit the entry of organism causing decay. Prior to storing, pumpkins should be cured for a period of two weeks. This can be done by placing the fruit in the sun, or, in the cooler months, by placing it in the sun on an iron roof. The best curing temperature is 80-85 degrees.

The process of curing completes ripening and heals mechanical injury which may have occurred during harvesting. Pumpkins free from frost injury should then be stored in a dry airy place, preferably on slatted shelves, and they should be examined regularly for any signs of decay.

GENERAL NOTES

Staff Changes and Appointments.

Noel Henry Adams, Q.D.A., Assistant Instructor in Agronomy at the Queensland Agricultural High School and College, Gatton, and Jim Hart, Q.D.A, Field Assistant, Regional Experiment Station, Biloela, have been appointed Advisers, Agriculture Branch, in the Division of Plant Industry, Department of Agriculture and Stock.

The designation of the position of Assistant Experimentalist, Regional Experiment Station, Biloela, has been changed to that of Experimentalist, and the redesignated and reclassified position has been assigned to Roy Wesley George, Q.D.A., the present occupant.

Rickard Brock de Lisle, Dip. Agr. (Dookie) has been appointed Adviser on probation, Sheep and Wool Branch, Department of Agriculture and Stock, Emerald.

Wild Life Preservation.

In pursuance of the provisions of *The Fauna Protection Act of* 1937, an Order in Council has been issued declaring Lilliesmere Lagoon, Ayr, to be a sanctuary under and for the purposes of the abovementioned Act.

Quarantine Area—Maroochy Shire.

The disease brown spot of Emperor mandarins has been found to occur in the Maroochy Shire and, because of the serious nature of this disease, a proclamation has been issued under *The Diseases in Plants Acts*, 1929 *to* 1937, proclaiming the whole shire a quarantine area in respect of all parts of Emperor trees, other than the fruit.

Open Season for Duck and Quail.

An Order in Council has been issued under *The Fauna Protection Act of* 1937 to make provision for an open season for duck (except Burdekin Duck) and quail in Queensland. The effect of this Order in Council is to fix the open season for duck (except Burdekin Duck) and quail in Southern Queensland from 1st June, 1947, to 31st August, 1947, both inclusive, and in Central and Northern Queensland from 1st July, 1947, to 30th September, 1947, both inclusive.

The attention of shooters is drawn to an Order in Council which prescribes that twenty (20) duck and twenty-five (25) quail are the maximum numbers, respectively, which any one person may take during a period of twenty-four hours.

Plywood and Veneer Boards.

Orders in Council have been issued extending the operations of the Plywood and Veneer Marketing Board and the Northern Plywood and Veneer Marketing Board from 3rd May, 1947, to 2nd May, 1950. Members of the Boards appointed for that term are:—

The Plywood and Veneer Marketing Board.—James Fairlie Brett; Robert Halliwell Bentley; Marcus John Gordon Brims; Eric Stanley Hancock; Percival Charles Pascoe; Harold Henry Thomas Greentree; George Ernest Newman; Frederick James Thompson, and Henry Roy Hancock.

The Northern Plywood and Veneer Marketing Board.—James Fairlie Brett; George Douglas Gummow; Charles Raff Paterson; and William Patterson.

Honey Board.

The counting of votes at the referendum on the question of the extension of the operations of the Honey Marketing Board for a further three years from 9th March, 1947, resulted as follows:—

For the extension	144
Against the extension	73

Rural Topics

No Substitute for Wool.

For a generation or more science has gone flat out trying to find a satisfactory substitute for wool, but the quest has been unsuccessful. Here is what the Chief of the Textile Station, Research and Development Branch, Office of the Quartermaster-General, United States of America (Colonel S. J. Kennedy), told a Senate Committee (U.S.A.) recently:—

"At the beginning of the war we were much concerned over the prospects for the wool industry. There was a possibility that sufficient wool would not be available to meet military requirements.

"Considerable research was undertaken to find out if there were other materials which could be used by the Army in place of wool. However, no important change was made in the use of wool over-all for military clothing."

Japanese Machines Idle.

In a broadcast heard from Radio Tokio by the Department of Information, interesting figures relating to the present position of Japan's woollen manufacturing industry were given.

The statement was presumably issued with the approval of the American authorities.

It was stated that woollen manufacturing equipment actually in operation comprised 87,000 spindles for combed wool textiles and 245 carding machines for spun yarn textiles.

This low figure, it was pointed out, was due entirely to the prevailing coal shortage in Japan, for the total equipment in a usable condition reached the figure of 295,000 spindles for combed wool textiles and 373 carding machines for spun wool textiles.

In addition, there were 127,272 spindles for combed wool and 57 carding machines and 10,212 weaving machines for spun yarn textiles in Japan, all of which were out of action because of lack of spare parts and other material.

The report gave production figures for June last at 2,671,000 lb. of yarn and 5,337,920 (figure uncertain) yards of woollen fabric.

However, if there was sufficient coal to enable all available 295,000 spindles and 373 carding machines to operate 12 hours daily, these machines could, it was estimated, cope with 480,000 bales of wool annually.

Prevention of Sickness in Stock.

There is too often a tendency on the part of the farmer and stockowner to regard veterinary science as only capable of coming to his aid when stock are already sick, forgetting that the most valuable part of veterinary advice is that dealing with prevention. The treatment of sick stock is of value, infrequently perhaps, but good hygiene—the correct application, that is, of those systems of stabling, housing, grazing, sheltering, grooming, clipping, clothing, feeding and watering which are most conducive to the good health and economic efficiency of the animals—is of value at all times.

"From Quenchless Springs."

A new book of poems, *From Quenchless Springs*, by Emily Bulcock, breathes the spirit of the Queensland countryside. The title poem is a gem and others have the beauty of thought and expression characteristic of the work of a gifted Australian writer. Among the titles are "The Lost Company" (dedicated to Australian Prisoners of War, Far East), "The Test," "The Return," "The March of the 9th Brigade," "Youth Immortal" (a tribute to the R.A.A.F.), "Curramundi —Caloundra," and "Lake Barrine." *From Quenchless Springs* is an excellent gift book. Our copy is from the author, by whom the book is distributed from her home, "Ungula," Wight Street, Milton, Brisbane. (Price, 2s. 6d. posted.)

Hints on Painting.

Everyone about the farm and home should be able to do a little occasional painting, and do it skilfully. The following simple hints have been gathered from practical experience, and from cabinetmakers of the old school; all of them are tried and tested. They should help the amateur.

Turpentine will soften putty as quickly as oil. To keep putty moist and pliable, place on a piece of glass or tin.

In thinning prepared paint, always follow directions printed on label.

If you stand brushes in water overnight, do not sink them below the bristles, or the wool will swell and burst the casings. The best way is to hang them in raw linseed oil, so the bristles are just covered, in a covered vessel.

To remove fresh paint from anything, including brushes, use petrol. Its action is far more rapid and perfect than turpentine, and it is much more pleasant to use.

To put a new brush in proper condition for painting, dip it in paint and lay it aside for several hours, turning it over once during this time.

An oil stain like mahogany can be put on a hard and glossed surface without any roughing of the surface.

To paint wicker work, thin the paint so that it is runny, and use a long bristle brush that is limber in the bristles.

To refinish a hard surface that has become scratched and bruised, it is not necessary to burn away and scrape away all the old surface. All that is required is that it be roughed slightly yet evenly with medium grained sandpaper. Such a roughed surface will grip the first coat of flat paint.

Before using paint that has been standing, strain carefully through a wire screen with a fine mesh so as to remove all foreign particles.

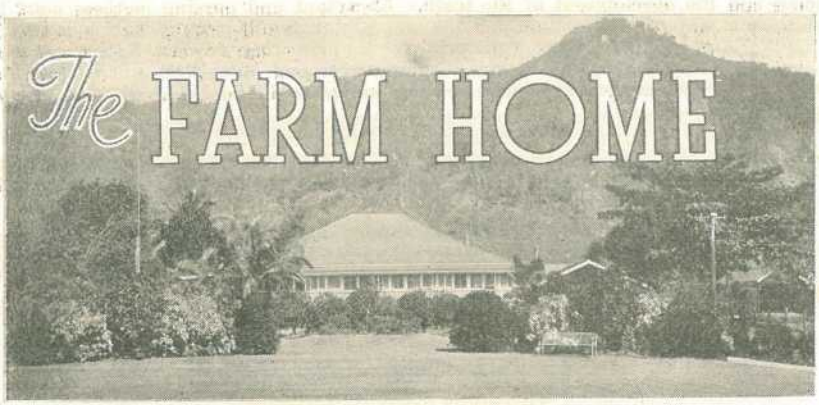
A hard or enamelled surface can be given to anything painted if to each coat of the flat paint there be added clear varnish in the proportion of two of paint to one of varnish, or half and half. This varnish will set the surface hard, and will not chip off so easily as cheap enamel. The varnish can be added to paint of any colour without affecting that colour.

To Bend Metal Pipes.

Get some dry, clean sand. Prepare a tapered wooden plug and drive tightly into one end of the pipe, after making sure that no foreign substance is in it. Stand on end and pour in sand, tapping gently to get it down until it is filled to within an inch of the top. Make a dozen or fifteen thin soft-wood wedges, 6 inches long, and drive them 4 inches into the piping until the end is completely blocked, so that the sand cannot escape. The piping is now, to all intents, solid, and may be heated and bent to the desired angle like ordinary bar-iron. Do not use damp or wet sand, or when it is heated it will either burst the piping or blow out the plugs.

When Moving Bees.

When moving bees a short distance, say, less than a mile, from their usual situation, it is advisable to take them two or three miles away and keep them there several weeks to let the colonies settle down in the strange locality, and forget about the old one, before transporting them to the selected site. When bees are moved only a short distance there is considerable risk of a large number of field bees returning to the old location, where they get lost and perish. When it is necessary to move a hive or two a few yards distant to a better position in the apiary, they should be moved a foot or two each day until the desired place is reached. Any greater distance may cause a deal of confusion and probable loss of field bees.



Care of Mother and Child.

Under this heading an article supplied by the Maternal and Child Welfare Service of the Department of Health and Home Affairs, dealing with the welfare and care of mother and child, is published each month.

ECONOMICAL HOUSEKEEPING.

Last month we talked about the need for spending at least one-third of the family income on food, because without food of the right kind children will not grow and remain well. Don't buy the children's food blindly. Know the right foods they should have and buy accordingly. Even in these days of high prices, economy in housekeeping can be practised by the woman who is a good manager and has some knowledge of the values of foods. Everything depends on the housewife and the care and skill with which she spends the available pounds, shillings, and pence which form the family income. It will help her if she makes use of the following hints.

Do not live from hand to mouth. Think out carefully the week's rations for the family—what will be needed and what it will cost.

Buy the food supplies yourself at local cash shopping centres. Watch the market prices, or listen to them on the radio, and buy what is cheap and in season.

Buy wisely. It is not the costly foods that are the most valuable. The cheaper cuts of meat if nicely cooked have just as much body-building value as the most expensive. Liver and kidneys are particularly valuable foods, and are usually cheaper than other meats.

The best vegetables are those you grow yourself, and if you have even a small piece of ground you can grow silver beet, lettuce, carrots, tomatoes, and parsley. With a larger plot you can add other varieties and easily grow enough vegetables to support a family. Even if you have no ground at all, you may grow lettuce, parsley, and tomatoes in tins or boxes, and save two or three shillings a week. If you have a yard, plant a lemon tree or an orange or a few papaws. Choko vines can be grown over fences or outhouses and pumpkins and squashes in spare corners.

Do not waste your money on ready-cooked or tinned foods, biscuits, rusks, or fancy breakfast foods. First or second break wheatmeal is the best breakfast food, oatmeal comes next, and both are inexpensive. Left-over porridge may be made into milk puddings, so may stale bread or scones, or these may be made into rusks or fried into sippets of toast. Stale cake may be made into trifle with junket or custard and jam. Crumbs are always useful for cooking. Cold potatoes may be sliced for salads, made into soup or into scones.

The one thing of which you should always buy enough is milk. Every child under six should have at least one pint of milk daily; from six to sixteen, half a pint at least is absolutely necessary owing to the big demand for the growth of

bones and the development of the teeth. Expectant and nursing mothers *must* have at least a pint of milk a day, and the rest of the family require half a pint. Milk supplies more valuable nutrient material for its price than any other food and cannot adequately be replaced in the diet. In the west and north-west where fresh cow's milk is not available, goat's milk or dried milk should be used. *Do not skimp on milk.*

Save fuel by arranging your meals so that several dishes may be cooked at the same time. Remember that raw fruits are better than cooked fruits, and well-washed lettuce with sliced tomatoes and shredded young carrots should sometimes replace cooked vegetables.

If there is any difficulty with the family budget or advice is wanted on any other diet problem, write to the *Maternal and Child Welfare Information Bureau*, 184 *St. Paul's terrace, Brisbane,* or address letters *"Baby Clinic, Brisbane."* These letters need not be stamped.

IN THE FARM KITCHEN.

Culinary Uses of Lemons

Not only do lemons enter into the preparations of all sorts of dishes—they have many other culinary uses, including:—

In boiling fish, add lemon juice to the water; this helps to keep it whole and thus preserves flavour and nutriment.

A few drops of lemon juice in the water in which old potatoes are cooked will keep them from discolouring.

Before using bananas or apples for salads or desserts, sprinkle them with lemon juice to preserve their colour.

A few drops of lemon juice in the water in which eggs are poached will keep the eggs from separating.

When whipping cream, add three or four drops of lemon juice to a cup of cream to make it stiff and firm.

A teaspoon of lemon juice added to the water in which lamb and veal for stew are cooked will improve the flavour and tenderness of the meat.

One dessertspoonful of lemon juice added to one pint of brine used for preserving vegetables improves their flavour and colour.

Dutch Apple Tart.

Children love this tart, for which you require some cooking apples (windfalls will do), some sultanas, sugar, a little lemon flavouring, and short pastry. Grease a shallow tin and cover it with a rather thick layer of pastry, then slice the apples, mix with the chopped-up sultanas, sprinkle a little sugar over, then add a few drops of lemon flavouring, dot with margarine and cover with a top layer of pastry. Brush over with milk, sprinkle with sugar, and bake in a moderately hot oven till done.

Green Tomato Pickle.

No sugar necessary. Take 6lb. green tomatoes, 2 lb. onions, 1 lb. beans (or cucumber), 1 oz. allspice, 4 cups golden syrup, 1 oz. turmeric, ¼ lb. salt, ½ cup flour, ¼ lb. mustard, 2 quarts vinegar, 1 oz. cloves, 1 teaspoon cayenne. Cut vegetables overnight and sprinkle with salt. In the morning drain and boil half-hour with the syrup, vinegar and spices. Mix mustard flour and turmeric with a little extra vinegar and boil all another five minutes.

"Scotch Baps."

To make these take 1 lb. flour, add to this ½ oz. bicarbonate of soda, add ½ oz. cream tartar. Well mix, then add a pinch of salt and work in 3 oz. butter. Now add sufficient milk to make into dough (sour milk if possible). Roll out, cut into triangles, dust with flour, and bake for 15 minutes. These are usually eaten cold.

Apple Tartlets.

Line a dozen patty tins with good short pastry, and bake about 20 minutes in a moderate oven. When cold fill with the following: One gill of apple pulp, sugar to taste, a pinch of ground cloves, ½ oz. butter, 1 egg, all put in a pan and stirred over a gentle heat till cooked. Do not boil. Fill up the prepared pastry cases. Bake again for four or five minutes till slightly brown. Serve hot or cold.

QUEENSLAND WEATHER IN APRIL.

Above-normal rainfall distribution during the month was confined to the South Coast, Moreton, and Darling Downs, the former 27 per cent. and the latter 8 per cent. above normal, being mainly due to rains on 1st, 16th, and 22nd. South Coast Moreton registered several three to four inch falls on 1st, highest being Springbrook 861, Dunwich 830, Maryborough 560, Tamborine 572, Southport 535, Tallebudgera and Palmwoods 500. These flood rains following flood rains of the previous month were probably not welcome and not needed in these districts already soaked with March rains. Excepting for South Coast Port Curtis, 22 per cent. below normal, and Peninsula North, 36 per cent. below normal, all other districts were 70 per cent. to 100 per cent. below normal. The majority of these benefited from the almost general March rains, but the Central Lowlands and Lower Western Divisions, receiving patchy amounts in February and being below normal in March, still need rain in some parts to ensure winter pastures. Heaviest rainfalls for the month were Sprinkbrook 1,103, Dunwich 1,050, Coolangatta 880, Bribie Island 805, and Tallebudgera 802.

Floods.—The Burdekin, Fitzroy, and Burnett River systems carried considerable run-off water for the first week of April, but continued to fall steadily, the Inkerman Bridge, over the Burdekin, being clear for traffic on and after April 1st. Flood rains over South Coast Moreton on 1st caused sharp stream rises in the Mary and Logan Rivers, but, without heavy rains following, these streams had fallen below danger level by 3rd. The Condamine, Balonne, and Macintyre continued to carry considerable run-off water until 8th, rainfall on the head-waters of these streams on 1st April and late March taking some time to pass down these streams.

Pressure.—Pressure changes in the first week of April showed a marked change over from Summer to Winter type charts. The active cold front moving across the Continent on 31st March, followed by a vigorous high pressure system, reached the coast on 1st April, its passage being associated with widespread rains in the south-eastern quarter of the State and flood rains South Coast Moreton. By 3rd the high pressure system had covered the whole Continent, had replaced entirely the warm moist northerly air which gave such widespread rains during March and had produced strong S.E. winds on the Queensland coast. These were further strengthened by a depression which developed over New Caledonian waters on 4th, and, resulting from these two systems, strong S.E. winds and very rough seas were unfortunately experienced on the Queensland south coast during the whole Easter period and persisted until 9th. From 9th to 14th normal seasonal highs moved across the Continent, but on 15th a dip developed on a weakening cold front in the south-eastern quarter of the State where light to moderate rain fell during 15th, 16th, and 17th, with local heavy South Coast Moreton.

South-easterlies persisted along the coast for the first two weeks, with rough seas south from Townsville from 3rd to 8th and slight to moderate seas from 8th to 11th. Otherwise seas were chiefly smooth to slight but slight with patches moderate along the south coast on 19th and from 27th to end of the month.

Temperatures.—A cool night with mean maximum temperatures chiefly below normal, except at Palmerville, 2 deg. above normal, where highest maximum for the State was 96 deg. on 17th. Thargomindah, with mean maximum 4.5 deg. below normal, had chiefly below normal daily maxima after 11th and Rockhampton, with mean maximum 4 deg. below normal, had below normal daily maxima after 17th. Excepting Palmerville, highest temperatures for the State were recorded in central, western, and Carpentaria where highest maxima ranged from 91 deg. to 95 deg. Minimum temperatures were generally below normal for the latter half of the month; falling minima after 7th showing signs of the approaching winter. Mean minimum temperatures were chiefly below normal, ranging from 5.5 deg. below at Mitchell and 5.2 below at Georgetown to 0.4 deg above normal at Brisbane. Many minimum temperatures were below 50 on the Downs, Maranoa, Warrego, and Central Highlands on the 16th, 17th, and 18th, Tambo 39 deg. in screen and 33 deg. on grass on the 18th being the lowest. Again for these districts, from 22nd to the end of the month many minima were below 50 deg., a cold snap on 28th resulting in frosty conditions at Mitchell where grass minimum was 29 deg. and at Tambo grass minimum 31 deg.

Brisbane.—Mean Pressure $\frac{9 + 3}{2}$ 29.978 ins. (normal 30.039 ins.). Temperatures.—Mean maximum 78.2 deg. (normal 78.8 deg.), highest 84.5 deg. on 12th; mean minimum 61.8 deg. (normal 61.4 deg.), lowest 55.9 deg. on 20th; mean temperature 70 deg. (normal 70.1 deg.).

Rainfall.—654 points on 12 days (normal 366 points on 12 days). Highest April rain since 894 points in 1933. Rainfall position summarised:—

Division.	Normal Mean.	Mean April, 1947.	Departure from Normal.
	Points.	Points.	Per cent.
Peninsula North	659	423	36 below
Peninsula South	164	Nil	100 ,,
Lower Carpentaria	101	Nil	100 ,,
Upper Carpentaria	115	Nil	100 ,,
North Coast Barron	788	199	75 ,,
North Coast Herbert	822	126	85 ,,
Central Coast East	288	41	86 ,,
Central Coast West	145	Nil	100 ,,
Central Highlands	150	35	77 ,,
Central Lowlands	121	Nil	100 ,,
Upper Western	57	Nil	100 ,,
Lower Western	80	Nil	100 ,,
South Coast, Port Curtis	249	194	22 ,,
South Coast, Moreton	416	527	27 above
Darling Downs, East	161	174	8 ,,
Darling Downs, West	119	48	60 below
Maranoa	129	12	91 ,,
Warrego	110	2	98 ,,
Far South-West	86	Nil	100 ,,

Commonwealth of Australia, Meteorological Bureau, Brisbane.

ASTRONOMICAL DATA FOR QUEENSLAND.

JUNE.

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	6.30	5.00	Cairns	8	50	Longreach	26	43
6	6.32	5.00	Charleville ..	24	30	Quilpie	37	33
11	6.34	4.59	Cloncurry	36	63	Rockhampton ..	1	19
16	6.36	5.00	Cunnamulla ..	32	27	Roma	15	19
21	6.38	5.01	Dirranbandi ..	22	16	Townsville ..	8	42
26	6.39	5.02	Emerald	11	28	Winton	29	52
30	6.39	5.03	Hughenden ..	21	49	Warwick	5	3

TIMES OF MOONRISE AND MOONSET.

At Brisbane.		
Date.	Rise.	Set.
	p.m.	a.m.
1	3.21	3.50
2	3.55	4.46
3	4.33	5.43
4	5.15	6.39
5	6.01	7.34
6	6.50	8.27
7	7.43	9.17
8	8.38	10.01
9	9.33	10.42
10	10.28	11.18
11	11.23	11.52
		p.m.
12	..	12.24
	a.m.	
13	12.19	12.55
14	1.16	1.27
15	2.15	2.01
16	3.18	2.39
17	4.25	3.23
18	5.35	4.15
19	6.45	5.15
20	7.53	6.22
21	8.55	7.32
22	9.48	8.42
23	10.33	9.49
24	11.12	10.52
25	11.47	11.52
	p.m.	a.m.
26	12.20	..
27	12.51	12.49
28	1.23	1.46
29	1.57	2.41
30	2.33	3.38

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	24	15	40	30	15	6	46	35
6	30	10	45	24	20	0	53	27
11	23	14	39	30	14	5	45	34
16	14	25	30	41	5	16	34	48
21	10	29	26	44	0	19	28	52
26	19	18	35	34	10	9	40	38
30	27	13	43	28	18	2	51	31

MINUTES LATER THAN BRISBANE (NORTHERN DISTRICTS).

Day.	Cairns.		Cloncurry.		Hughenden.		Townsville.	
	Rise.	Set.	Rise.	Set.	Rise.	Set.	Rise.	Set.
1	41	19	57	43	42	28	34	17
3	50	10	64	37	48	23	41	10
5	54	5	67	34	51	20	44	6
7	53	4	67	33	50	19	44	5
9	47	9	63	36	47	22	39	9
11	39	17	56	42	41	27	33	16
13	34	27	53	48	38	33	28	23
15	23	38	46	56	30	41	20	33
17	13	47	39	62	24	47	12	39
19	6	53	35	66	19	51	5	44
21	6	51	35	64	20	50	6	43
23	14	41	39	58	24	44	13	35
25	25	31	47	51	32	36	21	26
27	34	26	54	47	38	33	29	22
30	48	11	63	38	48	23	40	11

Phases of the Moon.—Full Moon, June 4th, 5.27 a.m.; Last Quarter, June 12th, 8.58 a.m.; New Moon, June 19th, 7.26 a.m.; First Quarter, June 25th 10.25 p.m.

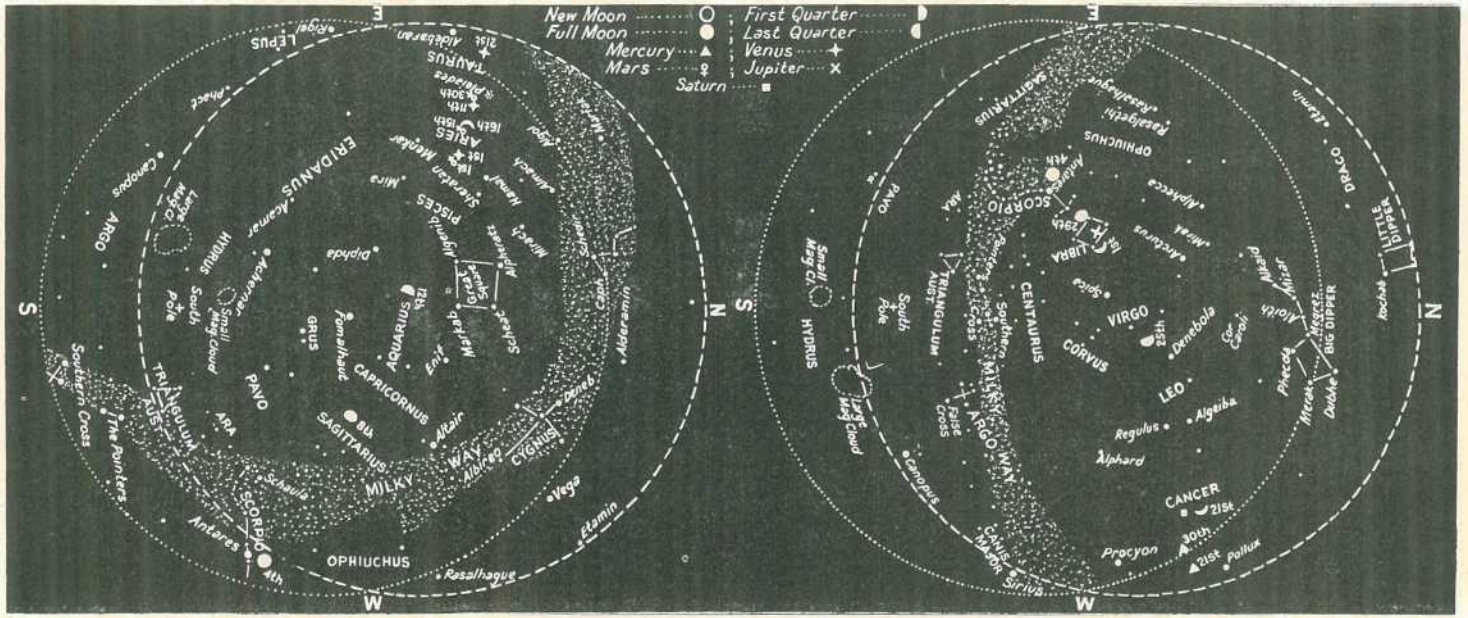
Solstice.—On June 22, at 4 p.m., the Sun will reach its maximum angle north of the equator and will then rise and set about 25 degrees north of true east and true west respectively.

Partial Eclipse of the Moon.—A partial eclipse of the Moon will be visible from Queensland on the night of June 3rd-4th. The Moon will enter the penumbra of the Earth's shadow at 2.49 a.m. on June 4th, after which there will be a noticeable decrease in its brilliance.

At 4.56 a.m. the Moon will enter the umbra and a dark "bight" will appear on the edge of the Moon. This "bight" will increase until 5.15 a.m. when it reaches its maximum. By 5.34 a.m. the full disc of the Moon will again be visible and the emergence from the penumbra occurs at 7.42 a.m.

Mercury.—An evening object all this month. In the constellation of Taurus, will set about 1 hour after the Sun on the 1st, and on the 17th will reach its greatest angle east of the Sun, when it will set about 1¾ hours after sunset. Towards the end of the month it will be in the vicinity of Castor and Pollux in Gemini. On the 30th it will set about 1½ hours after the Sun.

Venus.—Still a morning object. At the beginning of June, in the constellation of Aries, will rise about 2 hours before the Sun, but at the end of the month, in the constellation of Taurus, will rise only 1 hour 18 minutes before the Sun.



Mars.—On the 1st, in the constellation of Aries, will rise 2½ hours before the Sun and on the 31st, in the constellation of Taurus, will rise between 3.45 a.m. and 4.45 a.m.

Jupiter.—In the constellation of Libra may be seen throughout the night this month. At the beginning of June will set just before sunrise about 18 degrees south of true west. At the end of the month it will set between 2.45 a.m. and 4 a.m.

Saturn.—Will now set during the evening—between 9 p.m. and 10 p.m. on the 1st and between 7.15 p.m. and 8.30 p.m. on the 30th.

Star Charts.—The chart on the right is for 7.15 p.m. in the south-east corner of Queensland to 8.15 p.m. along the Northern Territory border on the 15th June. (For every degree of Longitude we go west, time increases 4 minutes.) The chart on the left is for 10 hours later. On each chart the dashed circle is the horizon as viewed from Cape York and the dotted circle is the horizon for places along the N.S.W. border. When facing North hold "N" at the bottom; when facing South hold "S" at the bottom and similarly for the other directions. Only the brightest stars are included and the more conspicuous constellations named. The stars which do not change their relation to one another, moving east to west, arrive at any selected position about 4 minutes earlier each night. Thus, at the beginning of the month the stars will be in the positions shown about one hour later than the time stated for the 15th and at the end of the month about one hour earlier han that time. The positions of the moon and planets which are continually changing in relation to the stars are shown for certain marked days. When no date is marked the position is for the middle of the month.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

APRIL RAINFALL.

(Compiled from Telegraphic Reports.)

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	April	No. of years' records.	April 1946.	April 1947.		April	No. of years' records.	April 1946.	April 1947.
North Coast.	In.		In.	In.	*South Coast—cont'd.*	In.		In.	In.
Atherton	4·42	42	2·20	1·99	Gatton College ..	1·86	44	1·13	..
Cairns	11·23	61	0·84	4·21	Gayndah	1·46	72	0·14	5·42
Cardwell	8·78	71	0·52	1·45	Gympie	3·43	73	4·21	4·66
Cooktown	8·69	67	1·77	0·93	Kilkivan	2·20	62	2·09	4·44
Herberton	3·73	57	0·49	0·83	Maryborough ..	3·81	72	2·50	6·78
Ingham	7·64	51	0·27	0·68	Nambour	6·13	47	6·92	6·21
Innisfail	20·21	62	2·84	4·16	Nanango	1·93	61	1·42	3·45
Mossman	7·41	19	0·88	3·41	Rockhampton ..	2·53	72	0·14	0·44
Townsville	3·29	72	0·03	0·01	Woodford	4·52	55	5·29	2·32
Central Coast.					*Darling Downs.*				
Ayr	2·77	56	0·10	..	Dalby	1·39	73	0·97	1·06
Bowen	2·91	72	0·12	0·29	Emu Vale	1·32	47	1·00	2·18
Charters Towers ..	1·54	61	..	..	Jimbour	1·42	64	0·60	1·48
Mackay	6·31	72	0·53	0·99	Miles	1·43	58	1·78	0·35
Proserpine	6·11	40	0·33	1·21	Stanthorpe	1·70	70	0·79	3·35
St. Lawrence ..	2·73	72	..	0·79	Toowoomba	2·56	71	1·63	2·11
					Warwick	1·60	78	1·22	1·54
South Coast.					*Maranoa.*				
Biggenden	2·15	44	0·58	5·16	Roma	1·28	69	0·25	..
Bundaberg	3·25	60	2·73	1·99	St. George	1·29	62	0·47	0·42
Brisbane Bureau ..	3·66	95	4·11	6·54					
Caboolture	4·48	67	4·48	2·94	*Central Highlands.*				
Childers	2·85	48	1·56	3·74	Clermont	1·64	72	..	..
Crohamhurst	6·68	50	8·77	..	Springsure	1·56	74	..	0·29
Esk	2·89	56	1·51	2·06					

CLIMATOLOGICAL DATA FOR APRIL.

(Compiled from Telegraphic Reports.)

Divisions and Stations.	Atmospheric pressure. Mean at 9 a.m.	Shade Temperature.		Extremes of Shade Temperature.				Rainfall.	
		Mean Max.	Mean Min.	Max.	Date.	Min.	Date.	Total.	Wet Days.
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Pts.	
Cairns	..	86	69	91	1	58	27	421	9
Herberton	..	77	57	84	17	45	28	83	7
Townsville	..	86	67	92	1	59	27	1	1
Rockhampton	..	..	..	..	..	..	..	..	..
Brisbane	30·01	78	62	84	12	56	20	654	12
Darling Downs.									
Dalby	..	77	52	81	1	43	30	106	4
Stanthorpe	..	69	50	74	12	41	24, 28	335	11
Toowoomba	..	72	51	79	12	42	28	211	9
Mid-Interior.									
Georgetown	29·92	89	61	93	16	50	22, 27, 28	..	..
Longreach	30·01	87	59	92	19, 20	43	26	..	..
Mitchell	30·04	79	47	87	21	35	28	..	..
Western.									
Burketown	..	90	64	94	21	57	24, 27	..	..
Boulia	29·98	85	58	94	11	45	29	..	..
Thargomindah	30·03	78	55	88	11	39	28	..	..

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