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QUEENSLAND AGRICULTURAL JOURNAL

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Event and Comment.

The Governor's Speech.

INTERESTING references to rural industries in the State were made by His Excellency the Governor, Lieutenant-General Sir John Goodwin, in the course of his speech at the opening of the fourth session of the Twenty-fifth Queensland Parliament. Commenting on the increase in land occupation, he said that the Upper Burnett and Callide Settlement had been placed on a firm footing, about 1,400 new settlers having thus been added to the primary producers of the State. Pioneer access roads in that area, totalling 847 miles in length and involving the building of twenty-three bridges, had already been constructed. Water facilities had also been provided for the settlers by the Government. The pastoral industry had also benefited by a wise policy that had already resulted in a very large saving to landholders. Referring to the present revival of interest in the tobacco industry, His Excellency said that the first year's returns from the Mareeba settlement were distinctly encouraging. Notwithstanding the fact that the season in that region was the driest for fifteen years, and only half the normal rainfall was recorded, good payable crops were obtained. Tobacco growing, which is expected to soon develop into one of our more important staple industries, was being given every practical encouragement that our scientific and technical services could devise. New legislation relating to efforts to eradicate the prickly-pear pest had been actively applied. The first matter to determine was the priority areas that would be granted to existing lessees on infested lands. Seven hundred of these settlers had already intimated their willingness to surrender their existing leases in order to obtain a freehold priority right over a living area, subject to developmental conditions.

Land Settlement and Forestry.

CONTINUING, His Excellency said that it was proposed to undertake a vigorous policy of land settlement and forestry administration in North Queensland. A Royal Commission had been appointed to ascertain the ways in which the progress and development of the tropical North could be encouraged, and a definite land settlement and forestry policy had been framed for the next ten years. The Forestry Board, during the year, had carried out economic inquiries into the state of the timber industry and a conference had been convened, as a result of which the Board was commissioned to assist in the devising of ways and means for the rehabilitation of the trade. In the course of the year the Forest Boundaries Committee had been constituted to examine closely all forest reservations with a view to their permanent demarcation, after full consideration of the claims of other rural interests. That committee had already entered upon its onerous and difficult task. Consideration was also being given to a general developmental forestry plan which would be later submitted to Parliament.

Progress in the Primary Industries.

REVIEWING the general progress in the primary industries of the State, the Governor remarked on the extensive development that had taken place in the Dawson Valley irrigation area in which cotton-growing is firmly established. Last year's output of fibre aggregated 1,460,000 lb., yields up to 1,500 lb. an acre being obtained. The 1930 wheat crop was a record for Queensland, both in acreage and yield. Climatic conditions favoured the dairying industry, and were reflected in a production of over 93,000,000 lb. of butter and 13,000,000 lb. of cheese. Of this quantity, over 70,000,000 lb. of butter and 7,500,000 lb. of cheese were exported. There was every prospect that frozen pork export trade would grow greatly in importance. Steady progress had been maintained both in the quantity of wool produced in individual fleeces and the number of sheep, which at the end of December last amounted to 21,795,899—the highest number recorded since 1914. Referring to the activities of the Pasture Improvement Committee, His Excellency said that its work had already proved that it was possible not only to increase the carrying capacity of coastal pastures, but at the same time to increase the nutritive value of the grasses produced.

"A Very Happy Memory."

HIS Excellency's speech was remarkable for a warm personal note, and he spoke as one who, in the course of his term of office, had made himself acquainted intimately with Queensland and its people. "Provided that affairs of State pursue their normal course," he said, "I assume that this is the last occasion on which I shall have the honour of opening Parliament in Queensland. I think that towards the termination of his period of office it is inevitable that a Governor should view matters in retrospect, and it is also inevitable that he should realise his own limitations and feel regrets for omissions, for errors, for imperfect work in which he has fallen short of those standards and ideals of accomplishment to which he aspired to attain. I have felt, and do feel, such regrets, but in one particular sphere I have none but the very happiest experiences on which to look back, and that this is so is due entirely to you gentlemen of the Legislative Assembly and to your predecessors.

I would express my most sincere appreciation of, and gratitude for, the unfailing and untiring courtesy, patience, consideration, and kindness which I have received from both sides of this House ever since the day on which I had the honour to assume office as Governor. After more than four years I may say that my lines indeed have fallen in pleasant places and that, come what may, I have been blessed in very many ways, and not the least so as regards my relationship with the gentlemen of the Legislative Assembly. I shall always be proud to recollect this happy relationship and to remember that I can number amongst my personal friends gentlemen on both sides of this House. To you and to the people of this State I tender my most sincere gratitude, for to you and to them is due the fact that my term of office will always be for me a very happy memory. Intense appreciation of this State, love for its people and its children, and sincere hopes and prayers for the future progress and prosperity of Queensland and Queenslanders, will be foremost in my heart so long as I live.''

A Northern Asset.

THREE things in particular evidently impressed the Governor, Sir John Goodwin, on his recent tour of North Queensland—the interest evinced in tobacco growing, the recuperative climate of the Atherton Tablelands, and the attractions that the Great Barrier Reef offers to tourists. He returned from his mission inspired by great hopes of the future of the Mareeba tobacco-growing industry. He brought back with him a supply of the bright lemon-coloured leaf in the state in which it was removed from the flue-curing kilns. He declared that it provides an enjoyable smoke. In the course of his tour, which embraced most of the towns up the coast as far as Cairns, His Excellency made a special point of seeing the school children. He actually saw the pupils of no less than ninety-five schools—in several cases the children from several schools were gathered together at one centre. He found generally that the children were of a fine type, both mentally and physically. ''I do not think that the immense importance of the tableland from a health point of view is fully recognised,'' he said. ''Situated in the tropical North, it is a natural sanitorium for those people who can there seek recuperation in an invigorating atmosphere. In this respect the tableland is a tremendous asset to the people of the tropical North. My personal belief in Queensland is unshakeable. . . . .''

Science on the Farm.

STRESS was laid by the Minister for Agriculture and Stock (Hon. Harry F. Walker), at the opening of the Wondai Butter Factory recently, on the necessity of the reduction of farm costs. To achieve this he advocated more consideration for dairy herd improvement. The position facing the farmer was that he had either to make slaves of himself and his family or make use of the facilities provided by his Department for herd-testing and scientific direction in other matters pertaining to rural industry. ''If the dairymen of Queensland could give us a further 10 lb. of butter-fat per cow per year it would mean a tremendous increase in our butter trade,'' pointed out the Minister, who went on to explain that that result could be attained by herd-testing, rotational grazing, the fertilization of pastures, and the wider use of machinery. He felt sure that the butter factories would assist their suppliers in having their cows tested. If Australian farmers could produce another bushel of wheat per acre it would mean an enormous increase in our annual returns, while 1 lb. of wool more on every sheep's back would represent, approximately, an additional £4,000,000 to the Commonwealth annually. If all the cows in Queensland yielded 260 lb. of butter-fat per head per year, it would represent an annual increase in production of the value, at the present price, of £4,500,000. Our dairying returns generally showed that there was ample room for herd improvement. At the present time, said Mr. Walker, Queensland producers were getting the highest prices paid in the world for their products. This went to show that the farmer by organising and stabilising his industry would ensure for himself a living wage, besides adding to the general prosperity.

THE QUEENSLAND SUGAR INDUSTRY.

By H. T. EASTERBY, Director of Sugar Experiment Stations.

PART XVII.

(c) Mills and Milling Work—*continued.*

BETTER times were dawning for the Queensland sugar industry though the depression mentioned in the two previous chapters lasted a long time. The proposal that "after the 31st day of December, 1890, no licence to introduce islanders shall be granted," which was carried in Parliament in 1885, was repealed, and planters got a further breathing space for carrying on—that is, as far as cheaper labour was concerned. The elimination of the smaller and less efficient mills gradually took place. More central mills, better equipped, were erected during the 'nineties, and as previously outlined the plantation system began to give way to numbers of small farmers doing their own work and supplying cane to the factories. Many of these men had been labourers, and had naturally a sympathy with their own class, and so they began to employ white labour wherever they could. Gradually, too, the making of white sugars direct for the market was given up and raw sugars were made and sold to the refineries. Labour-saving appliances were introduced from time to time, which helped to cheapen production and manufacture. The industry, of course, had its ups and downs during the 'nineties, owing to being upon the open market, with hostile tariffs against it to a greater or less degree in the other States.

The desire to greatly improve the efficiency and output of the mills then existing may be said to have commenced in earnest when federation was introduced and the Customs barriers were destroyed. Queensland sugar was now to rely on white labour, but it had the whole of Australia for a market. From the period which may be said to have commenced in 1901, steady improvement has been made until we now find our mills manufacturing sugar from less cane than in any other cane sugar country in the world.

For the purposes of comparison, it will be interesting at this stage to show how the large numbers of mills which were listed as operating in the 'eighties had dwindled by 1901, although a few new mills (centrals) had been erected. The following is a list of those mills that had survived up till 1901:—

Above Townsville.—Mossman and Mulgrave, central; Hambledon and Goondi, Colonial Sugar Refining Company; Mourilyan and Ripple Creek, private companies; Victoria and Macknade, Colonial Sugar Refining Company.

Lower Burdekin District and Proserpine.—Kalamia and Pioneer, private companies; Proserpine, central.

Mackay District.—Marian, Racecourse, North Eton, Pleystowe, and Plane Creek, central; Habana, Farleigh, Palmyra, Meadowlands, and Palms, private companies; Homebush, Colonial Sugar Refining Company.

Central District.—Yeppoon, private company.

Bundaberg District.—Qunaba, Bingera, and Fairymead, private companies; Gin Gin, central; Spring Hill, Windermere, Waterview, Sharon, Woondooma, Bellevue, Ashgrove, Miara, Waterloo, Tegege, Bonna, Sunnyside, Pemberton, Ashfield, Annesley, Woodlands, Invicta, and Rocky, private companies.

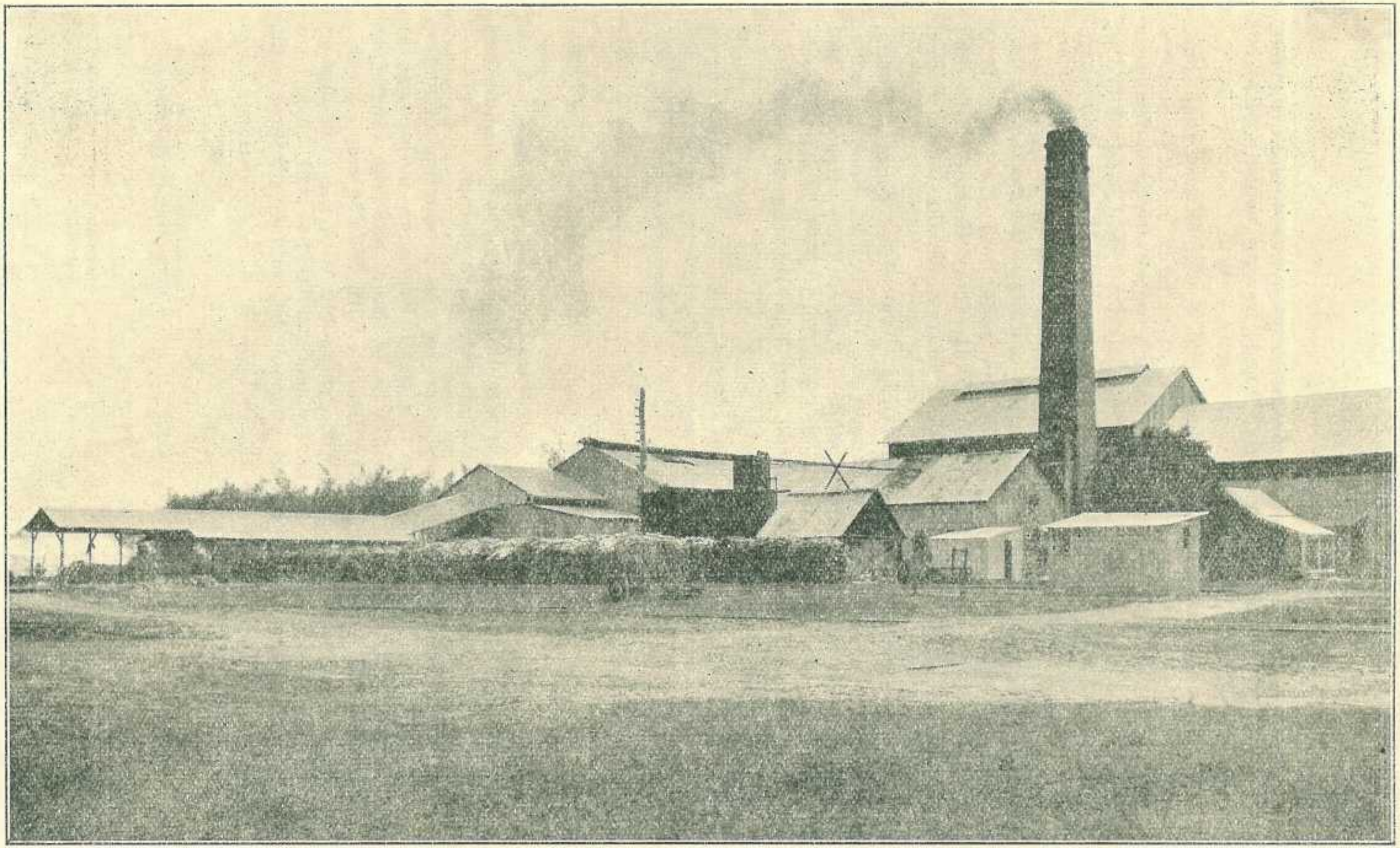


Plate 39.—Old Pleystowe Mill, Mackay, in the 'Nineties.

Maryborough and Isis District.—Childers, Colonial Sugar Refining Company; Isis, central; Doolbi, Knockroe, Goodwood, and Maryborough, privately owned; Mount Bauple, central.

Nambour.—Moreton, central.

Logan and Albert District.—Steiglitz, Eagleby, Carbrook, Alberton, Rocky Point, and Junction, privately owned; Nerang, central; Rosevale and Albert River Milling Company, privately owned.

The above list shows sixty-two mills and it will be seen that there were still a number of small mills existing, principally in the Bundaberg and Logan and Albert districts, most of which were destined to disappear within the next ten or fifteen years. For instance, out of the twenty-two mills shown as still continuing operations in 1901 in the Bundaberg district, only Qunaba, Bingera, Gin Gin, Millaquin, and Fairymead are left to-day, and, although Invicta Mill crushes, it is in a new environment. In that year (1901) the smallest crushing of cane was at the Woondooma Mill, Bundaberg, with 736 tons, and the largest at Hambledon with 74,683 tons. By 1931, the following mills had disappeared:—Ripple Creek, Habana, Palmyra, Meadowlands, Palms, Homebush, Yeppoon, Spring Hill, Windermere, Waterview, Sharon, Woondooma, Bellevue, Ashgrove, Miara, Waterloo, Tegege, Bonna, Sunnyside, Pemberton, Ashfield, Annesley, Woodlands, Rocky, Doolbi, Goodwood, Stegelitz, Carbrook, Junction, Albert River, Rosevale, and Nerang. In the interval between 1901 and 1931, Cattle Creek, Inkerman, Babinda, South Johnstone, and Tully have been erected.

A comparison of the number of mills and the amount of sugar manufactured in 1888 and 1928 is of interest, and is given below:—

Year.	Number of Mills.	Tonnage of Sugar Made.
1888	122	57,960
1928	35	520,620

These figures speak for themselves and show the enormous progress the industry has made in the forty years that have elapsed.

In 1928, which was the record year for the production of sugar, the smallest crushing (excluding the small Beenleigh mills) was at the Maryborough Mill with 22,162 tons of cane, and the largest at Victoria Mill in the Herbert River district, with 252,648 tons of cane. The mill tonnages in 1928, even when compared with the crushings in 1901, will give some idea of the tremendous strides that have been made in mill capacities. For this purpose the tonnage of those mills crushing in 1928 which were also crushing in 1901 are given in the following table:—

Mill.	Tons of Cane Crushed, 1901.	Tons of Cane Crushed, 1928.
Mossman	56,342	78,542
Hambledon	74,683	181,511
Mulgrave	51,429	189,749
Goondi	71,313	173,888
Mourilyan	22,656	161,794
Victoria	65,919	252,648
Macknade	52,535	221,456

Mill.	Tons of Cane Crushed, 1911.	Tons of Cane Crushed, 1928.
Pioneer	68,624	123,864
Kalamia	31,012	159,998
Proserpine	18,682	120,485
Racecourse	25,147	91,350
Farleigh	9,267	92,943
North Eton	15,108	66,216
Marian	27,429	88,387
Pleystowe	21,425	108,995
Plane Creek	26,281	122,425
Qunaba	20,168	43,756
*Millaquin	..	94,980
Bingera	40,708	96,298
Fairymead	44,383	83,581
†Gin Gin (1904)	23,974	30,452
Childers	56,725	82,962
Isis	30,506	88,110
Maryborough	7,368	22,162
Mount Bauple	13,005	24,202
Moreton	9,430	35,364

* Millaquin did not crush cane in 1901; it was then a juice mill and refinery only.

† Gin Gin did not crush in 1901 or 1903, and the crop in 1902 was very small due to the drought, so the tonnage for 1904 has been taken.

Invicta in 1901 was in the Bundaberg district, and its crushing then was 22,734 tons. In 1928, in its new location at Giru, in the Lower Burdekin district, its crushing was 76,494 tons. In the above comparison the small mills operating at Beenleigh have been excluded.

For many years after 1901 there were far too many mills and few of them were supplied with cane to much more than 50 per cent. of their capacity. The Northern sugar-mills had a much better record in this respect than those from Mackay south, but many of these did not get anything like the cane they could crush except during abnormally good seasons. In the Southern districts, drought is far more frequent, frosts often cause considerable damage and reduce yields, and in some localities at that time other crops could be more profitably grown. A Board of Inquiry into the Sugar Industry, which sat in 1916, elucidated the fact that there was at that time sufficient milling power in Queensland to manufacture 355,000 tons of sugar, yet the average production for the fifteen years previous was only 176,000 tons of sugar. One of the reasons was the low price for sugar during the war period, and the ever-growing cost of labour, and it was not till 1920 that the industry began to be treated fairly.

In 1915 the general manager of Central Sugar Mills reported that

> "Large areas of cane land situated adjacent to mills and permanent tramways (constructed at considerable cost) are still lying idle. . . . It is very unfair to growers who are endeavouring to keep the mills supplied with cane that such lands are allowed to lie idle. Moreover, the mill is faced with increased expenditure in putting down fresh tramlines to tap outside areas to keep up the cane supply, largely because the lands mentioned are not being utilised for the purpose of canegrowing."

He went on to say that the Government were faced with the necessity of heavy expenditure in connection with the Southern sugar-mills to make them efficient. . . . The records show long years of short supplies, and it was his opinion that when the time arrived for new mills to be established localities within the tropical zone should have first preference and that—

> "the mistakes of the past should be avoided and no mills erected in localities of inadequate rainfall or which are subject to adverse climatic conditions of frost and drought. Already there were some mills erected in the Southern portion of the State under '*The Sugar Works Guarantee Act of* 1893,' which show under present conditions little promise of ever becoming successful business undertakings, and they are an ever-increasing burden to the general taxpayer."

It became generally apparent about 1915 that the sugar industry was being harshly treated in the matter of price. Sugar values were increasing in all parts of the world except Australia. The matter of prices will be dealt with in a later chapter, but it is now sufficient to say that the improvement in the price for Australian sugar made from 1918 on enabled both farmers and millers to get on their feet, and great improvements were introduced into the sugar-mills. In many instances these were completely remodelled and the capacities practically doubled. Growers began to put more land under cultivation, and during the past few years there has been little or no shortage of supply to those mills operating above Townsville. This is due in a measure to the absence of drought conditions in those areas, and also to the completion of the North Coast Railway, which opened up large areas of land hitherto not available.

The following table gives some idea of the great progress the sugar industry has made in the districts north of Townsville since 1916:—

THE DEVELOPMENT OF THE SUGAR INDUSTRY IN DISTRICTS NORTH OF TOWNSVILLE SINCE 1910.

Year.	Locality.	Number of Mills.	Tons of Sugar Produced, 94 net titre.
1910	Above Townsville	7	57,135
	Below Townsville	42	153,621
1913	Above Townsville	7	62,414
	Below Townsville	41	180,423
1916	Above Townsville	9	98,396
	Below Townsville	38	78,577
1919	Above Townsville	9	101,351
	Below Townsville	33	60,785
1922	Above Townsville	9	120,617
	Below Townsville	31	167,618
1923	Above Townsville	9	161,227
	Below Townsville	29	107,948
1924	Above Townsville	9	189,947
	Below Townsville	29	219,189
1925	Above Townsville	10	216,755
	Below Townsville	27	268,830
1926	Above Townsville	10	221,104
	Below Townsville	26	168,168
1927 ..	Above Townsville	10	228,839
	Below Townsville	25	256,906
1928	Above Townsville	10	255,188
	Below Townsville	25	265,432
1929	Above Townsville	10	273,820
	Below Townsville	25	244,696

[TO BE CONTINUED.]

Bureau of Sugar Experiment Stations.

CANE DISEASE IN THE MARYBOROUGH DISTRICT.

The chief disease in the Maryborough district continues to be Fiji disease. Although over the whole area the amount of infection appears to be slightly less than last year, on a number of farms, particularly those situated on the island plantation, the position is still very unsatisfactory. It has been proved over and over again that this disease can be controlled by the simple practice of using disease-free plants and the subsequent rogueing of any diseased stools. If healthy plants are used very little rogueing will be required, and the cost will be negligible. Such growers are therefore urged to obtain their cane for this year's planting from approved sources, and make an effort to eradicate this comparatively readily controllable disease. Fiji disease was recently found on two farms in the Yerra district, and growers in that locality should now be on their guard and be particularly careful in their selection of plants.

The Pialba section is extremely fortunate, inasmuch as, with the exception of Mosaic, there are no major diseases present. In order to preserve this desirable state of affairs it is essential that no cane should be brought into Pialba from outside districts, except under the supervision of an officer of the Bureau. In order to prevent the introduction of Fiji diseased plants from adjoining areas a Proclamation has just been issued declaring the parishes of Maryborough, Bidwell, Tinana, Walliebum, and Young to be a quarantine area. Under the conditions of the Proclamation no cane plants may be sent out from these parishes without the written permission of an inspector under the Diseases in Plants Act. Mosaic is confined to a small number of farms, being serious in those cases, chiefly due to the presence of the variety Shahjahanpur 10, and the growers concerned should obtain their plants from other farms.

In order to assist farmers to obtain suitable cane for planting purposes a list of farmers having such cane is appended. This is not a complete list of the disease-free farms of the district, but merely represents those which have been inspected recently. Any further inquiries regarding cane for plants should be made to the Field Pathologist, Mr. N. L. Kelly, Sugar Experiment Station, Bundaberg:—

S. Seamer, Saltwater Creek; F. C. D. Pohlman, John street North; B. Meyer, The Pocket; F. J. L. Stellmach, Bidwell; O. Wendland, Magnolia; Mrs. E. Leather and R. Johnson, Teddington; J. Philpott and W. Yull, Tinana; A. S. Berthelsen, T. H. Fielding, and C. H. Reiske, Yerra; A. Didgens and P. Petersen, Pialba; C. H. Wilschefsk, Torquay; R. Campbell, F. Christensen, C. Christensen, Mrs. C. Cohen, C. C. Grinstead, H. Jacobsen, M. B. Lawlor, O. Moes, A. Neilsen, C. E. Tench, and G. H. Whittaker, Nikenbah; B. Andersen and E. J. Poacher, Takura.

ENTOMOLOGICAL HINTS TO CANEGROWERS.

The Director of the Bureau of Sugar Experiment Stations, Mr. H. T. Easterby, has received the following Entomological Advice for August from the Northern Entomologist, Mr. E. Jarvis:—

NOTES ON THE TERMITE PROBLEM.

The most destructive "white ant" occurring in our canefields at the present time is the so-called "Giant Termite" of the Lower Burdekin district. Every effort should be made to control the ravages of this pest, which is reported to be locally spreading rather than diminishing.

Damage caused by these insects consists, firstly, in destruction by the worker and soldier forms in the community of newly planted setts and young shoots arising from same; and secondly, of invasion of the basal portion of cane sticks below ground level, followed by ultimate removal of the entire internal cellular tissue of these canes, which are thus reduced to mere hollow tubes, nothing being left excepting the rind.

Common-sense control methods should be practised whenever possible, the first step in this direction being a careful survey of the extent of the infested area, with a view to discovering sources from which invasion may have originated. Such line of procedure often proves successful where this pest has just made its appearance and not had time to obtain a secure footing. Endeavour to trace as far as possible the path of any tunnels discovered amongst the cane. A stout twig, about 2 feet in length from which the bark has been peeled, will often be found helpful in such work, and enable one to successfully trace a tunnel without risk of losing the course of it through loose ground. Nests of this insect can be destroyed by fumigation with benzine.

Importance of Clean Seed.

During planting operations reject all setts showing indications of tunnelling by beetle or moth-borers. Avoid procuring seed from localities in which either the Giant Termite or the Weevil Borer of cane is known to occur plentifully. It is by means of such diseased seed that the latter insect often obtains a footing in clean canefields and gradually becomes firmly established.

Occurrence of Green Metarrhizium Fungus.

Grubs which are attacked by this insect-destroying vegetable parasite do not decompose, but, retaining their ordinary shape, gradually harden, turning at first white, then olive-green. At this stage of development the body is filled with roots of the fungus, and becoming mummified and of cheese-like consistency can be broken into pieces. Growers would do well to collect all such green, crusted-looking grubs which may be noticed in plough furrows, crush them into powder, and thoroughly mix this with about 100 times the quantity of moist, finely-sifted soil. Such spore-laden earth should then be sprinkled as thinly as possible in furrows when cultivating land known to be grub-infested each season.

Farmers chancing to find specimens of grubs attacked by this vegetable parasite are asked to communicate with the Entomologist at Meringa, as this fungus is wanted for experimental purposes at the laboratory.

GUMMING DISEASE IN THE MORETON DISTRICT.

Owing to the fact that gumming disease is present throughout the Maroochy River area, the control of the disease by means of seed selection among susceptible varieties does not offer any great promise. The Bureau has instituted a system of gumming resistance trials in which all available varieties are being tested for the resistance to this disease. In this connection, a large number of canes have been introduced from abroad, and, in addition, the raising of seedling canes in Queensland is being pushed forward. In 1929 some sixty varieties were planted in trials on the Maroochy River, and on examination at the end of last season the following varieties were found to possess an adequate standard of resistance:—Q. 813, Uba, Chin Chin, B.H. 10/12, S.C. 12/4, H. 227, Co. 210, Co. 213, Co. 227, Oramboo; Korpi, Nanemo, and P.O.J. 2878. In addition three or four Hawaiian canes were held for further tests.

The varieties Q. 813 and Uba are already well known in the district. Some doubt existed among growers as to whether they have the true Q. 813 or not, and consequently an officer of the Bureau was despatched to make a survey of this variety. He reports that the Q. 813 of the Moreton district is the true Q. 813, and, with the exception of a little Q. 1098, this was the only "Q" cane grown.

Chin Chin, B.H. 10/12, S.C. 12/4, and H. 227, while satisfactory from the standpoint of gumming resistance, are poor yielders and cannot be recommended.

The Co. canes have attracted a great deal of attention on account of their vigorous growth and apparent suitability to wet conditions. It must be emphasised, however, that these three varieties have a rather low sugar content, and therefore it would be unwise to plant large areas until their performance on the particular farm has been further studied. In any case they should not be harvested until late in the season.

The three New Guinea canes, Oramboo, Korpi, and Nanemo are canes of good sugar content and should be tried out where possible; of the three, Oramboo appears the most promising.

P.O.J. 2878 has done very well in the very small plantings made to date, and is being propagated as rapidly as possible. It is expected that a distribution will be made next year.

Special mention should be made of the variety P.O.J. 2714 (a bronze-coloured cane). In our Bundaberg trials this variety exhibited pronounced susceptibility to gumming disease, but is more tolerant to the disease under the conditions of higher soil moisture which obtain on the Maroochy River. Nevertheless it has proved definitely susceptible, and it is not expected that this variety will last long. On the other hand it is a most vigorous cane, and provided good seed is available it is thought that it will be justifiable to plant P.O.J. 2714 this year at least, and take the risk of losses due to gumming disease. Any grower who wishes to have any particular source of P.O.J. 2714 inspected before planting is asked to communicate immediately with the Director, Bureau of Sugar Experiment Stations, Brisbane, and arrangements will be made to send an officer to the district.

Quite apart from the use of resistant varieties a very important aspect of the control of gumming disease is the question of drainage. Bad drainage very markedly increases the damage due to gumming disease, and many canes which cannot be grown under present conditions could be cultivated if the drainage were satisfactory.

FERTILIZERS AND THEIR USE.*

By H. W. KERR.

The use of fertilizers is becoming an increasingly important factor in cane production in Queensland. Farmers in all districts have learned that manuring is absolutely essential to successful cane farming, but there are many who have yet to appreciate the value of these materials as an aid in crop production.

There still exists a considerable degree of ignorance regarding the true function of fertilizers in their influence on plant growth. Even farmers who have consistently manured their lands fail to understand just what they are doing when they apply, say, a top dressing of sulphate of ammonia to a crop of ratoons. They know that under favourable conditions the effects on the crop become visible almost immediately, the leaves develop a deep green colour, and the cane puts on a vigorous growth. A frequent explanation is that the sulphate of ammonia acts as a crop "stimulant," but if the use of this stimulant be continued indefinitely, the stage will ultimately be reached when it ceases to produce the desired results. Let us examine briefly the question of plant nutrition, and see how such a theory agrees with the facts which have been revealed by studies in agricultural science.

As recently as the seventeenth century we find a profound degree of uncertainty as to what are the chief factors influencing plant growth. Thus, a careful thinker like Bacon stated as his opinion that water was probably the all-important substance which became elaborated into plant tissues. This view was apparently completely substantiated by the experiments of van Helmont, who grew a willow-tree in a large pot of soil for a period of fifteen years, during which time it was supplied with nothing more than distilled water. Although the plant gained in weight by more than 150 lb., no difference in the weight of soil in the pot could be detected.

Jethro Tull, in 1730, originated the theory that crop roots digested the fine particles of the soil with which they came in contact. As evidence, he showed that intensive tillage resulted in an increased crop, due, as he said, to the production of a greater proportion of fine particles for the nutrition of the plant.

* Paper read at the Second Annual Conference of the Queensland Society of Sugar Cane Technologists in March, 1931, and published by permission of the Society.

Further, it was early known that plants contained carbon, for by incomplete combustion of vegetable matter charcoal was readily produced. The value of incorporating animal and plant residues with the soil was also appreciated, so it is not surprising to find the suggestion being advanced that crops fed directly on the soil humus as their source of carbon; and without soil humus there could be no crop.

Much of the confusion which existed was swept away by the brilliant work of a French investigator, de Saussure, during the early years of last century. By conclusive experiments he showed that crops absorbed their carbon entirely through their leaves in the form of carbon dioxide gas gathered from the atmosphere. From the soil the crop received its water supply, and by chemical analysis of plants he showed that the soil also provided a definite small amount of mineral matter, which is found in the ash when the vegetable matter is burned.

The famous German chemist, Liebig, was a staunch supporter of de Saussure. Between them the "humus" theory was completely overthrown, and the foundations laid for the modern science of agricultural chemistry.

We now know that there are certain essential conditions and requirements necessary for successful plant growth. They may be summarised as follows:—

(1) A suitable medium for the mechanical support of the crop;
(2) Water;
(3) Heat;
(4) Light;
(5) Air, for oxygen supply;
(6) Nutrients.

Heat, light, and oxygen supply are factors essentially beyond our control, and, except under irrigated conditions, the crop is dependent on natural rainfall for its moisture. The provision of a suitable medium for the support of the crop and for the development of its root system comes under the heading of soil tillage and cultivation. The nutrients are the raw materials from which the plant manufactures its tissues, and we must study them in detail to acquire a clear understanding of plant nutrition.

If we should select a stick of cane and determine its composition, we would find first of all that it contained about 70 per cent. of water. The dry matter is largely composed of fibre, sugars, and proteins. If we should burn away all of the vegetable substance, we would find a residue of mineral matter, to the extent of about ¾ lb. from 100 lb. cane. Let us further examine these constituent parts of the cane, and determine the simplest units or *elements* from which they in turn are built up. Sugars and fibre contain only carbon, hydrogen, and oxygen; proteins contain, in addition, nitrogen, phosphorus, and sulphur; the ash is composed of silica, lime, magnesia, potash, soda, iron, and small amounts of other elements. It has been shown that there are ten elements essential to crop growth. These are carbon, hydrogen, oxygen, phosphorus, potassium, nitrogen, sulphur, calcium, iron, and magnesium. If one of these is withheld, crop growth is not possible. The plant usually contains other elements in small amounts, but these are incidental. Where, then, does the crop obtain its supply of essential nutrients, or plant-foods, as they are popularly known?

Water from the soil and carbon dioxide from the air supply all the carbon, hydrogen, and oxygen required; and indeed these elements constitute over 99 per cent. of the cane crop. The remaining seven elements make up between them less than 1 per cent. of the weight of the plant. They are supplied to the crop by the soil, being absorbed through the roots in solution with the soil moisture.

Most agricultural lands are able to supply all the sulphur, magnesium, iron, and lime which a cane crop requires; but it frequently happens that there is a marked deficiency in one or more of the remaining three plant-foods—nitrogen, phosphorus, and potassium. In order then to maintain the highest possible crop yields, it is necessary to supply any deficiency by the application to the soil of materials containing the required nutrients. These concentrated forms of plant-food materials applied in this way are known as *manures* or *fertilizers*.. Such a fertilizer may consist of a substance which supplies only one of these three plant-foods; others contain a mixture of two; while those spoken of as *complete* fertilizers consist of a mixture of all three elements in various proportions.

The following list shows the composition of the chief ingredients employed in the preparation of these mixtures:—

(1) SOURCES OF NITROGEN.

Sulphate of ammonia, containing 20 per cent. nitrogen in the water-soluble condition, as ammonia.

Nitrate of soda, supplying 16 per cent. of nitrogen as nitrates.

Blood, bone, and offal, containing from 3-14 per cent. of nitrogen in the organic form.

(2) SOURCES OF PHOSPHORUS.

Superphosphate, with 22 per cent. of water-soluble phosphoric acid.

Basic superphosphate, yielding 18 per cent. of phosphoric acid, not water-soluble, but readily available to the plant.

Rock phosphate, the naturally occurring material from which the commercial phosphates are manufactured. It contains up to 38 per cent. of phosphoric acid in a slowly soluble condition.

Bone, containing about 22 per cent. of phosphoric acid, in addition to a small amount of nitrogen.

(3) SOURCES OF POTASSIUM.

Muriate of potash, yielding 50 per cent. of water-soluble potash.

Sulphate of potash, with 48 per cent. of water-soluble potash.

Of the nutrients which are taken up in solution by the roots, all except nitrogen are ultimately derived from the rock minerals found in the soil. Under the action of the destructive forces of nature, these minerals are undergoing a continuous process of breaking up and decay, and the resulting decomposition products are thus made available for crop nutrition. Obviously, the nature of the products of decay will be governed by the composition of the minerals from which they are derived. Therefore soils formed from rocks of different composition will vary widely in the relative amounts of the different plant foods found in the soil solution. One soil may be able to supply an abundance of available potash, while the phosphorus supply is decidedly deficient.

Such is the case with many of our alluvial soils of the North derived from granite. The Woongarra red volcanic loam, on the other hand, is notably deficient in the amount of available potash which it is able to provide for crop needs.

At first sight it would appear to be a simple matter to determine what a soil lacks, in order to provide for any plant-food deficiency. Chemical analysis of the soil would show the percentage of the various nutrients present, and the earlier soil chemists eagerly seized on this method of investigation. But it was soon found that the method was often misleading. A soil may often contain 10,000 lb. of potash per acre, yet it is incapable of supplying the modest requirements of a 20-ton crop of cane—which is only about 80 lb. of potash. The fact is that the crop can use the potash only when it is in the so-called available condition; and the amount of potash made available to the crop during its growth period will depend on the rate at which the potash-bearing minerals decay under the natural soil conditions.

The average of a large number of analyses of Queensland cane crops shows that 1 ton of cane (including tops and trash) absorbs from the soil—

2 lb. nitrogen.
1 lb. phosphoric acid.
4 lb. potash.

A 30-ton crop will then require—

60 lb. nitrogen.
30 lb. phosphoric acid.
120 lb. potash.

Or, expressed in terms of common fertilizer constituents—

300 lb. sulphate of ammonia.
135 lb. superphosphate.
250 lb. sulphate of potash.

Total 685 lb. of the mixed fertilizer.

In addition, excessive rains during the wet season result in the leaching away of a further amount of the available plant-food before the crop roots are able to absorb it. Hence we can reckon that for our 30-ton crop the soil must be able to make available plant-foods considerably in excess of the amount contained in the 685 lb. of mixed fertilizer as calculated. In its virgin state, the soil might readily provide in a year all of the plant-food required by even a 60-ton crop. Under scrub vegetation, for instance, there is a considerable supply of available plant-food continually passing through the cycle—(*a*) absorption by tree roots; (*b*) passing into the leaves; (*c*) returning to the soil when the leaves die and fall; (*d*) decomposition of the vegetable matter in the soil to return the plant-food to the soil solution for reabsorption by the plant roots. When the natural vegetation is cut down and burned, this cycle is interrupted, and the available plant-food is diverted for use by the cane crop. Now, unlike the natural scrub growth, where all crop residues are returned to the soil, the cane, with all its plant-food, is removed from the land. Further, intensive cultivation of the soil stimulates the decomposition of humus and mineral matter; and some of the plant-food supply thus made available will be leached from the soil before the crop roots are sufficiently extensively developed to absorb it. Unless some attempt is made to compensate for this rapid removal of plant-food, the soil supply must become seriously depleted, with a consequent falling-off in crop yield.

This has been the story throughout the Queensland cane areas. Certain soils have been able to maintain a supply of nutrients for a longer period than others, but even the most fertile lands will require, sooner or later, substantial additions of fertilizer if their fertility is to be maintained.

It has been stated that chemical analyses do not tell us absolutely what particular nutrient or nutrients are lacking in a soil. Certain soil tests do, however, provide us with a very useful guide in this respect, but the most reliable method of determining any deficiency is by means of direct field experimentation. Our problem is essentially this: Under the existing conditions of temperature, moisture supply, cultivation methods, &c., what crop might normally be expected? Provided other conditions are favourable, if our unfertilized crop falls below this value we might reasonably suspect that there exists a plant-food deficiency. We have already seen what a ton of cane requires in this respect; and we must therefore add to the soil at least the deficit between what the soil can normally supply and the total plant-food requirement of our crop.

This is stating the problem in its simplest terms, but actually the question is much more complex. However, the illustration should make it clear that the *kind* and *amount* of plant-food necessary to restore the balance of crop nutrients demanded by the increased crop might differ markedly from soil to soil. Unfortunately we have no method of determining the amounts of each plant-food which the soil can supply, and therefore must ask the soil the question by means of plot experimentation. If our experiment is well planned and carefully carried through, we will receive our answer in simple terms. As climatic and other environmental factors are by no means constant from year to year, our crop response to the same treatment will vary accordingly. By continuing our experiments over a period of years, it becomes possible for us to arrive at an accurate approximation of the kind and amount of fertilizer which will give, on the average, the most profitable return from fertilizing. The problem naturally becomes complicated by economic considerations, such as the fluctuating value of the crop, the purchase price of fertilizer constituents, &c. But our experiments have shown that under the present conditions it is possible to derive highly profitable returns from added fertilizer, provided that it contains the correct ingredients applied in the correct proportions.

We are now in a position to understand why the sulphate of ammonia alone gave splendid returns for a time, but later it ceased to increase the crop yield. The entire reserve of nitrogen in the soil is bound up in the soil organic matter or *humus*. This portion of the soil is the natural food of the numerous micro-organisms which live in the soil, and in the course of decomposition of this substance the nitrogen ultimately becomes available to our crop in the form of nitrate. If no attempt be made to restore the nitrogen supply by the ploughing under of leguminous crops, or the addition of fertilizers, the reduced supply of available nitrogen under our Queensland conditions rapidly becomes a limiting factor in crop growth. The sulphate of ammonia discussed above furnished a supply of nitrogen which, in becoming rapidly nitrified and made available for crop growth, produced its visible effects very readily.

So long as the nitrogen supply w. s the only factor limiting crop production the addition of sulphate of ammonia alone was all that was necessary. Conditions similar to these actually exist on many of the rich Javan cane lands, and for many years the application of nitrogenous fertilizers alone has maintained their characteristically high degrees of productivity.

If, however, the phosphate or potash supply begins to enter as a limiting factor, the efficacy of the nitrogenous fertilizer alone will be seriously impaired; and if the situation becomes particularly acute, the response to nitrogen may be completely annulled. Hence, it is not a question of the failure of our "stimulant," but rather the entrance of new deficiencies for which no provision is being made. What we are actually adding in fertilizing is a concentrated form of plant-food, and the intelligent use of these materials is the true solution of the permanent productivity of our soils.

THE CONTROL OF THE BRONZE ORANGE BUG.

By W. A. T. SUMMERVILLE, B.Sc., Assistant Entomologist.

FOR some time past experiments have been in progress in an endeavour to find some more efficient method of combating the Bronze Orange Bug (*Rhœcocoris sulciventris* Stal.) than those which had previously been devised.

These efforts have now met with success. A series of tests have been conducted which show conclusively that a spray made up and applied as described below can be confidently recommended for use against this pest.

The tests have been made at each season of the year, and it was found that the spray, though somewhat effective against all immature stages of the insect, gave by far the best results against the second or over-wintering stage.

This is very fortunate for until the third instar is reached the insect does very little damage to the trees.

As regards the efficacy of the spray against the older-stage bugs the kills obtained in the experiments varied from 60 per cent. to 80 per cent. according to the stage in which the pest was sprayed.

Results with Second Stage Bugs.

The final test was made on the 21st May, 1931. On that day eighteen trees heavily infested with second-stage bugs were sprayed. The varieties used were Fewtrell early mandarins and Late Valencia oranges. The former trees were very thickly foliaged and were not less than 12 feet in height. These trees then gave as difficult conditions for spraying as would ordinarily be met with in this State.

Rain commenced to fall shortly after midnight on the 21st, and thus some of the dead bugs were undoubtedly lost. The trees were examined on the 26th May, and large numbers of dead bugs were seen on the leaves and under the trees. As tapping would have resulted in knocking off too much fruit, only two trees were so treated. The following are the particulars obtained from these tapped trees:—

Tree Number 1.—Total number of bugs found, 792; number of these alive, 49. Apparent kill, 93·82 per cent.

Tree Number 2.—Total number of bugs found, 458; number of these alive, 18. Apparent kill, 96·1 per cent.

Grand total from two trees, 1,250; number alive on two trees, 67; number dead on two trees, 1,183. Apparent kill, 94.64 per cent.

The kill is stated as apparent as it is not possible to state that every bug was collected. However, the factors operating against the finding of the living bugs, it is considered, are not so numerous as those which tend to prevent the finding of the dead ones. This is borne out by the fact that an examination was made of the ground one week after the test was completed, and 102 more dead bugs were found. A light tapping brought down only one more live bug. These 103 insects are not included in the figures given above. They apply to Number 1 tree.

In regard to the other sixteen trees sprayed in this experiment, thorough examinations have been made, and it appears that an equally good result has been obtained on every one of them.

The previous tests against this stage of the bug gave similar figures.

Effect of Spray on Trees.

The effect of the spray on the trees has been given due consideration, and from all the experiments it is known that except in the very hot weather the trees suffered no ill effects whatsoever. Indeed, there is evidence that apart from its action on the Bronze Orange Bug the spray has other insecticidal value and possibly has some fungicidal properties also.

Thorough Application Necessary.

The spray is purely a contact one, and it cannot be too strongly emphasised that the results obtained by its use will depend absolutely on the thoroughness of the application. It is therefore recommended that if at all possible a power pump be used and the pressure kept as high as practicable.

Time of Application.

As regards time of application it will be found that the best results will be obtained by spraying as soon as possible after the insect reaches the second stage. In normal years this will be towards the end of March or early in April.

Unfortunately, it has not been possible to finalise the tests in time for the spray to be used generally at the best time this year, but growers will gain considerable benefit by spraying any time before the bugs moult into the third stage.

Under normal circumstances it is advisable to wait only until no more eggs are being deposited by the adults.

On account of an oil being one of the ingredients the spray must not be used in the very hot weather.

Preparation of Spray.

The formula of the spray is as follows:—10 lb. resin, 3 lb. caustic soda (good commercial quality), 1½ lb. fish oil, 40 gallons water.

The spray is prepared in the following manner:—Grind up the resin as finely as practicable. Mix the resin and caustic soda while dry. Put one-twentieth of the total volume of water into a container in which it can be boiled. It must be remembered that there will be considerable expansion when the solution boils, and the container should therefore be large enough to allow for this and thus eliminate the possibility of boiling over taking place. In small lots it was found that not more than 2 gallons of water should be put in a 4-gallon container. The addition of the solids, of course, increases the total volume.

Add the mixture of the resin and soda to the water and boil until a clear, dark solution is obtained, stirring occasionally to prevent sticking to the bottom. This boiling will take somewhere about two hours.

When the clear solution is obtained, add the fish oil and allow to boil for a few minutes to ensure emulsification of the oil. This stock solution is then ready for dilution—one part of stock solution to nineteen of cold water.

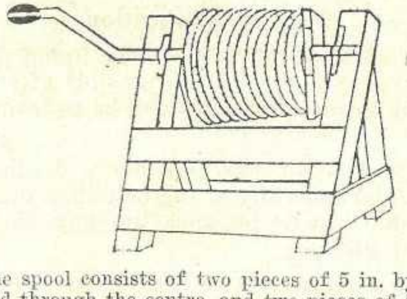
It will be found that, on cooling, the above stock solution deposits a good deal of solid. It is therefore advisable to draw on the stock only while it is hot. Most barrels hold either 40 or 75 gallons. It is then a good plan to divide the stock up into lots of 2 or 3¾ gallons as soon as it is prepared.

Before commencing to spray allow the agitator to work for a few minutes so as to make sure that an even solution is obtained.

The cost of the spray is about 2d. per gallon in small lots. It is an excellent spreader.

BARBED-WIRE WINDER.

The barbed-wire winder shown in the illustration can readily be made from material found on every farm, and it winds the wire on a spool just as neatly as is done in the factory. Two V-shaped end supports, 36 in. long, are made of 4 in. by 2 in. timber, the ends being spiked and bolted together. The supports are inverted, and cross-pieces are nailed on, the cross-pieces being about 30 in. long. A strap-iron bearing is screwed on each support near the top, or, if preferred, a ¾-in. hole can be drilled through the ends of the V supports to serve as bearings instead of the strap-iron pieces. A ¾-in. pipe or rod is bent to the shape of a crank, and a ¼-in. hole is drilled through the crank about 6 in. from the straight end, so that the spool can be



securely attached. The spool consists of two pieces of 5 in. by 1 in. by 16 in. wood, with a ¾-in. hole drilled through the centre, and two pieces of 5 in. by 1 in. by 20 in. wood nailed across the first. The winding crank is pushed through the bearings of the frame and holes in the spool, and a 6-in. spike or round piece of iron held by ordinary fence staples driven through one board of the spool keeps the spool securely on the crank.—"Farmers' Advocate" (South Africa).

EXPERIMENTS WITH THE HEAT TREATMENT OF FLY-INFESTED FRUIT.

By J. A. WEDDELL, Assistant Entomologist.

FOLLOWING on correspondence with the Committee of Direction of Fruit Marketing this Department decided to investigate the recently-evolved American heat-treatment method of handling fruit-fly-infested fruit. During last summer experiments were accordingly carried out to determine whether it would be at all applicable to Queensland conditions and to fruits other than citrus.

American Method.

The treatment of the citrus fruit as carried out in North America consisted of heating the fruit to a temperature between 110 deg. Fahr. and 112 deg. Fahr. (not to go above 115 deg. Fahr.) at the centre of the fruit and holding it at that temperature for a period of eight hours in an atmosphere saturated with water vapour. It had been found that this temperature was effective against the insect concerned (the Mediterranean fruit fly) without either being harmful to the fruit, affecting the flavour and eating qualities, or inducing the growth of rots. The saturated atmosphere ensured that drying and withering of the fruit did not take place. While details of the apparatus used in America were not given, it was indicated that the cases of fruit were stacked in insulated rooms and "conditioned air"—that is, air at the right temperature and humidity was pumped at low pressure through ducts in the floor of the chamber at the rate of five to six thousand cubic feet of air per minute for a chamber holding a carload of fruit, approximately 500 cases. Specifications of the apparatus have been asked for, and until these come to hand a definite idea of costs cannot be obtained. It has, however, been ascertained that a standard air-conditioning plant to handle that volume of air would cost approximately £350 fitted up in Brisbane. Allowing another £250 to £350 for a small building containing a chamber to treat 500 cases, housing for the plant and a small reception area, which appears to be quite a conservative estimate, it is then seen that an outfit would cost £600 to £700. This brief approximation is presented so that some consideration may be given to the financial aspect of the method.

Apparatus used in Brisbane.

Apparatus giving the required conditions in the manner described was, of course, not available for the Brisbane experiments, but through the courtesy of Dr. L. S. Bagster, of the University of Queensland, the use of a small experimental banana-ripening chamber was obtained, and this, with slight adjustments, gave the required conditions of temperature and saturated atmosphere. The apparatus consisted of an insulated chamber heated by means of carbon filament lamps, the number and candle power of which were adjusted so that a temperature somewhat in excess of the one required was obtainable. Exact control was then given by means of a relay circuit operated by contacts fitted in a bulb of toluene. The heated air was circulated by means of a fan, first through a baffle of wetted cloths dipping in water, and then throughout the chamber. The essential point to be noted is that in the experiment the same enclosed air was continuously circulated, whereas in the larger apparatus as used in America fresh-conditioned air would be continuously supplied. Owing, however, to the small volume of the chamber and to the relatively small quantity of fruit placed therein at each treatment it was not considered that the difference of method would be material. Furthermore, an examination of the air after one of the treatments showed only 0·6 per cent. CO_2 to be present.

The chamber was fitted with wet and dry bulb thermometers, and a long-stemmed thermometer was available for recording the temperature at the centre of the fruit.

Preliminary Trial.

On 24th February, after the apparatus had been adjusted to the required conditions, a preliminary trial was given for the purpose of observing the time required for the heat to penetrate to the centre of one fruit. For this purpose the long-stemmed thermometer was inserted into an apple which was packed into a case, and it was so arranged that the scale of the thermometer protruded to the exterior of the chamber.

Table I. shows the results from this trial. It will be seen that while the chamber had arrived at the required temperature in one hour, a total of four hours was necessary before the centre of the fruit became suitably heated.

TABLE I.

TEMPERATURES TAKEN AT HALF-HOURLY INTERVALS SHOWING PENETRATION OF HEAT TO CENTRE OF FRUIT.

Time of Reading.	Temperature—Deg. Fahr.		Relative Humidity.	Temperature at Centre of Apple—Deg. Fahr.
	Dry Bulb.	Wet Bulb.		
			Per cent.	
24th February, 1931—				
2.40 p.m.	77	70·7	72	78·3
3.10 p.m.	99·5	98·6	96	79·2
3.40 p.m.	111·2	109·8	95	83·1
4.10 p.m.	112·1	111·2	96	90·5
4.40 p.m.	115·7	114·5	97	97·7
5.10 p.m.	110·2	110·2	100	103·1
5.40 p.m.	110·3	110·3	100	106·5
6.10 p.m.	113·4	113	98	109·1
6.40 p.m.	111·2	111·2	100	110·5

Experiment I.

At 8.30 p.m., 25th February, the following fruit was placed in the chamber:—Two oranges (normal), two oranges (fruit fly infested), three peaches (fruit fly infested), three persimmons (fruit fly infested), a half a bushel of apples (mostly infested with codling moth). It is necessary to state that a certain difficulty was experienced in obtaining a sufficiency of suitably stung fruit for the purposes of the experiments. Throughout the experiments the fly concerned was the Queensland fruit fly (*Chætodacus tryoni* Frogg.).

The chamber was opened at 8.30 p.m., 26th February, thus allowing the four hours which had been proved necessary to heat up the fruit together with the eight hours' treatment. Sample temperatures taken during the treatment were as follows:—

TABLE II.

Time of Reading.	Temperature—Deg. Fahr.		Relative Humidity.
	Dry Bulb.	Wet Bulb.	
25th February, 1931—			Per cent.
8.30 p.m.	86	84·2	92
9.50 p.m.	114	113	97
10 p.m.	110·3	110·3	100
10.10 p.m.	112·7	112·5	99
10.20 p.m.	110·3	110·3	100
10.30 p.m.	112·5	112·5	100
10.40 p.m.	110	109·8	99
26th February, 1931—			
8.35 a.m.	111·6	111·2	98

A quarter bushel of apples and samples of the other fruits were held as controls.

Portion of the treated fruit was opened immediately after treatment, when it was found that the fruit fly maggotts were motionless. They were later proved to be dead; no living maggotts or codling moth larvæ were seen in any of the treated fruits subsequently. Apples were tasted at intervals and were found to be unaffected in flavour by the treatment. Five days after the treatment some apples were noticed with a "cooked" appearance. The tissue while still remaining white was soft and watery, the skin was loose, broken, and wrinkled, and the normal reddish colour of the skin was bleached to a dirty cream. A brown heart often accompanied the softening of the fruit. Others of the apples became affected also with normal brown rotting and bruising. By 9th March, eleven days after treatment, only one apple remained unaffected from one rot or the other. One orange kept until then was of good flavour.

The larvæ in the untreated fruit were still alive at the end of eighteen days. Although rotting did take place in the untreated fruit, in no instance was it of the same nature as the "cooked" symptom of the treated.

Experiment II.

Half a bushel of apples (codling moth and slight fruit fly infestation), a quarter bushel of pears (fruit fly infested), and three peaches (fruit fly infested) were treated from 10.45 a.m. to 10.30 p.m., 27th February. One third of the quantity of apples was retained untreated for comparison.

Temperatures taken during this run were as shown in Table III. It will be noticed that the relative humidity was somewhat variable in this instance.

TABLE III.

Time of Reading.	Temperature—Deg. Fahr.		Relative Humidity.
	Dry Bulb.	Wet Bulb.	
27th February, 1931—			Per cent.
10.45 a.m.	77	71·6	79
12 noon	114	110·9	88
12.30 p.m.	110·9	108·5	92
4.30 p.m.	110·9	110·9	100
10.30 p.m.	109·4	107·7	94

No living insects were seen in any of the treated fruits after removal from the chamber. A total of ten apples became affected with the "cooked" symptom, the first two showing up on 4th March (five days). All of the apples except five developed soft areas or rots by 19th March (twenty days after treatment). Five apples were apparently unaffected by the treatment. The pears were unfit for food because of fly infestation prior to the treatment and so could not be sampled later.

The control fruit was examined at intervals, but none were seen exhibiting the "cooked" appearance, although rots of various kinds showed up in a number of them.

Experiment III.

Eight grape fruit showing fruit fly stings were treated from 10.50 p.m., 27th February, to 11.5 a.m., 28th February. Six grape fruit were held as controls. The fruit was matured but unripe. Temperatures taken during the treatment were as shown in Table IV.

TABLE IV.

Time of Reading.	Temperature—Deg. Fahr.		Relative Humidity.
	Dry Bulb.	Wet Bulb.	
27th February, 1931—			Per cent.
10.50 p.m.	85·1	83·3	91
11.20 p.m.	115·2	114·9	99
11.30 p.m.	110·9	110·5	98
28th February, 1931—			
9 a.m.	112·7	112·7	100
11.5 a.m.	111·2	111·2	100

The fruit of both the treated batch and the control was examined at intervals. Although batches of eggs were dissected from both lots, at no time was it possible to find any hatched larvæ. Whereas, however, by 16th March (sixteen days after treatment) the eggs in the treated batch had become brownish, some of those that remained in the control were still healthy in appearance. This record of the non-development of the larvæ in green citrus is corroborative of field observations made by Mr. W. A. T. Summerville, Assistant Entomologist, Nambour.

The texture of the fruit remained unaffected by the treatment.

Experiment IV.

A small case of fruit-fly-infested oranges was treated from 9 p.m. 4th March to 9.20 a.m. 5th March. The fruit was variously affected, recent stings to mature larvæ being represented. Similar fruit was held as a control. The following temperatures in Table V. were taken:—

TABLE V.

Time of Reading.	Temperature—Deg. Fahr. Dry Bulb.	Temperature—Deg. Fahr. Wet Bulb.	Relative Humidity.
4th March, 1931—			Per Cent.
9 p.m.	82·4	78·8	84
9.30 p.m.	96·8	95·1	94
9.45 p.m.	106·7	105·8	97
10 p.m.	113	111·2	94
10.10 p.m.	110·9	110·2	97
10.20 p.m.	111·2	111·2	100
5th March, 1931—			
9.20 a.m.	110·8	110·8	100

No living maggotts were seen in the treated fruit. Unhatched eggs were still present in stings that were examined up to 20th March (fifteen days after treatment). Unfortunately, however, unhatched eggs were similarly found in stings in the control fruit on that date. Maggotts, however, remained alive in the control fruit. No difference in flavour could be detected between the treated fruit and the control.

Experiment V.

A small case of quinces infested by fruit fly was treated from 10 a.m. to 10 p.m. 6th March, some of the fruit being held as a control. The temperatures given in Table VI. were recorded.

TABLE VI.

Time of Reading.	Temperature—Deg. Fahr. Dry Bulb.	Temperature—Deg. Fahr. Wet Bulb.	Relative Humidity.
6th March, 1931—			Per cent.
10 a.m.	76·2	75	94
10.15 a.m.	95·7	91·4	84
10.30 a.m.	106·3	102·4	84
10.45 a.m.	114	108·2	81
11.30 a.m.	111·2	111·2	100
11.45 a.m.	110·5	110·5	100
2.30 p.m.	110·9	110·9	100
4 p.m.	110·3	110·3	100
5 p.m.	111·1	111·1	100
9.15 p.m.	110·7	110·7	100
10 p.m.	110·3	109·4	97

The infesting larvæ were killed in the treated fruit. A comparison of flavour was not possible owing to the inedibility of the fruit, but there was no obvious difference in the appearances of the two batches.

Summary of the Experimental Results.

1. It was found possible to approximate fairly closely to the requirements of temperature and relative humidity as laid down for citrus fruit treatment in Florida.

2. It was proved that exposure to temperatures between 110 deg. Fahr. and 115 deg. Fahr. at approximately 100 per cent. relative humidity for eight hours would kill the larvæ of the Queensland fruit fly (*Chætodacus tryoni* Frogg.) infesting apples, oranges, peaches, pears, and persimmons. Incidentally it was also found that codling moth larvæ were killed by those conditions.

3. Ability to kill the eggs of the Queensland fruit fly in oranges and grape fruit was not proved owing to the failure of eggs laid in the control fruit to hatch. There is, however, no reason to doubt that the eggs would be killed.

4. A number of the apples became peculiarly soft, watery, and loose-skinned, presenting a "cooked" appearance some five days or more after treatment, and this symptom appeared distinct from various storage rots and bruises. Apparently these fruits were affected by the treatment.

5. Only fruit-fly-infested fruits of peach, pear, and persimmon were used, so the keeping qualities of treated fruits could not be ascertained. It is likely that such fruits would, however, be more adversely susceptible than apples to the treatment.

6. The flavour of the citrus fruit was unaffected.

Discussion.

It has often been stated in connection with the fruit fly problem that if there were available some method of killing any eggs or very young larvæ that were present in the fruit at the time of packing a saving of fruit and of otherwise wasted labour of handling and cost of freight would be effected. No matter how carefully the fruit is inspected when being packed a percentage, during a serious fruit fly season, contains unnoticed recent stings, and by the time this fruit has arrived at the market the work of the insects has become obvious, and the fruit is rejected. It has consequently been argued that any practical method of reducing these losses when they occur would be of value. Consideration must, however, be given to some general principles to see how far this contention is borne out.

An acceptable method would need to fulfil the following conditions:—

1. It must be effective in killing the insects within the fruit.

2. It must accomplish this without injury to the tissue of the fruit or to the eating qualities, either immediate or showing up at a later date in comparison with similar untreated fruit.

3. The treatment must occupy as short a time as possible so as to enable the marketing of the fruit without undue delay, and also to save as little duplication of apparatus as possible, duplication that would be necessary in order to handle the incoming fruit if the process were a long one.

4. The apparatus should not be of a very expensive type nor entail any considerable upkeep, as under Queensland conditions of relatively scattered fruitgrowing many sets of the apparatus would be needed in order to provide each centre with a suitable outfit.

As well as being able to fulfil these conditions it must also be definitely established that the fruit fly losses of the type mentioned (that is, recently stung fruit unobserved at the time of packing) are generally of a sufficient magnitude to warrant the expense entailed.

The heat method of treatment in relation to Queensland conditions can now be considered.

It must be recognised that the treatment was originally designed in North America as a quarantine measure and not merely to save the actually stung fruit. The Mediterranean fruit fly had been found in a very important citrus district which was also in relative proximity to the huge fruit industry of California and other States. As a portion of a heroic effort to prevent the spread of the fly and the consequent damage to the whole industry, all of the fruit from a large area surrounding the infestation was subjected to treatment before leaving the area either by the heat method as herein described or by cold storage at a temperature of 30-31 deg. Fahr. for a period of fifteen days. It was absolutely essential that not a single fruit containing living fruit fly in any stage should be exported from the infested district.

Here in Queensland the fruit fly is already present throughout the deciduous and citrus fruit districts, and no comparable saving to the industry as a whole could follow the treatment of the fruit. The incidence of fruit fly infestations would not be noticeably affected.

When packing fruit, all stung fruits that are seen are rejected, and no matter how satisfactory were the methods of treatment this practice obviously could not be varied. The only saving of marketable fruit that would be effected by the heat treatment would be the fruit which had been recently stung but which was overlooked when packing.

As the treatment would need to be applied as soon as possible after picking the fruit in order to prevent damage to the tissue by young larvæ, a treatment plant would be necessary at each railing centre at least, and a large capital expenditure would thus be involved. However, from the point of view of the possible establishment and extension of export trade, particularly in citrus fruit, wherein the fruit might require a guarantee of freedom from living fruit fly in any stage, this method of treatment may eventually prove worthy of consideration.

The method of treatment would need to be modified somewhat in order to be suitable for use in the deciduous fruit industry, owing to the indicated risk to the tissue of such fruits, and the modifications necessary could be determined only after considerable experimental work, even supposing such modifications to be possible.

TO SUBSCRIBERS—IMPORTANT.

Several subscriptions have been received recently under cover of unsigned letters. Obviously, in the circumstances, it is impossible to send the journal to the subscribers concerned.

It is most important that every subscriber's name and address should be written plainly, preferably in block letters, in order to avoid mistakes in addresses and delay in despatch.

CLIMATOLOGICAL TABLE—JUNE, 1931.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Atmospheric Pressure. Mean at 9 a.m.	Shade Temperature.						Rainfall.	
		Means.		Extremes.				Total.	Wet Days.
		Max.	Min.	Max.	Date.	Min.	Date.		
Coastal.	In.	Deg.	Deg.	Deg.		Deg.		Points.	
Cooktown	30·04	81	71	84	13,14,15	62	29	334	14
Herberton	..	71	56	75	16, 30	40	26	166	15
Rockhampton	30·16	77	58	85	12	45	17	37	11
Brisbane	30·21	71	54	79	12	46	16	57	10
Darling Downs.									
Dalby	30·22	69	46	78	11	34	27	133	3
Stanthorpe	..	61	40	72	11	26	14, 16	205	8
Toowoomba	..	63	45	72	8, 11	33	27	140	4
Mid-Interior.									
Georgetown	30·03	87	63	91	12	56	18, 30	0	..
Longreach	30·12	79	52	88	11, 18	40	26	25	1
Mitchell	30·20	68	45	82	11	33	27, 1	134	4
Western.									
Burketown	30·04	85	63	92	13	52	26, 27	0	..
Boulia	30·10	78	51	90	10	40	1	21	2
Thargomindah	30·17	64	47	82	10	40	1	195	4

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF JUNE, IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1931 AND 1930 FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	June.	No. of Years' Records.	June. 1931.	June. 1930.
North Coast. ..	In.		In.	In.
Atherton	1·60	30	2·05	1·14
Cairns	2·80	49	5·80	3·40
Cardwell	2·02	59	1·14	0·70
Cooktown	2·03	55	3·34	4·00
Herberton	1·03	44	1·66	0·57
Ingham	2·35	39	1·60	2·92
Innisfail	7·13	50	11·17	11·26
Mossman Mill ..	2·05	18	3·95	2·29
Townsville	1·32	60	0·10	1·37
Central Coast.				
Ayr	1·46	44	0	1·71
Bowen	1·64	60	0	3·28
Charters Towers ..	1·31	49	0·01	1·86
Mackay	2·68	60	0·48	3·07
Proserpine	3·49	28	0·79	6·57
St. Lawrence ..	2·58	60	0·31	7·77
South Coast.				
Biggenden ..	2·32	32	0·36	7·01
Bundaberg	2·96	48	1·17	8·76
Brisbane	2·82	80	0·57	7·58
Caboolture	2·88	44	1·14	12·37
Childers	2·65	36	0·50	8·70
Crohamhurst ..	4·88	38	1·09	21·36
Esk	2·40	44	0·38	9·95
Gayndah	1·89	60	0·37	4·04
Gympie	2·80	61	0·69	10·69

Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	June.	No. of Years' Records.	June. 1931.	June. 1930.
South Coast—continued:	In.		In.	In.
Kilkivan	2·21	52	0·44	5·63
Maryborough ..	3·14	59	1·63	11·37
Nambour ..	4·05	35	1·50	18·54
Nanango	2·12	49	0·43	5·07
Rockhampton ..	2·57	44	0·37	10·47
Woodford	3·14	44	0·82	14·56
Darling Downs.				
Dalby	1·71	61	1·33	2·36
Emu Vale	1·59	35	1·54	3·75
Jimbour	1·74	43	1·13	2·25
Miles	1·84	46	1·55	2·24
Stanthorpe ..	1·96	58	2·05	4·70
Toowoomba ..	2·52	59	1·40	8·31
Warwick	1·80	66	1·70	3·23
Maranoa.				
Roma	1·64	57	1·04	1·28
State Farms, &c.				
Bungeworgorai ..	1·47	17	0·87	1·34
Gatton College ..	1·74	36	0·47	5·93
Gindie	1·52	32	0	1·61
Hermitage ..	1·93	25	1·61	2·84
Kairi	1·43	17	..	0·86
Mackay Sugar Experiment Station	2·40	34	0·26	3·38

GEORGE G. BOND, Divisional Meteorologist.

BRIGHT TOBACCO.

By N. A. R. POLLOCK, H.D.A., Senior Instructor in Agriculture, Department of Agriculture and Stock.

In this comprehensive article Mr. Pollock deals with the production of bright tobacco in North Queensland from all angles. He is one of the men of long vision who early realised the potentialities of the North as a producer of bright leaf of high commercial value, and his account of the development of the industry and cultural methods employed—the result of close study, experiment, and lengthy practical experience—will be welcomed by all interested in the present strong revival in the cultivation of tobacco, which has already proved to be a profitable crop on suitable Queensland soils.—Ed.

HISTORICAL SKETCH.

That the use of tobacco for smoking was known and practised by the indigenes of America long before the dawn of our civilisation has been proved by the researches of archæologists, who, amongst ancient ruins and in excavations of prehistoric mounds, in widely separated parts of both North and South America, brought to light many examples of pipes of varied and curious design which could only have been used for smoking tobacco.[1]

There is nothing to suggest that the tobacco plant, or its use, was known to the inhabitants of other parts of the world prior to the discovery of America by Columbus in 1492, since neither in history nor legend is mention made of it, nor are relics of ancient smokers' appliances found elsewhere than in America.

On his first voyage Columbus beheld the natives smoking tobacco, and in a subsequent voyage noted that they also chewed and snuffed it,[1] while the observations of subsequent explorers established the fact of its universal use.

It can readily be imagined that trials of what appeared to give so much satisfaction to the natives were soon made and the habit of smoking acquired by many of these early adventurers.

Though the first recorded instance of its importation into Europe was in 1558, when Francisco Fernandez returned from Mexico to Spain, and into England through the agency of Sir Walter Raleigh in 1586,[1] it is extremely probable that a knowledge of its use was carried by sailors and others many years before, not only to Europe but to Asia, as a record of its cultivation in Ceylon in 1610[2] suggests a much earlier acquaintance in India and China, where the Portuguese missionaries and traders had made much travel.

The fact that smoking became popular in England from 1586 suggests that the importation then and subsequently was in appreciable quantity, indicating that production on a commercial scale had already been entered upon. This would give credence to the contention that the Spaniards first commenced the culture of tobacco at the settlement in San Domingo in the year 1531.

The first recorded instance of tobacco production in a British possession was in 1612, when John Rolfe grew a crop in the then colony of Virginia for export to the mother country.[1] This proving successful, areas were placed under crop by other settlers, and production rapidly expanded until tobacco leaf became the chief article of export. Tobacco is now grown in every country where climatic conditions permit, and with an annual output, that has been estimated as probably in the vicinity of 4,000,000,000 lb. avoirdupois, forms one of the major agricultural products of the world.

In Australia, though the crop has been grown for upwards of sixty years, the quality of leaf has not found favour with consumers owing to defects in flavour and aroma, due, it has been suggested, to the crop being grown on unsuitable soil.

Recent developments, however, in Queensland, especially in the Northern division (detailed in the "Queensland Agricultural Journal" for October, 1930, and in the Departmental pamphlet, "Bright Tobacco in North Queensland"), where there are

[1] "Tobacco Leaf," Killebrew and Myrick.
[2] "The Commercial Products of India," Watt.

large areas of very suitable soil in a congenial climate, have demonstrated that bright tobacco leaf can be produced that will merit the approval of the Australian consuming public as well as that of connoisseurs, and eventually displace almost, if not wholly, that which is now imported from overseas.

It has been also affirmed by competent authorities that when Australia's consumption has been overtaken a profitable market awaits the best grades of North Queensland leaf in Great Britain.

STATISTICS OF TOBACCO.

The following figures, extracted from the latest Commonwealth Year Book available, indicate the amount of Australian-grown and imported leaf manufactured in each of the previous five years, the values of imported unmanufactured leaf, and those of imported tobaccos manufactured elsewhere:—

RESPECTIVE QUANTITIES OF AUSTRALIAN-GROWN AND IMPORTED TOBACCO LEAF MANUFACTURED IN AUSTRALIAN FACTORIES.

Year.	Australian Grown.	Imported.	Total.	Relative Australian.	Percentages Imported.
	Lb.	Lb.	Lb.	%	%
1924-25 ..	1,066,763	17,006,274	18,133,037	5·88	94·12
1925-26 ..	1,152,132	17,509,175	18,661,307	6·17	93·83
1926-27 ..	1,212,794	17,396,718	18,609,512	6·51	93·49
1927-28 ..	1,007,089	17,613,104	18,620,193	5·40	94·60
1928-29 ..	978,030	18,157,689	19,135,709	5·11	94·89

QUANTITIES AND VALUES OF IMPORTED TOBACCOS.

Year.	Manufactued.	Value.	Unmanufactured.	Value.
	Lb.	£	Lb.	£
1924-25	645,020	105,071	19,110,700	2,005,939
1925-26	619,503	97,648	22,040,123	2,250,305
1926-27	1,273,873	176,046	22,140,918	2,018,295
1927-28	1,187,202	171,800	23,682,640	2,168,402
1928-29	1,013,981	149,173	21,129,742	1,904,469

Year.	Cigars.	Value.	Cigarettes.	Value.	Snuff.	Value.
	Lb.	£	Lb.	£	Lb.	£
1924-25 ..	97,789	94,895	328,503	203,209	3,159	1,076
1925-26 ..	107,221	113,491	547,425	297,812	2,638	920
1926-27 ..	121,779	115,360	744,571	393,386	4,315	1,667
1927-28 ..	128,713	138,591	946,350	480,798	3,442	1,029
1928-29 ..	85,980	94,760	840,027	428,127	2,961	1,169

Year.	Total Lbs. of Tobacco Imported.	Total Value.
	Lb.	£
1924-25	20,185,171	2,410,190
1925-26	23,316,910	2,759,332
1926-27	24,285,456	2,704,754
1927-28	25,948,347	2,960,620
1928-29	23,072,691	2,577,698

It will be noted from these figures that, excluding cigar leaf, White Burley, or other leaf such as Turkish, Latakia, &c., which are cured by other processes and which, though considered possible of production in the Commonwealth, are not discussed herein, there is an existing market annually for at least 20,000,000 lb. of flue-cured tobacco.

While the average yield of bright tobacco in America, where the average grower has had years of experience, is in the vicinity of 600 lb. per acre, it is not to be expected that in Queensland, with so many growers entering on production with little if any previous experience, an average yield of more than 500 lb. per acre could be contemplated in Australian production for many years to come.

Allowing 500 lb. per acre as an average yield, upward of 40,000 acres will be required to meet Australia's present demand, which will probably be much increased before that acreage is placed under crop.

Duties and Excise.

During the year 1931 the import duties on tobaccos other than cigar leaf and manufactured cigars were substantially increased, all lines in addition being subjected to an additional primage duty of 4 per cent.

Excise duties were unaltered except on cigars, when a reduction of 2s. 5d. per lb. was made both in hand and machine made.

It is not considered likely that the Customs tariff now operating will suffer reduction for many years to come, if at all, as tobacco is regarded in most countries as a fruitful source of revenue. With these duties operating, the production of bright tobacco should offer a great attraction in those districts of the State that provide the requisite soil types and climatic conditions.

IMPORT AND EXCISE DUTIES ON TOBACCO.

IMPORT DUTIES.

Item.	Per lb. s.	d.
18. Tobacco, unmanufactured	8	6
19. Tobacco, unmanufactured, entered to be locally manufactured into tobacco or cigarettes, to be paid at the time of removal to the factory—		
(*a*) Unstemmed	5	2
(*b*) Stemmed, or partly stemmed, or in strips	5	8
20. Tobacco, cut, n.e.i.	9	3
21. Tobacco, manufactured, n.e.i., including the weight of tags, labels, and other attachments	9	0
22. Cigarettes, including weight of cards and mouth-pieces contained in inside packages; fine-cut tobacco, suitable for the manufacture of cigarettes	16	0
23. Tobacco, unmanufactured, entered to be locally manufactured into cigars, to be paid at the time of removal to the factory—		
(*a*) Unstemmed	2	6
(*b*) Stemmed, or partly stemmed, or in strips	3	0
24. Cigars, including the weight of bands and ribbons	20	0

In addition, all lines are subject to a primage duty of 4 per cent.

EXCISE DUTIES.

Item.	Per lb. s.	d.
Item 6. Tobacco—		
(*a*) Tobacco, hand-made strand	2	1
Hand-made Tobacco.—"Hand-made tobacco" shall mean tobacco in the manufacture of which all operations are entirely carried on by hand without the aid of machine tools or machinery other than that used in the pressing of the tobacco.		
(*b*) Tobacco, manufactured, n.e.i., made in Australia both from imported and locally grown leaf	2	4
(*c*) Tobacco, fine cut, suitable for the manufacture of cigarettes	7	3
Item 7. Cigars—		
(*a*) Hand-made	0	3
Hand-made Cigars.—"Hand-made cigars" shall mean cigars in the manufacture of which every operation is performed by hand, provided that moulds may be used.		
(*b*) Machine-made	1	3

Item 8. Cigarettes (including the weight of the outer portion of each cigarette)—

(*a*) Hand-made 7 3

Hand-made Cigarettes.—"Hand-made" shall mean that the whole of the operations connected with the filling and completion of cigarettes shall be performed exclusively by hand.

(*b*) N.e.i. 7 6

THE TOBACCO PLANT.

Tobacco is botanically classified as the genus *Nicotiana* under the natural order Solanaceæ, which embraces many other genera, of which the potato, tomato, egg plant, capsicum, &c., afford well-known examples.

The so-called wild tobacco, a species of the genus *Solanum*, which grows so freely on newly-cleared scrub lands, and the tree *Duboisia Hopwoodii*, the leaves of which, containing an alkaloid analogous to nicotine, form the Pituri of the Australian aborigine, are also members of this natural order.

Systematic botanists have described and classified over thirty-five distinct species of *Nicotiana* which, excepting a very few found in Australia and some of the Pacific Islands, are indigenous to America.

Only a small number of the species of *Nicotiana*, each of American origin, have been found to yield tobacco, and of these but three are noted as being cultivated to-day:—

Nicotiana persica, cultivated in Persia, from which the Shiraz tobacco is obtained.

Nicotiana rustica, which is cultivated to an extent in India and also in Western Europe, and is suggested by Killebrew and Myrick ("Tobacco Leaf," Orange Judd Company, New York) to yield the tobaccos known as Turkish, Hungarian, and Latakia.

Nicotiana Tabacum, from the varieties of which by far the greatest part of the world's supply of cigar, cigarette, and pipe tobacco is obtained.

The tobacco plant has been aptly termed a weed, since it will grow on almost any soil that is sufficiently warm and well drained, and under very diverse climatic conditions when enough moisture is provided and frost is not experienced in the growing season.

There is, however, a pronounced difference in the quality of leaf produced on different soils, and also on similar soils in different climates.

Probably no plant is more influenced by environment than tobacco—changes in that direction leading to mutations and variations not only in plant characteristics but in essential leaf quality.

Climatic conditions in the production of leaf grown on different classes of soil are held to exert an influence on texture and colour, while the original growths from which the humus in the soil was derived are suggested to have an influence on the aroma and flavour of the cured product.

As a result different types of the plant have been developed which will yield under certain conditions of soil and climate, together with a particular method of treatment, a class of tobacco peculiar to each.

These types have again been divided into varieties and strains of such varieties by selection and hybridisation to allow of one or more, while conforming to type, suiting particular areas or localities.

In the early years of production by the Virginian colonists attention was given to the most fertile soils, which yielded generally a leaf of more or less heavy texture, but as settlement proceeded others of varying texture and fertility came into use. The result was to produce tobacco leaf differing in degrees of essential quality, which allowed a discrimination by the consumer.

Early Curing Methods.

The first system of curing consisted in a simple drying of the leaf under natural atmospheric conditions, which were later regulated to a considerable extent by the use of buildings in which control of ventilation played an important part.

Subsequently the curing process in these buildings was assisted and accelerated by the use of heat from the burning of wood in open fires, to be later improved by the use of charcoal through which the creosotic odour and flavour imparted to the leaf by the smoke from the burning wood was avoided.

The heat of the burning charcoal, without any attendant smoke, being found to allow the attainment of a brighter colour in the cured leaf, especially in that grown on light-textured soils, invited the application of heat radiated from pipes or flues arranged close to the floor of the buildings, through which the heated gases and smoke from a fire would pass without coming into contact with the leaf.

The substitution of heating flues for charcoal fires not only eliminated the possibility of any smoky flavour or odour being transmitted to the leaf under cure, but allowed the definite regulation of heat and humidity in the curing structure. By this means it was found the percentage of bright-coloured leaf could be much increased and the quality of the cured article greatly improved.

Thus the variation in leaf quality through growth on dissimilar soils, as well as under different climatic conditions, was further amplified by the methods of curing.

Properties of the Plant.

The chief attraction in the use of tobacco, whether for smoking, chewing, or snuffing, is due to the generally pleasurable and soothing effect on the nerves from the action of the narcotic alkaloid nicotine which it contains in varying proportion according to the character of the leaf. The heavier and stronger the leaf the larger, as a rule, is the proportion of nicotine.

Other properties contained in the leaf combine to produce a flavour and aroma which, by adding to or detracting from the satisfaction engendered, influence the demand for leaf produced on different soils and also in different districts, as well as in different countries, according to the manner in which it is cured.

Hence the mildness, pleasing flavour, and aroma of flue-cured leaf to the degree of which its beautiful colour is regarded an index has found such flavour as to be now in almost universal demand in Australia.

PRODUCTION OF BRIGHT TOBACCO.

Climate.

In the production of bright tobacco climatic conditions will throughout growth, and especially during the ripening and harvesting period, exercise considerable influence on leaf quality as well as yield.

Extremely humid conditions, particularly under high temperatures, tend towards the production of extra large thin leaves which are deficient in gum, and, though occasionally curing a bright colour, generally are lacking in lustre and do not weigh well.

On the other hand, with little rainfall and hot, bright days, with little atmospheric humidity, the leaf will be small in size, thick and firm, with an abundance of gum which interferes with its burning quality.

The best quality leaf is yielded by plants in which the growth has been regularly maintained from the time of setting out in the field to the ripening of the leaf. Warmth and a sufficiency of moisture in the soil without extremes of atmospheric temperature and plenty of sunshine, especially during the ripening period, are conducive to the best results. Cold nights, during which the growth is not maintained, or very hot, dry days, when the plants droop, cause a check in development that is more or less prejudicial to quality.

An ideal climate is one in which the daily average temperatures are high without extremes, and accompanied by an appreciable atmospheric humidity.

In the State of Queensland suitable climatic conditions will be found practically in all its degrees of latitude where the rainfall averages between 25 and 45 in. per annum.

Rainfall.

The rainfall should be moderate rather than heavy, and well distributed during the growing season, being limited to light showers when the leaf is approaching ripeness, with fine weather at harvest.

About 20 in. during the growing period is regarded as very satisfactory, but on well-drained soils a heavier precipitation is not detrimental, while excellent crops can also be secured with a lighter fall when soil conditions are suitable.

Dull cloudy days with frequent light showers are most effective in promoting establishment and early growth when the young plants are set out in the field. Occasional falls thereafter with days of bright sunshine broken by passing clouds through which excessive evaporation is hindered and a more even temperature sustained, combine, when growth is made on suitable soil, to produce leaf of the highest quality and brightest colour.

Season.

In a suitable season with proper cultivation the period covered from the sowing of the seed in the seed-bed to the harvest of the leaf should not exceed 160 days, or 120 days after the plants were set out in the field.

The growing season after transplanting can thus be calculated as four months, during the first two of which the rainfall should be ample to promote growth, with lessening falls in the third month and practically fine weather in the fourth.

In most parts of the State average seasonal conditions would suggest the setting-out of the plants in late December or early January, or at the commencement of the wet season, so that the best rainfall would be experienced from then on to mid-March, when precipitations as a rule rapidly decline, with only occasional light falls in April and May, when the harvest would be completed.

In the cooler parts, however, an earlier transplanting is indicated, so that the leaf will ripen before the nights become cold, and be all cured before frost is likely to occur.

Irrigation.

Irrigation will be of value in seasons when the rainfall is deficient, but leaf grown wholly by that means cannot be expected to yield a quality comparable with that produced under natural conditions.

When irrigating, light applications in furrows between odd and evenly numbered rows alterately are suggested at short intervals rather than otherwise. A heavy saturation of the soil should be avoided, as excessive moisture induces a coarse-textured leaf that is difficult to cure a bright colour.

Cultivation should closely follow irrigation to keep the soil aerated and to lessen evaporation.

Shelter.

When clearing land for tobacco it is advisable to leave belts of trees standing on the windward side as a protection against the effects of a strong breeze, which is apt to cause damage to the leaf, especially towards and at maturity, when it is brittle and easily broken. Where the stand of timber is somewhat thin the planting of others of quick growth is suggested. In addition to acting as a wind-break the shelter belt will afford harbourage for many of the birds that are of material assistance in the control of insect pests.

Soil.

The texture of the soil on which tobacco is grown exerts a marked influence on the quality of the product, which varies from a thick gummy leaf on heavy soils of high clay content to a light chaffy leaf of indifferent quality on very coarse sandy or gravelly soils.

To produce bright tobacco with a silky elastic leaf of good body and bright uniform colour, such as will command the highest price from manufacturers, a light fine sandy to sandy loam soil is suggested by all authorities. It must be understood that the term light as applied to a soil refers to the facility with which it can be worked, and not to its weight.

The most attractive soils in this category will be found in those carrying upward of 70 per cent. of sand together with silt and organic matter, and a very small proportion preferably not more than 7 or 8 per cent of clay.

Other soils with a little less sand and more silt and clay suggest a heavier cropping capacity, through which, though the average price obtainable for the leaf may be lower, the monetary return due to the increase in yield would be satisfactory.

It is considered advisable, however, that the amount of clay in any bright tobacco soil should not exceed 12 per cent., as a larger proportion will tend to produce leaf that will cure out a dark colour.

Suitably textured soils of granitic or sandstone origin will probably be most abundant in the districts that are climatically suited for the production of bright tobacco in Queensland, but others derived from a variety of rock formations that have drifted or been transported, and from which much of the oxides of iron and fine particles of clay have been leached, may also be found in quantity and equally suited for the production of bright leaf.

Generally the best bright tobacco soils will occur on low ridges and on the lower slopes of hills and mountains. Many of the alluvial deposits on the highest terraces of streams will frequently be found of suitable texture, while at times the sandy alluvials deposited by streams of little length that drain highlands of sandstone or granite formations will be found quite satisfactory. The alluvials from large creeks or rivers, especially those on low terraces that are or have been in recent times subject to inundation, and especially bottom lands and those of delta formation, are rarely found to be suitable. In these the large proportions of fine silt and clay, together with a high humus and decaying organic matter content, render them far too fertile to produce leaf that would be capable of being cured a bright colour.

Soil Colours.

The brightest coloured soils, suggestive of an absence or extremely low content of the oxides of iron, will not only induce the production of leaf that will retain its bright colour when subjected to heavy pressure—a quality prized by manufacturers—but will tend to yield a higher percentage of the brightest yellow than others darker in colour.

Most surface soils show a more or less darkened colour according to their humus content, while many of the coloured soils may show a deepening in colour with depth due to the leaching of the colouring matter from the surface layers under the rainfall of many years.

With these considerations the colours of suitably textured soils in their relation to the production of the brightest coloured leaf may be suggested in an order of preference as light grey, grey, pale yellow, light brown, or their admixtures, dark grey, pale red, yellow, red, dark brown, dark red, black.

Subsoil.

In districts of comparatively light rainfall in the growing season, such as those of the highlands in the southern portion of the State, a somewhat retentive subsoil at a depth of 15 to 18 in. from the surface is advantageous.

In other districts, and especially those of more tropical latitude, however, where the rainfall during the growing season will average from 20 to 30 in. with liability to falls of 2 in. and upward in a day, the subsoil should be more porous. In these latter districts a deep soil is of advantage.

As with the soil a low content of iron oxide is desirable in the subsoil, one bright yellow in colour being much esteemed.

Drainage.

A well-drained soil is a necessity in tobacco production, excessive moisture in the soil being detrimental to leaf quality and provocative of fungus diseases.

Most bright tobacco soils occur on the crest and slopes of ridges, the drainage of which underground or by open channels will, usually, not offer any great difficulty, especially with storm waters. Seepage, however, is to be guarded against. In many deep soils the water from rain falling on higher levels sinks down to a more or less impervious strata along which it flows to emerge when obstruction is met or the impervious strata rises closer to the surface.

On uncleared land the presence of tea-tree (*Melaleuca* sp.) and grasses, sedges, &c., peculiar to undrained land are a sure indication of saturated soil conditions during the rainy season. The direction of the seepage flow is not always indicated by the contour of the surface, as many instances have been noted where the flow has been across rather than down the slope. Deep open drains in the requisite direction are suggested to guard against soil saturation from this cause. The distance between drains will be suggested by local conditions, but with deep soils the intervals will be greater than with those of lesser depth. A system of tile drainage where possible will be found of great advantage in the production of the highest quality leaf, as the soil is not only thoroughly and expeditiously drained thereby, but its aeration, so necessary for the best development of the plants, is greatly facilitated.

FERTILIZERS.

The friable sandy to sandy loam soils in districts where the production of bright tobacco is recommended cannot, from their high content of silica, be regarded as other than infertile. They can, however, be expected to make a ready response to the application of a suitable fertilizer.

While in the virgin state it is possible with some of the sandy loams to secure a payable crop without fertilizer, the application of a suitable quantity will not only increase the yield but greatly improve the quality of the leaf, and thus induce a greater profit.

The elements of fertility sought in a tobacco soil are nitrogen, phosphoric acid, potash, lime, and magnesia. As a rule, the latter two will be found in sufficient quantity in the soils of districts where the rainfall is suitable for bright tobacco production. In districts of light rainfall they can be expected to occur in greater quantity than in others where a heavier precipitation occurs, since in the latter they would be leached to an extent from the surface layers.

Magnesia is regarded as more necessary in the tobacco soil than lime, as it is an essential constituent of chlorophyll, the green colouring matter of the leaves. Lack of sufficient magnesia is indicated by a poor development of leaf accompanied by a pale yellow colour in the tip, contrasting strongly with that of the remainder of the leaf.

Lime is regarded more in the light of a mechanical agent than a plant food. Its effect is to neutralise the acidity of a soil and to improve the texture of clayey soils by rendering the clay more flocculent, and to make loose soils more compact.

In the form of sulphate, lime is a constituent of superphosphate. Where applications of lime and magnesia are indicated, ground dolomite or magnesian limestone is suggested at the rate of 500 lb. per acre broadcasted as a top dressing. In American practice ground dolomite is frequently used as a filler in making up fertilizer mixtures.

Nitrogen.

Nitrogen hastens and increases leaf production in all plants. In suitable quantity it increases the yield and adds body to the leaf. In the soil it is contained in the humus and decaying organic matter; and is also added to the soil as ammonia in the rain from thunderstorms, which are particularly prevalent in tropical parts during the usual period in which the tobacco crop is grown.

The amount of humus in the soil will be a guide to its application in a fertilizer mixture. It is important when applications of fertilizer are made to the soil that it should not be in excess, neither should it be deficient.

Lack of sufficient nitrogen will result in a lower yield, while the leaf will be thin. This leaf, however, will cure out a brighter colour.

If used in excess it will cause a rank coarse growth of leaf, which will be slow to ripen and difficult, if not impossible, to cure to a colour that could be classed as bright.

In fertilizer mixtures it is advised to make up half the percentage from an organic source and half from an inorganic source; in the former dried blood (red being preferable to black), fish meal, and oil cakes are suggested, while in the latter nitrate of soda is to be preferred of those at present available. Sulphate of ammonia is not favoured, as its action is held to create a brittleness in the web of the leaf.

Potash.

Potash forms between 30 and 40 per cent. of the ash of tobacco plants, which is somewhat more than that revealed in the analyses of the ash of other cultivated crops. Its use increases the yield by inducing body in the leaf, and also tends to improve the burning quality of the tobacco. In sufficient quantity it is also held to render the tobacco plant more resistant to fungus diseases.

In many of the tobacco soils of the State, especially those of granitic origin, the potash content will be classed as fair, but generally its inclusion in a fertilizer mixture in fair quantity will prove of benefit. Sulphate of potash is considered the best source of supply. Chloride of potash should not be used.

Phosphoric Acid.

The percentage of phosphoric acid revealed in the analyses of tobacco plants is less than in that of other commercial crops. Though it does not enter to a large extent in the plants structure, it is of especial benefit in increasing leaf development and in hastening maturity, through which the production of a desirable bright colour is favourably influenced.

When nitrogen is in excess as in soils of high humus content, or when leguminous plants have been ploughed under as a green manure, the application of phosphoric acid in increased quantity is advised to overcome the effect of excess nitrogen by accelerating the ripening of the leaf.

Superphosphate is invariably recommended as the best source of supply.

In all fertilizer mixtures suggested for a tobacco crop in all countries the percentage of phosphoric acid is higher than either that of nitrogen or potash.

In Queensland tobacco soils, especially those of sandy nature, the amount of phosphoric acid is notably low, indicating a larger application than is suggested in other countries where the supply in the soil is, in general, considerably greater.

Fertilizer Mixtures.

The relative proportions of nitrogen, phosphoric acid, and potash in the fertilizer mixture and the quantity to use per acre will be influenced in largest measure by the degree of natural fertility that exists in the soil.

In Queensland, unfortunately, no comparative trials of fertilizer mixtures with tobacco have been carried out from which any reliable deductions could be made, so that the practice in other countries where bright tobacco is produced in large quantities must be considered with due regard to such differences as may be shown in a comparison of average soil analyses and also of climates.

In speaking of a fertilizer mixture it is usual to quote the numerals relating to the fertilizing elements in the order of nitrogen, phosphoric acid, and potash—e.g., 3-8-5 mixture would signify 3 per cent. nitrogen, 8 per cent. phosphoric acid, and 5 per cent. potash.

On the bright tobacco soils in the United States of America heavy applications of fertilizer are made either broadcast or in drills, where it is mixed with the soil before the ridges are thrown up.

Until recently a 3-8-3 mixture was generally recommended, a formula for which, supplied by Mr. H. A. McGee, an American specialist in tobacco culture, who carried out many trials on behalf of the British Australasian Tobacco Association Proprietary in New South Wales and Victoria from 1925 to 1928, indicates the admixture of—

Dried blood, 84 lb.;
Nitrate of soda, 67 lb.;
Dried fish, 166 lb.;
Sulphate of potash, 60 lb.

High-grade superphosphate, 363 lb., and ground dolomite, 260 lb., for each 1,000 lb. of the fertilizer.

This mixture at 750 lb. per acre was used in the exploratory test plots in North Queensland in the 1927-28 season.

More recently the "American Fertilizer," in the September number of 1930, reports the result of a conference of agricultural workers, representatives of fertilizer industries and officers interested in tobacco culture in the United States, held at Oxford N.C., was in agreement on the following recommendations with regard to the use of artificial fertilizers for tobacco culture on all average American soils:—

> "For the growth of bright flue-cured tobacco on heavy or more productive soils, 800 lb. to 1,200 lb. per acre of 3-8-5 mixture was recommended. On the light or less productive soils 4-8-6 mixture was preferred. In these fertilizer mixtures the nitrogen to be supplied is at least one-fourth by nitrate of soda, one-half by high-grade organic material like cotton-seed meal, fish, or meat meal, the remaining one-fourth by urea or other inorganic sources. Phosphoric acid must be in form of high-grade superphosphate. Potash is used in the form of high-grade sulphate which should not contain more than 2 per cent. of chlorides. In many cases the addition of magnesia may be a great advantage, and the mixed fertilizer should supply 2 per cent. of magnesia. Part of the fertilizer can, with advantage, be supplied as top dressing about three weeks after planting."

Allowing 1,000 lb. per acre as an average application, 30 lb. and 40 lb. of nitrogen, 80 lb. of phosphoric acid, and 50 lb. and 60 lb. of potash would be supplied respectively with each mixture.

In Rhodesia, where bright tobacco production is an important industry, Taylor, in his book "Tobacco in South Africa" (South African Agricultural Series No. 4) remarks—

> "In Southern Rhodesia heavy applications of fertilizer have not given the most profitable results. It has been found that an application of 150 lb. per acre of what is known as a double complete fertilizer will produce a normal yield without inducing a rank growth, which makes curing difficult and renders plants susceptible to disease. Double complete fertilizer is made up of water soluble components as follows:—Nitrogen, 8 per cent.; phosphoric acid, 20 per cent.; potash, 10 per cent. If lower-grade fertilizers are used the bulk is increased proportionately."

Allowing an application of 150 lb. per acre of this fertilizer, 12 lb. nitrogen, 30 lb. phosphoric acid, and 15 lb. of potash would be supplied. This application would be applied in small quantity, slightly less than half an ounce, at the spots where each plant is to be grown.

American practice it will be noted suggests application over a very much larger area.

In a comparison of the analyses of such bright tobacco soils as are available from America and Queensland respectively, it is noted that on the average the supply of phosphoric acid and potash is lower than that of lime and magnesia higher in those of Queensland origin.

In a comparison of climates and seasons of growth in the three countries there is a close similarity between those of Rhodesia and Queensland. The degrees of latitude embraced in Rhodesia are from 11 to 22, while in Queensland they are from 11 to 29. The growing season of the tobacco crop is practically the same in each country. In Rhodesia, however, the very much higher altitudes suggest cooler temperatures, especially at night, and a generally lower soil temperature than would be expected in Queensland except, perhaps, on the southern highlands.

The applications of the mixed fertilizer generally recommended in Rhodesia could probably be followed with advantage in Queensland. Viewing, however, the apparently lower average content of phosphoric acid and potash in Queensland soils, it is thought that a 4-12-6 mixture would prove more suitable.

A fertilizer such as this could be compounded by the admixture of 15 lb. dried blood (13 per cent. nitrogen), 13 lb. nitrate soda (15 per cent. nitrogen), 60 lb. high-grade super. (20 per cent. phosphoric acid), 12 lb. sulphate of potash (50 per cent. potash), for each 100 lb.

An application at 300 lb. per acre would supply 12 lb. nitrogen, 36 lb. phosphoric acid, and 18 lb. of potash per acre, which compares favourably with the 12-30-15 of the Rhodesian application.

The application of fertilizer to a tobacco crop should be calculated to produce a moderate growth, in which the leaf quality would be improved, rather than to induce a heavy growth by which quality would be sacrificed.

It is suggested that applications of the 4-12-6 mixture might be tried at 200 lb. per acre in the case of the more fertile sandy loams to 500 lb. per acre on the sandy soils that have been previously cropped.

On virgin sandy soils probably 300 lb. per acre would secure a satisfactory return.

In applying the fertilizer it will be advisable to either apply the quantity for each plant and mix it with the soil at the spot where it is intended to set out the plant, or to apply it with a fertilizer drill, so that it will be mixed with the soil immediately under the centre line of the ridge in which the tobacco is to be planted.

Fertilizer should be applied some days before transplanting is effected, so that by becoming dissolved in the soil water it will be more evenly incorporated with the soil and rendered immediately available for the plants use.

In order to arrive at an early conclusion as to the suitability of the application for his particular soil, it is suggested that the grower should experiment with increased quantities on small areas in order to note if increase in yield is commensurate with quality and colour.

ROTATION OF CROPS.

In farm practice the value of a rotation of crops, or what might be more correctly defined a diversity of cropping, as particular crops would not necessarily be grown in regular sequence, is generally recognised.

It is a matter of common observance that crops grown in succession on the same soil show not only a decline in yield but frequently a lowering in the quality of such yields. Under natural conditions also it is often observed that a particular weed that has overrun the soil in one season may be almost, if not entirely, replaced by one of another kind in a season shortly following. It is now generally conceded by scientific agriculturists that such lessened production is due not so much to the depletion of the elements of fertility in the soil as to the presence of matter from the decay of plant tissues or from excretions of the growing plants which poison the soil for plants following which are similar in kind.

A change of crop is especially valuable in overcoming or preventing a trouble of this nature, since it has been found that the excreted matter of one plant is not necessarily objectionable to that of another kind, also that different species of plants aid in the destruction and removal of deleterious organic substances from the soil.

Another advantage to be obtained from change of crop lies in minimising the risk from plant diseases. Fungus parasites, as is well known, reproduce from spores which will lie dormant in the soil for a certain time. A slight infection in one season will thus in all probability be greatly increased in that following if the same crop is grown. Fortunately the parasitic affections peculiar to one plant are generally inocuous to another of a different kind, so that when crops are varied opportunity will be given for the parasite to perish for lack of a suitable host.

The practice of a dry fallow between tobacco crops, such as will be imperative from lack of rain in most bright tobacco districts, will act somewhat in the same direction as a change of crop. The soil, however, should be ploughed immediately after the crop has been removed, so that it can be well aerated during the time that will elapse before preparation for the next crop is necessary. Maintenance of the organic matter in the soil is of great importance in successful tobacco production, not only from the amount of plant food available therein but on account of its mechanical effect.

Decomposed organic matter or humus renders the soil less liable to extremes of temperature, and also renders it more easily worked, while its spongy nature assists in the retention of moisture. The generally superior quality of tobacco leaf produced on virgin soils is recognised as due to the larger amount of humus then contained. Bright tobacco soils, from their generally infertile nature, seldom possess a high humus content. Under cultivation, as well as when fallowed, the supply will be rapidly lessened, while the action of termites (white ants) and other soil dwellers can be calculated to appreciably hasten this depletion. It is imperative, therefore, to ensure the most profit from tobacco production that the depletion of organic matter in the soil should be remedied by the turning under of a growing crop at least once in three years on sandy soils, and probably once in four years or five years on a sandy loam.

A choice of crops to grow in succession to tobacco from which some profit is derivable is necessarily limited by the texture and general infertility of the soil under use.

Grain and fodder crops will be required for domestic use, and possibly portion of the crop could be marketed. Sudan grass for hay and non-saccharine sorghums for grain should prove of most value in this direction.

Cotton, broom millet, and peanuts are also indicated as avenues of profit. Crops to plough under as a green manure are suggested in velvet beans, cowpeas, and field peas, the first mentioned being considered most serviceable. All green manure crops should be ploughed under during the wet season to ensure sufficient soil moisture to allow their early conversion to humus.

Suitable crops rotations that might be adopted after a virgin soil has grown two successive crops of tobacco are suggested as:—

3-year Rotation.

1st year, legume to be ploughed under;
2nd year, sudan grass, grain sorghum, broom millet;
3rd year, tobacco.

4-year Rotation.

1st year, cotton, broom millet, or peanuts;
2nd year, legume to be ploughed under;
3rd year, hay or grain crop;
4th year, tobacco.

Other crops will probably be found more suitable in certain climates than some of those mentioned, but provided the crop is different the same benefit can be expected.

VARIETIES.

A considerable number of tobacco varieties are listed as suitable for the production of bright leaf, but until comparative trials have been made in the different districts it will not be possible to indicate those that could be expected to give the best results. The uniformly good results, however, with Hickory Pryor and Warne wherever tried enables them to be recommended, the former preferably for sandy soils and the latter for sandy loams or soils of somewhat heavier texture.

TOBACCO SEED.

One of the most important factors contributing to success in tobacco production is the use of seed that will not only give a satisfactory percentage of germination but produce strong healthy plants capable of yielding a desirable number of leaves which in size and quality will be typical of the variety.

The tobacco plant, perhaps more than any other, is subject to variation, particularly under a change of environment in which both soil and climate may exert an influence. In order to ensure that a variety will grow true to type it is important that the seed for its propagation should be selected from acclimatised plants exhibiting the typical characteristics that denote its value.

Carelessness in the selection of seed plants can be expected to result in a more or less rapid deterioration of the crop, both in yield and quality of leaf, while with the exercise of due care quality can not only be maintained but yield materially improved.

In the selection of plants for seed purposes it is advisable to go through the crop when it is about half-grown and mark off a much larger number of plants than are actually required so that a further selection can be made from these at a later period in growth.

The plants selected in the first instance should be typical of the variety, showing a reasonably vigorous and uniform growth with similarly coloured leaves of desirable texture with fine veins and small mid rib. The leaves should not be spaced so closely on the plant as to render suckering difficult, neither should they be too far apart.

When the flower heads have appeared, but before any blossoms have opened, these selected plants should be again carefully examined, and those showing the greatest uniformity in development while still retaining the desirable characteristics retained and the balance excluded.

With the second selection allow one or two flowers to open on the flower head, snip these off with a knife or scissors together with all flowering branches excepting the three or four at the top, at the same time remove the top leaves down to where the plant would otherwise be topped.

To ensure that there will be no possibility of cross fertilisation a 12 or 14 lb. manila paper bag such as grocers use should now be inverted over the flower-head and tied closely round the stem of the plant, but sufficiently high so that further growth of the flower-head will not be impeded.

The paper bag should be removed once a week to inspect the seed-head, when if any insects or their larvæ are noticed a light dusting of arsenate of lead powder should be given and the bag replaced.

When about eighty capsules have been formed the remaining unopened flowers and secondary shoots should be removed, as the whole strength from the plant needs to be concentrated in the fullest development of the seed already formed.

Careful note should now be taken of the manner in which the leaf ripens on the seed plants, and those finally selected that show the most uniformity in this direction, and the remainder topped and the seed-heads destroyed. Leaf should not be picked from the plants finally selected.

When the eighty or so capsules left on the seed-heads of the finally selected plants have all turned brown the seed-heads with a foot of the stem should be cut from the plant and with the paper bag still attached suspended head down in a warm and dry place until they are quite dry.

When proceeding to thresh out the seed it will be found that a quantity will have been shed or shaken out in handling and caught in the paper bag.

This should be placed on one side, as it will be cleaner than that later collected when the capsules are cut across or broken. After the seed has been secured it should be carefully cleaned of foreign matter by sifting and winnowing.

Seed Grading.

As with other crops, the heaviest of tobacco seeds can be expected to produce the most vigorous and profitable plants. As the seed threshed out will naturally show a variation in size, it will be advisable to dispense with those lightest in weight.

The separation of the heavy seed is most easily accomplished by the use of a tobacco-seed grader. This is a simple apparatus the parts of which may be purchased at no great cost from dealers in chemical supplies. They consist of an ordinary foot bellows, 3 feet of ¼ inch rubber tubing, one 3 inch piece of ¼ inch glass tube, 3 feet of inch rubber tubing, one glass tube 1 inch diameter, 6 inches long, and two glass tubes each 4 feet 6 inches long by 1 inch in diameter, and a large cork bored to receive the ¼ inch glass tube. This cork should fit into the inch glass tube.

In assembling, the ¼ inch tubing is attached to the bellows and to the short piece of ¼ inch glass tube, the other end of which is inserted in the cork stopper, covered with a piece of fine muslin which is fitted into the end of the 6-inch length of glass tube. This glass tube will form the seed receptacle, the fine muslin being necessary to keep the seed from passing into the rubber tubing. The seed receptacle is now connected by a short piece of inch rubber tubing to one of the 4½ feet pieces of inch glass tube placed vertically. The other end of this glass tube is connected to the second glass tube similarly placed but a foot distant by a 15-inch length of inch rubber tubing, and the balance of this tubing connected to the bottom end of the second glass tube to convey the rejected material to a receptacle.

In operation a quantity of seed is placed in the seed receptacle and the bellows worked with the foot to create a current of air which will pass through the tobacco seed. The heaviest seed will be suspended in the air current and the lighter seed with dust or other foreign matter will be carried over the top of the first glass tube into the second one and be caught in the receptacle provided.

As the seed will be visible in the glass tube the current of air can be regulated so that all the seed will not be carried over. With a little practice, or by passing the light seed through a second time, the seed can be very nicely graded.

Another method of separating the heavy seed will be through its rate of subsidence in water. When the seed is placed in water it will all float; it should be stirred round for a minute or so in order to become well wetted and then allowed to stand. The heavy seed will soon sink to the bottom, while the light seed will continue to float and can be poured off with the water and discarded. The heavy seed is now collected and dried immediately, when it can be stored away. Separation in this manner, however, it is considered will be best effected when the seed is to be sown.

Storage of Seed.

Stored under proper conditions tobacco seed will retain its vitality for upwards of ten years. Under unsuitable conditions, however, loss of vitality may occur within a year.

Amber-tinted or blue glass bottles make very suitable containers, as the passage of certain light rays which would affect vitality would be prevented.

The bottles of seed should be corked and stored in as cool and dry an atmosphere as possible.

A method of storage practised by some cigar-leaf growers in North Queensland which proved very effective was to place the seed in pickle bottles which were well corked and then buried in a box filled with dry sand.

Seed Treatment.

In the control of disease the first essential is the use of disease-free seed. While that saved on the holding will naturally be from plants free of any sign of disease there is always a possibility of a slight infection having passed unnoticed. Where seed has been purchased also, unless known or guaranteed to be free from disease, there is a possibility of some infection being carried.

A simple treatment of the seed occupying only a little space of time is a precaution against disease that might well be adopted by all tobacco growers.

Two formulas can be recommended:—

(1) A corrosive sublimate (bichloride of mercury) solution of 1 part in 1,000 parts of water.

Place the seed in this solution and keep it well stirred for five minutes; allow seed to settle, pour off the liquid, then wash the seed in six changes of rain water; spread and dry in the shade.

(2) Dissolve 9 grains of silver nitrate in a pint of water.

Place the seed in this solution and keep it well stirred for fifteen minutes, then drain off the solution and wash the seed in six changes of rain water; spread and dry in the shade.

(In connection with the treatment of seed for blue mould control, the reader is referred to Mr. Mandelson's notes thereon in his contribution on tobacco diseases.—Ed.)

CULTIVATION.

Ploughing.

When practicable, the land should be ploughed immediately after the previous crop has been removed, and allowed to stand until shortly before the time for planting arrives, when it should be reploughed and well harrowed to bring it to a fine degree of tilth.

In the case of newly cleared land, or land that has been under grass for some time, ploughing is indicated, in the wet season, to allow of the vegetation turned under being converted to humus.

An early ploughing allows a thorough aeration of the soil, which is thus rendered more friable, while it also tends to eradicate weeds and diminish insect pests.

Depth of Ploughing.

Land should not be ploughed to a greater depth than that to which the humus and decaying organic matter obtains. On most bright tobacco soils in Queensland other than those of alluvial formation the depth to which this occurs is usually from 5 to 7 inches. Ploughing to a greater depth on these soils is not only unnecessary, as the soil below that depth is sufficiently loose to allow of root penetration, but harmful, as the humus comprising the most fertile part of the soil is buried below the reach of the main feeding roots of the plants and less fertile soil placed on top.

If the soil below 6 inches from the surface is so compact as to suggest deeper ploughing, a subsoiler should be used or, better still, the land devoted to another crop.

The value of humus in the soil cannot be over-estimated. Its presence in more or less quantity assures a certain supply of nitrogen and other elements of plant food as well as the action of those soil micro-organisms so necessary in the desirable growth of plants.

Soils with a fair humus content are rendered more friable, capable of a better retention of moisture, and preserve a more uniform temperature. It is an accepted fact, also, that in the absence of sufficient humus artificial fertilizers are unable to exert their best effect.

Ridging.

After the soil has been thoroughly prepared it is advisable to throw up ridges to a height of from 4 to 8 inches at desired intervals on which to set out the plants. Planting on ridges is strongly advised in districts where heavy falls of rain are likely to occur, in order to provide additional drainage and to prevent the young plants from being washed out or covered by soil from storm waters. On shallow soils the higher ridging is indicated, but where the soils are 12 inches and upwards in depth and the field is satisfactorily drained 4 or 5 inches is regarded as sufficient. As a rule the ridges should run in a direction to assist drainage, but care should be exercised where the slope is well defined to see that no erosion of the soil will take place when the storm waters are running off. Erosion can be expected where the fall of the channel is in excess of 1 in 300.

Ridging is satisfactorily effected with a light plough, disc cultivator set to throw the soil inward, or an ordinary scuffler fitted with hilling attachments. A disc cultivator with wheels whereby the depth of the cut can be regulated will find favour.

As fertilizer will be applied in almost all instances, a saving of time and labour will be effected by attaching the fertilizer distributor, such as that of a corn-planter, in front of the implement used for hilling. No doubt a compact machine to effect both operations will ere long be purchasable.

Spacing of Plants.

The distances between plants when set out will be regulated to some extent by the growth that may be expected and the employment of hand labour or machine in cultivation.

Where machine cultivation is to be practised the ridges should be 4 feet apart, and if normal growth is anticipated the plants spaced at intervals of 2 feet thereon. Under this spacing one plant will occupy 8 square feet, 5,445 plants being required for the acre.

Where the soil is naturally fertile and a large growth of plant expected it is sometimes advisable to set the plants out at intervals of 21 inches to secure a better textured leaf. At this interval one plant will occupy 7 square feet and 6,222 plants be required for one acre.

With a lesser space between rows, as is sometimes advocated where cultivation is effected by hand, there is, unless the plants make small growth, a danger when bending down in the act of removing suckers from one plant of breaking or otherwise damaging leaves or plants in the next row.

Five thousand plants are usually regarded as an indication of one acre.

Where the field is large and the rows of plants a good length it may be advisable, at intervals, to miss a row or to make the distance greater between two to allow the passage of the vehicle used during harvesting operations for transporting the leaf to the barn.

TOBACCO SEED-BEDS.

The production of strong healthy plants, free from disease and insect infestation, that will most easily bear transplanting to the field and there make satisfactory growth is a prime factor in successful tobacco leaf production.

Not only will such plants make better growth and reach a more even maturity, but they will through their unimpaired vigour offer a greater resistance to attack by disease than would others less well grown.

Soil.

A tobacco seed, being exceedingly small, can provide but a small amount of nourishment for the young seedling, which in consequence is soon forced to draw its food from the soil. In view of this and the foregoing a friable fertile soil of fine texture, with a good humus content, capable of easy reduction to a fine tilth, should be selected for the seed-beds. A sandy silt loam or a fine textured alluvial or other loam is considered very suitable.

Where such a soil is not available on the holding, the existing soil can be built up by the addition of fine sand or heavy soil, whichever is called for, to improve the texture, and by the addition of well-rotted organic matter, either as leaf mould or animal excreta, or both, to improve both texture and fertility. In the case of the latter addition it should be well dug in some time before the seed-beds are required in order to become thoroughly incorporated with the soil.

Drainage.

Good drainage is imperative for tobacco seed-beds, since the seedling plants will not make a satisfactory growth on wet soil and will also be liable to damage from fungous diseases so engendered.

Site.

The situation of the seed-beds should be as sheltered as possible from strong winds, which are apt to damage the coverings (alluded to later on) and to dry out the soil. It should be such as to allow of easy drainage, if such is not naturally provided, and convenient for ease of access and attention. Proximity to a permanent supply of water is of the utmost importance. Tree growths should not be close enough to cast their shade on the beds, or through their roots rob them of food or moisture.

Area.

In calculating the area of seed-bed required, though it is usual to allow 100 square feet as sufficient for each of the acres it is intended to plant, a surplus of 50 per cent. is considered advisable, to allow for eventualities.

It is also advisable to make two sowings at intervals of two or three weeks in case sufficient rain does not fall to allow of setting out the first-raised plants before they are too old. It is considered inadvisable to set out in the field plants that are older than eight weeks. Plants four to six weeks old are much to be preferred.

Size.

The seed-beds may be formed to any desired length, but they should not be of greater width than will allow ease of weeding or of lifting plants preparatory to transplanting. A satisfactory width for such purpose is 3 feet, with a distance of 2 feet between beds to make provision for pathways. The width of 3 feet corresponds with the width of butter muslin or cheese cloth, which material is regarded as very suitable for covering purposes.

Preparation.

The land, being first cleared of all surface growth, should be thoroughly pulverised by ploughing or spading to a depth of 5 or 6 inches, and brought to a fine tilth. The seed-beds should now be marked out by drawing drills at intervals of 5 feet to make the breadth of beds, and across these at such intervals as the length of beds is desired.

These drills should be the depth of the ploughing and approximately 18 inches wide, the soil therefrom being thrown back and spread over the beds thus formed. A double mouldboard plough is very suitable, or an ordinary plough used as when making a finish. The beds will thus be 3 feet 6 inches in breadth, which will allow of the framework enclosing the 3 feet to be seeded resting thereon.

Sterilising.

Before further preparing the seed-beds for sowing, the soil should be sterilised. There are several methods of doing this, such as by steaming, the application of boiling water, solutions of formalin or similar agents, but the most effective in general estimation and recommended for Queensland growers is by the application of direct heat from the firing of tree branches, brushwood, or similar heat-giving material, piled on the beds, to such an extent as will, when fired, produce sufficient heat in the soil to cook a 4-oz. potato buried 3 inches deep, or an egg buried 5 inches deep. It is difficult to state the exact amount of material for burning purposes, but the equivalent of poles 3 inches in diameter laid side by side is regarded as likely to prove satisfactory. Successful sterilisation of the soil is most readily accomplished when the amount of moisture therein is what is regarded as satisfactory for cultural operations. Excess of moisture is as undesirable as a deficiency, since in either case the penetration of the desired heat in the soil is less easily permitted.

Properly burnt beds show a more or less reddish tinge of colour, while the soil is rendered more friable and breaks easily to a fine powder. The object of burning the beds as well as the soil for a couple of feet surrounding them is to destroy any fungus spores, weed seeds, insect or other life therein, that may cause damage to the young plants.

Another effect of burning the soil is to render the nitrogen content more readily available, and in other directions, probably to exert an improvement in growth thereon. The addition of the ash from the material burnt also tends to increase fertility.

Time to Burn.

The time to burn the seed-beds is preferably a few days or a week before it is desired to sow the seed.

Final Preparation.

After the fire has burnt out and the soil is sufficiently cool, all unburnt pieces of wood and large charcoal should be removed, and the beds and paths, disarranged when placing the firing material thereon, trimmed up to proper shape. The fine ashes from the firing should now be thoroughly incorporated with the soil of the seed-beds, which at the same time should be reduced to the desired degree of fineness by digging and raking, back and forth, to a depth of 3 inches and finally levelled off.

Framework.

It is necessary for tobacco seed-beds, more especially in North Queensland, to be shaded when the seed is germinating, as the heat from the direct rays of the sun is apt to scorch the young seedlings; it is also advisable for the seed-beds to be protected against the ingress of insects which would be likely to cause damage. To satisfactorily effect this latter and to allow of the covering used for shading not interfering with the growth of the plants, a frame or box with sides 6 or 7 inches high should enclose the beds. An adequate frame can be made of boards 6 or 8 inches wide; the ends if these should be squared so as to fit closely at the joins, over which a short piece of board or sheet iron could be nailed and at the corners, when the boards could be nailed to each other and further protection afforded by sheet iron, such as a piece of a petrol tin fixed to enclose the right angle so formed.

The top of the frame should be even, so that the covering will fit closely, and the boards should be sunk 1 inch or so in the soil and the soil on the outside heaped against them.

Protection against the ingress of insects is regarded as most important since the setting out of plants in the field free of infestation, either in the form of eggs or larvæ, must be regarded as a distinct advantage. Other types of framework can be considered for use, but the main essential to be observed, while allowing for support of the shading, is to have them so constructed as to allow insufficient space for the entrance of even very small insects when the covering for shade is applied. The breadth of the framework should be commensurate with the width of the covering material used so as to allow ease of attachment. With material 1 yard in width a breadth of 3 feet overall is suggested as a limit.

Covering.

Provision for sufficient light and the circulation of air in the seed-bed is necessary for the successful growth of plants. Choice of material for covering, especially in North Queensland, suggests consideration being given not only to a protection against the direct rays of the sun, which at the time of seeding is vertically overhead or nearly so at midday, but against storms of rain likely to occur while the plants are being raised, which would tend to damage the young plants or to wash them out. Glass is probably the most effective all-round covering, but would require to be shaded during the hottest part of the day. The initial cost, in the first instance, would be considerable, but where operations are on an extended scale it will be likely to prove most economical over a period of years.

Cheese-cloth or butter muslin, purchasable at comparatively small cost per yard, secured across the framework usually make a very satisfactory covering, but can be further improved by the addition of hessian, calico, or canvas placed tentwise or with sufficient pitch to run off heavy rain a little distance above.

When placing the covering, of whatever nature, on the frames, provision should be made for its easy removal when watering, or otherwise attending to the plants. Loops of tape sewn to the edges of the material to slip over nails or hooks on the outside of the frame, with wires drawn taut or supported at intervals across or along the beds to prevent sagging, will be effective, but perhaps the most satisfactory will be to attach the material to the underside of pieces of lath placed at intervals across the breadth of the frame, with one at each end overhanging to keep the material stretched. The covering can thus be conveniently lifted or rolled back and as easily replaced.

Fertilizing Seed-Beds.

When the soil is of low fertility or it has not been practicable to enrich it by the previous addition of manure the application of a little fertilizer is suggested. In this connection it would be advisable to make use of a complete fertilizer, of which a suitable mixture would be 6 parts superphosphate, 3 parts of nitrate of soda or dried blood, and 1 part of sulphate of potash, applied at the rate of 1½ oz. per square yard of seed-bed.

Where the beds have been burnt, however, there should be sufficient potash supplied in the ash from the firing, when a satisfactory application will be superphosphate at the rate of 1 oz. or a heaped tablespoonful evenly dusted over every square yard. Nitrate of soda could be added at the rate of ½ oz. per square yard applied in solution by a watering can. Fertilizer should preferably be applied the day before sowing, and brushed rather than raked into the surface of the soil.

Rate of Seeding.

Tobacco seeds being so very small induce a tendency to sow too heavily. An ounce by weight will contain approximately 300,000 seeds, which quantity will fill a teaspoon to its level twelve times. A level teaspoonful will thus contain about 25,000 seeds, which quantity is regarded as ample for 100 square feet of seed-bed unless the seed is known to be of low vitality. A heavy seeding results in a crowding of plants, which consequently make a spindly growth; another bad feature is that such crowding prevents the access of air and light to the soil, thus inducing the production of fungus diseases.

Time to Sow.

The time for sowing the seed-beds will be regulated by a knowledge of the seasonal conditions usual in the district, the object being to have plants four to six weeks old when sufficient rain has fallen to ensure growth after transplanting. The best quality of leaf is grown during the warmest months of the year.

In North Queensland, where the rainy season usually commences in December, it is advisable to make sowings in the second and fourth weeks of November. It takes from seven to ten days usually for the seed to germinate; old seed sometimes taking up to fourteen days or longer. Seed thus sown can be expected to provide plants for setting out from mid-December to mid-January.

Sowing.

It is probable that the soil at the time it is desired to sow the seed-bed will be rather dry; if this is the case a good watering is indicated a day or so before the seed is sown, since a heavy application immediately afterwards is not desirable.

When the moisture content is satisfactory the surface soil should be broken finely and then slightly compacted, as by the pressure of a board, to prevent an even and level appearance. To secure an even distribution of the seed over the seed-bed will be extremely difficult unless some medium is used. In South Africa success is reported by distributing the seed, suspended in water by agitation, from a watering can with a fine rose. The usual method, however, is to mix the seed very thoroughly with fine, dry, sifted ashes, using 1 quart to that for each 100 square feet. In mixing, it is advised to take a bucket or similar receptacle and place a layer of ashes in the bottom then sprinkle a pinch of seed over it, then another layer of ashes followed by a pinch of seed until the desired amount has been used up. The ashes and seed should now be thoroughly mixed with the hands and then by pouring from one bucket into another several times. By broadcasting this mixture over the bed the colour of the ashes will give an indication of the evenness of distribution. After the seed is thus sown it should be lightly pressed into the soil. This is nicely performed by the use of a board to the centre of which a handle has been vertically fixed. Some growers prefer to add a mulch after sowing, in which direction dried and finely-teased horsedung is very suitable as it forms a mat over the soil, which prevents disturbance of the seed when watering and is easily penetrated by the young seedling. It is advisable, however, in preventing the introduction of weed seeds or fungus spores to sterilise this material by contact with boiling water or steam for ten minutes or so. Tobacco seed should not be covered too deeply, as germination will thereby be retarded, if not prohibited, consequently any form of mulch used to cover must be in a very thin layer.

Watering.

Immediately after seeding, the beds should be lightly and evenly watered and kept damp but not wet whilst under shade. A watering can with a finely perforated rose can be used, but a hose with a nozzle capable of giving a fine spray under pressure, such as would be obtained with water laid on from an overhead tank, would be more satisfactory.

The frequency of waterings will to an extent be regulated by the evaporation, but a light watering in early morning and late evening is preferable to a heavier watering once a day. When the seed has germinated and the plants have made some growth the watering can be effected more rapidly by using a rose with larger perforations on the watering can or hose.

Hardening Off.

Plants grown entirely under shade would be too tender to withstand the shock of transplanting to the field, where bright sunshine would prevail; they should, therefore, be gradually hardened off by removing the covering when they are 1 inch to 1½ inch high for an hour or two in early morning and late afternoon, gradually extending the period until they will bear the direct sunlight all day. The covering, however, should always be on the beds through the night or between sunset and sunrise, as most predatory insects on tobacco plants are night fliers. When the plants are half grown the waterings should be lighter but not enough to allow of the plants wilting.

Added Precautions.

As a preventive against fungus diseases the young plants can be sprayed with Bordeaux or Bungundy mixture, diluted to three-quarters the usual strength, to which might be added arsenate of lead, especially if grasshoppers are in evidence, as a protection against insect attack. A spraying with arsenate of lead or Paris green the day before the plants are lifted for setting out in the field will afford a further protection and is recommended.

Should the plants not be making satisfactory progress in the seed-bed, or it be necessary to accelerate their growth, the application of a liquid manure is advisable.

This can be prepared by half filling a cask or similar vessel with cow, horse, or fowl dung, the lastnamed being regarded as the best, and then filling up with water. After a few days, during which the contents should be stirred occasionally, the liquid can be used when diluted with nine or ten times its bulk of water to water the beds.

TRANSPLANTING.

The plants in the seed-beds having grown to a height of from 4 to 6 inches, and a sufficiency of rain having fallen or irrigation been applied to secure a desirable amount of moisture in the soil, transplanting to the field may be undertaken.

Before drawing the plants the seed-beds should be thoroughly moistened to allow ease of lifting with as little damage to the root system as possible. Should the soil be insufficiently loose after this has been done, a thin, flat piece of wood about 1 inch wide, or something similar, should be inserted near the selected plant which will be loosened by gently prising under it.

The stockiest and best plants of as uniform size as possible, with broad leaves, should be selected and lifted one at a time. The tips of the two largest leaves should be held between thumb and forefinger above the bud, and the plants gently lifted with as much adherent earth as possible and placed in a basket or other receptacle with the roots resting on a wet bag or in a slurry of soil and water, the container when filled being covered with a wet cloth until the plants are dropped in the field.

It is important when transplanting from seed-bed to field not to bruise the stem or in any way to injure the growing bud, the bruising of the tips of the leaves is of no consequence as they will not in any case come to harvest.

Whenever possible the plants should be set out the same day as they are lifted.

After the plants have been selected from the seed-beds another good watering should be given to set the smaller plants disarranged when lifting the selected ones, and the shades placed over the beds until they are again established.

It is not considered advisable to set out plants that are small and tender, though success might be achieved if the days following were dull and cloudy with occasional showers. The stocky plant with a firm stem is much to be preferred as it will be much hardier, take root sooner, and make a much more satisfactory subsequent growth.

As evenness in growth of leaf to maturity is most desirable in successful tobacco production, it is advisable to have the plants, as far as possible, of uniform size and age for each planting.

Where the operation of transplanting is accomplished by hand, it is found most satisfactory to have one person dropping the plants at the proper intervals on each of two ridges with two others immediately following to plant them. It is advisable to drop two plants on each ridge at the start so that the planters will each have a plant in hand to replace a defective one if necessary; this extra plant will also be found to facilitate planting.

An ordinary gardening trowel, or a dibbling stick or round peg 8 or 9 inches long and about 1½ inch in thickness, tapered roundly to a point, is generally used to make the hole in which to set the plant to the desired depth. Deep planting is desirable in order to allow the roots opportunity of securing moisture should the surface of the soil dry out, and as a protection against a scorching of the stem by a hot sun; care, however, should be exercised to see that there would be no likelihood of the growing bud being covered with soil should heavy rain be experienced before growth is made. In general, a planting to a depth that will allow the base of the two large leaves to appear level with the surface will be satisfactory.

Should the tap-root be so long that it would be bent up when the plant is set in the hole it should be nipped off.

After the plant is set in the hole the soil should be firmed round the roots and stem by inserting the peg at an agle nearby and pressing the soil in towards the plant, being careful especially to firm it around the roots.

If the soil is in good planting condition when the plants are set out, and the days are dull and cloudy or rain falls shortly after, the plants will soon take root and commence growth. They will generally wilt during the day if the sun is shining, but if in the early morning they look fresh they can be expected to do well.

Two or three days after setting out plants that are going to fail can usually be detected. These should be replaced as soon as possible with larger plants, if available, than those first set out, to secure uniformity. Where the number of replacements are not too many a little water should be given to each as they are put out.

When conditions are not very favourable at the time the plants are set out a protection should always be given against the effect of the sun by shading the transplants with a wisp of grass laid over each, a leafy sprig of bush stuck in the soil alongside, or pieces of paper placed tentwise over the plants and kept in position by weighting the edges with earth.

Machine Planting.

An expeditious and very satisfactory method of setting plants in the field will be found in the use of a transplanting machine. There are two makes of planting-out machines on the market. The "Bemis Transplanter," made by the Fuller and Johnson Manufacturing Co., Madison, Wisconsin, U.S.A., and a similar machine manufactured by Albert Smith, engineer, Wangaratta, Victoria.

These machines are drawn by two horses, and require one man to drive and two men or boys to drop the plants. One row is planted at a time, and up to 6 acres a day can be completed, the amount being governed by the ready supply of plants and water and the skill of the droppers.

A barrel of water is carried on the machine, while the planters are seated at the rear close to the ground with the drill opener and closer between them. From a box in front of each the plants are set alternately or handed by one to the other.

The machine can be regulated to allow of planting at desired distances, a warning being given to set the plant in the opened furrow as a small supply of water is delivered at the roots, around which the soil is immediately compacted by the drill closer.

The use of this machine will permit of the setting-out of plants in drier lands than would be permissible in hand planting.

It is not advisable to use the machine, however, when the land is very dry or very wet, as in the former the strike would be endangered and in the latter the compaction of the soil, caused by the heavy wheels from which the watering mechanism is driven, would be too great.

Cultivation.

After the plants are set out in the field the soil immediately around them, unless to break the crust for 1 inch in depth, should not be disturbed for about ten days or until they have become established, though if advisable a scuffler could be run between the rows without however coming close to the plants.

After the plants are well established shallow inter-row cultivation should be practised, and the soil kept loose between and immediately around the plants to aerate the soil, conserve moisture, and keep down any weed growth.

As the plants grow a little soil should be drawn towards the stems at every scuffling and a furrow formed midway between the ridges; the furrow thus formed, however, and the cultivation at any time, should not be deeper than the ploughing. This will allow the top of the ridge on which the plants are growing to be 9 or 10 inches higher than the bottom of the furrow between the ridges which, in a field adequately drained, should disallow any saturation of the soil around the plants, even under an exceptionally heavy fall of rain.

The number of cultivations required will vary according to the soil and season, but they should be so arranged as to keep the surface soil for a couple of inches in a fine, loose condition.

After the plants are topped further cultivation is not desirable.

FIELD WORK.

Priming.

When the plants are about 1 foot high the small leaves lowest down on the plant should be removed; this tends to a better growth of plant and allows a circulation of air below the leaves which tends to the prevention of fungus diseases.

Just before topping, also, it may be advisable to go over the plants to remove the smallest bottom leaves—these besides being small are of poor texture and the nourishment required by them would probably be of greater advantage to leaves of better size borne higher on the plant. The value of the leaf when cured, even when of poor texture, however, may be sufficiently attractive to allow of discrimination being exercised.

Topping.

The operation of topping is the removal of the flowering stem to prevent the formation of seed.

Natures objective being reproduction, the plant as it grows elaborates and stores a food supply in the leaves to be later transferred to the stem and used in the formation of seed. The leaves on a plant that has been allowed to run to seed will be found to have much less body than one nearby that has been topped at the proper time. The object then in topping the plant is to conserve, as far as possible, those products in the leaves that would otherwise be lost to them when transferred to form the seed, and to concentrate further growth in the leaves remaining on the plant so that their size and body will be satisfactorily increased.

A good time to top is when the flower stalks are well up all over the field, with odd ones showing one or two opened flowers. The height at which the stem with a number of small leaves is broken off will be indicated by the growth of plant, and requires some practical illustration or experience in order to gain the correct idea.

Topping too low has a tendency to cause the plant to develop coarse, heavy leaves that are slow to ripen and difficult to satisfactorily cure. Topping too high increases the quantity of short leaf at the expense of body in the other leaf. It is better, however, if uncertain, to top a little high than low, as a mistake in the first direction can be corrected later.

A proper height is suggested as just above the leaf that can be expected to grow into a nice saleable size. According to the vigour of the plant this would leave from six to eight leaves on a poorly developed plant, to twelve or fourteen on one of average growth, and correspondingly more on one of extra vigorous growth.

Seasonal conditions will influence the height of topping, also the plants being topped a little higher in a season of heavy rainfall and a little lower when the precipitations are under average.

Suckering.

The plant being defeated in its first attempt to produce seed now makes a further endeavour by sending out suckers or shoots from the axils of the leaves a week or ten days after topping, which, if left to grow, would produce flowers and later seed. These growths must be removed or the objective in topping would be defeated. Just as soon as they are 2 or 3 inches long the plants should be carefully gone over and each sucker removed. Fresh suckers will continue to form where the others have been broken off until the leaf is harvested. Usually in a normal season three suckerings will be necessary. They should never be allowed to grow too far before being removed, except when a period of wet weather occurs as the leaves are ripening, when they may be allowed to grow temporarily to absorb plant food and prevent the leaves from becoming coarse and difficult to cure.

RIPENING.

There is analogy between the ripening of a tobacco leaf and that of a dessert fruit, of which an orange or apple will afford a good example. As full growth is attained in each, a gradual change in colour will be noted, during transition from greenness to ripeness, which is indicative of the change that is occurring in those components, that determine the ill-flavour in the unripe product and the maximum of palatability in that fully ripe. Just as the stage at which a dessert fruit or tobacco leaf is picked falls short of full ripeness, so will the flavour and palatability, when it becomes ripe or is so cured, fall below that which it would possess if allowed to ripen naturally on the plant.

While the fruit, however, can be left upon the tree to become fully ripe, in which condition it will remain for some considerable time before decay sets in, a similar procedure cannot be followed in the case of the tobacco leaf; this, owing to its comparative thinness and largeness of surface area, must be picked at a somewhat earlier stage and full ripeness accelerated in the curing process, so that deterioration, which is otherwise rapid, will not take place before the desirable qualities can be preserved. It will be noted that when a tobacco leaf is allowed to remain on the plant beyond the stage of ripeness at which it should be picked, the bright yellow colour, suggestive of full ripeness, will commence to show at the tip and gradually spread from there over the blade of the leaf towards the stem. As this bright colour spreads, however, it will be followed by a dark brown colour, indicative of dead tissue or decay, so that before the last part of the leaf has become fully ripe, or so coloured, the first part has perished and become worthless.

Too much emphasise cannot be laid on the fact that the finest flavour and smoking quality of the cured tobacco leaf is due to the natural changes that occur in ripening while the leaf remains upon the plant.

As with other plants, such as maize, sugar-cane, &c., it may be noted that the leaves on a tobacco plant ripen progressively, from the base of the plant upwards. During growth, the leaves on the plant are soft and pliable and characterised by a generally deep green colour; after topping and the removal of suckers the body and size of the leaf increases, due to the accumulation of the plant food that would ordinarily be transferred to build up the seed heads. When the leaf has reached full growth, from smooth and pliable it has become rough to the touch and somewhat brittle, since on folding portion of the leaf with the underside uppermost and pressing it will crack across the fold; this is due to the accumulation of starch granules with other plant food within the leaf cells. Though fully grown this leaf is not necessarily ripe enough to harvest.

In a normal season, from two to four weeks after topping, and, according to the soil, eleven to thirteen weeks after setting the plants out in the field, the lowest leaves should be approaching ripeness.

Just as an orange or apple may be fully developed but not sufficiently coloured to be deemed ripe, so will signs of ripeness in a tobacco leaf be indicated by the change of colour from a generally deep green to a more or less greenish yellow.

The yellowness will be more pronounced in leaves of light texture, while in leaves of heavy texture the yellow may only show in flecks of colour over the surface.

The degree of yellowness, or the amount of departure from the original greenness, will vary according to the soil on which the crop is grown.

In many crops grown on poor sandy soil, the leaf during growth will possess a yellowish tinge, which will become more and more pronounced as ripening progresses.

In crops grown on more fertile soil, or, where the percentage of clay is greater, the leaf will possess more body, in which case the yellowing will be less pronounced, or, as was previously noted, will appear only as flecks upon the leaf surface. These flecks, however, will be accompanied by a general lightening of the original green colour of the leaf.

Close observation of the crop during growth, and of the gradual change of colour as ripeness is approached, will be most helpful, while the depth of greenness during growth will be an index to the degree of yellowness that may be expected when the leaf is ripe.

Probably the best indication of ripeness is the definite change of colour in the blade of the leaf, closest to the stalk of the plant.

Practical experience is necessary to allow of leaf being harvested at exactly the right stage of ripeness, for to secure the best results in flue curing, the leaf should neither be under nor over ripe, though it is better to err slightly in the latter direction than the former.

HARVESTING.

Leaf should not be picked when wet with dew or rain unless it can be immediately strung on the sticks and suspended, for if kept for any length of time in a heap it will probably become discoloured.

After a heavy fall of rain it will be noted that the leaf has lost its gummy feel. Picking should not be resumed until, after a few fine days, the gum has again become apparent.

Two methods of harvesting tobacco leaf can be employed. One is to pick the leaves from the plant, as they become ripe, and the other, to cut the whole plant. The latter method is not recommended, as, although a saving in labour is effected in harvesting, it is more than offset by the extra fuel and attention required during a longer period of cure and a lower average price for the product, since the leaves will be in various stages of ripeness, and so incapable of being cured to the best advantage.

As success in curing depends on having the leaves at a uniform stage of ripeness it is evident that, as they ripen progressively, such uniformity can only be secured by picking the leaves singly.

The number of ripe leaves that can be secured from a plant at one picking will vary; usually three will be found sufficiently ripe, but at times only two will be ready, and not infrequently four, or even six, will be available. Where evenly-sized plants were set out in the field and uniform growth made, harvesting will be facilitated as each plant can be expected to yield about the same number of ripe leaves at a picking. As these leaves would have occupied the same position on the respective plants they would possess a similar texture, which would be a great advantage in curing.

The number of pickings required to harvest a field of tobacco varies according to the growth of the plants, but usually from three to five will be found necessary.

At all times great care should be exercised in handling tobacco leaf, especially at harvest when the leaf is crisp and easily broken or bruised. As the leaves are picked they are carefully laid, one on top of the other, in suitable containers, or placed in similar fashion across the hand and forearm, from which they are periodically transferred to a vehicle for transport to the barn or stringing shelter. The latter method will probably be found most expeditious, but will be improved if a light shallow tray, or something of like nature, is first supported by the hand to allow a greater resting surface for the leaf. When the container is full and the leaf is transferred to the vehicle for transport to the barn or stringing shelter it should be protected from the sun's rays by a covering of light cloth or hessian. Sunburnt or bruised leaf will not cure a good colour.

Transport of the picked leaf will be facilitated when a wider space has been left between rows at successive intervals across the field to permit of the passage of a vehicle, to which the leaf would be progressively transferred by the pickers on each side.

A slide, about 2 feet wide by 6 feet long, built to carry a removable container of a form somewhat similar to an ambulance stretcher, but with a box-like frame, say 2 feet deep, covered with hessian, replacing the usual canvas, would be convenient.

This container when filled would be drawn on the slide to the headland and there transferred to a wagon or motor lorry built to carry several, so that bruising of the leaf will not occur during transport to the barn or stringing shelter.

STRINGING.

Stringing the leaf is carried on in the shade, either under an improvised shelter in the field where the leaf is picked or in a stringing shed at the barn.

It should be noted that the leaf at all times after picking should be protected against the effect of a hot sun so that it will retain its crispness. Wilted leaf is difficult to cure. In the stringing shed the leaves are placed in piles on benches or tables, with butt ends all one way. A stand with two uprights, each with a slot on top, so spaced as to carry the tobacco stick as a rail, about waist high, is most convenient for tying.

The sticks, which are either 1 inch square or 1 to 1¼ inch round by 4 feet 6 inches long to allow them to rest on the tierpoles spaced at 4 feet centres are arranged in a handy stack.

Ordinary fine counter twine, such as grocers use for small parcels, usually sold in reels, answers admirably for attaching the leaf to the sticks. When tying, a stick is placed on the stand while the reel or ball of twine is placed in a bucket or similar receptacle at the end of the stand to the right.

Two persons, one handing up the leaf and the other attaching it to the stick, will do quicker work than if each acted independently. The one tying takes the end of the string and attaches it to the stick 4 inches from the end at the left; the other hands up the leaves two, three, or four at a time, according to the size, placing them so that the sides with the veins prominent will be facing one another and holding them between thumb and fingers at the extremity of the butts. With the twine held in the right hand, the operator grasps the bunch of leaves 2 or 3 inches below the other's fingers, and placing the stems against the stick, with butts about 1 inch above near where the string is tied, passes the string anti-clockwise round the stems, at the same time giving the bunch of leaves a half twist to make the stems come close together and cause the string to bind tightly; keeping the string taut, another bunch of leaf is grasped in a similar manner, brought over the stick and tied to the side opposite the first, by passing the string clockwise round the stems and giving the leaf the same kind of twist as previously. This is repeated, spacing the bunches of leaf 3 or 4 inches apart on each side of the stick, so that the bunches on one side of the stick occupy a position midway between those on the opposite side, until the stick is filled to within 4 inches of the other end, when the string is tied to the stick by lifting the end and throwing two or three half-hitches over it near the last bunch of leaf and drawing tight.

The number of leaves in a bunch, and the number of such bunches on a stick will vary according to the size of the leaf. Two large leaves, three medium, four small or more if very small, are usual to form a bunch, while twelve to sixteen bunches can be placed on each side of the stick.

When the stick is filled the operator removes it and lays it carefully down on a bench, while the other places another stick in the stand and ties the string to its end. As the sticks are tied they are stacked carefully to avoid bruising until a sufficient number is available for transference to the barn with least loss of time.

IN THE BARN.

Filling the Barn.

When filling the barn the sticks are usually passed carefully from hand to hand to be suspended between the tierpoles.

The sticks should not be crowded upon the tierpoles as this would induce sponging; depending on the size of the leaf, they would be spaced from 8 inches with small leaf to 12 inches apart with large leaf, the object being to allow sufficient space for the necessary free circulation of air.

A standard 16 by 16 five-tier barn can be expected to hold around 360 sticks of average sized leaf.

Thermometers.

As control of heat and humidity is the essential factor in flue-curing it is necessary that a hygrometer (wet and dry bulb thermometer) as well as a thermometer should be provided, the latter for use chiefly when the higher heats are in operation. Hygrometers on wood backs are procurable from 12s. 6d. upwards—the difference in readings between the wet and dry bulb of the hygrometer will indicate the amount of humidity present. A range up to 130 degrees Fahrenheit is quite sufficient, as this instrument is only necessary in the early stages of the cure.

The thermometer should register to 200 degrees Fahrenheit, with bold figures, and present a broad column, preferably coloured, that will permit of easy reading at a distance.

A "flat wood back black spirit thermometer" manufactured by Wilson Nafis & Co., Wharf street, Brisbane, and sold at 12s. 6d. can be recommended.

These instruments are suspended in the centre of the barn as nearly as possible level with the leaf of the bottom tier.

Humidification.

During the early part of the curing process it is necessary to have a humid atmosphere in the barn. Sometimes there will be enough moisture given off by the leaves to create a sufficiency, but not infrequently it will be necessary to add moisture to obtain the degree of humidity desired.

This is most easily effected by the introduction of steam from a boiler at low pressure—superheated steam is entirely unsatisfactory—either through a permanent pipe leading under one of the walls or by a hose through one of the bottom vents, to discharge in a tub or other receptacle, placed on the centre of the barn floor. The use of this tub is advisable to collect the water from condensation, so that the floor will not become saturated.

Another method is to start a small fire in the furnace and to place wet bags on the hot flues; these should be kept damp by the application of hot water, without however, unduly wetting the floor.

Should only a small addition of humidity be desired, it can be obtained by suspending wet bags over the flues.

The application of water to the floor is not recommended, especially if it is of earth. The reason for this is suggested in the fact that before proceeding to extract the moisture in the leaf during the fixation of colour all extra humidity must be expelled from the barn. When the floor is saturated this could not easily be accomplished, so that the ventilating air, introduced through the bottom ventilators, passing upward through the leaf would probably carry extra humidity, thus limiting its power of absorption of the moisture transpired therefrom and occasioning a liability to sponging.

Sponging, it may be noted, is a term descriptive of the darkening of colour induced when the moisture transpired from the leaf, not being immediately absorbed by the circulating air, collects upon its surface.

FLUE CURING.

In the production of bright tobacco there is no operation of greater importance than the curing of the leaf, for upon the success of this will depend in largest measure the monetary return that may be expected from the crop.

The process demands the greatest care and attention to all details, for good leaf can be completely spoilt by neglect, while leaf of apparently poor quality can be much improved in value by skilful treatment.

In order to secure the best result, it is imperative that the leaf should be of uniform body and texture, picked at the proper stage of ripeness, properly handled, and cured in a correct manner.

Leaf to an extent under-ripe can often be cured to a colour that would be classed as bright, though lacking in clearness; but proportionately as the leaf is under-ripe so will the flavour and smoking quality, as well as the brightness in the cured article, be depreciated.

Leaf that is grossly under-ripe cannot be cured a bright colour, and when saleable realises the lowest price of all grades.

Leaf that is over-ripe, in the sense that it has been allowed to remain on the plant beyond the desired stage of ripeness at which it should be picked, also, will not allow of a satisfactory cure. Depending on the degree of over-ripeness, it will cure an uneven colour with parts brittle and inelastic, or portion, or the whole, may perish before the colour can be fixed and the leaf dried out.

Leaves varying in body or thickness even when the degree of ripeness is uniform do not permit of being evenly cured together. As will be noted when the process is explained a thin leaf will cure more rapidly than one of greater body, so that if the stages are regulated for one depreciation will be suffered by the other, while if a middle course is pursued both will be lowered in value.

The flue-curing of tobacco leaf must not be regarded merely as a more or less rapid abstraction of the moisture therefrom, by the application of heated air; but rather as a process under which those leaf constituents that establish excellence in the cured product are further elaborated, during a prolongation of the life process, and brought to perfection as the leaf is killed by the gradual abstraction of moisture, so that they may be preserved in an unimpaired condition when the leaf is dried right out.

The process is the most modern and scientific method of curing tobacco, and it is due to the excellence of the quality thus obtained that the demand for bright tobacco, so cured, now greatly exceeds that for leaf cured by all other methods.

Descriptively the process is usually divided into three stages, viz.:—

(1) Yellowing the leaf;

(2) Fixing the colour and killing the leaf;

(3) Drying the leaf right out.

The yellowing stage might aptly be termed an acceleration of the ripening process, while the leaf is kept alive under particularly favourable atmospheric conditions, artificially obtained.

These are gradually modified in the second stage to allow of full ripeness, indicated by a more or less uniform yellow colour, being secured over the leaf, just as it is killed by the drying of the last of the moisture from the blade. The final stage is the simple evaporation by increased heat of the moisture remaining in the stem and mid rib.

As the change to a yellowish colour is regarded as an indication of ripeness in the field, so is the evenness and brightness of the yellow colour established in the cured leaf considered an index to quality, when the product is classified into various grades.

The colour most sought is the light bright yellow of a freshly ripened lemon, as leaf of this colour is in greatest demand and realises the highest price. Departure from evenness, clearness, and brightness in this particular colour induces a corresponding reduction in market value.

It is not possible to secure such a colour in all leaf, as climate and particularly the soil on which the crop is grown exercise an influence.

Much rain when the leaf is approaching ripeness will cause a delay in that direction by creating a further rise of sap, which is also apt to cause some regrowth, through which a cloudy or uneven colour with possibly some spotting will result in the cured leaf. Cold weather, also, will cause a delay in ripening that is prejudicial to colour.

The class of soil, however, on which the crop is grown will exercise the greatest influence in determining the colour possible of attainment in the cured article. Those light in texture where the percentage of sand is high and that of clay very low will produce leaf that is much easier to cure a good colour than those of heavier nature.

In proportion as the clay and fine silt content increases in the soil so will the body of the leaf be augmented and the opportunity of securing the brightest colour lessened.

Yellowing.

In the yellowing of leaf under cure it must be recognised that the change of colour will continue while there is life or moisture in the leaf; also that the yellow colour when obtained will turn to brown and later to black if the moisture is not abstracted in the correct manner to kill the leaf and thereby fix the colour at the proper time.

Colouring will progress most rapidly in a warm and humid atmosphere, such as would be indicated by hygrometer readings between 80 and 95 degrees dry bulb with a corresponding depression of from two to four degrees wet bulb while the leaf is fresh and crisp. Yellowing will continue up to 125 degrees provided there is life in the leaf, but will become slower as temperatures are increased and humidity is reduced.

In the early stages of the cure a low temperature is essential until the leaf has yellowed; a high temperature at this stage would ruin the tobacco.

The degree of heat to use at the beginning will be indicated to a certain extent by the average maximum temperatures that operated during the ripening of the leaf; it should be higher, but not in excess of 10 degrees. In most parts of the State a temperature of 90 degrees would be considered most suitable, but on the highlands of the South, where the days are much cooler, it might be better to start at a lower temperature and increase gradually over several hours to that degree. On the other hand in certain of the tropical districts where the days are likely to be hot a temperature of 95 degrees might be indicated. The barn being filled and the hygrometer suspended as indicated, the readings of the wet and dry bulbs are noted, and the door and all ventilators tightly closed.

A small slow-burning fire is now started in the firebox in order to raise the temperature in the barn slowly to that required, so that the heat may be gradually absorbed by the leaf. The time occupied in securing the desired temperature will be regulated to some extent by the number of degrees indicated by the readings when the barn was closed, but usually not less than two hours should be employed.

The humidity recorded by the difference in readings of the wet and dry bulb of the hygrometer should now be observed. Ordinarily during this period the leaf will transpire enough moisture to render the atmosphere sufficiently humid, but if the readings differ by more than three or four degrees, moisture should be added, as advised under the heading "humidification".

The desired atmospheric conditions being obtained in the barn, the fire can now be drawn and the damper in the stack, and door and cover of firebox and ashpit closed. If the barn has been properly constructed it will not lose any appreciable heat or humidity, and can be left untended for six or seven hours during which a drop of three or four degrees will not matter.

The leaf should be allowed to remain in this atmosphere until a distinct yellowing of the tips and edges of the leaves is noticeable, or as is often the case with very thin leaf until it has turned a pea-green colour.

Depending on the degree of ripeness and the amount of body in the leaf, this will take from twelve to thirty-six hours or longer. The temperature being at 90 degrees dry bulb and 87 degrees wet bulb is now raised gradually in the course of about two hours to 95 degrees, and so maintained until the yellow spreads towards the midrib or the pea-green colour becomes more evident. The temperature is then advanced during about two hours to 100 degrees and held there until the yellow colour is pronounced.

Ventilation.

Up to this point, the high degree of humidity indicated at the start should have been maintained in the barn to prevent any evaporation of moisture from the leaf taking place, by the introduction of more steam or by placing wet bags again on the flues, whenever the difference between the wet and dry bulb readings was in excess of 4 degrees.

When the leaf is placed in the barn it contains about 80 per cent. of moisture, which has to be abstracted during the curing process. The amount in each leaf will vary according to its thickness or body, thus indicating a longer or shorter period over which the colouring should proceed and evaporation of moisture take place. As colour changes while there is moisture in the leaf, and more rapidly when a high degree of atmospheric humidity prevails, it is evident that these forcing conditions must not be allowed to operate beyond a certain stage, otherwise establishment of the desired colour would be jeopardized through inability to dry out the blade of the leaf in time.

The art in curing is to abstract the moisture from the leaf after the yellowing has reached a certain stage, proportionately with the progress of further colouring so that the desired degree of yellowness will be secured just as the last of the moisture is dried from the blade of the leaf, thus killing it and fixing the colour coincidently. The importance of filling the barn with leaf of similar character as suggested under ''Harvesting'' is thus emphasised.

While a high degree of atmospheric humidity is maintained in the barn no evaporation can take place, consequently this humidity must be lowered before reduction of moisture in the leaf is possible. It is here that the use of the hygrometer is of great value, as it will indicate the degree of humidity, so that transpiration of moisture from the leaf can be regulated by judicious use of the ventilators.

The top ventilators are now opened about 1 inch and the heat increased gradually over two hours to 105 degrees, where it is held until the difference in readings of the hygrometer is approximately 8 degrees. When this difference is obtained transpiration of moisture from the leaf will be taking place and the fixation of colour will shortly be entered upon. The evaporation of moisture from the leaf takes place most rapidly in a dry atmosphere and is accelerated by increase of temperature.

It should make equal progress with the advance of the balance of colour sought. A decided advantage in this connection will be found when the heating flues are arranged to give an equal distribution of heat over the base of the barn and the bottom ventilators so constructed that the entering air would immediately come in contact with their hot surface. Under such an arrangement the air would be quickly and evenly heated and dried, so that in its upward passage it would draw and absorb the moisture in uniform measure from each of the suspended leaves and carry it out of the barn through the vents on top.

Control of evaporation is thus suggested in regulating the admission of the air through the bottom vents and its passage out of the barn through the vents on top, as well as by the degree to which it is heated. If the air outside the barn is very dry, as when a westerly wind prevails, the drying of the leaf can be effected at a lower temperature, while the circulation of the air should be lessened by reducing the openings of the top ventilators almost to a minimum to prevent the leaf from drying out too quickly. Should, however, the weather be wet the bottom ventilation should be reduced, more heat applied, and the top ventilation increased, in order that the most atmosphere should be driven out of the barn. When a satisfactory evaporation of moisture from the leaf can be effected at a low temperature the establishment of the desired colour is most easily effected. If, however, the circulating air is insufficiently dry and warm to absorb the moisture as it is transpired it will collect on the surface of the leaf and cause sponging or a change in colour to a reddish brown, which will materially reduce its value. The remedy when this occurs is to open the ventilators wide and rapidly increase the temperature by 10 degrees, or until the moisture has disappeared, and then reduce to what should be correct in each. On the other hand, if the heat is advanced too rapidly while there is much moisture in the leaf it will be killed too quickly, and a greenish red or black colour, which is even more objectionable, will develop.

The desired atmospheric conditions having been obtained at 105 degrees the ventilation is now increased by opening the top ventilators to a quarter of their capacity and the bottom ones sufficiently to cause the desired circulation of air. This will be dependent on the body of the leaf. Thin leaf will be about wholly lemon colour at this time and will need to be dried quickly, suggesting more bottom ventilation. Thick leaf on the other hand will need a somewhat longer time in order to secure additional colour.

The heat is now advanced gradually over about two hours to 110 degrees and not allowed to go above that temperature until the extreme tip of the leaf, on being touched with the finger, is found to be firm. This will indicate that not only has all excess moisture been expelled from the barn but that the leaf is commencing to dry, and fixation of the colour can be commenced.

The hygrometer should now show a difference of not less than 9 or 10 degrees between wet and dry bulbs.

Fixing Colour.

The top ventilators are now opened to half their capacity and the bottom ventilators to half or less, according to the thickness of the leaf; the heat is also advanced during about two hours to 115 degrees and held there until the ends of the leaves have shrunk and curled up. The difference in hygrometer readings at this time should be not less than 12 degrees. The instrument can now be removed and the large thermometer used during the remainder of the cure.

After this the top ventilators are fully opened and the bottom ventilators adjusted accordingly and the heat advanced over two hours to 120 degrees and held at that temperature until the edges of the leaf curl inward.

With full ventilation top and bottom the heat is now advanced over two hours to 125 degrees and held at that until the web of the leaf if dry except, perhaps, just near the midrib.

Keep ventilation at full top and bottom and then advance to 135 degrees in about four hours, and hold at that until the veins of the leaf are quite dry.

Drying Out.

After this is effected the moisture in stems and midrib must be extracted to complete the cure. The ventilation is now progessively decreased and the temperature increased by 5 degrees each hour until at 160 degrees the bottom ventilators are practically closed and those on top reduced to a mere crack.

The temperature is held at this point until the stems are all dry and will break without bending. This will be best determined by testing the leaf in top and bottom tiers at the corners of the barn, especially that nearest the door. The fire must now be drawn and the door and all vents opened wide to allow the barn and tobacco to cool down prior to conditioning the leaf for removal to the bulk shed.

It is not considered advisable to carry the heat beyond 160 degrees as higher temperatures will tend to reduce the elasticity of the leaf and dim the lustre of its colour. With heavy-bodied leaf, however, in which the brightest colour cannot be expected, higher temperatures might be employed but these should not exceed 175 degrees.

The period occupied during the cure will vary according to the body of the leaf, from three days with extra thin leaf to five days with medium-bodied leaf being usual. With heavy-bodied leaf, however, the cure will probably take six or even seven days.

Modifications.

No set formula can be suggested for curing tobacco, as the type of leaf and the climatic conditions prevailing during the process will necessitate a variation in the method of treatment.

The following modified directions, however, for curing leaf of different texture if followed should give a more or less satisfactory result.

EXTRA THIN LEAF.

Start at 90 degrees dry bulb 88 or 87 wet bulb, hold until the edging of the leaf shows a light yellowish or pea-green tint. Raise in two hours to 95 dry bulb and 92 or 91 wet bulb and hold until the yellow tinge has spread towards the midrib or the major part of the leaf has assumed a definite pea-green colour. Raise during two hours to 100 dry bulb and 96 or 95 wet bulb and hold until the yellow tint or light pea-green colour is shown all over the leaf or it is just short of lemon colour.

Now give one-fourth of the ventilation on top and bottom and increase the temperature during two hours to 105 degrees and hold until the tips of the leaf are firm. The leaf should now be practically a lemon colour. Then give half ventilation on top and one-fourth or more below and increase the temperature to 110 degrees. Hold at this until the ends of the leaf shrink and curl up. Now give full ventilation top and bottom and increase the heat over two hours to 115 degrees and hold until the edges of the leaf curl inward.

Then increase to 120 degrees over two hours with full ventilation and hold until the web of the leaf appears dry. Now advance at the rate of 2½ degrees per hour until 130 degrees and hold at that until the veins are all quite dry.

Now progressively decrease the ventilation and increase the temperature by 5 degrees per hour to 160, when the bottom vents should be closed and those on top reduced to the merest crack. Hold at 160 until the stems will break without bending.

The cure is now completed and the fire can be drawn and the door and all vents opened wide to allow the barn and tobacco to cool down.

MEDIUM-TEXTURED LEAF.

Start at 90 degrees dry bulb 88 or 87 wet bulb and hold until the tip and edges of the leaves become yellow. Advance in two hours to 95 degrees dry bulb with wet bulb 92 or 91 and hold until this colour spreads about half-way towards the midrib. Advance during two hours to 100 degrees dry bulb with wet bulb not lower than 96 and hold until the yellow colour is more pronounced. Now open top ventilators about an inch or two and advance temperatures in two hours to 105 and hold until the wet bulb registers 8 degrees below the dry bulb; if the colour increases too rapidly during this stage open the bottom vents a little. Now give one-fourth top ventilation and one-eighth or one-quarter bottom ventilation and increase the heat during two hours to 110 degrees. Wet bulb should now read 101 or 100 degrees. Hold at this until the extreme tip of the leaf is firm to the touch. Now give half ventilation top and bottom and increase the heat during two hours to 115 degrees, hold at this until the end of the leaf shrinks and curls up.

Now give full ventilation and advance the heat during two hours to 120 degrees and hold until the edges of the leaf curl inward. Advance to 125 degrees during two hours and hold until the web of the leaf is apparently dry. Now advance with full ventilation at 2 degrees per hour to 135 degrees and hold at that until the veins of the leaf are quite dry.

The ventilation is now progressively decreased and the temperature increased by 5 degrees each hour until 160 degrees, when the bottom vents should be closed and those on top show only a small crack. Hold at 160 degrees until the stems will break without bending, then draw the fire and open the door and all vents to allow the barn and tobacco to cool down.

HEAVY-TEXTURED LEAF.

Start at 90 degrees dry bulb and 88 or 87 wet bulb and hold until the tip and edges of the leaves assume a yellow colour and the balance of the leaf has turned a lighter green.

Advance to 95 degrees dry bulb and 92 wet bulb and hold until the yellow colour spreads towards the midrib. As there is a lot of moisture in heavy leaf, in the evaporation of which further colouring will be made, it is advisable at this stage to commence the reduction of the atmospheric humidity in the barn.

Open the top vents 1 or 2 inches and just crack the bottom ones and raise the heat during two hours to 100 degrees. Hold at this until the wet bulb is reduced to 95 degrees and the yellow colour has advanced over half the leaf. Now increase the top ventilation to one-third and the bottom ventilation to one-quarter and increase the temperature gradually at the rate of about 2 degrees per hour to 110 degrees, when the wet bulb reading should be 101 or 100. When this disparity obtains increase at the same rate with half ventilation to 115 degrees and hold until the tips of the leaves harden. Now advance at the rate of 2 degrees per hour to 120 with full ventilation and hold until the end of the leaf shrinks and curls up. Then advance at the same rate to 125 degrees and hold until the edges of the leaf curls inward.

Now advance to 130 degrees and hold until the web of the leaf is dry, when a further advance should be made to 135 and maintained until the veins of the leaf are quite dry.

During these periods careful watch should be kept on progress of colour and reduction of moisture in the leaf. If the colouring is too fast when the ventilation is limited increase the openings top and bottom and rise the heats a little quicker to accelerate the drying of the leaf.

On the other hand if the colouring is too slow reduce the bottom ventilation considerably and the top slightly to retard drying, but be careful in so doing not to induce sponging. When conditions at 135 degrees are satisfactory dry out the midrib and stem by raising the temperature 5 degrees an hour, decreasing the ventilation at the same time until at 160 degrees it is reduced to a minimum.

In some instances it will be advisable to extend the heats to 175 degrees, in which case reduction of ventilation will be more gradual.

Keep at the higher temperature until the stems will break without bending, then draw the fires and open the door and all vents to allow the barn and tobacco to cool down.

POINTERS FOR CURING.

In each barn full of tobacco, some slight variation in the curing may be expected.

Humidify the atmosphere and avoid saturating the floor as it will cause trouble later.

With late-grown leaf yellow at lower temperatures.

In cool weather use lower temperatures.

In wet weather start ventilation earlier and increase top ventilation.

When external atmosphere is very dry decrease top ventilation and regulate bottom ventilation to prevent too rapid drying.

Dry over-ripe leaf at a low temperature with full ventilation.

When the leaf is colouring too quickly increase ventilation, and then gradually increase the heat.

When leaf is drying too quickly reduce or close bottom ventilators and lessen top ventilation.

Increase ventilation with increase of temperature when fixing colour.

Do not decrease ventilation with a view to raising temperature except when drying out between 135 and 160 degrees.

A fire with little blaze permits a steadier heat.

A blazing fire increases the heat rapidly—use the damper when adding more fuel.

Use the peep-hole when reading the hygrometer or thermometer.

Open the door only when unavoidable or when necessary to inspect the leaf.

Do not take a naked light into the barn when tobacco is drying—use an electric torch.

Examine leaf through top ventilators as well as by the door.

Colour in daylight is more apparent than under artificial light.

A slight greenish tinge in the cured leaf will disappear in bulking.

LOG BOOK.

A log book, of which the following is suggested as a heading for each page, should be kept at the barn and the particulars of each cure entered therein.

NAME OF FARM.

Number of Barn.	Number of Cure.	Number of Sticks.

Weather conditions during growth: ....

Weather conditions at harvest: ....

Kind and condition of leaf: ....

Temperature.				Remarks on colour and condition of leaf, ventilation, &c.
Date.	Time.	Dry.	Wet.	

The observations thus recorded will be a guide in further cures when modifications where indicated would ensure a better result.

CONDITIONING.

When the cure has been completed and the barn cooled down the leaf will be exceedingly dry, and so brittle that it cannot be handled without liability to damage until it has absorbed sufficient moisture from the atmosphere to render the blade of the leaf pliable. Usually when the door and ventilators are left open during the whole or part of a night the tobacco will have come into condition for handling by the morning. When, however, the weather is particularly dry, and the atmosphere at night is insufficiently humid, artificial means will need to be adopted.

In this case the barn must be tightly closed and the atmosphere within humidified by the introduction of steam at a very low pressure, damping the walls, or by laying wet bags upon the floor and the flues, as was suggested at the beginning of the cure.

Care should be taken when conditioning to see that the leaves do not absorb too much moisture. Those on the sticks of the lower tier will come into condition first and should be removed from the barn as soon as they are ready.

Where tobacco is to be grown on an extended scale conditioning will be facilitated by the provision of a conditioning room in which the atmospheric humidity can be regulated by mechanical means, or by the excavation of a cellar in which the sticks of leaf could be suspended as in the barn and brought into condition without delaying the use of that structure. In this connection the leaf would first of all be rendered sufficiently limp by the introduction of steam from a boiler at low pressure to allow of transference from the barn. It may be noted that the leaf rendered limp by hot steam will become less pliable as it cools down.

The correct condition for transference to the bulk shed for bulking down is when the web of the leaf and a half of the midrib back from the tip are pliable and the remainder of the midrib is slightly supple but will break before bending to a right angle. On removal to the bulk shed the sticks of leaf should be carefully stacked; in forming this the floor is first covered with bags, matting, or such like, to keep the tobacco clean; the sticks are then laid carefully thereon so that the leaves lie evenly, those on the second stick overlying those on the first except for a fw inches back from the stick, and so on to the length desired. The stack is then built up by layers of sticks commencing from each end alternately.

If not convenient to detach the leaf from the stick immediately the stack should be covered with a tarpaulin or bags for a few hours, during which the tobacco will tend to even in condition.

BULKING.

When proceeding to bulk the leaf, which should be effected as soon as possible after conditioning, the sticks are taken a few at a time into the grading shed, which is well lighted, and the leaves detached. Opportunity at this time should be taken to roughly grade the leaf into, say, four grades, of which the preponderating colours would be bright, medium, dark, and green.

Each of these grades should then be bulked separately in the bulk shed, the brightest being built in the most accessible position, as it will be finally graded and packed first, and the green in the least convenient part, as it will require to be left longer in the bulk for the colour to improve and will be finally graded and packed last of all.

The bright leaf should be bulked in as dry a condition as will allow of handling without breakage, while that of green colour will be benefited with a little more condition but with insufficient moisture to induce moulding.

When untying the leaves from the sticks careful watch should be kept for any in which the midrib has not been properly dried out during the cure. These soft or "fat" stems contain much moisture and would induce mould if included in the bulks. They should be put on one side, restrung and suspended in a dry place until the temperature in the next barn of leaf under cure is about 140 degrees, when they should be placed therein and dried out.

The bulks should be built in a floor at least 1 foot above the ground level, either of straight poles or boards with a space of not more than 1 inch between. When the surface of the flooring is rough or uneven it is advisable to cover it with bags or hessian before forming the bulk.

The bulks can be built to any convenient length and should be at least 4 feet high and 4 to 6 feet wide. When placed in very small bulks the tobacco has less chance of improving in quality, as the leaf tends to dry out too quickly.

When constructing the bulk it is advisable to lay the leaves with butts outward to form the edges of the sides and ends, slightly rounding the corners; the leaves should not be bent so that the tip points in any direction except directly away from the butt, nor should they be flattened out; they should be bulked just as they are taken off the stick. The next lot of leaves should be laid in similar fashion but with the butts about 4 inches back from those first laid and this procedure followed as far as possible to the centre, where it is not material in which direction the butts face. Successive layers are thus added to build to the height desired.

When the grower, however, is not thoroughly experienced in the conditioning of leaf it will be advisable to construct the bulks by laying two rows of leaves to any convenient length, butts outward and with tails overlapping about one-third of their length, and as high as practicable.

When the bulks are completed, planks are placed on top and weighted to press the tobacco down. The whole can then be covered with a tarpaulin, blankets, or other suitable material to exclude strong light and protect the tobacco from atmospheric changes.

In a properly constructed bulk shed the temperature and humidity will not show much variation. Should, however, the atmosphere become very dry water can be added to the ground below the floor to prevent the leaf from drying out. A hygrometer will be found of much value in the bulk shed.

The bulks should be inspected daily for the first week and regularly thereafter to detect any heat or fermentation that would ensue if the leaf contained too much moisture. Should any rise of temperature occur the bulk must be broken down and rebuilt after the leaf has been shaken out and aired, placing that from the centre to form the sides and that from the bottom to form the top of the new bulk.

The close contact of the leaf in the bulks when in proper condition induces certain changes in the leaf which improve the texture and develop aroma, while much of the green tinge will disappear and the colour generally be evened up and brightened.

It is considered advisable to hold the tobacco in the bulks for five or six weeks before assorting the leaf into its different classes and packing for despatch to market.

GRADING.

In order to secure the best price for his product it will be necessary for the tobacco-grower to have particular attention paid to the assortment of his leaf into distinct classes or grades.

Properly graded leaf in which the colour, texture, quality, and size of leaves are uniform provides an attraction to the buyer that invariably results in a more profitable return than would be the case if colours were mixed, texture and quality varied, or the lengths too uneven.

In a systematic classification of leaf it would first be divided into types suggestive of body or thickness of leaf, and the manner of its use or manufacture, such as wrappers, fillers, cutters, and lugs. These would be divided into colours as lemon orange, bright mahogany, mahogany, dark, and green, and then further separated into a number of qualities covering texture, elasticity, oil venation, finish, &c., as well as extent of damage.

Before, however, such a classification could be fully effective it would be necessary to have a standard of grades adopted that would be satisfactory to manufacturers, so that the leaf could be sold under competition by public auction or otherwise.

It is not to be supposed that the grower will be able without considerable experience to grade his leaf into definite classes; this would be most advantageously accomplished in a grading warehouse where a trained staff would be engaged. He will, however, find it profitable to grade as far as possible on the farm, as this will not only lessen the cost of further grading but improve his knowledge of leaf quality, and thus suggest directions in which improvement could be effected.

A well-lighted room is absolutely necessary to permit of satisfactory grading, as well as a good sense of colour on the part of the assorter.

When a preliminary rough grading to colour was made before the leaf was bulked down further grading will be facilitated.

The benefit also of an even stand of plants will be appreciated when assorting if the bulks from each cure are kept separate, as the leaves will have been picked from the same positions on the respective plants and consequently be of much the some texture.

The bulks of brightest leaf should be graded first, and that of greenish tinge last, as a longer period in the bulk will allow an improvement in colour.

Until a more satisfactory system of grading is made possible, the following simple descriptions will allow the grower to classify his leaf to advantage.

The leaf in each grade should be separated into lengths permitting a range of 5 inches in each.

The following descriptions are suggested for the leaf in each grade:—

Lemon 1 (L. 1).—Clear lemon to light orange, free from damage by disease, insect pests, or bad handling. Leaf with a greenish-yellow tinge may be included in this grade.

Lemon 2 (L. 2).—Clear lemon to light orange, slightly perished from being over-ripe, slightly damaged by disease, insect pests, or bad handling. Leaf with a yellowish-green tinge may be included in this grade.

Lemon 3 (L. 3).—Lemon to light orange in colour that would not be placed in the previous grades.

Lemon Scrap (L.S.).—Leaf of clear lemon colour that is broken, torn, or undersized. This leaf would not be put into hands.

Bright Mahogany 1 (B.M. 1).—Orange to light red, clean and free from damage. Leaf with a greenish-yellow tinge may be included.

Bright Mahogany 2 (B.M. 2).—Orange to light red, slightly perished from being over-ripe, or lightly damaged from disease, insect pests, or bad handling.

Bright Mahogany 3 (B.M. 3).—Orange to light red, sponged, or showing more damage than B.M. 2.

Mahogany 1 (M. 1).—Red to reddish-brown, clean, sound leaf, but may be somewhat sponged or show a slight greenish cast.

Mahogany 2 (M. 2).—Same as M. 1, but slightly perished from being over-ripe, or slightly damaged from insect pests, disease, or bad handling.

Mahogany 3 (M. 3).—Same in colour as M. 1, but would not be placed in the previous grades.

Dark 1 (D. 1).—Dark red to dark brown with parts of lighter colour; clean whole leaf. Leaf with a slight greenish tinge may be included.

Dark 2 (D. 2).—Similar to D. 1, but slightly perished from being over-ripe, or lightly damaged from disease, insect pests, or bad handling.

Dark 3 (D. 3).—Inferior to D. 2, or dark brown to black.

Green (G.).—All leaf having a pronounced greenish colour.

Inferior Bright (I.B.).—All leaf of generally bright colour that cannot be classed in the bright grades mentioned. Need not necessarily be put into hands.

HANDLING.

After the leaf has been sorted into the different grades it is tied into hands, each containing from twelve to twenty leaves according to their size. It is not necessary to count the leaves to form a hand, but a sufficient number should be used to make the butt measure as near as possible 1 inch in diameter; if made too big the hands are less presentable and liable to become loose.

Medium-sized leaves of the same grade, made extra limp by steaming or other suitable means, are used to bind the hands. Each such leaf is folded so that the midrib will be on the inside and not show when the hand is tied. Grasping the bunch of leaves in the left hand, the butts are beaten or pressed down until they are level. The binder is then held with the tip pressed firmly against the stems about 1½ inch from the ends by the left thumb and wound tightly round with the edge about ⅛ inch above the butts until about 4 inches remains. The leaves of the hand are now evenly divided and the butt end of the binder pulled through to keep it from becoming unwound. A neater tie is made when the binder is made to cover the ends of the butts before being wound around, but this is not essential. The binder should not reach too far down the hand, a width of 1½ inch to not more than 2 inches with large leaf from the butt end being desirable.

A neatly tied hand renders the tobacco more attractive.

After being tied into hands the tobacco can be built into bulks, following the same procedure as with loose leaf, until packing for market is desired.

PACKING.

Where sawn timber is to be obtained at a reasonable price the packing of tobacco in boxes is recommended for transport to market, as it will not only carry in better condition but will be less subject to damage from rough handling than if packed in bales.

A suitably sized case of ¾-inch boards of suitable timber such as pine, 48 inches long by 30 inches wide and 30 inches deep external measurements, is suggested as a standard. This sized case can be expected to hold up to 430 lb. of the brightest leaf and somewhat more of lower grades.

Where it is desired to pack the tobacco in bales a standard size is suggested as 34 inches long by 24 inches wide by 16 inches deep. This sized bale should weigh from 160 lb. to 200 lb., according to the quality of the leaf.

Whether packed in cases or in bales, it will be necessary to have a method of applying considerable pressure in the process of packing.

When a standard size for case and bale has been adopted, specially manufactured presses will doubtless be purchasable. Suitable home-made presses, however, can be constructed for boxes or bales, the pressure being applied as in a wine or wool press, or by a lever as in an old type of cheese press.

Where cases are to be used it would be necessary to have a frame to hold the case during packing. A box frame of the same length and width of the case would also be necessary to fit on top of the packing case to allow of the requisite quantity being pressed therein.

Where the tobacco is to be packed in bales a stout baling box with hinged sides and ends is suggested of the length and breadth of the bale but of double the depth. A loose bottom would be provided as well as a loose top, so that when the requisite quantity of tobacco had been pressed to the desired depth the sides of the press would be allowed to fall back and four steel rods with each end turned a few inches at right angles in the same direction slipped over the edges of the top and bottom, so that the tobacco would not spring when the pressure was released. To avoid delay this lot could then be taken from the baling press and set on one side for several hours to allow the leaf to bind, so that the covering could be sewn without trouble.

Particular attention should be paid to the condition of the leaf when it is being packed, as too much moisture will cause a darkening of the leaf, if not the formation of mould, while too little will cause a breakage of leaf.

The correct moisture content is from 12 to 14 per cent., which is denoted when the blade and tip of the leaf are pliable but not soft and the midrib slightly pliable but breakable before bending to a right angle over the greater part of its length.

If the leaf is too moist or too dry it will need reconditioning. This can be effected by dividing the leaf of the hands at right angles to where they were parted to receive the end of the tie and placing them astride tobacco sticks, or they can be tied on with string in the same manner as with green leaf and placed in the barn or conditioning room to be properly ordered.

In packing the hands into the cases or baling-box a layer is placed at each end with tails pointing towards the centre of the case, then another layer is placed in a similar manner but 6 inches back from the first and continued until the tips of the last layer overlap the previous one by more than half its length; if it is short of this, one layer is placed across the centre of the case.

This procedure is followed with the next layer, but starting at the sides so that the hands will form a bond, and so on alternately until the case is filled. Where an odd layer is required in the centre the butts should be placed to point in the opposite direction in alternate layers.

As each layer is placed in position it should be pressed down with one or two smooth boards 12 inches wide, respectively an inch shorter than the width and length of the case. Care should be exercised in placing either of these boards on the leaf and in pressing upon them so that no stems are broken. When the requisite quantity of leaf has been packed the high pressure is gradually applied and the tobacco compressed to the desired extent.

As each case or bale is completed the distinguishing grade mark should be neatly stencilled thereon, together with the weight of leaf enclosed.

MARKETING.

Farm Selling.

At the present time it would appear that the only manner in which a grower can dispose of his leaf is to make a sale on the farm to a visiting representative of a manufacturer, who, after inspecting the tobacco in bulk, makes an offer of a price for each grade or an average price for the crop, the leaf to be packed and delivered in good condition by the grower either free on rails or at the tobacco factory.

This manner of sale is unsatisfactory to both grower and manufacturer. Even with a reasonably good classification the buyer's offer will be on the conservative side to allow for the possibility of a percentage of the bulk proving inferior, while in the absence of open competition the best price cannot be realised. The grower also is at another disadvantage in that he is responsible for the delivery of his tobacco in good condition at the buyer's factory after it has been transported probably upwards of 1,000 miles.

In the manufacture of high-grade smoking mixtures either for pipe or cigarettes the standard of excellence is maintained by adherence to a particular formula under which certain grades of leaf are blended in definite proportion. Manufacturers consequently who only require particular grades are thus forced to buy a proportion of leaf they cannot use.

Organisation of Growers.

Viewing the probability of a rapid extension in the production of bright tobacco in the State, especially in northern parts, where the quality of leaf produced has earned the commendation of both manufacturers and consumers, the early formation of a tobacco-growers association is indicated, through which the interests of the producers can not only be protected but advanced in many directions.

The benefits received by sugar-cane growers through their associations could, it is thought, be experienced in perhaps fuller measure by tobacco-growers if organised under somewhat similar lines.

Immediate attention is desirable towards the institution of a better system of marketing tobacco leaf, through which the grower will be able to obtain the true market value of his product. Sales by auction or other competitive means are indicated.

Standard Grades.

Before sales of tobacco by auction or otherwise could be most satisfactorily effected it would be necessary to have standard grades adopted throughout the State so that buyers at a tobacco auction could make their bids with as much confidence in the description of each such grade as the wool buyers have in those of the catalogues at the various wool sales.

Grading Centres.

As the accurate classification of leaf into standard grades would not be possible on all farms, the establishment of conveniences for grading, conditioning, and packing, preferably on co-operative lines, is indicated at various convenient centres.

Research.

With a comparatively new industry the necessity for experiments to determine the suitability of varieties, fertilizer mixtures and their application, cultural methods, &c., &c., for each district is apparent. In this direction results will be more easily and rapidly secured when there is collaboration between growers through their organisation with the Department of Agriculture.

Stabilising Prices.

Notwithstanding the fact that a high degree of protection is afforded the Australian tobacco-grower through the Customs tariff, the possibility of an understanding being arrived at between manufacturers to fix the price of leaf must be taken into consideration.

Tobacco properly conditioned and packed will keep for a number of years. With an effective organisation the growers can counter any move to fix lower prices than they are agreeable to accept by withholding supplies or engaging in manufacture themselves.

FLUE CURING BARNS.

By N. A. R. POLLOCK, H.D.A., Senior Instructor in Agriculture.

DURING the years since the process of flue curing tobacco leaf was evolved it will readily be understood that various types and sizes of buildings have been used for the purpose and that experience so gained, coupled with an appreciation of the principles involved in the promotion of a satisfactory cure, would suggest a particular structural form embodying certain essential features as being most desirable.

Control of temperature and atmospheric humidity within the barn is a sine qua non in successful flue curing.

The process, which will be more particularly set out under flue curing, demands the retention of a high degree of humidity at regulated temperatures in the early stages of the cure, when it is desirable that the barn should be air tight.

In later stages, as temperatures are progressively increased, this humidity is gradually lessened by the use of the ventilators, and finally the cure is completed and the leaf dried by the circulation of further air, introduced through the bottom ventilators, where it comes in immediate contact with the hot flues and is dried and heated to particular temperatures. It then rises, passing between and around the suspended leaves, from which it absorbs the moisture transpired and is discharged through the ventilators on top.

It is important, therefore, that the barn should be provided with adjustable top and bottom ventilators of suitable capacity, and that it should be practically airtight when these are closed. Should the barn not be airtight, or the ventilation not be capable of being increased or decreased as required, adequate control would not be possible.

The walls and roof of the barn should be of sufficient thickness or so insulated as to disallow undue escape of heat and to prevent the atmosphere within the building from being affected by external conditions.

An even application of heat is most desirable, in which connection it is found that the heating flues can be arranged to the best advantage when the base of the barn is square rather than oblong and the desired capacity of the structure obtained by the provision of comparatively high walls with a restricted ground area rather than otherwise. Under this arrangement the air admitted to the barn is not only more evenly and quickly heated, but its circulation upward, owing to the narrowed column, is more easily accelerated or retarded by means of the ventilators and control thus facilitated.

A variety of materials can be used in barn construction, choice being influenced by cost, effectiveness, and durability. A point of great importance is the proofing, as far as possible, of all woodwork against white-ant attack.

Walls.

For the walls reinforced concrete, hollow concrete blocks, and brick are naturally suggested as the most durable; but equally effective structures can be made of pisé de terre, logs, slabs, or a wooden frame sheeted wholly with iron, wood and iron, or with a non-inflammable composition such as asbestos cement.

Logs.

Where straight logs can be easily procured, quite effective walls for the barn can be constructed. Each log should be trimmed where necessary and halved or grooved at the ends where the logs of the other walls, similarly treated, would join to form the corners. Butt ends should alternate with small ends so that the top of the wall will be level when completed. All interstices throughout are filled with puddled clay, or mortar made of sand with lime or cement, in order to render the building as airtight as possible.

The wall at the firebox end is preferably built up with stone and mortar for about 2 feet above the top of the firebox or a total height of 5 feet, a further advantage being gained where the first 2 feet of the other walls are similarly constructed.

Where the nature of the ground will permit, the base could be excavated within a foot of each wall up to 5 feet in depth, thereby saving the building of that amount of wall and considerably lessening the danger from fire.

The possibility to damage from white ants should be carefully considered as well as the liability of the bottom logs to decay; these should be of the most durable timber, deprived of all sapwood and kept well poisoned.

Slabs.

Sawn or split slabs with dressed edges can be used, laid horizontally between posts the requisite distances apart, being held in position either by a groove cut vertically the full height of the post or by cleats nailed or bolted thereto.

The slabs can be laid double so that the joins on one side are covered by the slabs on the other, or single slabs of 2 or more inches in thickness can be laid and the joins covered with strips of iron or board inside and out. All interstices should be filled with clay or other material as with log walls.

As the posts of this structure will be of necessity sunk in the ground, any excavation could hardly go deeper than 2 feet, to allow the posts to be sunk to a sufficient depth below to ensure stability in the structure.

As with the log walls, precautions should be taken against the decay of the timber and damage from white ants.

Pise.

Walls of pisé will be found very effective, and when well constructed most durable, especially if the roof is made to project and the part exposed to the weather plastered with a cement compo.

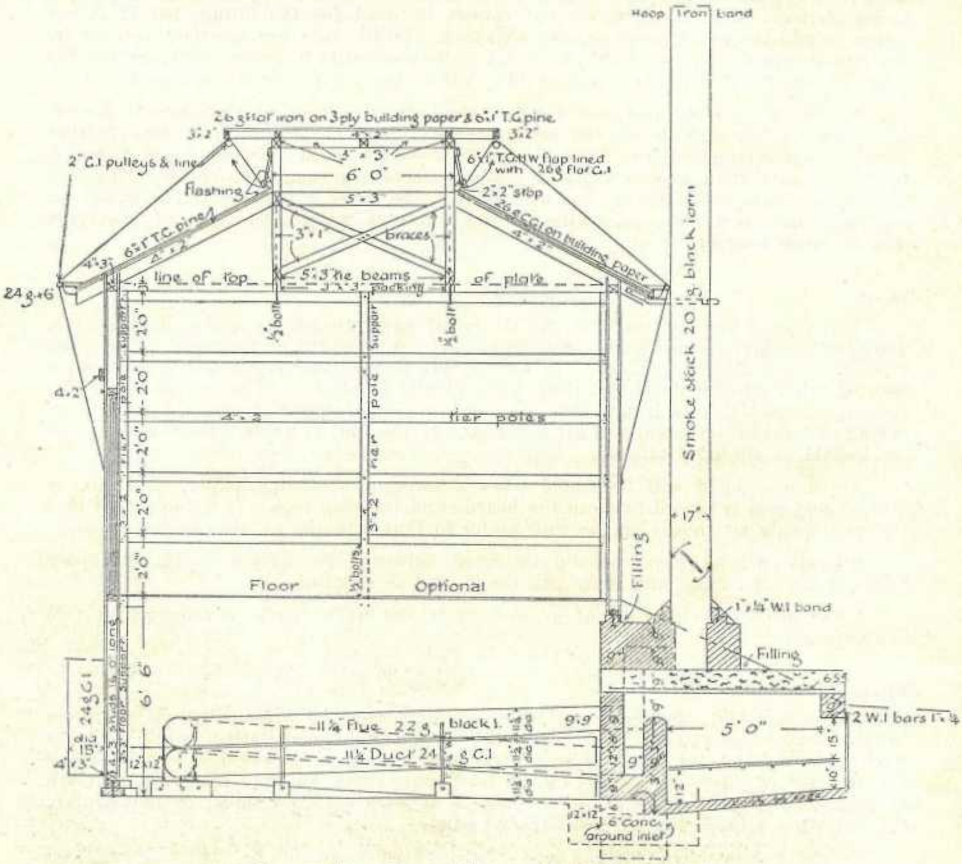


PLATE 10.—FLUE CURING BARN (SECTION).

Pisé is a term applied to stiff earth or clay when used to form walls by being rammed into moulds as they are carried up. These moulds or boxes should be of convenient size and made of a timber that will not warp or shrink, lightness in weight being an advantage when handling. Twelve by 1½ inch boards are suitable, while a convenient depth of mould is 2 feet.

Wood and Iron, &c.

The type of wall that will probably find most favour will be that constructed of a framework of sawn or dressed hardwood sheeted with iron inside and out, and the space between filled with perfectly dry sand or soil. The studs, preferably 4 x 2 with ground plates of 4 x 3 or 4 x 4 and wall plates of 4 x 2, should be at intervals of 2 feet centre to centre when corrugated iron is used and 18 inches centre to centre where the sheeting of flat iron is used. Corrugated galvanised iron of 26 gauge should be used on the outside, the sheets being laid horizontally, while the same material or flat galvanised iron can be used on the inside; the corrugated article makes a stronger job. On the outside the top sheet should lap over the bottom sheet to keep rain water from entering, while on the inside it is preferable to reverse this proceeding and make the sheet below lap over the one immediately above so that the fine parts of the filling will not escape. The framework should be erected and properly braced at each corner and the wall plates temporarily fixed. The inside sheeting is now completed, after which the bottom sheets on the outside are nailed to the studs and the space filled with the dry earth or sand with each successive sheet, the top plate being removed as the last sheet is put on to allow of the filling being completed.

It is advisable that the sand or soil should be perfectly dry and finely broken so that it will fill the corrugations of the iron and no spaces will form after the job is completed. Other material can, of course, be used for the filling, but it is not likely to be cheaper or more readily obtained. White ants are guarded against by laying the ground plate on strips of flat galvanised iron 9 inches wide, preferably soldered together, well tarred and sanded, while they could also be well poisoned.

Another type of framed wall has been used where a sheeting of T. and G. boards is nailed on the outside of the studs, covered with building paper, and further sheeted with corrugated iron. The T. and G. sheeting would in most places, however, be more costly than iron. Asbestos cement sheets are suggested for sheeting and may prove quite satisfactory, but are likely to be more expensive when landed on the barn site than iron, as, owing to their greater weight, the cost of transport will be much heavier.

Roof.

The framework for the roof should be of sawn timber to make the best job, though straight bush poles are possible of use. A sheeting of tongued and grooved flooring boards should be laid on top of the rafters, over which galvanised corrugated iron or other equally durable waterproof material is placed. The boards should be thoroughly seasoned, as if not they are liable to shrink apart during the process of curing and thus allow escape of air and heat. If the roof is gabled, the walls at each end should be similarly treated.

An improvement will be found when a lining of building paper, ruberoid, or similar material is placed between the boards and covering iron. It is important that the roof should sit snugly on the wall plates so that leakages of air will not occur.

Shaped packing pieces should be fitted between the rafters to fill the space between the top of the wall plate and the T. and G. sheeting.

Good insulation in the roof as well as in the walls tends to economy in fuel consumption.

Furnaces.

Suitable material for the construction of the furnace or firebox will be found in bricks, cement concrete, or pisé, preferably made from good antbed, while in cases where excavations for the purpose are made, the natural walls so obtained can occasionally be used. The top should be formed with an arch of brick set with antbed mortar, a slab of reinforced concrete at least 9 inches thick, or boiler plate covered with a thick coating of clay and sand.

Where cement concrete is used the aggregate should be fire-resistant and broken to pass through a 1-inch mesh. Igneous rocks such as quartz, basalt granite, &c., should be selected, as sedimentary rocks are generally unsuitable.

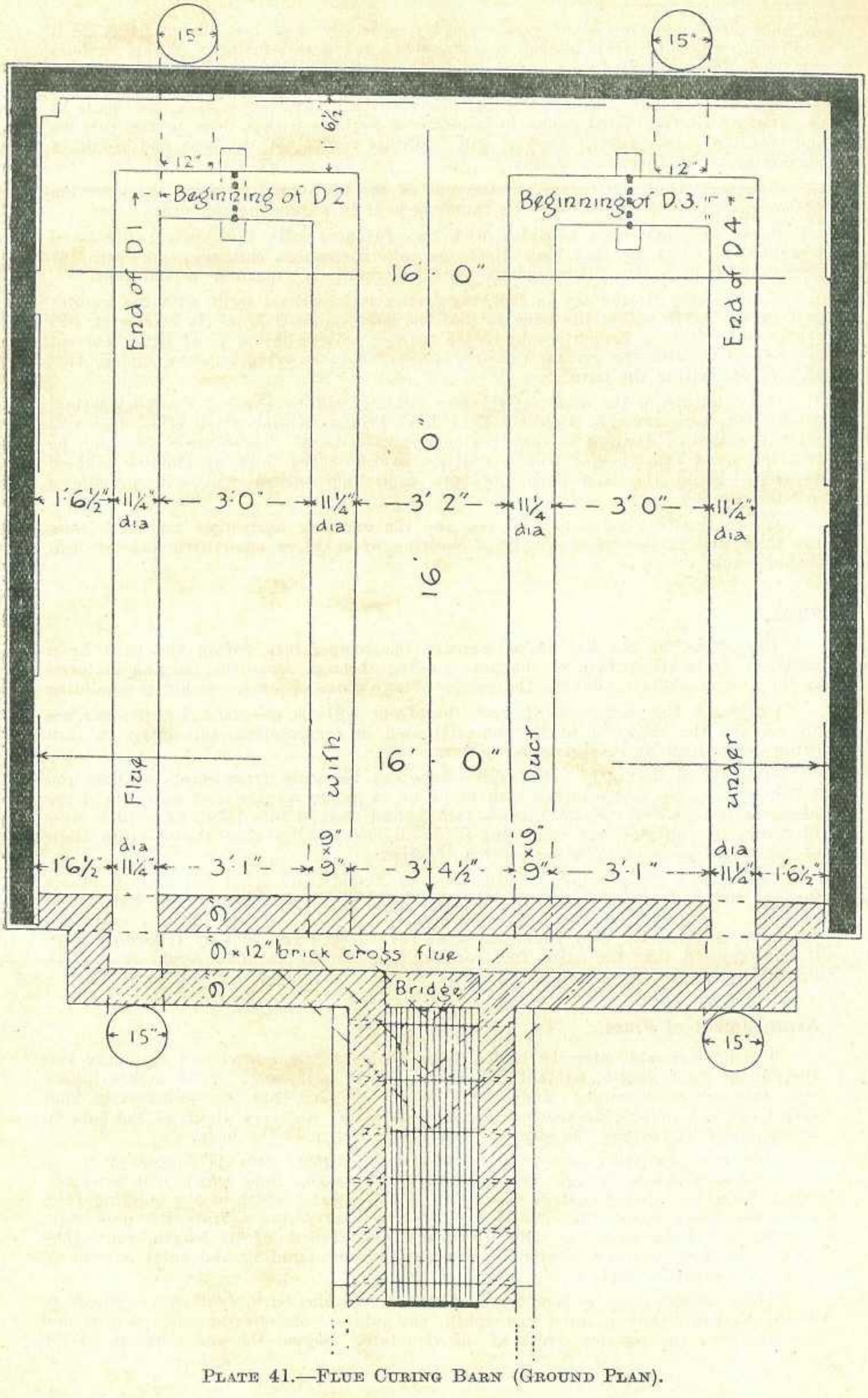


Plate 41.—Flue Curing Barn (Ground Plan).

The firebox should be of good capacity, a width of 2 feet, height of 2 feet, and length of 6 or 7 feet, interior measurements, being satisfactory. Where firebars are used, an ashpit 15 to 18 inches in depth must be added and the firebox fitted with a door and cover over the ashpit to control the draught. Without firebars it is found the fire will burn steadily and allow, with a little experience, the heats to be satisfactorily regulated. The installation of firebars with a door to the furnace and cover over the ashpit, however, will facilitate control of the heat and result in some economy in fuel consumption.

Construction of the furnace at the side of the barn furthest from the direction of the prevailing wind will also be found helpful in regulating the fires.

Barns are sometimes provided with two furnaces with independent flues and separate chimneys, or they may discharge into a common chimney; but with the largest sized barn now advocated one, properly built, is regarded as sufficient.

With a view to economy in fuel, the firebox is sometimes built with the greater part of its length within the barn so that the heat radiated from its brickwork will not be lost. With a properly constructed furnace this radiation is of little moment in comparison with the greater difficulty presented in securing an even distribution of the heat within the barn.

It is considered the most satisfactory heating will be ensured by constructing, outside the barn, a single firebox with a flame bridge, behind which cross flues will carry the divided draught to the flues entering the barn. These cross flues can be of brick or of iron covered with a coating several inches thick of puddled antbed, so that, should the iron burn out, the encircling antbed will still provide a satisfactory flue.

Where the furnace walls and top and the encasing antbed of the cross flues are thick and further insulated by a covering of earth or sand little loss of heat should result.

Flues.

The object of the flue is to increase the temperature within the barn by a radiation from its surface of the heat passing through from the burning material in the firebox without allowing the escape of any gases or smoke within the building

Obviously the radiation of heat therefrom will be governed by the surface offered and the thickness of the material used in construction, this latter in turn being determined by its resistance to wear.

It is found that very satisfactory flues can be made from sheets of flat iron 3 feet wide and 3 feet 6 inches long of 22 or 24 gauge respectively, curved and the edges lapped and riveted, or turned, folded, and swaged into tubes of a little over 11 inches in diameter, one end being made slightly smaller than the other to allow of telescopic joins or of being riveted together.

The heavier gauge should be used from the firebox and for 3 feet after it passes through the wall, where provision should be made to allow of easy replacement when required. Gauges of 20 and 22 will naturally provide a longer service; but when provision is made for easy replacement at the furnace end and by telescopic joins it is suggested that the extra fuel consumption thereby entailed would render the lighter gauges more economical.

Arrangement of Flues.

The flues should enter the barn a little above the floor level and gradually rise throughout their length, so that the centre of the exit is 12 or 15 inches higher than that of the entrance. They should be so disposed that the radiation of heat therefrom will induce the temperature in each corner at every stage of the cure to be as nearly as possible the same as that in the centre of the barn.

The most satisfactory arrangement to approximate this is suggested in an equal division of the draught from the furnace into two flues which will enter the barn at that end, being centred one-eighth of the interior width of the building from the sides, along which they are carried to a similar distance from the next wall, to turn and continue at the same distance for one-fourth of its length, when they would turn and continue parallel, to emerge from the building and enter a common chimney above the firebox.

There would thus be four lines of flue across the barn, centred progressively from the walls they parallel one-eighth, one-quarter, one-quarter, one-quarter, and one-eighth of the interior width of the structure. Across the end opposite to the furnace there would be two lengths of flue, together equal to half the width of the building. It is calculated that the increased radiating surface thus provided at this end would ensure a heat equal to that given out by the flues at the furnace end, which are naturally the hottest.

Chimney.

The chimney or smoke stack can be made of iron or brick, and should be carried a foot or so above the highest part of the roof. For convenience in cleaning an aperture should be left at the base of the shaft which may be closed with a metal shutter or, in the case of a brick structure, by a brick, projecting slightly for ease of removal when necessary. A sheet-iron damper for controlling the draught should be provided.

Top Ventilators.

The top ventilators are constructed as apertures in the roof, fitted with outward opening, hinged shutters made of tongued and grooved boards sheeted with flat galvanised iron, which should close of their own weight and sit snugly over the opening to render it weather-proof and as airtight as possible. The movement of each shutter for ventilation is effected by the agency of a metal arm projecting from its centre, to which is attached a wire cord which passes over a pulley under the lower sill of the opening and is carried under the roof and over the wall to the ground outside, where it can be fixed to keep the shutter open to the extent desired.

Where the roof forms a gable at each end two ventilators can be provided on each side to occupy the centre of each half of the respective slopes, or the ridge can be constructed to allow of an opening the full length on both sides which can be closed by a number of independent shutters.

Where the roof is hipped the slopes can be carried up until a square opening 4 to 6 feet in diameter is formed, when a box frame of suitable height to allow of an aperture with a hinged shutter, forming a ventilator on each of the four sides, can be constructed and provided with a flat projecting roof.

The ventilators should be of ample capacity, so that, when necessary, the use of those furthest from the direction of the wind will be sufficient. Ordinarily ventilating space equal to one-twentieth, or 5 per cent., of the ground area of the barn will be sufficient.

Bottom Ventilators.

It is considered that the best system of bottom ventilation is effected by the admission of the air through ducts similar in design to the heating flues, though perhaps of lighter material, leading under the walls to the lower surface of the heating flues, on which it would immediately impinge to be dried and heated to the desired temperature before coming into contact with the leaf.

Four such ventilators are advisable, two at the furnace end and two at that opposite, so arranged that each duct will enter and be carried under and in line with one of the flues.

As air on being heated expands and rises, that entering the barn and coming in immediate contact with the hot flues would cause a suction through the bottom ventilators proportionate to the degree to which it is heated, thus indicating a much lower capacity in the bottom ventilators than in those on top. It is considered that the combined capacity of the bottom ventilators should be equal to one-fourth of that regarded as sufficient on top.

Where the base of the barn has been excavated and the duct has to descend some distance before turning to pass under the wall, it will be necessary to increase the diameter with the depth of the outside portion or to sink a shaft from which the duct would lead. The ventilation can be regulated by fitting a plate to slide over the opening of each duct or by a revolving shutter inside.

Tiers.

The tiers are formed of poles across the barn from the furnace end to that opposite, the outside ones being placed against the walls and those intermediate centred, at 4 feet intervals, from the sides of the walls. The first tier should be 7 feet 6 inches or 8 feet above the ground floor of the barn, with successive tiers at vertical intervals of 2 feet until the top of the wall is reached.

Sawn hardwood 4 inches by 2 inches forms the best tier pole, though bush timber can be used.

Side play is prevented by nailing a batten across the centre of the poles from wall to wall in each tier, and extra strength secured by connecting the similarly placed poles in each of the successive tiers by a batten bolted to each about the centre of its length.

Door.

A door 6 feet 6 inches high by 2 feet 10 inches wide should be provided in the wall opposite to the furnace to open outwards and give entrance under the space between the second and third tier pole.

A satisfactory door can be made with a braced frame sheeted on both sides with dressed T. and G. flooring boards.

Floor.

The work of filling and emptying the barn is facilitated if a floor is installed 2 or 3 feet below the bottom tier, even if it does not extend to cover the rooms next to the walls. Satisfactory flooring boards will be 2 inches by 1½ inch spaced 2 inches apart.

Peep Holes.

In order to avoid opening the door on each occasion the thermometer is read an aperture, say 12 inches high by 4 inches wide, closed with a thick wooden shutter, can be constructed in the wall just below the bottom centre tier pole.

As the thermometer should be suspended in the centre of the barn on a level with the leaf in the bottom tier, it can be attached to an endless cord, passing over pulleys fixed to the tier pole in or near the centre of the barn and at the peep hole, to be brought forward for inspection and returned whenever desired.

Bulk and Grading Shed.

The construction of the bulk and grading shed is more simple than that of the barn, since provision is not required for the application of heat or so much ventilation.

In the bulk shed, to which the leaf is transferred after curing and in which it is held through the process of bulking and grading until despatched to market, the degree of atmospheric humidity should as far as possible be under control and not easily affected by weather conditions outside.

A wooden frame building with walls 10 feet high, lined and ceiled with wood or other insulating material, sheeted outside with weather-boards or galvanised corrugated iron, and roofed with iron or other equally durable weather-proof material, will be found quite satisfactory.

Reinforced concrete, bricks, pisé, logs, &c., are also serviceable in construction.

Floor.

The floor should be of boards, preferably 4 inches by 1 inch, laid with an inch space between and raised at least a foot above the ground to allow of a free circulation of air around the bulk of tobacco, which would be built up thereon.

Light.

Very little light is needed in the bulk shed, as tobacco leaf will bleach in colour under a strong light. One window in each end of the building is usually sufficient. These should be provided with shutters, to be closed when no work is being performed.

Ventilators.

Small rabbit-hutch or slide-covered ventilators should be provided at the base of the walls under the floor and a hinged shutter ventilator in each gable end.

Doors.

Double doors should be provided into the bulk shed and from it to the grading shed.

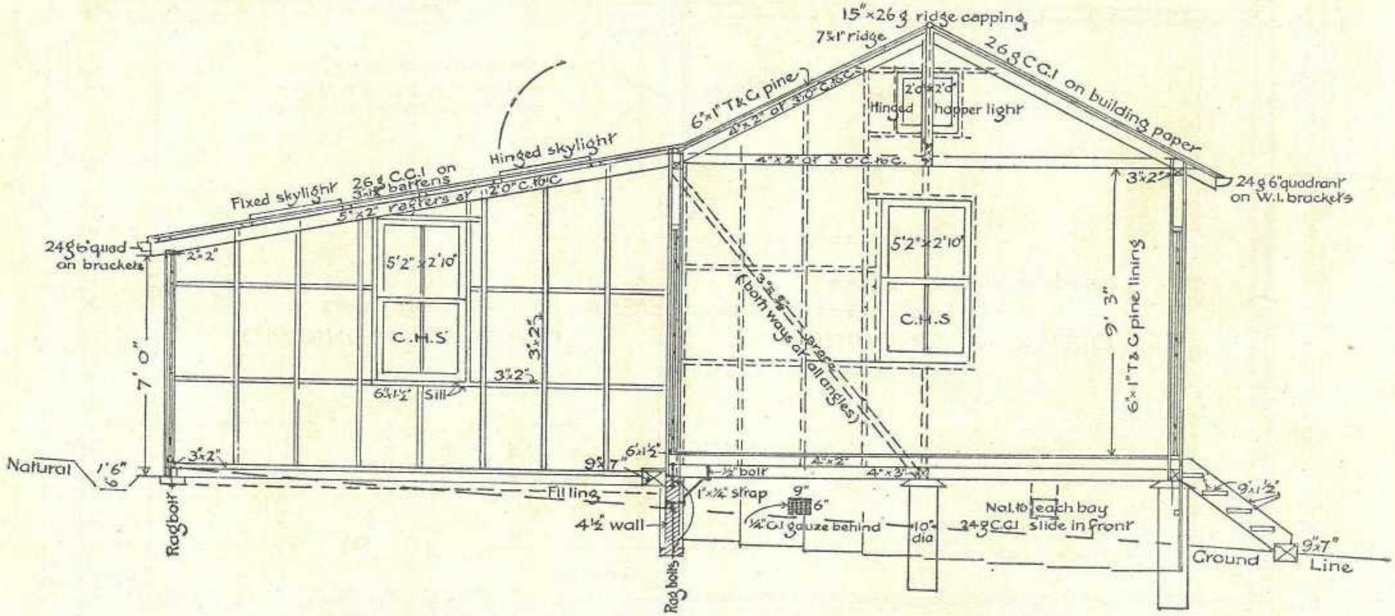


PLATE 42.—BULKING AND GRADING SHED (SECTION).

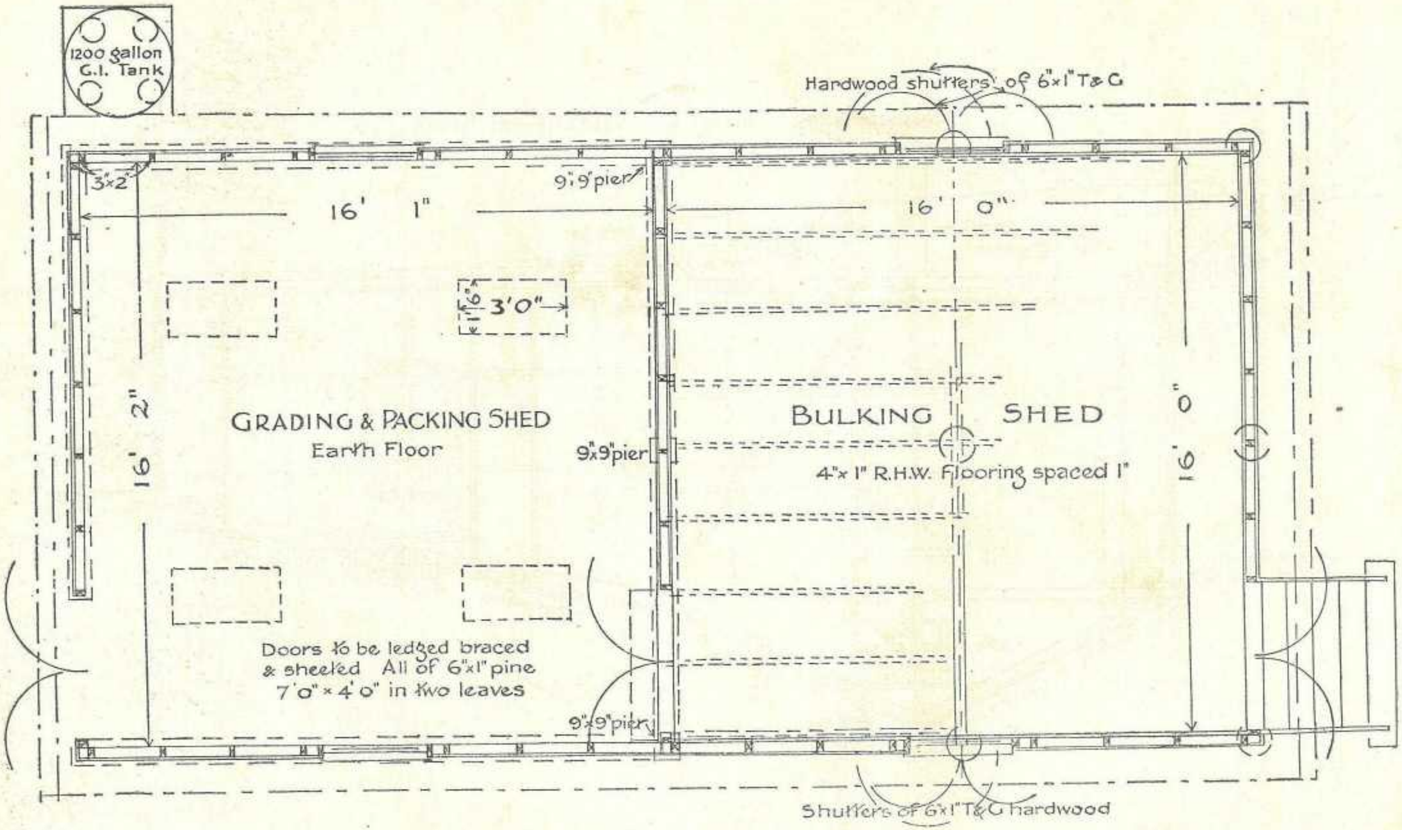


Plate 43.—Bulking and Grading Shed (Ground Plan).

Grading Shed.

In the grading shed, as the leaf would only be held during the process of grading, there is not the same necessity for a thick wall or for the use of lining and ceiling boards, a single wall and simple roof being sufficient, while the construction of a floor, though most convenient, is not absolutely necessary.

Economy is indicated in building the grading shed as an annexe to the bulk shed.

Light.

Much light is naturally required, which should be provided by windows in the wall and skylights in the roof; the latter can be purchased set in the centre of a sheet of ordinary corrugated iron.

As far as possible the grading shed should face the south so that the lighting will be away from the direct rays of the sun.

Tobacco Buildings.

The size and number of the flue-curing barns and the capacity of the bulk and grading sheds will be governed by the area that is to be placed under crop.

To secure the best results in curing, uniformly ripe leaf of similar texture should be picked, the barn filled, and the curing started within the space of eighteen hours.

As the lowest leaves on the plant ripen before those above them, it follows that the size and number of barns will be indicated by the amount of similarly textured leaf, suggested by the number of plants or the acreage under crop that can be expected to ripen at more or less regular intervals to allow of the whole crop being progressively dealt with.

Flue-curing barns of large size are not favoured, experience in most countries suggesting that where the area is in excess of 10 or 12 acres barns 16 feet square with walls 16 feet high, interior measurements, which can now almost be considered a standard size, are preferable to others of larger capacity.

A barn of this size with five tiers would provide a collective length between tier poles of 320 feet, allowing, according to the size of leaf, an output of between 350 and 450 lb. of cured leaf from each filling. One such barn would be required for each 5 acres under crop on soil recommended for bright tobacco.

Where the acreage under crop is large and plenty of labour available the capacity could be increased by making the walls 18 feet high to allow of an additional tier, or 20 feet to allow two additional tiers. In the first instance the six tiers would provide a collective length between tierpoles of 384 feet and increase the output by 70 to 90 lb. of cured leaf, while in the second the collective length between tier poles would be increased to 448 feet and the output by 140 to 180 lb. Where, however, the area is not expected at any time to exceed 10 or 12 acres, and there would be insufficient work to keep the number of hands required to fill the larger barn fully employed during the curing season, constructions of lesser capacity, such as 12 feet square by 16 feet high, interior measurement, would be preferable. A barn of this size having five tiers would provide a collective length between tier poles of 180 feet and give, according to the size of leaf, an output of from 190 to 250 lb. from each filling.

One such barn would be required for each 3 acres under crop on suitable bright tobacco soils.

Economy is suggested in the provision of an adequate number of barns of suitable capacity, as the leaf in a partly filled barn can be more satisfactorily cured than in one filled with more than the appropriate quantity.

While the cost of fuel is regulated by the weight of leaf, suggestive of the amount of moisture to be evaporated, that of attention during the cure is the same for one as for two or more barns, irrespective of their capacity.

In comparison with the output, the construction of the larger size is relatively less costly, since if 20 acres were placed under crop, four barns, each 16 by 16 by 16, that would effectively deal with the crop could be erected at considerably less cost than the seven barns, each 12 by 12 by 16, that would be required should the smaller size be decided upon.

Site.

The situation of the tobacco buildings should be as convenient as possible to the homestead for obvious reasons and not too far distant from the fields where the leaf is grown, though with motor transport now almost universal the carriage of the leaf a few hundred yards further from field to barn is of little importance.

The site should be naturally well drained or capable of being easily made so, and should offer a good foundation for the buildings. A water supply at the barns is necessary, and provision therefore should be made by the erection of tanks if no better facility is offered.

Often a site will be suggested on the crown of a ridge or just near the edge of a steep slope or bank, such as is often found in a terrace left by a stream that has worn its way to a deeper level.

Here a saving in construction of the flue-curing barn could be effected by making an excavation for the basement to a depth of 5 feet or less, as the nature of the ground permits, which would lessen by a like amount the height of wall to be built and obviate the necessity for so much brick, concrete, or other fire-resistant material at the back of the barn, where the furnace would be situated and the hot flues enter and emerge from the structure.

Where such an excavation would be possible a drain to a slightly greater depth would be necessary round the barn to carry off any storm or seepage water, as the floor and walls of the basement should be kept dry.

The cost of cutting such a drain for one or more barns compared with the saving in building costs effected would be a deciding factor.

In marking out the site for the tobacco buildings that of the bulk shed with grading annexe should be placed parallel to the front of the barn and, to lessen the premium for fire insurance, distant therefrom at least 30 feet, wall to wall, an enclosed or louvred shade or veranda in this connection being regarded as a wall.

It is usual to build the furnace on the side of the barn opposite to the direction of the prevailing wind, but this is not a matter of very great importance.

Additions.

Provision should be made to allow of additional barns being added and also of the bulk and grading shed being extended.

When adding another barn, a reduction in cost can be effected by making use of an existing wall, by which three additional walls only will be necessary.

When adding to the bulk and grading shed, one end of each is removed and replaced when the extra length of walls and roof have been added.

It is usual with the addition of each barn to make a corresponding increase in the capacity of the bulk shed and, up to a point, in that of the grading shed. In this latter, however, where leaf would only be held whilst being graded or when packed ready for transport to market, provision for the same extra space is not called for. As the leaf will be taken from the bulks in the bulk shed as required and returned thereto or packed immediately after grading, just sufficient space to allow ease of handling during grading and subsequently while packing and storage of a load or two of cases or bales is all that is necessary.

Thus, where a nest of four barns, each 16 by 16 by 16 is erected, it is suggested that the bulk shed should be 64 feet long and the grading shed 48 feet long, each being 16 feet wide.

The addition of a fifth barn would necessitate probably another 16 feet to the length of the bulk shed, but the capacity of the grading shed could be regarded as sufficient.

When smaller sized barns are installed the capacity of the bulk shed will be regulated accordingly.

Where the area to be placed under crop is extensive it would be preferable, in view of the possibility of loss by fire, to build the barns in nests of three, four, or five, each nest being provided with a separate bulk and grading shed, so isolated as to minimise risk.

TOBACCO PESTS.

By J. HAROLD SMITH, M.Sc., Entomologist, Department of Agriculture and Stock.

DURING recent years attention has been focussed on the possibility of a large-scale expansion of tobacco growing in the State of Queensland. Under official auspices steps have been taken to prove the suitability of certain areas for the crop, and, as a result, quite a number of growers planted commercial areas during the past two years. As would be expected, the problems with which such a growing industry will be faced have, in this period, become more or less clearly defined, and of these concerted action to control the several pests partial to the crop will be important. Observation in most of the tobacco-growing areas of North Queensland has crystallised these problems and it is now possible to discuss with reasonable accuracy the status of the various insect pests, the potentialities of each, and the measures which will necessarily become constituent parts of agricultural practice in coping with them.

GENERAL CONSIDERATIONS.

Tobacco belongs to the natural order Solanaceæ, which includes quite a number of plants, both indigenous and introduced with subsequent establishment in the State. Among these are both cultivated and wild tomatoes, various nightshades, cape gooseberries, and the wild tobaccos. It is usual to find that insects tend to restrict their activities to host plants within the one natural order, or, at least, to show a preference for related plants. It is, therefore, curious that some of the more serious pests of tobacco can best be regarded as general feeders, being already known as serious pests of cultivated and wild plants belonging to more than one natural order. Thus some of the Noctuids (cutworms, budworm, &c.) so far recorded are common to such widely differing plants as maize, cowpeas, and tobacco, while some of the subterranean pests feed on any plants which may be accessible to them.

The possibility of control is thus complicated by the fact that there is slight prospect of preventing the ingress of a recognised pest to an area where tobacco has not been previously grown. The most serious pests already exist in most districts, and their presence compels the attention of growers to proved agricultural measures which will mitigate normal losses and to the use of insecticides known to be of value in coping with the individual insects. It should, therefore, be clear that the control of insect pests in tobacco requires special consideration, owing to the peculiar nature of the crop and the generalised pest complex with which the grower has to deal.

Tobacco differs from most other crops in certain respects which have a material bearing on the subject-matter. In the first place, the commercial article is the leaf, the quality of which determines the price paid for the crop. Quality is a term very difficult to define, but uniform growth of the plant and even maturity of the leaves are indispensable to the production of the higher grades. Agricultural operations usually ensure these, but the tobacco grower knows only too well that insect pests often frustrate his aims. For example, the destruction of plants by insects when first transferred to the field may reach a noticeable fraction of the whole. Replants which take the place of these destroyed seedlings lay the foundation for irregular maturing of the leaves. Even in the best regulated crop a percentage of plants will succumb to the altered conditions when exposed to field conditions. Both insect and fungoid enemies add to this irreducible minimum, the contribution of each varying from place to place. The differences in growth show up when harvesting, the replants maturing behind the bulk of the crop, often under climatic conditions anything but suitable for the purpose. Thus the expense of replanting is only a fraction of the loss actually sustained by the grower; the lack of uniformity in the leaf gathered at each picking adds difficulties to curing which may be beyond the ingenuity of individual growers to overcome.

The agricultural requirements of the crop are such that cultural methods differ in the several districts where tobacco growing promises to become an integral part of farming practice. In most parts of Queensland the monsoonal rains determine the time of planting, and field operations normally begin some time in December. In some districts, however, growers prefer to plant at a later date. Such devious practices originate in the peculiarities of individual areas, and may easily account for differences in both the pest fauna and the status of species in each district. The extremes of summer and winter in a temperate climate are sufficiently far apart to impose seasonal habits on the various insect pests. In Queensland insect development may proceed through the whole year, but the rate of such development may be vastly different in, say, January and July. This may be sufficient to give the several insect pests associated with tobacco in various districts a relative importance which may be somewhat confusing. How far such differences may be significant should be learnt during the next few years.

Again, the fact that the leaf is the commercial part of the crop limits the scope for the use of insecticides which would normally be used for some of the principal pests. The cured leaf varies from dark mahogony to lemon in colour, and its appearance at the time of sale contributes largely to the price realised for it. The indiscriminate application of arsenicals—e.g., lead arsenate to plants, the leaves of which are ripening—leaves a white deposit on their surfaces, characteristic enough to prejudice the sale of the cured leaf, though in other respects the tobacco may be excellent. Hence poisons of this class must be used sparingly and heavy treatments restricted to the early stages of the growth of the plants. Alternative measures, often less efficient for the control of a particular pest, must sometimes be substituted for recognised remedies on obvious grounds of expediency.

It is the purpose of these notes to record the more significant pests of tobacco, remark their distinctive habits, and outline control measures which cannot but assist the farmer to make tobacco growing a payable proposition. The pest complex will recur with insistent regularity from year to year with more or less severe effects, and the grower who systematically embodies the several suggestions in his ordinary farming practice will have no reason to regret it.

MAJOR AND MINOR PESTS.

Among the pests associated with tobacco are some which attack the plant below ground and others restricted to the aerial parts of the plant. The major pests can, therefore, be grouped as follows:—

- (*a*) Subterranean forms—e.g., wireworms, false wireworms, cutworms, and nematodes;
- (*b*) Aerial forms—e.g., leaf-eating Noctuids and the tobacco leaf miner.

They will be considered in this order, while a number of minor pests with which the grower should be acquainted will be treated later in a separate section.

Wireworms.

Immediately plants are transferred from the seed-bed to the field they face the most critical stage in their whole development. This is especially the case when the crop is grown in North Queensland, for the difficulty of establishing a new root system is accentuated by adverse climatic conditions and the ravages of several serious pests. Losses when planting out have, therefore, been high in the past, and though it is difficult to assess the precise contribution of cultural deficiencies, fungoid troubles, and insect attacks to the total loss, there is no doubt that the share of the last is considerable.

Thus, on certain types of soil, an examination of the plants which fail to establish themselves, or which, having struck root, wilt within a week or so, will often disclose signs of wireworm injury. The larvæ may either feed externally or enter the stalk below ground level and burrow up the centre of the stem for an inch or so. Plants so entered tumble over at the ground level and seldom, if ever, recover. During the present year the losses have doubtless been accentuated by the unusual conditions under which the crop has been grown, but even so there have been noticeable differences on the various farms under observation.

The insects classed as wireworms are the larvæ of Elaterid or click beetles. Queensland possesses quite a number of species, but their systematic affinities are not clearly understood and the larval characteristics have not been studied. Consequently this discussion must proceed on general lines, though individual species may possess quite different habits. The Queensland species associated with tobacco have not yet been identified, but later work should shed some light on the status of individual forms and the habits peculiar to each. The adults are typically flat, elongate beetles, slaty grey in colour, and distinguishable from most other families by the backwardly projecting angles of the thorax. These beetles lay their eggs in the soil where any cover is available, and from these the larvæ, yellowish white in colour, hatch. The posterior segment is typically ornate. The duration of the larval period varies with the species and is generally lengthy, covering in known cases some months to five years, a characteristic which complicates the whole problem of control.

Insecticides are of very little use against pests of this class, for they appear to be immune to the poisons which normally render such excellent service in the control of insect pests. Recourse has, therefore, to be made to special practices which will minimise the trouble. Among these are:—

(*a*) In clearing the land for a first crop of tobacco it sometimes happens that the debris is heaped for months before removal from the field. Such heaps offer sanctuary to the adults and favour an influx of the pest to the soils in the immediate vicinity. This is anything but desirable, and clearing should, therefore, be expedited as a matter of principle.

(*b*) A pre-baiting method for the treatment of wireworms in heavily infested soils has been developed in America. It depends on the partiality of the insects for germinating grain crops and consists in planting these in drills a yard or so apart and fumigating the soil

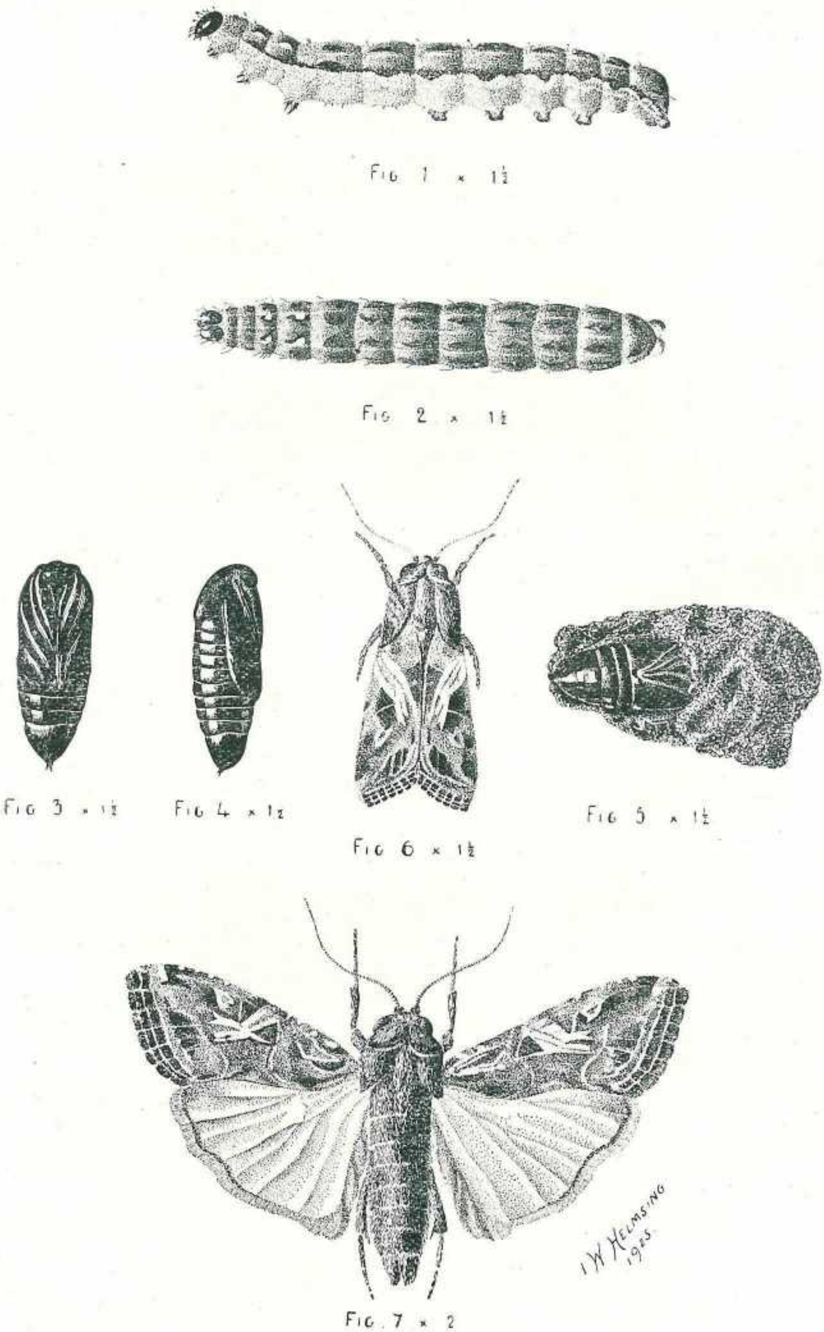


PLATE 44.

Prodenia litura Fabr.

Fig. 1, Larva, lateral view, × 1½. Fig. 2, Larva, dorsal view, × 1½. Fig. 3, Pupa, ventral view, × 1½. Fig. 4, Pupa, lateral view, × 1½. Fig. 5, Pupa within earthen cocoon, × 1½. Fig. 6, Imago, wings closed, × 1½. Fig. 7, Imago, wings expanded, × 2.

with granular cyanogas a month later. Before fumigation the wireworms have congregated round the germinating plants, hence a fairly complete kill can be secured. In North Queensland the application of this method would delay planting the tobacco for some four of five weeks, hence the measure would have practical value only in acute cases.

(*c*) Once the plants have become established in the field, it is rare to find them obviously suffering from the pest. The tunnelling habit is apparently confined to young plants, and there is some evidence that losses could be reduced if plants about to be transferred to the field from the seed-bed were hardened by exposure to the sun for some time before their removal. They would then be in a better position to withstand both the physical disabilities inseparable from the transfer and the depredations of subterranean pests. Wireworms do, of course, attack both soft and hard plants, but the burrowing habit seems to be restricted to the former. A plant nipped at the base has a reasonable chance of recovery; a plant into which the pest has actually entered has none.

(*d*) Thorough cultivation serves a dual purpose. The pests present in the soil are continually being disturbed and often destroyed, while the operation helps to keep the plant growing in even the most unfavourable seasons. A growing crop is a pest-resistant crop, and the continual use of scarifier and hoe is one of the principal factors in promoting the steady growth of the plant and reinforcing its innate capacity to resist pests.

Given due attention to agricultural methods, such as those outlined above, the seedling losses through wireworm attacks would certainly be reduced to a minimum and spare the grower much of the hard work and inconvenience inseparable from heavy replanting.

Cutworms.

A second group of pests whose habits link them with plants just transferred to the field includes the very familiar cutworms. These are the larvæ of Noctuid moths which are subterranean during their immature and growing life. In this stage they are a constant source of trouble to crops in which transplanting is a necessary operation. A number of species appear to be implicated in the injury to tobacco and among these *Prodenia litura* F. will by no means rank least. Noctuids are, for the most part, dull-coloured moths given to flying at dusk, and the group contains some of the most serious pests with which the farmer has to deal.

Plants attacked by these larvæ collapse just below ground level, the grub having nibbled the tissue until insufficient remains to physically support the head of the plant and permit the interchange of food materials between the roots and the leaves. Soft seedlings are especially subject to attack, but plants may suffer at all stages, though once they are thoroughly established the probability of total destruction is slight—unless, of course, the pest assumes plague proportions. Hence the aim of control is to shepherd the plants through their first six weeks of growth in the field.

The female moth (Plate 44, fig. 6) may lay its eggs in the soil near the base of the plant or on jutting surfaces. The larvæ which hatch from these develop rapidly, so much so that when they are sought in the vicinity of plants which have been destroyed full-grown individuals (Plate 44, fig. 1) are often recovered. These greyish black soft-bodied creatures curl up when handled, a characteristic habit of the group, and may reach a length of 2 inches or thereabouts.

Fortunately, efficient control measures have been formulated for these pests, and they should be regarded as part and parcel of the planting operation if attacks are anticipated. The grubs are very partial to cereal preparations such as bran, corn meal, and pollard, and advantage has been taken of this fact to compound a poison bait which gives excellent results in the field. The formula is as follows:—Bran, 12 lb.; pollard, 12 lb.; Paris green, 1 lb.; molasses, 1 quart; water, 2 gallons approximately.

In preparing the mash, the first three ingredients are thoroughly mixed together. Water in which the molasses has been stirred is then added until the mash has a crumbling texture; the bait is then ready for use. Some growers apply the mash broadcast, others as pellets the size of a walnut, always, of course, in the line of the rows. Both methods give good results in North Queensland where heavy dews revivify the mash daily during the planting and early growing season.

False Wireworm (*Gonocephalum* sp.).

A third pest which is liable to cause losses to the tobacco grower during transplanting is a squat greyish-black beetle, barely half an inch long. Certain types of soil, some of which will be used for tobacco growing, harbour these insects, and they normally feed on any available herbage. As with most subterranean pests, they present an entomological problem of some importance during a dry season.

Both larvæ and adults share in the injury attributable to this pest, each gnawing into the plant tissue at ground level. The plant either wilts through the interference with metabolism or collapses at the point of attack. Replanting is invariably necessary in such cases.

In many respects the larvæ of these beetles resemble wireworms, and confusion between the two is a common and reasonable error. As a general diagnostic character, it will be found that the last abdominal segment of the wireworm is ornate, while that of the false wireworm is plain. There are, however, exceptions to this rule, and there is consequently abundant scope for studies of the insects concerned.

Control measures suited to the false wireworm have already been enumerated in connection with pests already discussed, but may be briefly recalled here. They are—

(*a*) Adequate care that transplants are hardened by exposure before removal from the seed-beds.

(*b*) The application of Paris green baits at the base of the plants. These baits give results with this pest comparable with those secured against cutworms.

Nematodes.

Nematodes of the genus Heterodera are well known to farmers everywhere, for on certain types of soil they constitute one of his most serious pests. They occur throughout the State and attack most cultivated crops, often very severely. Tobacco is no exception to the general rule.

The characteristic symptoms may be found on most hosts and are particularly distinct in the case of tobacco. The roots of young plants possess irregular swellings (Plate 45, fig. 2) formed by reaction to the irritation due to the eelworms in their tissues. If old, the roots look quite different; the swellings have merged into one another until the

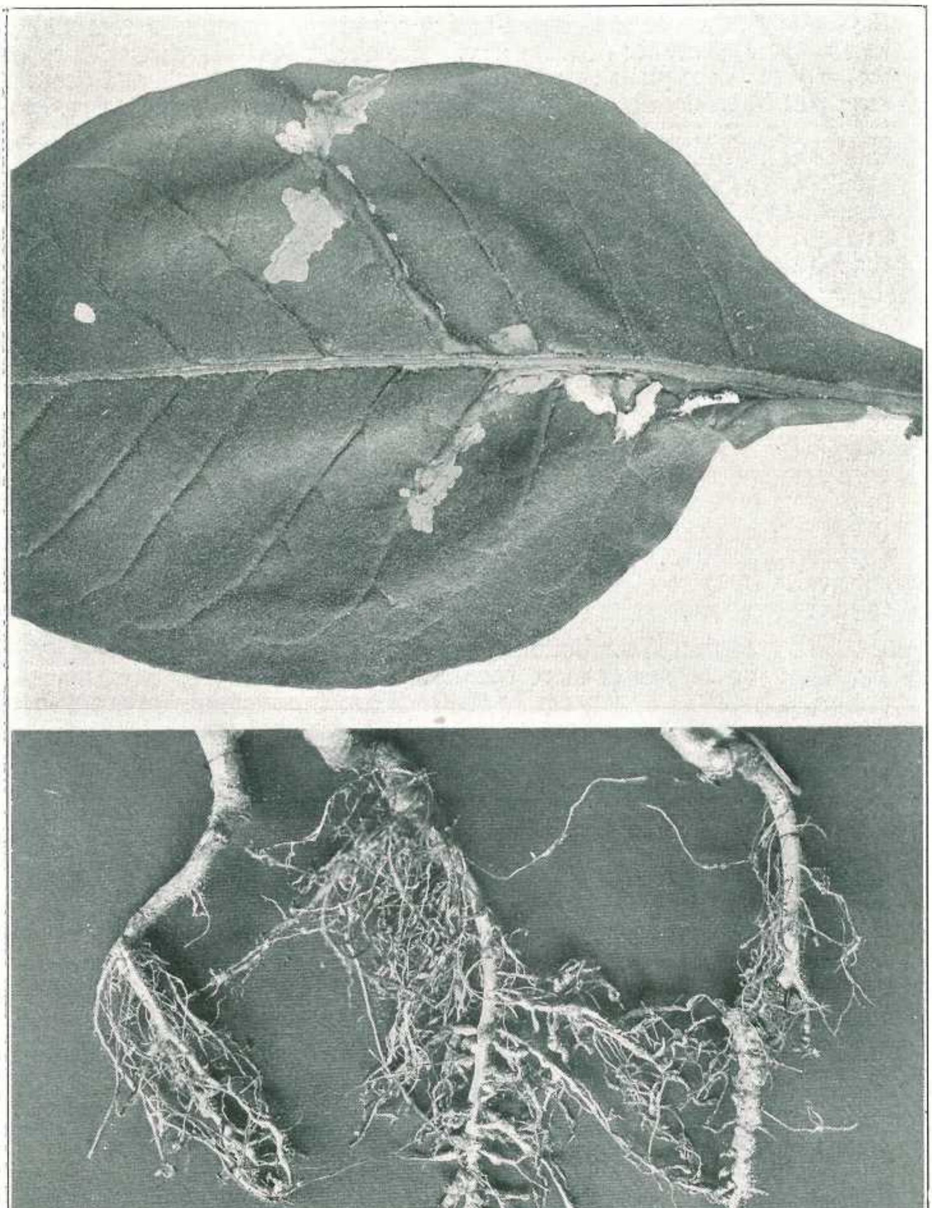


Plate 45.

Fig. 1.—Tobacco leaf attacked by the larvæ of the tobacco leaf miner.
Fig. 2.—Nematode galls on tobacco roots.

roots are irregular distended masses with numerous eruptions, should the disintegration of the tissues be far advanced. Secondary rots may hasten the appearance of this stage. The obvious interference with the metabolism of the plant through such abnormalities is serious, and death may and often does result. The capacity of individual plants to resist infestation, or rather to survive infestation, varies a good deal, and well established plants living under good growing conditions may mature even though the bulk of their roots are apparently destroyed. In such cases the pest has entered the root system some time after planting out in the field. Plants attacked in their early life rarely reach maturity, though they may persist as dwarf forms just retaining a vestige of life.

Most legumes—e.g., beans, cowpeas, &c.—naturally possess nodules on their finer roots (Plate 46, fig. 4). These have an entirely different origin to those under discussion, being due to non-pathogenic symbiotic bacteria, and may be distinguished by the ease with which they can be detached from the plant.

It is difficult to generalise on the soil types particularly affected with nematodes, but there can be little doubt that many of those suited to tobacco growing are normally infested with the pest. This handicap is offset somewhat by the fact that growth conditions in such areas are, as a rule, excellent, so that normally the balance is on the side of plant survival. In spite of this, nematodes promise to be a source of worry to many growers.

The organism is a minute eelworm of the type illustrated (Plate 47, fig. 4). The farmer is more familiar with the injury than with the organism itself, as he has rarely the facilities for examining the worm. The male retains his elongate thread-like shape throughout life, while his mate assumes a pear-shaped aspect when mature. She may then be detected in infested tissues, each individual appearing as a transparent globule the size of a pin head. Life history studies in this State are incomplete, but by analogy with the known habits of the organism elsewhere, it may be assumed that generation succeeds generation at approximately monthly intervals.

The pest has certain powers of movement, but cannot depend on these for distribution over considerable distances, hence it is generally conceded that part of the spread is effected by mechanical agencies, an abundance of which are available on the farm. Thus they may be carried from place to place on implements, while flood or drainage waters may transport free living stages from one part of the farm to another or from farm to farm. In spite of this, the persistence with which this pest turns up on newly broken land, far removed from other cultivation, suggests that the nematode is established almost everywhere, and maintains itself on host plants indigenous to the area. When such land is ploughed and a commercial crop introduced, the eelworms tend to divert their attention to it, the exigencies of farming having destroyed their primary host. As a precautionary measure, it is always advisable when introducing implements, seedling plants, &c., to the farm to take adequate safeguards to ensure their freedom from the pest.

Remedial measures involving the use of fumigants or soil insecticides have received considerable attention from entomologists in most countries, but, as yet, none have yielded results which would warrant serious discussion as methods of control. In all stages, particularly the egg which occurs freely in the soil, the worms show remarkable

Fig 1.

Fig 2

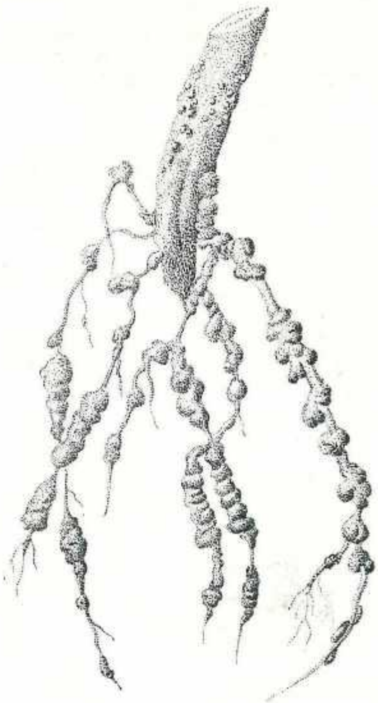


Fig. 3.

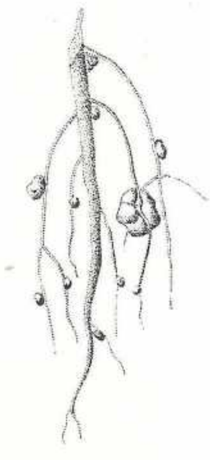


Fig. 4.

I. W. Helmsing 1927.

PLATE 46.—NEMATODES.

Fig. 1.—Nematode galls on Strawberry roots.
Fig. 2.—Nematode-infested Potato.
Fig. 3.—Tomato root infested by Nematodes.
Fig. 4.—Bacterial Nodules on roots of Lupin.
(All ½ natural size.)

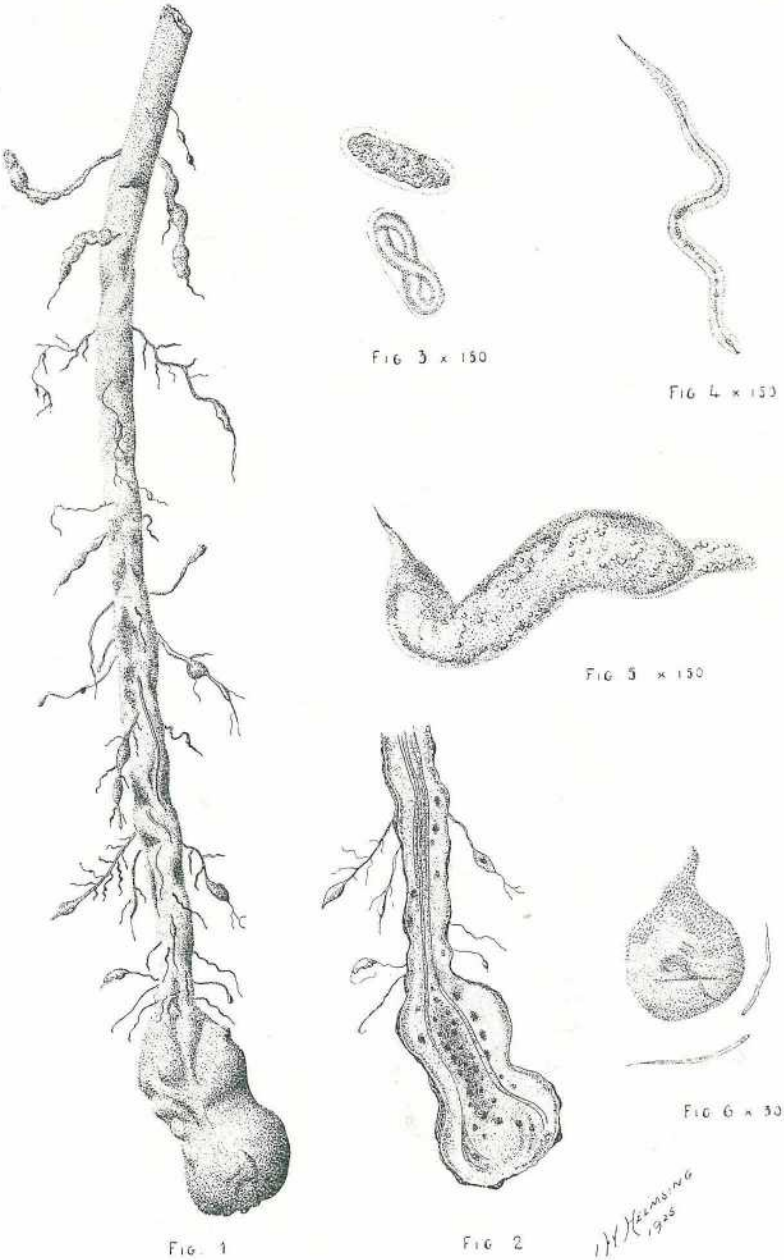


Plate 47.—Nematodes.

Fig. 1.—Infested Banana root.
Fig. 2.—Longitudinal section of Banana root showing Nematode infestation.
Fig. 3.—Eggs in different stages of development.
Fig. 4.—Larva.
Fig. 5.—Female.
Fig. 6.—Female (later stage).

powers of resistance to ordinary toxic substances. Growers must, therefore, recognise the value of preventive measures for keeping the eelworm population down to a minimum. Such measures would include—

(*a*) Scrupulous care that any plants introduced to the farm are themselves free from nodules on the roots—almost certain evidence of eelworm infestation.

(*b*) Seed-beds should preferably be made some distance from the land in which the plants are to be placed. During transplanting each seedling should be examined for knotty root, and any showing the typical symptoms discarded. Ordinarily such an inspection is necessary to eliminate plants injured at ground level or suffering from the attacks of damping-off fungi. Eelworm affected plants could be separated at the same time and with them, both discarded and destroyed.

(*c*) Occasional fallowing of the land supplemented by cropping with such plants as may be immune to the pest both reconditions the soil and reduces the nematode fauna. Few plants can claim immunity, but it is quite possible that these will be of value in districts suited to tobacco growing; examples are maize, peanuts, sorghum, millet, and some varieties of cowpea.

(*d*) Soil sterilisation by steam is practicable in the case of seed-beds only, and when properly performed does give good results. Nematode infestation in the seed-bed is invariably a foretaste of heavy losses in the field, hence it is advisable for growers to become acquainted with the equipment and the method of its use when opportunities occur.

Summing up the position with regard to this pest, it has to be emphasised that areas free from nematodes should be safeguarded from infestation at all costs. Once infested recourse must be had to the precautionary measures outlined above, attention to which should ensure a satisfactory crop in North Queensland where growing conditions leave little to be desired.

The Budworm and Other Leaf-eating Noctuids.

Many Noctuids infest the leaves of the growing tobacco plant, but one, the budworm (*Heliothis obsoleta* F.), supplements leaf destruction by a second type of injury so distinctive that the larva is commonly associated with its secondary habit. Few pests can effect equal losses if unchecked, and few better pay the systematic use of adequate control measures.

The name "budworm" is apt, as the larvæ show a definite partiality for the young growing point of the plant, at or near the tip. Often a single individual leaves the foliage and penetrates the growing point of the plant, boring for some distance down the stem. The habit is incidental rather than primary to the pest, for most of the larvæ of the moth may be found scattered about on the leaves feeding in the open. The secondary effects of the boring habit are, however, so serious that the losses sustained trouble the farmer most acutely. The terminal bud is destroyed and the natural growth impetus of the plant is such that lateral buds which would ordinarily remain dormant begin to grow from the angles of the lower leaves. These new shoots make rapid headway and may in turn be attacked by larvæ, and so the process goes on, its severity depending on the activity of the pest during any particular season. In addition to the time wasted in premature desuckering imposed on the tobacco grower through the destruction of the original growing points of the plants, the irregular growth subsequent to attack increases his actual loss. This irregular growth adds to the variability of the leaf and complicates both harvesting and curing operations.

The greater part of the larvæ are, however, open feeders and confine themselves to the leaves. Even if these are not totally destroyed, the growth after attack may cause malformations or so affect the general appearance of the leaves that their grade would be automatically reduced. The pest is so ravenous that it is not uncommon to find a plant stripped of most of its leaves, hence it is clear that, should the pest assume plague proportions, the total loss would be disastrous.

The moth (Plate 48, fig. 4) has a wide range of host plants, is known as a pest of maize, has won notoriety as the most serious pest of growing tomato plants, and may be found on many cultivated and wild herbaceous plants. It is commonly known as the corn-ear worm. The wing span is about 1½ inches, and the general body colour ochraceous, though the hind wings contrast with the fore in being more membranous and lighter in colour. The fore wings may sometimes have a greenish tint.

Egg-laying normally takes place at dusk, when the moths may be seen flitting from plant to plant laying eggs (Plate 48, fig. 1) while hovering over the leaves. After three or four days—the period varies with the time of the year—the first-stage larva emerges as a pale white grub which feeds on the leaves in the vicinity at a very early stage. Growth is achieved by successive moults, and at each the colour characteristics become more clearly defined. The colour of the caterpillar (Plate 48, fig. 2) is frequently green interspersed with ochraceous markings, but the range of variability is considerable. During growth the movements of the larvæ are dictated by the search for the tenderer leaves of the plant, hence the bulk of the immature stages will be found near the growing point. It is invariably correct to assume that older leaves which are stripped to the veins were originally attacked when first unfolded from the bud.

When full grown, some three weeks after emerging from the egg, the larva leaves its host plant and enters the soil. It here constructs an earthen cocoon at a depth of an inch or so, within which the transformation to the chrysalis takes place. The whole anatomy of the insect is remodelled in this stage, the voracious leaf-eating larva being changed to the nectar-loving moth. The chrysalis (Plate 48, fig. 3) lasts about ten days, while the moths may be on the wing for some two or three weeks. During this period its primary function is reproductive and an immense number of eggs may be laid by a single individual, each being placed singly in the bud region of the plant.

During the day the moths shelter among the older leaves of the plant and may be disturbed by anyone walking through the crop. Were it not for the natural enemies to which the immature forms are subject—some of them minute wasps, some insectivorous birds—together with unfavourable climatic conditions, the pest would increase, such is its fertility rate, to an extent disastrous to tobacco growing. In spite of these natural controls, the budworm is one of the most serious pests with which the grower has to deal.

The principal injury is caused during the last week of the larval period when the capacity of each individual to consume foliage is

Heliothis obsoleta F.

Fig. 1.
Egg x 28.

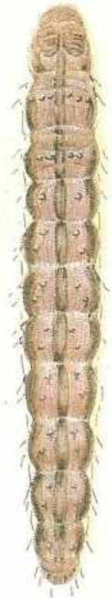


Fig. 2.
Larva x 2.

Fig. 3.
Pupa x 2.

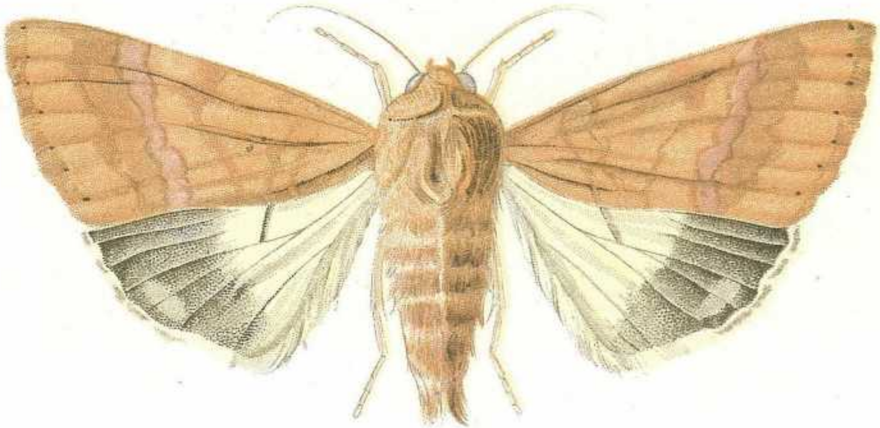


Fig. 4.
Imago or Adult x 3.

I. W. Helmsing. 1926.

Plate 48.—The Bud Worm (*Heliothis obsoleta*, F.)

exceptional. Hence control measures aim at the destruction of the larvæ when still young, special attention being given to the tip of the plant where they tend to congregate. In the seed-beds neglect to take reasonable precautions may lead to the entire destruction of the plants, for it often happens that the injury is detected only when the infestation reaches an abnormally high figure. The cover provided by plants growing in close proximity to each other may account for this, as the real dimensions of foliage loss in individual plants are masked by their neighbours. Consequently it is desirable to stereotype the treatment of seed-bed and early field plants with an arsenical spray or dust. The spray may be prepared at the following strength:—1½ lb. lead arsenate per 50 gallons water. A more even cover is ensured when a casein or flour spreader is added to the solution. It will be invariably found that when the leaves of the seedlings are large enough to intermingle, a spray merely covers the exposed upper surface of the leaves. It is then advisable to alternate the above spray with a 25 per cent. lead arsenate dust at weekly intervals. Seed-beds usually have water close at hand and spraying is practicable for the plants in them.

In the field the position is different and dusts tend to be used in place of sprays for the control of the budworm, their convenience compensating for a somewhat lessened efficiency. As tobacco is more sensitive to toxic action than most plants with which the farmer has to deal, the concentration of the dust is kept down to a minimum. Dusts containing 25 per cent. lead arsenate are sufficiently powerful for ordinary needs, though if the occasion warrants so doing 50 per cent. dusts may be used. Arsenical burning is always a danger at the higher concentration.

Arsenical dusts can hardly be used indiscriminately for the treatment of tobacco pests, hence it is usual to vary the treatment when the plants have reached a height of 18 inches or 2 feet. It is then desired to retain control of the pest while avoiding the accumulation of the white toxic dust on the leaves. The accumulation of such a dust, inseparable from repeated applications of lead arsenate, both disfigures the leaf to the prejudice of its sale, and leaves an undesirable poison on the harvested leaf used in the manufacture of tobacco. The solution of the difficulty depends on the consistent application of the following dry bait to the growing point of the plant:—1 lb. lead arsenate per 25 lb. pollard. Corn meal may be substituted for the pollard when it can be procured. The ingredients require thorough mixing and are applied to the tip of the plant by means of a finely perforated tin canister or through coarse hessian at weekly or fortnightly intervals. This suggestion for coping with the tobacco budworm follows the precedent established in various tobacco-growing countries.

A number of other Noctuids are partial to tobacco, the chief in the far North being the green tobacco looper (*Plusia argentifera* Gn.). These species feed openly, and should normally be kept in control by the measures already suggested for coping with the budworm.

Leaf-eating Noctuids are very susceptible to arsenicals. As, however, the growth of the plant is rapid, successive dustings, sprayings, or dry baitings should follow each other at fairly short intervals. Weekly treatments in the seed-bed and fortnightly treatments in the field are normally sufficient to meet ordinary requirements.

The Tobacco Leaf Miner (*Phthorimæa operculella* Zell.)

The tobacco leaf miner is a cosmopolitan species partial to most Solanaceous plants, and tobacco suffers to some extent from its attacks. The insect is more familiar to the farmer as the potato tuber moth, notorious for the losses which it causes to tubers held in storage for any length of time. Occasionally the larvæ bore into the stem of this plant and mine its leaves, but such losses are usually regarded as quite secondary. In tobacco, however, it is the last type of injury which is significant.

Unless the infestation is very severe, the damage is restricted to the older leaves of the plant—i.e., those nearer the ground. If the larvæ are still mining within them, irregular blotches indicating the amount of tissue destroyed may be discerned. (Plate 45, fig. 1.) These may be lesion-like, but if the larvæ have vacated the mines some time previously they become brittle discoloured patches of dead tissue. Though meandering over the surface of the leaf, each burrow terminates at some main vein or at the leaf stalk itself, and here the excreta has been systematically piled up by the former occupant. Occasional erosion in the leaf stalk suggests abortive attempts to burrow there. In tobacco, observations in North Queensland indicate that the mining habit has the greater significance for the crop, but there seems no reason why, given suitable conditions, the feeding habits should be different from those better known on the allied potato plant. Hence it is probable that the leaf stalk and stem boring habit will be noted as observations extend. It is difficult to assess the loss attributable to this pest, for affected leaves may be valuable though disfigured. At a minimum, the grade of part of the crop will be reduced. Ordinarily, the least valuable leaves suffer, but the ravages of the pest are such that it may ultimately prove more serious than at present appears to be the case.

In a concentrated tobacco area, periodic increases in the moth population are probable, and may warrant special attention from the grower.

The moth (Plate 49, fig. 7) is small and slender, possessing greyish wings tinged with indefinite yellow streaks and spanning some ¾ inch. They can usually be raised in numbers when walking through a tobacco crop. Eggs (Plate 49, fig. 1) are laid singly on the leaves of the host plant, and each is minute, pale yellow in colour, and strongly iridescent. Each moth may lay as many as fifty eggs, but this is a laboratory record, and it is quite probable that they lay much larger numbers in the field. The larvæ (Plate 49, fig. 3) are very active, and cling tenaciously to the leaves. The colour varies in different specimens, but is always a combination of green and grey which, as the individual approaches maturity, may be masked by a purplish hue. Pupation takes place in a lightly woven cocoon (Plate 49, fig. 4) constructed in any convenient shelter near the surface of the soil. As with many other insects of this

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THE TOBACCO LEAF MINER.

(Description of Plate 49, page 209.)

Fig. 1. Egg, x 35.
,, 2. Eggs laid on surface of potato tuber, x 10.
,, 3. Larva, lateral view, x 4.
,, 4. Earthen cocoon, x 2½.
,, 5. Pupa, ventral view, x 7.
,, 6. Pupa lateral view, x 7.
,, 7. Adult, x 4.
,, 8. Potato tuber showing external signs of infestation, ½ natural size.
,, 9. Potato tuber showing tunnelling, ½ natural size.

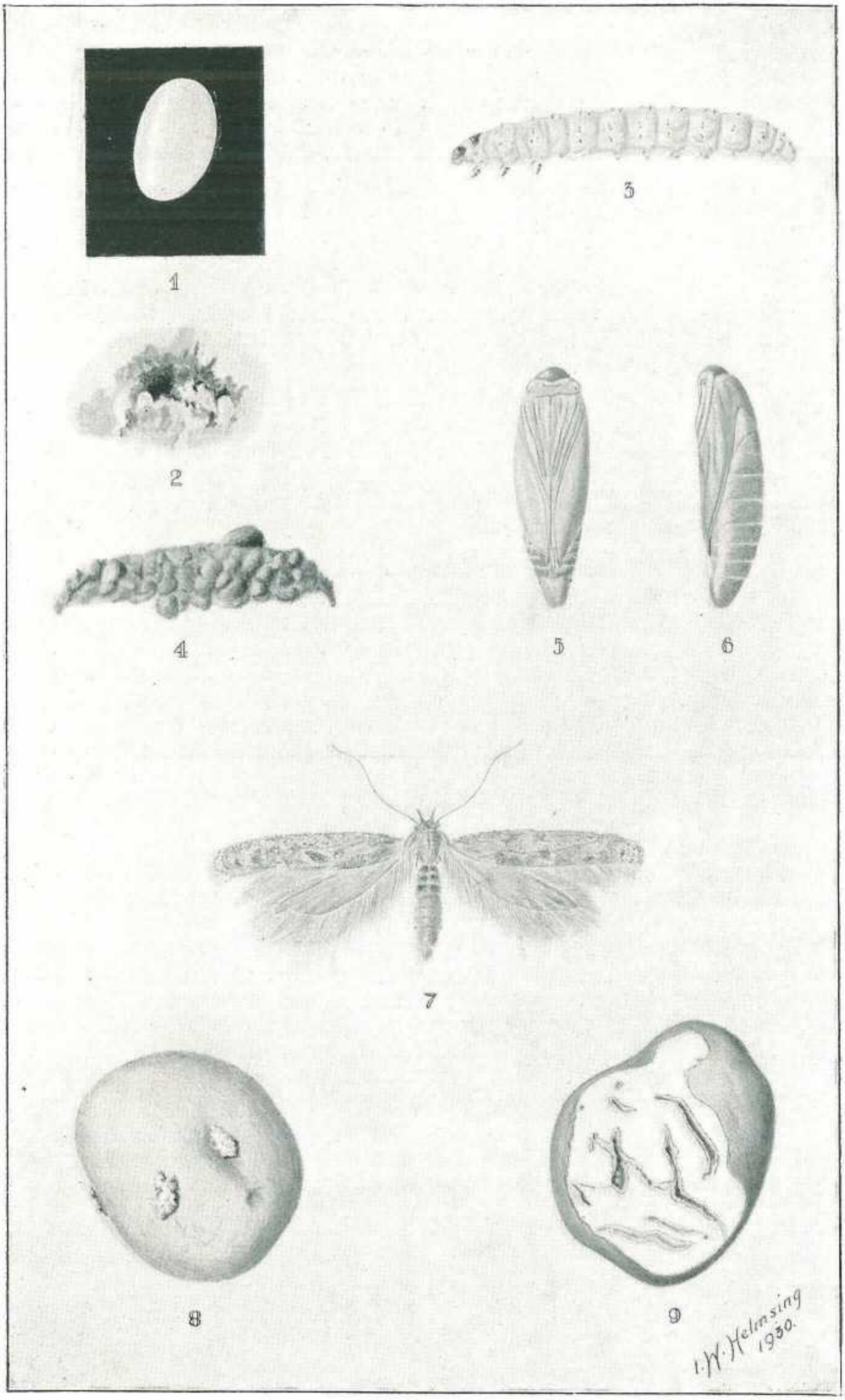


Plate 49.—The Tobacco Leaf Miner (*Phthorimœa operculella* Zell.).
(*For description of Plate, see page 208.*)

type, the life cycle is completed within three weeks, and generation follows generation with comparative rapidity.

There are a number of allied species, and all show a partiality to plants within the one natural order. Doubtless others than that under discussion will ultimately be found on the tobacco crop. Whether they will have the same importance for the tobacco grower remains to be seen.

The control of this pest is anything but an easy matter. Few modes of existence offer such complete protection from natural enemies as mining in the leaves of plants, and toxic substances, such as those used for external feeding insects, have only a limited scope of usefulness. Under the ordinary treatment of tobacco plants with arsenicals, a necessary procedure for coping with the various Noctuids, some protection should be afforded against this pest. The provision of supplementary methods must be reserved for special cases.

This is one of the pests which can be kept in check by good farming. In tobacco farming the crop is removed within seven months of planting, and for the remainder of the year the land remains fallow. During this period occasional cultivation, supplemented by the destruction of volunteer tobacco plants, Solonaceous and other weed growth, would do much to keep the pest in check.

MINOR PESTS OF TOBACCO.

A number of insects associated with the tobacco plant are for the most part regarded as minor pests, and do not require special attention from the grower. It is, however, desirable that he be acquainted with them, for they are all capable, given suitable conditions, of causing considerable injury—they are grasshoppers, leaf hoppers, and thrips. The following notes will assist in diagnosing the insects, but severe outbreaks should be brought under the notice of Departmental officials who are in a position to give information concerning the most suitable measures to be adopted in particular cases.

Grasshoppers.

These are too well known to require description. Sometimes they play havoc with plants in the seed-bed, and in a dry year may cause some trouble after planting out in the field. The nutritious green feed available in the seed-beds attracts these insects in large numbers, and their voracious habits may result in considerable leaf destruction. This may prove fatal to young plants, hence should the pest be noted in sufficient numbers to warrant alarm the seed-bed should be protected by some form of cover. Any light and readily available material will serve the purpose, provided the mesh is large enough to allow the light to enter; a cheap type of mosquito netting is suggested.

When the pest threatens trouble in the field special baits will be necessary. A number of such preparations have been recommended from time to time, among them the poison bran bait, the preparation of which has already been described when dealing with cutworms. Another type of bait depends for its action on the toxic properties of sodium arsenite. The formula is appended, viz.:—120 lb. sawdust, 2½ lb. sodium arsenite, 6 lb. salt, 1 gallon molasses, 10 gallons water.

It is unlikely that widespread baiting in the field for this pest will be necessary, except in a particularly dry year, and then in certain districts only.

Leafhoppers.

A small green Jassid about one-fifth of an inch long, whose wings are roof-shaped in repose, feeds on a variety of plants. Among these are the three Solanaceous plants—tomatoes, potatoes, and tobacco. In the lastnamed the typical symptoms of its presence may be found when the crop is reaching maturity. In the Bowen district the pest has achieved celebrity as an enemy of the tomato crop, and it is there known as the green fly. The term is rather a misnomer, for while the Jassid certainly flies the characteristic movement is better described as a hop in which the insect covers any distance from 1 inch to 2 or 3 feet.

The hopper is essentially a sap sucker, and when the insects are congregated on any plant in sufficient numbers the leaves possess a tracery of white blotches, each the spot where the leaf has been pierced during feeding. In severe cases the leaves curl up and die. In special circumstances the direct losses in this way may be considerable, but it should be further noted that pests of this type are often associated with diseases of the virus order known as serious pests of cultivated crops. Tobacco suffers from some of these—e.g., mosaic—and the insect under notice may ultimately be of importance as a vector in the transmission of diseases of this type.

Spraying with Bordeaux mixture is said to render plants toxic to insects of this class, while in some quarters claims have been made that sulphur dusts are of value in its control. Both claims are being investigated, and are merely cited here as probable measures to be adopted should the pest require special attention.

Thrips.

These minute delicately winged insects sometimes increase to prodigious numbers, and cause severe losses to tobacco growers. In the Southern States certain species of thrips cause some anxiety at times, for the life cycles of the insects implicated are brief, a circumstance which makes possible a rapid increase in numbers when climatic conditions are favourable to their development. The species associated with tobacco are one-twelfth of an inch long, pale yellow in colour, and when present on the plant may be located in company with the larvæ on the under surfaces of the leaves. All stages feed by a rasping and sucking action, for which the mouth parts are specially adapted, and the combined effect of large numbers feeding on the leaves may ultimately destroy the whole plant. It is probable that this insect will become of greater importance as the cultivation of tobacco extends.

Thrips respond readily to treatment with contact sprays, among which nicotine sulphate, marketed as Black Leaf 40, is perhaps the most useful. A single thorough application will destroy most of the insects on the plant, but it is always desirable to repeat the treatment after a week has elapsed. Larvæ, which hatch from the eggs laid in the tissue of the leaves, may then be accounted for.

SUMMARY OF CONTROL RECOMMENDATIONS.

The foregoing survey of the pests which the farmer may encounter in growing tobacco suggests the primary importance of an early diagnosis when insect pests warrant attention. Suitable control measures can then be applied before the injury becomes a measurable quantity. Frequently the farmer, hemmed in by the pressure of other work, finds his attention drawn to the pests when the damage is quite appreciable. Too often the entomologist or instructor in agriculture finds himself called in to advise ways and means of coping with a pest, when all he can do is to conduct a post-mortem which points the moral for the grower concerned. It is, therefore, preferable for the farmer to regard certain fundamental operations as part and parcel of the tasks inseparable from successful tobacco-growing.

The following summary of these should serve as a guide to the farmer and spare him much of the anxiety which may otherwise be his lot:—

(*a*) Spraying with a weak solution of lead arsenate (1 lb. of lead arsenate to 50 gallons water) should begin as soon as the plants are 2 or 3 inches high in the seed-bed. When these begin to interlock in the bed spraying with full strength lead arsenate (1½ lb. to 50 gallons water) should be alternated with dusting, using a 25 per cent. lead arsenate preparation at weekly intervals. In the event of cutworm attacks in the seed-beds, Paris green baits may be distributed through the plants.

(*b*) When transplanting, only seedlings free from injury or discolouration to the stalk should be used, the rejects being destroyed by the labourer laying out the individual plants. Paris green baits should be laid along the rows, the task being carried out by the person papering the seedlings as a protection against the sun.

(*c*) Until the plants are 2 feet in height lead arsenate should be applied in dust or spray form at fortnightly intervals, special attention being given to the buds of the plants where the leaf-eating Noctuids tend to congregate. When this stage is reached dusting or spraying with lead arsenate must cease, and the lead arsenate-pollard dry bait requisitioned. This bait may be applied to the growing point of the plant just so long as the grower considers desirable—usually to the commencement of harvesting, though if the insects still cause trouble the treatment may be continued.

A schedule of operations such as this is an insurance against the major pests of tobacco. In spite of this all must be considered as supplementary to sound agricultural practices, without which most control measures lose much of their value. Hence cultivation, adequate spacing of the plants in the seed-bed, the hardening of these before transplanting, the elimination of weed growth on both the field and headlands, constitute the basis on which the superstructure of efficient insect control rests.

All tobacco growers should consider the following as necessary parts of the farm equipment:—(*a*) Knapsack spray pump, (*b*) rotary dust gun, (*c*) plunge pump dust gun—hand model. A number of suitable models are on the market, all leading distributors holding stocks worth examination.

The following insecticides ought always to be available on the farm:—

(*a*) Lead arsenate—pure powder; also 25 per cent. dust.
(*b*) Paris green.
(*c*) Black Leaf 40.

None of these deteriorate in storage, hence no time is wasted in procuring supplies when they are urgently required.

For the convenience of growers some of the metropolitan distributors from whom insecticides and the associated apparatus can be procured are listed below:—

(*a*) A.C.F. and Shirleys Fertilizers, Limited, Little Roma street, Brisbane.
(*b*) Buzacotts (Queensland), Limited, Adelaide street, Brisbane.
(*c*) Southern Queensland Fruitgrowers' Association, Limited, Cleveland, near Brisbane.
(*d*) Taylors and Elliotts, Limited, Charlotte street, Brisbane.

TOBACCO DISEASES.

By L. F. MANDELSON, B.Sc.Agr., Assistant Plant Pathologist, Department of Agriculture and Stock.

THE following notes constitute a brief review of what is at present known of the diseases with which a grower may have to contend in the cultivation of tobacco. Some of these diseases are already known to occur in Australia, others are not. The object of this account is to describe the symptoms of these diseases, and to suggest methods for their control.

The following factors are involved in the control of tobacco diseases:—(1) Seed-bed sanitation; (2) use of resistant varieties; (3) rotation of crops; (4) judicious application of fertilizers; (5) efficient cultivation and drainage; (6) eradication; (7) exclusion.

SEED-BED SANITATION.

Too much stress cannot be laid on the importance of seed-bed sanitation. The majority of tobacco diseases are either characteristic seed-bed troubles—e.g., blue mould and damping-off—or are mainly contracted in the seed-bed in the first place—e.g., mosaic and bacterial leaf spots. Usually very little can be suggested to control tobacco diseases once the seedlings have been planted in the field. Prior to transplanting, however, a considerable measure of control can be effected, since (*a*) the seed may be efficiently sterilised or obtained from a disease-free source, (*b*) a relatively small amount of soil is involved and may be similarly treated, and (*c*) a large number of plants are congregated into a small area, and hence may be carefully observed and efficiently treated should diseases occur.

Seed-bed sanitation methods may be conveniently summarised thus:—

(1) Tobacco refuse from previous crops should be carefully destroyed before the commencement of the season, and should not be used for fertilizing seed-beds.

(2) Seed should be obtained only from healthy plants whose past history is known and should be suitably surface sterilised (see discussion of blue mould).

(3) Seed-bed soil should be virgin soil or suitably sterilised (see mosaic disease).

(4) Seed-bed covers and all equipment should be new or sterilised at the commencement of the season (see mosaic).

(5) Seed-beds should be situated well away from possible sources of contamination, such as weedy areas, curing barns, or seed-beds or fields of the previous season.

(6) Seed should not be sown too thickly or overwatered (see damping-off).

(7) Care should be taken that beds do not become accidentally contaminated during the season.

(8) Should diseases occur, affected plants and those in their vicinity should be eradicated at the earliest possible moment (see blue mould). Should infection be at all general it is safest to procure healthy plants from some other source.

(9) Diseased plants should never be planted in the field.

(10) Special care should be taken after handling infectious diseases (see mosaic disease).

These measures should form part of the regular routine of growing tobacco seedlings.

RESISTANT VARIETIES.

The greatest hope of controlling diseases in the field lies in the production and use of resistant varieties. Such measures, as yet, have not been successful with many diseases, although remarkable results have been achieved in some directions—e.g., with black root rot.

ROTATION OF CROPS.

With soil-borne diseases, for which resistant varieties are not available, rotation of crops is the best expedient. Such rotation is particularly applicable in the case of wilt diseases.

JUDICIOUS APPLICATION OF FERTILIZERS.

The judicious application of fertilizers is usually desirable in normal farming practice, but where plants show definite disease symptoms through malnutrition, the appropriate application of fertilizers is an obvious necessity.

EFFICIENT CULTIVATION AND DRAINAGE.

Similarly efficient cultivation and drainage are always important factors in successful farming, but with diseases especially favoured by poor aeration and water-logging, such as mosaic and brown root rot, the importance of these factors is materially enhanced.

ERADICATION.

It should be borne in mind that disease control depends almost entirely on methods of prevention. Diseased plants, with the possible exception of those suffering from malnutrition, can practically never be cured. Consequently when only a few plants become diseased eradication in the early stages is the wisest course.

EXCLUSION.

Tobacco diseases are yearly extracting an ever-increasing toll in the older tobacco areas of the world. Hence, in Australia, where many serious diseases are not yet present and where new areas are being opened up, it is essential that every effort be made for the control of the diseases that are present and for the exclusion of those that have not yet reached this country.

Specimens of new diseases should be forwarded as soon as possible to the Department of Agriculture and Stock in order that their diagnosis might be attempted, and that suitable control measures be suggested.

BLUE MOULD.

Blue mould is the most serious tobacco disease in Australia and has been known here for many years. Diseased tobacco leaves from Queensland were diagnosed as being affected with blue mould as early as 1887. In 1891, Cobb, in New South Wales, stated that blue mould

PLATE 50.—BLUE MOULD (*Peronospora* sp.).
Showing the fructification of the fungus on the under surface of an affected leaf.

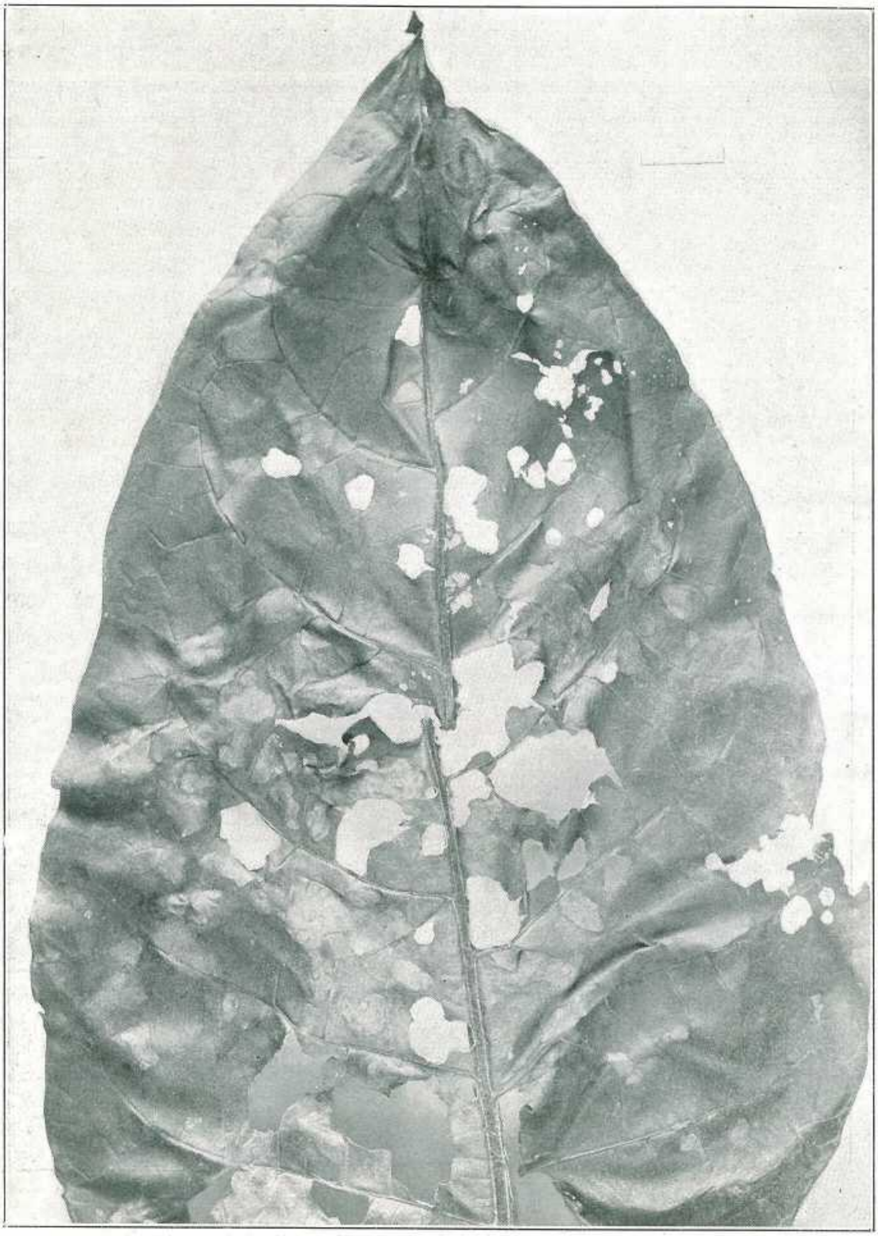


PLATE 51.—BLUE MOULD (*Peronospora* sp.).
Showing brown a.eas caused by the disease on a mature leaf and the final ragged appearance.

was "threatening the tobacco industry with extinction." Since then it has been reported from various parts of the Commonwealth. Isolated outbreaks of the disease have also been reported from the United States and South Africa.

Symptoms.

Blue mould is a disease which affects both seedlings and plants in the field. It is in the seed-bed, however, that it manifests itself as a serious menace. Seedlings with four to eight leaves are most frequently attacked, although infection may occur when the plant has only two leaves. The lower surfaces of leaves of affected plants are covered with a white to purplish fluff (Plate 50), which consists of the spores and vegetative parts of the mildew fungus which causes the disease. The leaf tissue breaks down, turns brown, and this is rapidly followed by the death of the seedling. The most alarming aspect of the disease is the rapidity with which it may spread under favourable conditions.

Plants may become affected in the field. In such cases patches of purplish fluff are to be observed on the under side of leaves. A brown irregular patch of dead tissue eventually develops on such areas (Plate 51), and other external manifestations of the fungus disappear. Plants so affected are not killed, but the quality of the leaf is impaired.

Cause.

Blue mould is caused by the fungus *Peronospora* sp. (possibly *P. hyoscyami*). This fungus is one of the downy mildews, some of which cause serious damage to several economic plants.

Hosts.

Blue mould has also been reported as parasitic on the native tobacco *Nicotiana suaveolens*, and on another plant of the same genus.

Overwintering and Methods of Dissemination.

Blue mould may survive from season to season on seed from diseased plants, on overwintering tobacco plants, and on weed hosts. The purplish fluff to be observed with the naked eye on the lower sides of affected leaves consists of fungous threads which in shape resemble spreading trees, with oval and practically colourless spores attached. These spores are produced in millions and are so light that they are readily blown about in the air. They may be carried to healthy plants by wind, water, or animals. The disease may readily be transferred from place to place by workmen. It was recently demonstrated that spores of blue mould were carried by the tobacco leaf miner (*Phthorimœa operculella* Zell.), and that healthy plants could be infected in this fashion. Probably many other insects can similarly transfer spores.

Conditions Favouring the Disease.

The development of blue mould is influenced to a remarkable extent by the prevailing weather conditions. Initial infection—i.e., apparently from special resting spores of the fungus on seeds and old tobacco debris—has in the past been associated with sudden periods of cold weather, especially at night, when the seedlings are at a susceptible age. Secondary infection—i.e., by the colourless spores produced on affected leaves—is apparently most favoured by dull, moist, and humid weather.

Control.

1. Use only seed which has been obtained from a healthy crop. It has been recently demonstrated that the disease is carried over in seed from diseased plants, whereas seed from healthy plants will produce seedlings free from the disease.

2. The seed treatments described by Mr. Pollock under that head are the usual recommendations for the surface sterilisation of seed. Recent research, however, by H. R. Angell has indicated that the following method is effective for seed sterilisation for the control of blue mould. The seed should be surface sterilised by enclosing it in a bag of muslin or some such material and immersing it in absolute alcohol for three to five minutes, care being taken that the seed is freed from air bubbles. After sterilisation the seed should be dried on clean blotting paper.

3. Do not overwater young seedlings. Make adequate provision for plenty of air and sunlight.

4. Destroy all volunteer or overwintering tobacco plants and weeds which may be native hosts, since such plants may harbour the disease and initiate an outbreak in the seed-bed.

5. Control as far as possible all insects in the seed-bed, since they may be capable of introducing the disease.

6. Transplant at the earliest opportunity.

7. Should the disease makes its appearance in the seed-bed, diseased plants and those in their vicinity should be immediately destroyed by applying a solution of 1 part formalin to 25 parts of water, and the bed then ventilated to prevent the rest of the seedlings being injured by the fumes.

8. If practical only plant out seedlings from beds which have not developed the disease.

MOSAIC DISEASE.

Mosaic disease of tobacco is extremely widespread, is probably the commonest tobacco disease, and occurs to some extent wherever tobacco is grown. In some cases although not usually, it may cause serious losses in yield as well as in quality. Carefully controlled experiments in the United States have shown that the yield may be reduced by as much as 50 per cent., and the gross value per acre by 75 per cent. in one year by this disease.

Symptoms.

As the name suggests the most characteristic symptom of this disease is a mottling which occurs on the leaves. Dark green and yellowish areas appear scattered irregularly over the leaf surfaces, and during the early stages of the disease are most noticeable on the youngest leaves.

When more severely affected, spots and blisters may appear and the leaves may be distorted. Plants affected with mosaic are often severely dwarfed, especially if they become affected early in the season.

The ultimate yield is, of course, directly affected by dwarfing, and the quality is affected by the production of abnormal leaves. Leaves showing the typical mosaic pattern are usually somewhat discoloured after curing, although this discolouration is not so marked nor is it of the same pattern as in the green leaf. Spots and blisters persist after curing and very adversely affect the quality of the leaf.

Cause.

Tobacco mosaic is extremely infectious, and healthy plants readily become affected with the disease if contaminated with the sap of diseased plants. It would appear, therefore, that some parasite is the cause, but, so far, probably due to its minuteness, no causal organism has been definitely demonstrated. Diseases of this nature are termed virus diseases. They are by no means uncommon and often cause considerable damage. Examples of such diseases are spotted wilt of tomatoes, bunchy top of bananas, and sugar-cane mosaic.

Hosts.

Tobacco mosaic can be transmitted to many plants, especially to those of the family Solanaceæ, such as tomato and potato. Many other plants are affected with a mosaic which is closely related to, if not identical with, tobacco mosaic.

Overwintering and Methods of Dissemination.

The virus causing mosaic may persist from season to season in crops and weeds susceptible to this disease. It may also survive for a year or more on infected material such as tobacco refuse, seed-bed equipment, and in the soil. In this connection it has been suggested that the greater prevalence of mosaic in Maryland, as compared with other tobacco-growing States in the United States, is probably due to the fact that there the previous year's crop is usually on the farm while the new crop is growing. Under such conditions seedlings and plants are handled by farm workers whose hands have probably become contaminated while working with the previous season's tobacco.

It is important to realise that practically all tobacco mosaic originates in the seed-bed. Usually only a few plants will be observed to be affected, and these only slightly. The disease, however, is readily transmitted to other seedlings by handling during the process of pulling, transplanting, replanting, &c. It has been demonstrated also that insects may spread the disease. The most serious damage from mosaic occurs when infection takes place at transplanting time or during the ensuing month.

In the field the disease may be spread by the usual cultural operations. The process of topping may be responsible for further dissemination. At this late period, yield is not significantly reduced although the quality of the leaf may be.

Conditions Favouring the Disease.

Mosaic develops best at relatively high temperatures (80 to 85 deg. Fahr.), but at still higher temperatures its development is retarded, and leaves tend to recover when the temperature exceeds 100 deg. Fahr. Rainfall and humidity do not apparently directly affect the spread of the disease. The survival of the virus in the soil is favoured by dry compact or waterlogged soils. Moist and well aerated soils tend to inactivate the virus.

Insects may transmit mosaic, and conditions affecting their occurrence may also affect the prevalence of the disease.

Mosaic is most noticeable and occurs earliest on rapidly growing plants.

Control.

Since it is not possible to control this disease in the field, efforts must be directed towards its elimination from the seed-bed.

1. All infected material should be destroyed in the seed-bed by soil sterilisation. This may be effected by burning brushwood over the bed. Sufficient heat should be generated by this method to cook a 4-oz. potato buried at a depth of 3 inches or an egg buried at a depth of 5 inches. After sterilisation all rubbish is raked off the bed, leaving the wood ashes, which should be worked into the soil.

2. All solanaceous weeds should be destroyed as soon as observed, especially in the vicinity of seed beds.

3. At the commencement of the season all seed-bed equipment should be suitably sterilised. For this purpose it should be painted or sprinkled with a disinfectant such as formalin (1 to 80 parts of water), corrosive sublimate solution (1 to 1,000 of water), or bluestone solution (1 lb. to 10 gallons of water). Cloth covers should be boiled for at least an hour.

4. Precautions should be taken against the introduction to the seed-bed of any trash from a previous crop.

5. After handling any old tobacco the hands should be thoroughly washed in soap and water prior to handling seedlings.

6. Should the disease be serious in the field and persist, notwithstanding the above precautions, then a rotation of crops, in which tobacco and other susceptible plants are not grown for a year or more, should be practised.

7. The beds should be carefully examined for mosaic plants prior to planting out, and if the disease is observed and seedlings from entirely healthy seed-beds are available, then it is best not to make use of any plants from beds showing the disease. If plants from a diseased bed must be used, then only pull those well removed from plants showing the disease. Be careful not to contaminate one's hands by handling diseased plants.

8. Should the disease show up in the field early in the season on a large percentage of the plants, it is usually advisable to replant.

BLACK ROOT ROT.

The parasite which causes this disease occurs in practically every tobacco district in the world, and consequently black root rot, from the economic view point, is probably the most important tobacco disease. It was first recorded by the writer in New South Wales in 1927, although probably the soil had been infested for many years previously, and was responsible for severe losses on that occasion. Plants are affected both in the seed-bed and in the field.

Symptoms.

In the seed-beds the roots of affected seedlings are rotted, and such plants show little vigour, and may eventually wilt and die.

This disease is rather difficult to definitely diagnose in the field, since the only symptoms to be readily observed are a general stunting, usually accompanied by a yellowish appearance and commonly premature budding. Similar symptoms may result from unfavourable soil or moisture conditions, or from attack by parasites such as eelworms. Usually some plants are dwarfed more than others, due to the individual resistance of some plants or to variations in the amount of inoculum present. This unevenness is not to be expected when stunting is caused by unfavourable soil conditions or drought, and hence is often an indication of a root disease. A rapid recovery after warm weather is another characteristic.

On removing an affected plant from the soil it will be seen that it is darker than usual, and parts of the stem below soil level and the roots may be black. In mild cases the fibrous roots may be depleted, and when more severely affected the greater part of the root system may be rotted away. This destruction of portion of the root system and injury of the remainder results in starvation of the growing parts. Consequently the plant becomes stunted.

Plants may be only slightly stunted, or the entire crop may be rendered worthless by this disease, and since its above-ground symptoms are so inconspicuous its presence may be often overlooked.

Cause.

Black root rot is attributed to the fungus *Thielavia basicola* Zopf., although *Thielaviopsis basicola* (Berk.) Ferraris, which is usually associated with it, may be the actual cause of the trouble.

This organism has been known for many years in Europe and America, and was first reported as a parasite of tobacco in 1897.

Host Plants.

The organism is known to attack over a hundred species of plants, although on many of them it only functions as a weak parasite. Amongst its hosts are peanuts, beans, peas, red clover, lucerne, alsike clover, cotton, and watermelon.

Overwintering and Methods of Dissemination.

This fungus may survive in the soil for several years. In the presence of its host plants soil infestation will gradually increase. It is introduced to clean areas through the transference of contaminated soil and of diseased plants. Soil, together with the causal organism, is usually introduced by running water, farm implements, farm workers, &c.

Conditions Favouring the Disease.

The most important factors influencing infection are soil infestation and soil temperature.

The severity of the disease is remarkably controlled by soil temperatures, apparently because at high temperatures susceptible plants, by the production of corky tissue, can ward off the invading parasite. For this reason affected plants may suddenly recover during warm weather. The disease is most serious at temperatures between 63 and 73 deg. Fahr. At 84 deg. Fahr. little actual damage results and at 90 deg. Fahr. no infection occurs. During warm seasons growth may not be retarded although the soil is heavily infested.

Control.

1. Soil for the seed-bed should be sterilised as indicated in the measures discussed for the control of mosaic disease.

2. Diseased seedlings should not be transplanted.

3. Heavily infested soil should not be used for growing tobacco or other highly susceptible plants more than once in four to eight years.

4. The most promising method of control lies in the use of resistant varieties. Excellent work has recently been carried out in America in the production of varieties of tobacco highly resistant to this disease.

5. Some degree of improvement may be affected by growers selecting their own seed only from the most vigorous plants in the field.

BLACK-SHANK.

This is a serious disease of Sumatra and Java and of some sections of the Southern States of America. It has not yet been recorded from Australia. It affects plants both in the seed-bed and in the field. Losses are frequently very severe.

Symptoms.

In the seed-beds a rot occurs similar to damping-off. In the field it causes a serious wilt rather similar to bacterial wilt, and also a rot of the stem which may extend from ground level to 24 inches above the soil. The pith and roots may also become involved. On the leaves large brown blotches are produced, especially after rain.

Cause.

The disease is caused by the fungus *Phytophthora nicotianae.* Fungi of this genus are ascociated with several serious diseases of cultivated plants—e.g., Irish blight of potatoes and tomatoes, citrus fruit and root rots and top rot of pineapples.

Methods of Overwintering and Dissemination.

The spores of this fungus may survive in the soil for at least two years. The disease may be transferred to new areas by the introduction of contaminated soil, which may be effected by the usual methods of soil transference—e.g., by running water, implements, apparatus, and farm workers. As with related fungi the spores may possibly be carried through the air in various ways.

Conditions Favouring the Disease.

Wet weather favours the development of the disease. In view of its geographical distribution it is also probably favoured by high temperatures.

Control.

1. Soil for the seed-bed should be sterilised in the manner discussed in the diseases already dealt with, or at least be free from possible contamination.

2. Diseased or doubtful plants should not be transplanted.

3. Care should be taken not to transfer soil from infested to clean areas.

4. Varieties differ greatly in susceptibility, and resistant types may ultimately be evolved. The use of such varieties could then be recommended.

DAMPING-OFF.

Damping-off diseases are those which cause a rot of seedlings in the stem near the surface of the soil. These diseases are not confined to tobacco, but attack many kinds of plants grown in seed-beds. They may attack seedlings at any stage of growth in the bed.

Symptoms.

Under favourable conditions these diseases cause the tissue of the stems to collapse near ground level, with the result that affected seedlings tend to topple over, lie flat on the soil, and the leaves and stems decay. In some cases only a dark sunken area is to be observed on the lower portions of the stems of affected plants.

Cause.

There are several causes of damping-off. The most usual causes are either of two fungi, *Rhizoctonia solani* (*Corticium vagum*), and *Pythium debaryanum.* They produce the same symptoms on affected plants although the organisms themselves are quite distinct. They attack a great variety of plants and occur as common soil-inhabiting organisms where their host plants have grown.

Overwintering and Methods of Dissemination.

These organisms may persist for a considerable time in the soil. The disease is not readily disseminated by spores being carried in the air, but an area of infection usually spreads from plant to plant through the soil from a centre of infection. Clean land may become contaminated by soil from an infested area being transferred to it.

Conditions Favouring the Disease.

This disease may be responsible for considerable damage under favourable conditions, and many of these conditions may be controlled by the grower.

It is favoured by excessive humidity for relatively long periods, poor ventilation at the surface of the soil, and by overcrowded seed-beds. High humidity may result from the prevailing weather conditions or from poor ventilation.

Control.

1. Soil for seed-beds should be well sterilised by the application of direct heat, as previously discussed, and care should be taken that they do not become reinfested with unsterilised soil, old tobacco trash, or animal manures being accidentally transferred to them.

2. Seed-bed soil should preferably consist of well-drained, sandy soil.

3. Do not plant too thickly.

4. Avoid watering beds too frequently since moisture on the surface of the soil encourages the development of the disease.

5. As a preventive measure plants may be watered with a solution of mercuric chloride at the rate of 1 oz. of mercuric chloride to 10 gallons of water one week after the plants emerge, and at weekly intervals afterwards.

6. Provide as much ventilation as is practicable.

7. Should the disease occur in small, isolated areas remove the infected plants and those in their vicinity. If the plants are still young apply a solution of 1 part formalin to 25 parts of water to the infested area, and ventilate to permit the escape of the gas. Dry the bed well off if possible.

8. Plants with damping-off lesions on the stem should not be planted out.

STEM ROT.

Invasion by various fungi may result in a stem rot condition. Plants which have recovered from damping-off in the seed-bed and have been planted out frequently develop this condition. In other cases infection probably occurs in the field.

Symptoms.

A rot usually develops on the stem near the surface of the soil (Plate 52). This rot is dark brown or black in colour, although it may be covered by the plant epidermis or outer skin, and then have a general light-brown appearance. Under favourable conditions the rot may affect the lower leaves. Diseased plants are usually stunted and yellowish since the injury to the stem interferes with their normal nutrition.

Cause.

Various organisms may bring about this condition. *Rhizoctonia solani*, *Pythium debaryanum* (typical damping-off fungi) *Sclerotium rolfsii*, and undescribed bacteria have been found responsible for this disease.

Conditions Favouring the Disease.

In most cases the plants are diseased when transplanted. Should the soil remain wet for a considerable time the causal organism is stimulated to activity, and consequently extensive decay may result.

Control.

1. Control measures as recommended for damping-off will eliminate initial infection.

2. Diseased plants should not be planted out.

3. Wet, poorly drained land should be avoided.

4. Should the disease frequently occur in the field a rotation of crops should be practised.

BACTERIAL LEAF SPOTS.

Three leaf-spotting diseases which are caused by bacteria are known to occur in the United States. They are wild-fire (*Bacterium tabacum*), black-fire (*B. angulatum*) and the Wisconsin leaf spot (*B. melleum*). Wild-fire is a relatively new disease which only made its appearance in 1917, but has since been introduced into practically all the American tobacco-growing districts. Black-fire or angular leaf spot is more or less confined to the Southern States. Wisconsin leaf spot is rarely as serious as the other two diseases and is apparently confined to the State of Wisconsin. None of these diseases have as yet been recorded from Australia. Serious losses may be caused by these diseases as is indicated by the fact that in Virginia in 1920 the loss due to black-fire alone was estimated as exceeding £1,000,000.

These bacterial diseases, like mosaic, originate in the seed-bed.

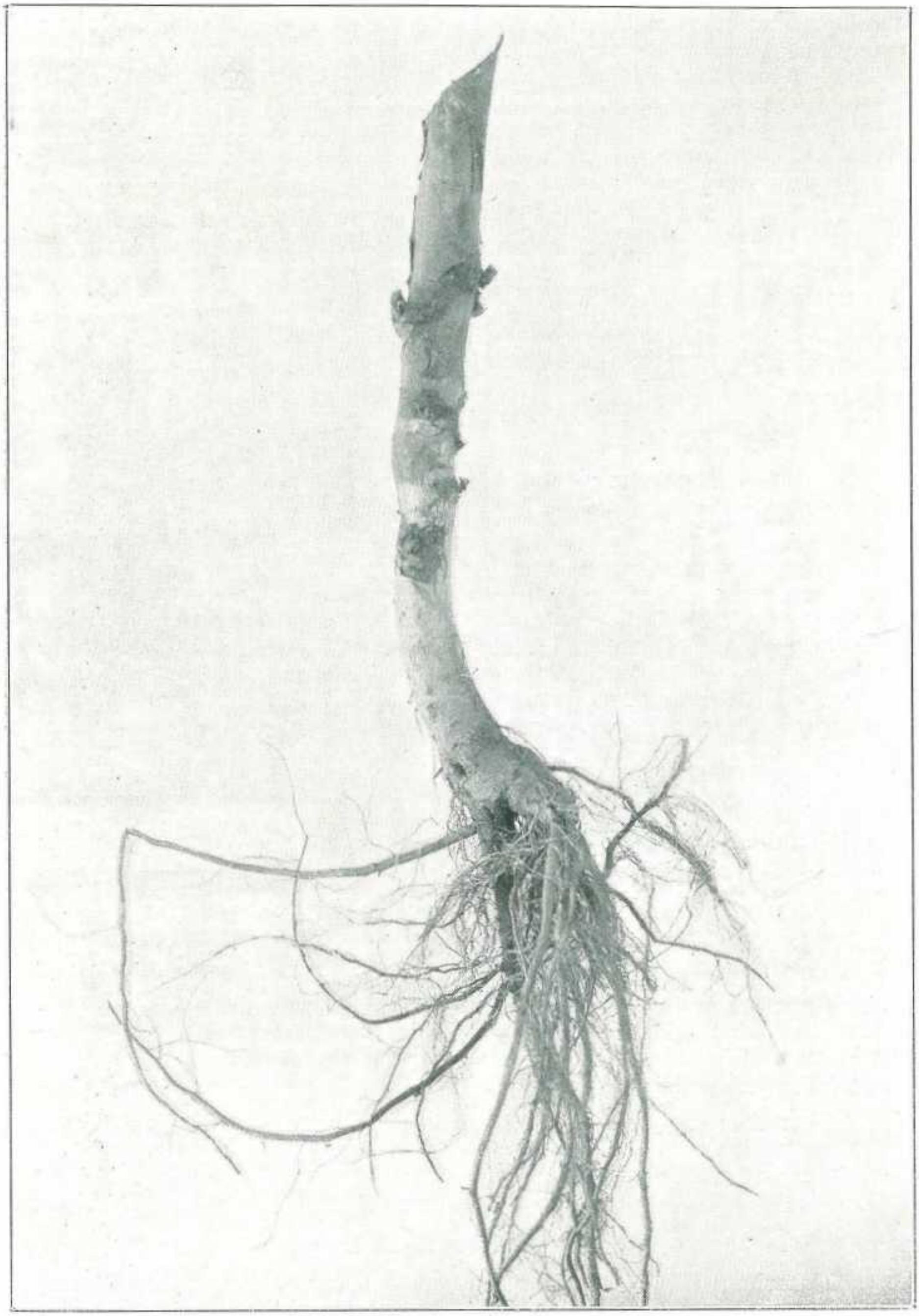


Plate 52.—Stem Rot (*Sclerotium rolfsii*).

Symptoms.

Wild-fire spots are usually circular, of a bleached or yellowish colour, and vary considerably in size. In the centre of each spot is a dried area which may vary from a pin point to half an inch in diameter. The surrounding pale area may consequently be considerable or be narrow or even entirely lacking. Spots of this description may be distinct or may coalesce. Affected plants fail to make satisfactory growth, and diseased leaves tend to dry up, break, and have a general ragged appearance.

In the case of black-fire the spots are small and angular on thin leaves, but more rounded on thick leaves, and black or dark brown in colour. They have a clear border, but not the conspicuous halo which is usually associated with wild-fire spots.

With Wisconsin leaf spot in the seed-bed small angular spots occur very similar to those of black-fire. On older plants the symptoms resemble wild-fire except that the halo is usually much narrower than that of the typical wild-fire spot.

Overwintering and Methods of Dissemination.

Bacterial leaf spots contain enormous numbers of pathogenic bacteria. They may be readily carried from plant to plant by wind, rain, farm workers, or on farm implements. These organisms are able to enter healthy tobacco leaves, especially through wounds, and there multiply and establish themselves and so give rise to a leaf spot. The disease most rapidly spreads during periods of driving rain, since under these conditions the bacteria are not only carried to neighbouring leaves, but these leaves are often damaged at the time, and the moisture present is another factor favouring infection.

It is not definitely known just how these organisms survive from season to season. The most likely manner of primary infection is from the previous season's diseased tobacco trash, whence the infection is accidentally carried to the seed-beds. The materials and equipment used in the seed-bed should also be regarded with suspicion as possible carriers of the disease.

Control.

The infectious nature and possibly the methods of overwintering of these diseases are similar to those of mosaic. Consequently the suggestions for seed-bed sanitation and elimination under that head apply equally well in this case. As an additional precaution seed should be suitably sterilised.

Should only a few isolated plants develop these diseases early in the season, it would be advisable to remove and destroy them in order to avoid their further spread.

FUSARIUM WILT.

Fusarium wilts are serious diseases of many cultivated plants, and their symptoms are very similar. The species of *Fusarium*, however, attacking tobacco does not, so far as is definitely known, affect other plants. In common with other soil-borne diseases it is very difficult to control.

Symptoms.

Infection probably occurs shortly after transplanting, but apparently depending on prevailing weather conditions symptoms may not be observed until affected plants are approaching maturity.

The disease causes a typical wilt which may be localised to one side of the plant or leaf. The leaves wilt, become yellowish, and dry up. Eventually the entire plant may die. The disease may be detected in the early stages by cutting across the stem with a knife. It will be observed with affected plants that the water-conducting vessels or woody portions are dark or yellowish in colour instead of white as in healthy plants.

Cause.

This disease is caused by the parasitic fungus *Fusarium oxysporum* var. *nicotianæ*. It establishes itself in the water-conducting vessels of the plant, and by mechanical blockage and by the secretion of toxic substances causes the plant to wilt.

Overwintering and Methods of Dissemination.

The organism may survive in the soil for at least three years, and so far as is known gains access to the tobacco plant through wounds in the roots or the lower portion of the stem. It is spread by the usual methods by which infested soil is transferred—e.g., by water, farm implements, and workmen.

Conditions Favouring the Disease.

Fusarium wilt thrives at relatively high temperatures, and hence its geographical distribution and virulence is limited thereby. It has been observed to be most aggressive at temperatures between 82 deg. and 88 deg. Fahr. It is most common in seasons when the soil temperature remains as high as 80 to 90 deg. Fahr. for some time. Eelworms, wireworms, and other factors which cause root injury favour infection. Factors influencing the severity of the disease are the amount of infestation in soil, the amount of wounding, temperature, and rainfall.

Control.

1. Do not grow tobacco on infested soil for at least three years if the disease becomes serious.

2. Use the most resistant varieties which may become available.

3. Avoid transferring the disease to healthy areas by way of diseased plants when transplanting, or by infested soil.

4. Avoid seed-bed infection by having such beds well away from possible sources of contamination and by soil sterilisation.

BACTERIAL WILT.

The characteristics of this disease are very similar to those of Fusarium wilt, and it also thrives best in warm weather.

Symptoms.

Usually symptoms are first observed two to four weeks after transplanting. Leaves droop in a characteristic umbrella-like fashion, become distorted, yellow, and finally dry up. Later the stem darkens and the plant dies. On cutting across the stem the woody portion is dark or black. When the cut end is pressed a dirty white ooze appears, which is characteristic, and serves to distinguish it from Fusarium wilt.

Cause.

This wilt of tobacco, as well as many other plants, is caused by *Bacterium solanacearum*. The bacteria establish themselves in the woody vessels of the plant, and there by mechanical and other means interfere with the nutrition of the plant and cause a wilt.

Host Plants.

This organism also attacks tomatoes, potatoes, peanuts, egg plants, velvet beans, garden beans, and several solanaceous weeds.

Overwintering and Methods of Dissemination.

The causal organism survives in the soil and in plant refuse for at least four or five years. Usually areas become gradually infested, but should tobacco or other susceptible crops be planted each year infestation becomes general, and will persist indefinitely.

Infested soil, and hence the disease, may be transferred to healthy areas by water, equipment, workmen, animals, &c.

Conditions Favouring the Disease.

Bacterial wilt is most aggressive under warm weather conditions, and its distribution is definitely limited by this factor. Its development is most favoured by wet weather, although its symptoms are naturally most marked under droughty conditions. Sandy soils are favourable for the development of the disease, since they tend to become heavily infested with eelworms, which are capable of injuring root tissue. Practically all infection initiates through wounds.

Control.

1. Investigations so far have shown that crop rotation is the only method known which has given satisfactory control. On badly infested soil tobacco should not be grown more often than once in five years. After the disease has been brought under control tobacco may then be grown safely every fourth year. Crops resistant to this disease include cotton, maize, cereals, sweet potatoes, cowpeas, grasses, and red and crimson clover.

2. The usual methods of seed-bed sanitation should be practised.

FROG-EYE.

Frog-eye is a parasitic leaf spot which occurs in Australia and elsewhere to some extent, but it is usually not considered of any great importance.

Symptoms.

The spots occur on the leaves as roughly circular brownish spots with a pale centre upon which are small black specks, these being masses of spores of the fungus causing the diseases (Plate 53). The leaf spot may vary considerably in size and colour, and the only definite method of diagnosis is by a microscopic examination. It is usually found on the bottom leaves, especially as the plant approaches maturity.

Cause.

This disease is caused by the parasitic fungus *Cercospora nicotianæ*. The spores are needle-shaped with cross walls, and are produced in tufts on the dark areas at the centre of the spot.

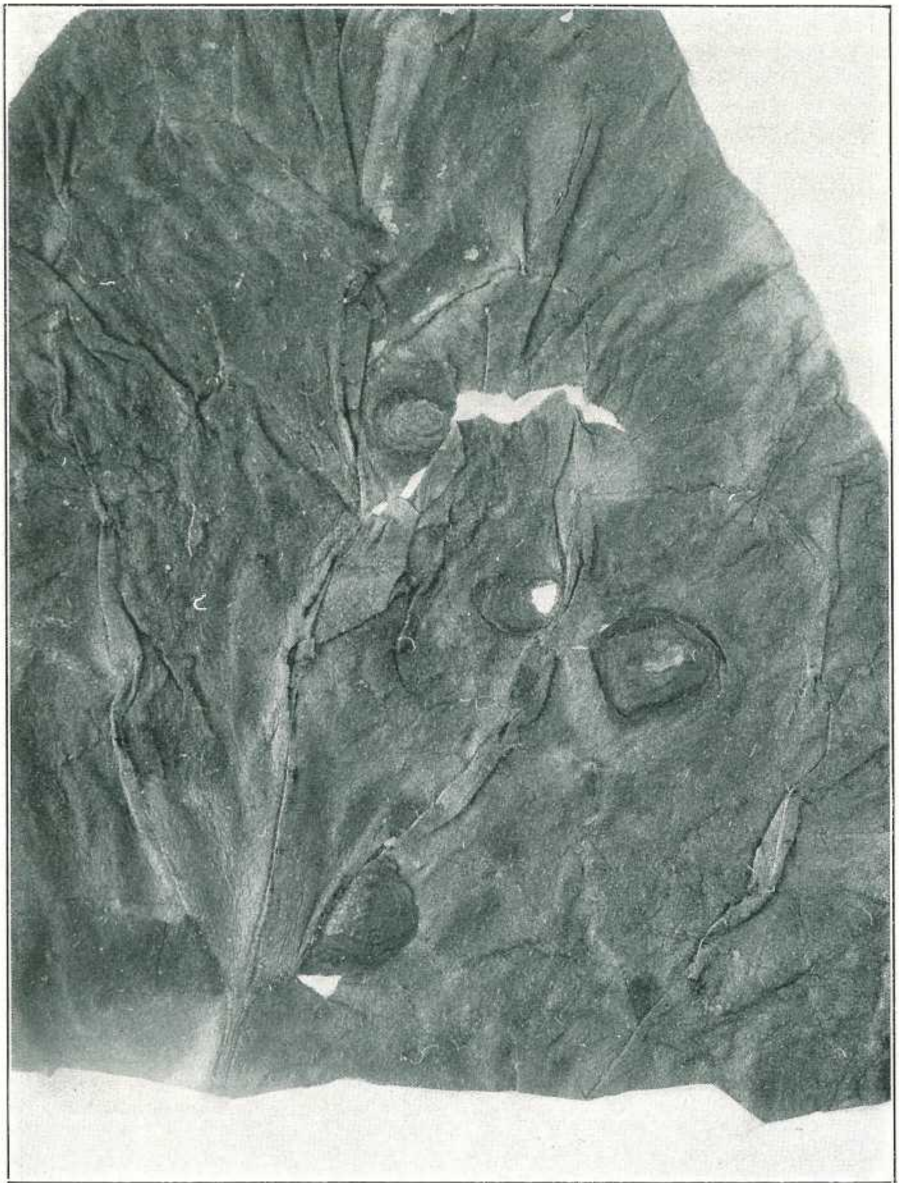


Plate 53.—Frog Eye (*Cercospora nicotianæ*).

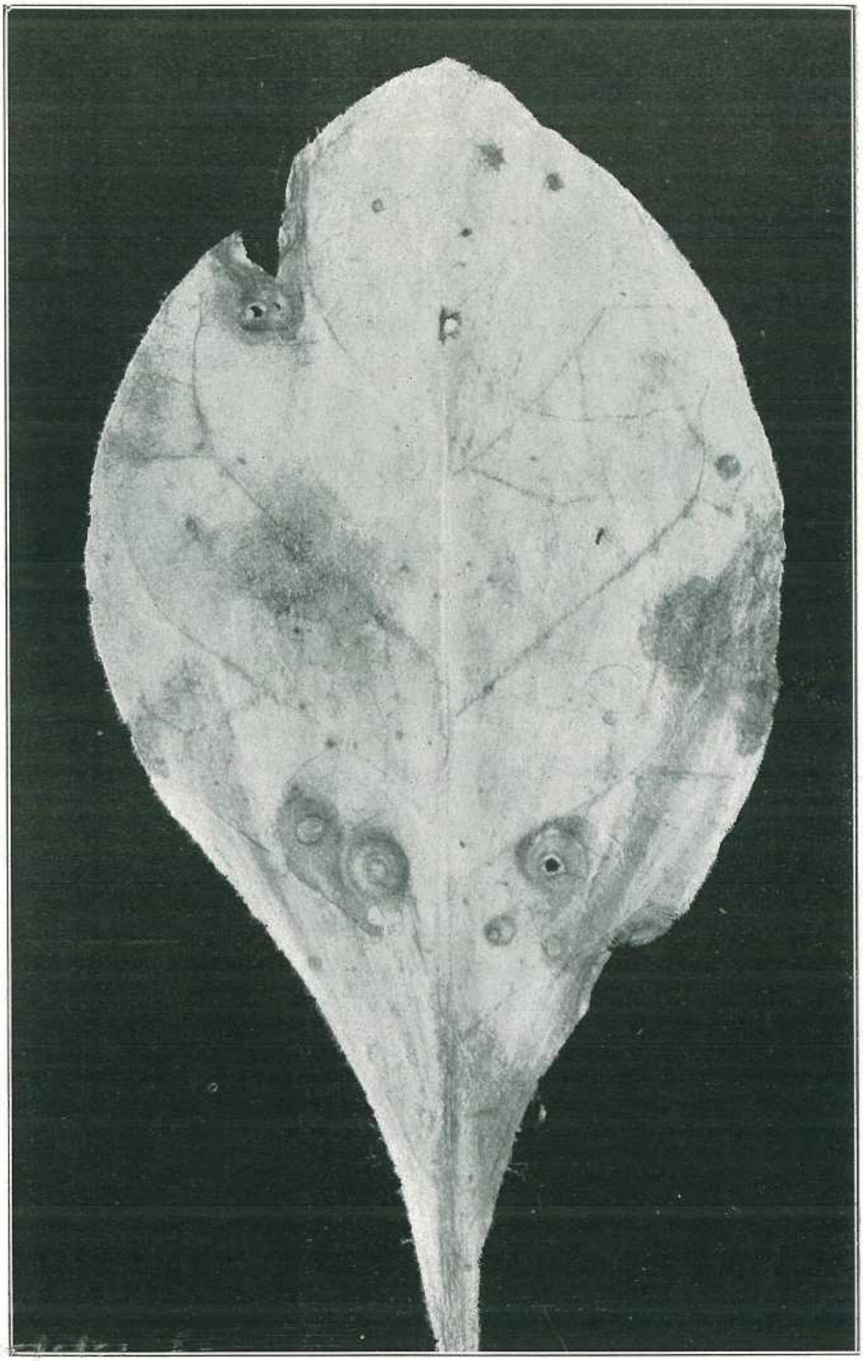


PLATE 54.—PHYLLOSTICTA LEAF SPOT (*Phyllosticta nicotiana*).

Conditions Favouring the Disease.

The development of frog-eye is favoured by rain or heavy dew, since moisture is necessary for the germination of the fungous spores. Leaves appear to become more susceptible to the disease with age.

Control.

The sporadic nature of diseases of this type has so far not warranted the adoption of special control measures. Initial infection, however, should be reduced to a minimum by efficient methods of farm sanitation.

PHYLLOSTICTA LEAF SPOT.

The Phyllosticta leaf spot affects foliage both in the seed-bed and in the field. The spots are brown, zonate, irregularly round in outline, and usually not greater than half an inch in diameter (Plate 54). The affected area is bordered by a slight, pale margin. The centres vary from a pale brown to a dirty white. With age the centres fall out of the leaves. The disease is caused by the parasitic fungus *Phyllosticta nicotiana*.

RING SPOT.

Ring spot may occur fairly uniformly over an affected leaf. The spots are circular or very irregular in shape and are bordered by a narrow line of dead tissue. The disease has been called "hieroglyphics" in allusion to the peculiarity of these markings. It has recently been proved that the disease is infectious and it is probably caused by a virus. It apparently occurs to some extent in Australian tobacco areas.

FRENCHING OR SWORD LEAVES.

This disease is characterised by the production of abnormal leaves. They are at first yellowish, thick, and brittle, and later show a tendency to narrowness and mottling. Eventually the leaves are bunched together in large numbers. Apparently this disease is not infectious, and seems to be associated with abnormal soil conditions. Observations indicate that it often occurs on poorly aerated soils.

In the present state of knowledge little can be suggested as control measures, except that proper drainage, subsoiling, and cultivation with a well-balanced fertilizer programme may tend to obviate this trouble

BROWN ROOT ROT.

This obscure disease of tobacco has been responsible for severe losses in some districts in America.

Symptoms.

The symptoms of this disease are very similar to those of black root rot—i.e., a stunting and yellowing associated with a damaged and depleted root system. It differs, however, in that the lesions on underground parts are brown rather than black.

Cause.

No parasite has been definitely proved to be the cause of this disease. Some evidence seems to indicate that the condition is induced by an abnormal soil condition resulting from the growth of certain crops—e.g., timothy, maize, and clover, in a rotation with tobacco.

Plate 55.—Potash Starvation.

Its disappearance is as remarkable as its advent, since the continuous growth of tobacco apparently results in a diminution of the disease. Consequently, in regard to this particular disease, continuous culture of tobacco on affected soils appears to be desirable.

Other Crops Affected.

Other crops, particularly the tomato, are affected by brown root rot. Potatoes and many legumes are affected to a lesser extent.

Conditions Favouring the Disease.

This disease is favoured by relatively cool weather. Warm weather followed by rain results in considerable recovery.

Sand-Drown or Magnesium Deficiency.

The leaves of affected plants become pale, and finally practically white between the veins and midrib. The trouble usually starts from the tips and margins of the basal leaves and works inwards between the veins towards the midrib.

This disease has been shown to be caused by a shortage of magnesium in the soil or in the fertilizer used.

It usually occurs on sandy soil of low natural fertility and especially in seasons of high rainfall when leaching may occur.

Control.

A relatively small amount of magnesium added to the soil will tend to rectify this trouble. Sulphate or chloride of magnesium or vegetable manures such as farmyard manure are recommended for this purpose.

POTASH STARVATION.

Insufficient potash in the soil causes a general stunting of the plant, and the leaves become crinkled and turn down at the margin. An indefinite yellowing commences around the margins of leaves and works in between the veins, and small, pale spots may appear. (Plate 55.) Leaves from plants deficient in potash are usually brittle.

Control.

This condition will not occur where suitable quantities of potash have been included in the fertilizers applied.

Should this condition be observed sufficiently early in the growing season some benefit may result from a liberal application of a readily available form of potash, e.g., sulphate of potash, between the rows of the crop.

BORON DEFICIENCY.

This is not a common disease, but is given as an example of how minute quantities of certain elements may materially affect the development of the tobacco plant.

When this element is lacking the terminal bud is injured and growth, more especially of the stalk, is markedly reduced. It has been found experimentally that normal tobacco plants may be grown when 0·5 parts of boron per million of solution are present, but that growth is abnormal when this minute quantity is absent.

The writer wishes to acknowledge his indebtedness to overseas literature, especially "Tobacco Diseases and their Control," by James Johnson, particularly in respect of diseases not occurring in Australia.

BLOW-FLY IN SHEEP.

SUGGESTED SAVING IN JETTING EQUIPMENT.

THE importance of jetting for the prevention and destruction of blow-fly maggots in sheep has been stressed in previous issues and the advice is no doubt appreciated by many woolgrowers. In these times of financial stringency many do not feel disposed to spend any large sum on plant; this often causes the adoption of less desirable means of control and, no doubt, in many instances prevention measures are not practised. The following points in practical economy are therefore suggested:—

1. A large proportion of western properties are using one or more farm pump engines.

2. Many others will require one of these as a pumping unit during the coming season.

3. The illustrations show how pumping equipment can be used as the major portion of a first-class reliable jetting plant.

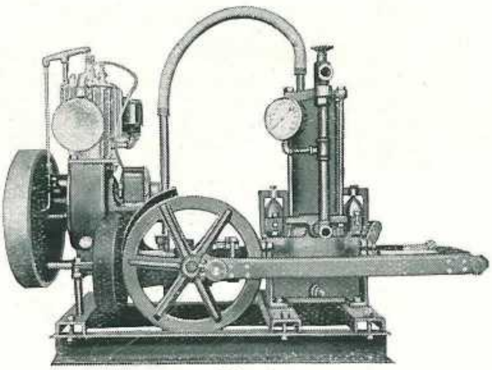


Fig. 1.

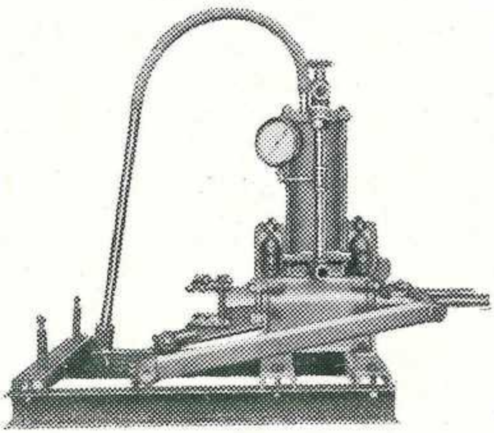


Fig. 2.

PLATE 56.

Fig. 1 illustrates a complete jetter. The suction hose is inserted into the drum or cask of jetting fluid. The outfit comprises the well-known Farm Pump engine, direct-coupled to a highly efficient double-action pump, the valves of which are easily accessible; also a removable brass cylinder lining with relief valve, enabling the pressure to be regulated at from 50 to 200 lb., and a reliable pressure gauge mounted on a channel steel base. The price is approximately £59 10s., as supplied by Buzacotts (Queensland) Limited.

Fig. 2 shows the same outfit as mounted on a channel steel base bored ready to take the Farm Pump engine. It is a matter of only a few minutes to fit it into position. The price is about £24 10s., hose and jetting pistol extra.

PIG FEEDING TEST.

Subjoined is a report on a pig-feeding trial, conducted by the Department of Agriculture and Stock, under the direction of the Minister, Hon. Harry F. Walker, at the Stock Experiment Station, Yeerongpilly.

The object of the test was to find the feeding values of barley, maize, and wheat when fed to pigs in combination with protein-rich supplements. The test commenced on 11th March, 1931, and the results now published should prove of great interest to Queensland pig-raisers.—Editor.

STOCK USED.

SIXTY-SIX pigs were used in the trial, and they were evenly divided into three lots of twenty-two each. Lot I. was fed barley. Lot II. was fed maize. Lot III. was fed wheat.

Having used this comparatively large number of animals, the average results may be taken as reliable, because the influence of individuality was largely overcome.

To suit the available accommodation and the variation in the size of the pigs, each lot was divided into five pens. (See Table I.)

Pens 1, 2, and 3 in each lot consisted of four Berkshires, while pens 4 and 5 in each lot consisted of two Berkshires and three Berkshire-Tamworth crosses. The distribution of sexes in each lot was fairly even.

The quality of the pigs used was fairly good. In type the crossbreds were good, while the Berkshires were rather short and thick and heavy in the foreparts of the body.

Each pig was given a worm capsule a few days prior to the commencement of the test. The pigs were accustomed to their food for several days before the test started.

Each pig was given a numbered eartag for identification purposes, and was weighed individually for three consecutive days, the average of these three weights being taken as the commencing weight on the second day, 11th March, 1931.

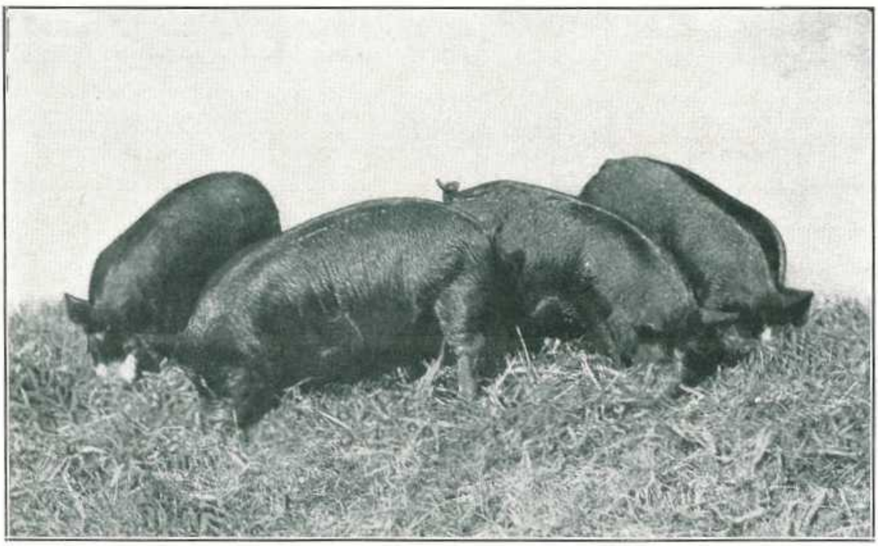


Plate 57.—Pen No. 3 of the Wheat-Fed Lot on 23rd April, 1931.

TABLE I.

(Lot I.)

Particulars.	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.
Number of pigs	4	4	4	5	4*
Average commencing weight in pounds	27·75	32·25	41·50	60·60	79·00
Number of days fed ..	103	103	89	55	48
Average final weight in pounds	130·00	140·25	141·75	132·40	148·75
Average gain per pig in pounds	102.25	107.75	100·25	71·80	69·75
Average daily gain per pig in pounds	·99	1·04	1·12	1·30	1·45

(Lot II.)

Particulars.	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.
Number of pigs	4	4	4	5	5
Average commencing weight in pounds	28·75	33·00	40·00	58·00	81·40
Number of days fed ..	103	103	89	55	48
Average final weight in pounds	143·0	150·50	137·50	146·20	166·20
Average gain per pig in pounds	114·25	117·5	97·50	88·20	84·80
Average daily gain per pig in pounds	1·12	1·14	1·09	1·60	1·76

(Lot III.)

Particulars.	Pen 1.	Pen 2.	Pen 3.	Pen 4.	Pen 5.
Number of pigs	4	4	4	4*	5
Average commencing weight in pounds	27·50	33·50	40·25	58·75	80·40
Number of days fed ..	103	103	89	55	48
Average final weight in pounds	131·75	145·25	141·25	147·25	156·20
Average gain per pig in pounds	104·25	111·75	101·00	88·50	75·80
Average daily gain per pig in pounds	1·01	1·08	1·13	1·60	1·57

* One pig in each of these pens developed sickness and was withdrawn from the trial soon after its commencement; their records have been eliminated from the results.

Accommodation.

Through the lack of more suitable accommodation the pigs were confined to small pens with an average area of 150 square feet, and had no grazing. The floors were partly concrete and partly earth. A section of the concrete was covered with a wooden sleeping platform. The pens were half covered in and half open.

Feeding.

As the object of the trial was to test the feeding value of barley, maize, and wheat, nothing was included in the ration as a substitute to these feeds, but just sufficient protein-rich foods were added to make (for practical purposes) balanced, complete, and palatable rations. The two protein-rich foods used were separated milk and lucerne, which was used both as chaff and as green fodder. These two foods were chosen as being commonly available on Queensland farms.

Particulars of Feeds Used.

BUSHEL WEIGHTS OF GRAINS.

Barley (malting)	53.38 lb.	(Above standard.)
Maize	53.40 lb.	(Below standard.)
Wheat	55.90 lb.	(Below standard.)

CHEMICAL ANALYSES OF GRAINS AND SEPARATED MILK.

Name.	Water.	Ash.	Protein.	Fat.	Fibre.	Carbo-hydrates.	Lime.	Phosphoric Acid.
	%	%	%	%	%	%	%	%
Separated milk	91·5	0·703	3·00	0·04	..	4·76 (Lactose)	0·140	0·196
Wheat meal	11·2	1·5	11·1	1·3	2·5	72·4	0·056	0·554
Maize meal	10·9	1·4	9·8	4·0	2·6	71·3	0·018	0·535
Barley meal	11·1	2·6	8·6	1·8	4·9	71·0	0·059	0·709

The lucerne chaff used was good quality, leafy chaff, mostly bright, but sometimes it had gone brown before being fed.

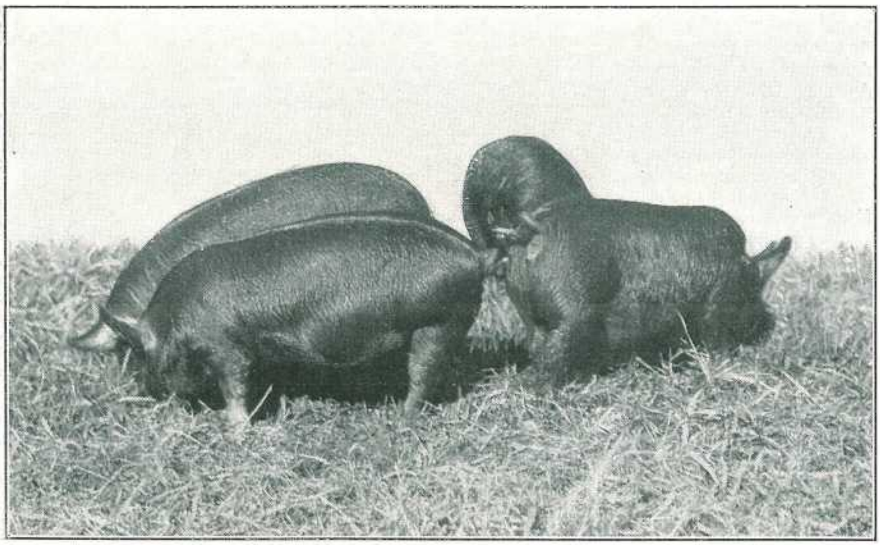


PLATE 58.—PEN NO. 3 OF THE BARLEY-FED LOT ON 23RD APRIL, 1931.

The mineral mixture was a proprietary line containing several common ingredients; its use was looked upon as an insurance against mineral deficiency, and, as less than half an ounce was fed daily per pig, its cost was very slight (less than 1½d. per month per pig).

All foods were of good quality. The meals were all ground to the one size, which was a little coarser than pollard. The meal, chaff, minerals, milk, and a little water were mixed together to make a wet mash, and this mash was allowed to soak from one feeding time to the next. The mash was weighed out and then thinned with water immediately prior to feeding, hot water being used on cold mornings. Only sufficient water was added to make the mash into a very thick slop. The pigs were fed twice daily—at 8 a.m. and 4 p.m.—with two even feeds. The green fodder was given at midday. In between feeds the troughs were kept supplied with water.

In order to feed the three grains on an equal basis, we have assumed that comparative feeding values are the same when the three are ground, and soaked as if they were fed whole, crushed dry, or steamed. If, for example, maize is just as efficient whole as it is ground, and barley is as efficient as maize only when ground, then the cost of grinding must be debited to barley; this and other questions, however, could not be incorporated in this trial, but could well be made the subject of investigation in other trials.

The green fodder consisted mainly of lucerne, which was mostly young and succulent, but at times rather old and fibrous; also a fair amount of grasses were mixed with the lucerne, and for a time green sorghum was substituted for lucerne.

The pigs were weighed weekly, and their rate of growth was taken as an indication of their food requirements.

Table II. shows the average daily food consumption per pig of each lot and the amounts of foods required to produce 1 lb. increase in the weight of the pigs.

TABLE II.

SHOWING THE COMPARATIVE GROWTH AND FOOD CONSUMPTION OF LOTS I., II., AND III.

Particulars.	Lot I. (Barley).	Lot II. (Maize).	Lot III. (Wheat).
Number of pigs	21	22	21
Total commencing weight in pounds	1,026	1,104	1,042
Average commencing weight in pounds	48·85	50·18	49·61
Average number of days fed	79	79	79
Total finishing weight in pounds	2,905	3,286	3,043
Average finishing weight in pounds	138·33	149·30	144·9
Total gain	1,879	2,182	2,001
Average gain per pig	89·47	99·18	95·28
Average daily gain per pig	1·13	1·25	1·20
Average Daily Feed per Pig—			
Grain (pounds)	2·73	2·79	3·06
Lucerne chaff (pounds)	·41	·42	·36
Separated milk (pounds)	6·66	6·80	5·38
Mineral mixture (ounces)	·50	·50	·50
Green fodder (pounds)	2·05	2·06	2·09
Feed required for 100 pounds Live Weight Gain—			
Grain (pounds)	239·38	217·46	251·22
Lucerne chaff (pounds)	36·72	32·66	30·14
Separated milk (pounds)	584·40	528·87	442·17
Mineral mixture (pounds)	2·70	2·32	2·51
Green fodder (pounds)	179·80	160·31	171·31

It will be noticed that Lot III. consumed more grain but less separated milk and lucerne chaff than Lots I. and II.; this difference in the ration was made because chemical analyses of the grains showed that the wheat contained a higher proportion of protein matter than did the maize or barley, and thus required less supplementary foods in the ration.

The pigs were fed practically as much as they would clean up at each feeding time.

Weather Conditions.

The trial was commenced during the wet season, and during the longest feeding period—viz., 103 days. There were twenty-one wet days. On two days very cold westerly winds were experienced. The average 9 a.m. shade grass temperature during the 103 days was 65 deg. Fahr.

Two pigs developed sickness and were withdrawn from the trial soon after the commencement, their records having been eliminated from the results as far as possible.

Marketing.

The corresponding pens of each lot were finally weighed and marketed when the majority of pigs in each pen were of correct weight and condition for bacon.

Quality of Meat.

Each carcass was reported on by the factory grader after it had been killed.

TABLE III.

SHOWING SUMMARY OF BACON FACTORY REPORTS ON CARCASSES.

Particulars.	Lot I.	Lot II.	Lot III.
	Per cent.	Per cent.	Per cent.
Percentage of loss from live to dressed weight ..	32·2	30·4	30·0
Percentage of carcasses graded "Choice" ..	38·0	19·0	47·0
Percentage of carcasses graded "First"	52·0	50·0	43·0
Percentage of carcasses graded "Second" (slightly overfat)	10·0	31·0 *	10·0

The average percentage of loss from live weight to dressed weight over all pigs was 30.8 per cent.

A summary of the bacon factory's grading of the pigs shows 34 per cent. choice, 48 per cent. first grade, and 18 per cent. second grade.

* It will be noticed that all lots had some over-fat carcasses, and that the percentage of over-fat carcasses was higher in the maize lot than in the wheat and barley lots. This, however, was not so much due to the maize producing more fat as it was to the fatty, quick-maturing type of pig used in the test. In every consignment of pigs slaughtered the heaviest pigs were over-fat, which indicates that the pigs might have been marketed at lower weights, and as the average finishing weights of the maize-fed pigs were heavier than those of the wheat and barley fed pigs a greater number of second-grade pigs appeared in the maize-fed lot.

It was quite evident that all the pigs could have been made over-fat had they been fed rapidly up to heavier weights. This observation reveals the necessity for larger and later maturing types of pigs for the production of fast-growing and lean bacon pigs.

No difference could be detected in the average quality with regard to firmness, texture, or colour of the meat of the three lots either before or after curing, and these qualities in the meat were commented on very favourably by the grader and the curer at the bacon factory.

Financial Aspect.

In computing the financial returns for the grains it must be understood that food is only a portion of the total cost in pork production, and other items, such as labour in caring for the pigs and interest on capital invested in stock and equipment, form a percentage of production costs, which vary on every farm, and must be computed by each farmer when he is considering his cost of pork production.

As this experiment was conducted for the purpose of testing barley, maize, and wheat as pig foods, a comparison of money values of these grains is shown in Table IV. It must be noted, however, that these comparative values will only be applicable when good quality pigs are well cared for and fed on rations similar to those used in this experiment; also, in computing the return for these grains in pork production, actual costs of caring for the pigs must be included by the farmer.

TABLE IV.

After allowing values of

£4 per ton for lucerne chaff,
1½d. per gallon for skim milk,
12s. 6d. per 100 lb. for mineral mixture,
15s. per ton for green fodder,

and allowing for 30 per cent. loss from live weight to dressed weight—

——	Barley per ton of 2,000 lb.	Maize per ton of 2,000 lb.	Wheat per ton of 2,000 lb.
	£ s. d.	£ s. d.	£ s. d.
Pork at 3½d. per lb. returns	4 4 9	5 5 0	4 17 5
Pork at 4d. per lb. returns	5 9 4	6 11 10	6 5 0
Pork at 4½d. per lb. returns	6 13 5	7 18 8	7 3 5
Pork at 5d. per lb. returns	7 17 9	9 5 6	8 6 5
Pork at 5½d. per lb. returns	9 2 1	10 12 4	9 9 5
Pork at 6d. per lb. returns	10 6 5	11 19 2	10 12 5
Pork at 6½d. per lb. returns	11 10 9	13 6 0	11 15 5
Pork at 7d. per lb. returns	12 15 1	14 12 10	12 18 5

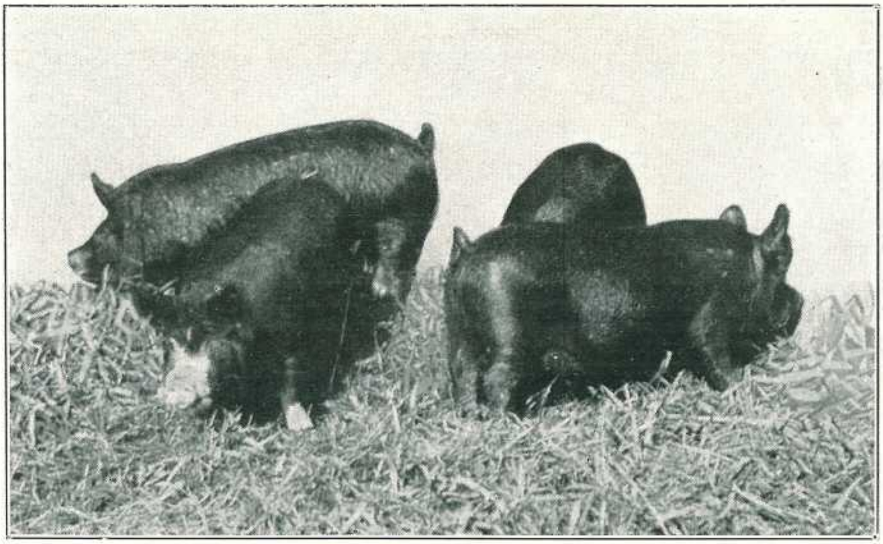


PLATE 59.—PEN NO. 3 OF THE MAIZE-FED LOT ON 23RD APRIL, 1931.

Conclusions.

(1) There is a slight difference in the feeding values of barley, maize, and wheat when fed in well-balanced rations to pigs from the weaner stage to baconer stage, maize being more valuable than wheat and wheat more valuable than barley.

(2) There is no apparent difference in the texture, firmness, or colour of the bacon produced from pigs fed heavily on maize, wheat, or barley when these foods are used in well-balanced rations.

(3) Well-fed pigs should increase in weight from 50 lb. to 150 lb. at the rate of over 1 lb. per day.

(4) Lucerne chaff is a very palatable food for young pigs when a small proportion is used in combination with grain and separated milk, and in this trial the lucerne had no ill-effect on the quality of the pork or bacon.

(5) An average ration of 2.3 lb. of grain, .3 lb. of lucerne chaff, 5.1 lb. of separated milk, and 1.7 lb. of greenstuff was required to produce 1 lb. live weight increase in pigs of 50 lb. to 150lb.

General Notes.

Staff Changes and Appointments.

The Officer in Charge of Police at Einasleigh has been appointed also an Inspector under the Diseases in Stock and the Brands Acts.

Removal of Cane Plants Prohibited.

The Governor in Council has approved of the issue of a Proclamation which provides that sugar-cane plants cannot be removed from the parishes of Maryborough, Tinana, Bidwell, Walliebum, and Young unless they are accompanied by a permit issued by an inspector stating that the property from which the plants are to be removed is free from the disease known as "Fiji" disease of sugar-cane.

Opossum Trapping Permits.

The Governor in Council has approved of the issue of a new regulation under the Animals and Birds Acts. This regulation provides for the issue of permits to opossum trappers by persons appointed by the Minister. During the previous three open seasons opossum boards operated in the eight districts constituted in the State, but it has now been decided that the Inspectors of Stock who previously occupied the position of chairmen of the boards should issue the required permits on this occasion.

Native Animal and Bird Sanctuaries—Kenmore and Mount Garnet.

The Governor in Council has approved of the issue of an Order in Council declaring the property of Mr. V. W. A. Moller, situated on the Kenmore-Lone Pine road, at Kenmore, to be a sanctuary under "*The Animals and Birds Acts*, 1921 *to* 1924," in which it shall be unlawful for any person to take or kill any animal or bird. Mr. V. W. A. Moller has also been appointed an Honorary Ranger under the abovementioned Acts.

An Order in Council was recently issued declaring the Oakey Creek Water Supply Dams near Mount Garnet as a sanctuary under the Animals and Birds Acts. A further Order in Council has now been approved extending this sanctuary, which now comprises the area within a radius of 3 miles from the Oakey Creek Water Supply Dams, Mount Garnet.

Metropolitan Rabbitries.

The Minister for Agriculture and Stock (Mr. H. F. Walker), accompanied by Mrs. I. Longman, M.L.A., and departmental officials, visited rabbitries in the metropolitan area recently, as it was his desire to have personal knowledge of the conditions under which Angora and Chinchilla rabbits were maintained. He was very impressed with premises known as the "Regal" Rabbitries, owned by Mrs. Edith Harris, situated on Anzac road, Belmont. These premises have been erected with due regard to the necessity for the observance of hygienic conditions, and the Angora and Chinchilla rabbits are admirably hutched.

Mr. Walker pointed out that the distribution of Chinchillas is prohibited, except to rabbitries where they have hitherto been maintained, but he laid emphasis on the necessity for prospective owners of Angora rabbits giving attention to the methods under which they are housed. He suggested that any person desirous of obtaining a personal knowledge of the most efficient method for housing these rabbits would study his interests by paying a visit to the rabbitry in question.

A Big Task.

There was a ring of sincerity in the voice of the Minister for Agriculture (Mr. H. F. Walker) when he congratulated an after-dinner speaker (at a function arranged recently by the Poultry Farmers' Co-operative Society) for almost completely avoiding all references to Parliament in proposing a toast in its honour. Mr. Walker said that, in these days of political turmoil and economic uncertainty, members of Parliament had depressing duties to perform, and if they had real responsibility they were faced with a big task. Despite the fact that that day the Parliamentary session was opened, on the previous night he had worked at his office until after midnight. He joined heartily in the general laugh that followed his declaration that men found it difficult to get into Parliament, but, if they worked conscientiously, their difficulties were considerably increased after they had been returned. "But," he added, "if it is difficult to get into Parliament now it will be considerably harder to get in at the next elections with a reduction in the number of members."—"Brisbane Courier."

The Home and the Garden.

OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staff of the Queensland Baby Clinics, dealing with the welfare and care of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable cases of infant mortality.

BABY IS NINE MONTHS OLD.

The "transitional period" is the name we sometimes apply to the stage following the end of baby's ninth month. It is a stage of transition in many ways—from milk feeding to mixed foods, from sucking to eating and drinking, from simple crying to commencing speech, from inability to move about to the liberty of crawling and toddling. What stirring times! What rapid development! So rapid, indeed, that we are apt to forget the transition in the accomplished facts. It is well to keep the idea of gradualness always in mind. Never make sudden large changes. The digestive organs have so far been accustomed to deal only, or almost only, with milk; they need education to deal with other foods. Much digestive trouble results from too sudden and too early introduction of a large variety of foods. The same thing applies to methods of taking food. Hitherto baby has been accustomed to take his food only, or almost only, by sucking. Sudden change throws a strain on the nervous system as well as on the digestion.

Learning to Eat.

A point which is often overlooked is that milk should continue to supply by far the greatest part of the nourishment needed during the remainder of the first year, and, indeed, right through the second year in gradually less proportion. From nine months to twelve months food other than milk is mainly of importance in educating baby to the feel and taste and digestion of solid and semi-solid food. The important thing during this period is that he should learn how to eat. He should learn to eat from a spoon and drink from a cup, and, most important of all, he should learn to bite his crusts and learn not to swallow anything solid before it has been chewed to a pulp. Once learnt this lesson will stand him in good stead throughout his life, helping to protect him from indigestion, decayed teeth, and many other evils which follow from them. Also he will be much less likely to swallow things he may pick up than the baby with whom the act of swallowing follows almost automatically the placing of anything in the mouth.

The best kind of hard food for him is bread about one day old, cut into slices of not more than half an inch thick, and baked hard, crisp, and dry in a slow oven. These home-made rusks may be kept for several days in a dry tin closely closed. They are hard, but not tough, and do not break into dangerous leathery lumps as ordinary crusts may do. But baby must never be left alone with any sort of crust or rusk until he has learnt to chew it thoroughly before trying to swallow it. While he is learning this he should also learn to eat other sorts of food, commencing with barley or oatmeal jelly prepared and given as recommended in the Queensland Mothers' Book. Do not forget that during this period milk is the most important part of the diet for his nourishment, while the solid foods are important as a part of his education. Neither can replace the other. Baby must have enough milk and daily lessons in biting and eating if he is to reach his first birthday well up to the mark in every way.

Common Colds.

What are "common colds"? How do we get them? Why are they more common in winter? How may they be avoided? Are they ever dangerous? Can they be made less dangerous? These are a few very practical questions, and they can be answered. If more attention were paid to these answers a great deal of illness and many deaths among infants and young children would be prevented.

A "common cold" is an infectious disease just like measles and whooping cough, and it spreads in the same way. It is due to tiny disease germs, which live in the nose, throat, and air passages, and may be present in immense numbers in the secretions from this part of the body. Little children who poke their fingers, all smeared with the secretions from their noses and mouths, into each other's faces convey the disease from one to another. Older people convey it also, not only those who are suffering from "colds" themselves, but also many who are carrying the germs, although they are apparently quite well. Visitors who delight in kissing other people's children are very dangerous persons, and should not be encouraged. Another way in which the disease is spread is more difficult to avoid. By coughing, the germs are expelled in a fine spray for a distance of several feet, and float in the air for some time.

Exposure to cold weather can never cause a "common cold" unless the person attacked happens to be at the time carrying the germs in his nose or throat. This may be the case with older people, but infants and young children always receive the infection from others. In winter people live more in closed rooms, and germs are more easily spread from one to another, so that more persons are carrying them.

An ordinary "cold" is not dangerous in itself, but by the complications which may follow it. They are chiefly inflammation of the ears, bronchitis, and pneumonia. Strong persons with ordinary care should throw off a cold in a few days, but young children, and especially infants, are in more danger. In the year 1929 in Queensland 115 babies under one year died of bronchitis and pneumonia. There is much carelessness in the protection of infants from infection. Unless the mother herself is infectious, it should nearly always be possible to protect the baby. Older children who go to school must take their chance. For them, as at all ages, the best protection is a strong, well-nourished body, the result of good feeding with plenty of vitamins. This may enable them to escape infection, or to recover from it quickly, unless they have been exposed to an overwhelming dose. A child with a feverish "cold" should be kept in bed for a few days; if he gets a chill while he has the "cold" he is more likely to develop complications.

THE FARM GARDEN.

It is not necessary to discuss whether the vegetable garden or the flower garden is the more valuable; we ought to take it for granted that both are essential to the complete country home. Fresh, succulent vegetables, full of vigorous vitamins, and appetising with a thousand precious ethers, make the farm table something that city folk can barely imagine.

Yet man shall not live by bread alone, and if we need vegetables for our bodies we equally need flowers for our souls—for that aesthetic hunger for the beautiful that is inherent in all of us.

Vegetable-growing is usually the task of those members of the farm household whose ordinary occupation is not laborious, muscle-straining work on the farm; and to them it represents exercise, recreation, stimulation of the bodily functions, and health.

For the younger members of the family vegetable-growing provides education in soil science, in cultural lore, in the elements of breeding, as well as in those qualities of the mind that are stiffened by adversity and nourished by success. There are pests to fight, frosts or guard against, air and water to put into the soil, and all the processes of nature to assist.

And vegetable eating is the cure for many disorders, and the proved preserver of health. Furthermore, the vegetable garden is the soil in which the herb "thrift" thrives most vigorously. A productive vegetable patch shrinks the store bill, and doctors' and chemists' bills. It does ever so much more—it trains the young people in ways of health and ways of thrift, in which they will walk all their lives. Every farm should have both a vegetable and a flower garden book,, to be able to supplement all the family knowledge of gardening, and as a reminder of what to sow and when to sow it.

Economists tell us that the fault of Australian agriculture is that it tends too much to specialise in one crop or other product, and thus the farmer is up against it when prices of his staple are low. There are side lines that the farmer with spare labour and spar capital might wisely take up; but there is one side line that calls for practically no capital, and for only spare-hour labour—the vegetable garden. And though vegetables may not bring much hard cash on to the farm, they will prevent a fairly considerable sum from going out.

Some farmers are rather contemptuous about vegetable gardening. Let such a one agree to fence, plough, and manure a quarter of an acre and pass it over to mother and the girls to make what they can of it. Let him agree to purchase all the vegetables needed for the farm table at current rates, and to market the surplus for his women folk.—"The County Woman."

THE COUNTRY WOMAN.

By arrangement with the Domestic Science and Technical Services of the Department of Public Instruction, information of especial interest to country women is published regularly under this heading.

SIMPLE COOKING.

FRIED CUTLETS AND TOMATOES.

Materials—1 lb. cutlets; 1 tablespoonful flour; 1 teaspoonful salt; ½ teaspoonful pepper; 1 cup bread crumbs; yolk of 1 egg or 1 tablespoonful milk; 3 tomatoes.

Utensils—Frying pan; chopper; board; knife; plate.

Method—

1. Trim cutlets and chop off ends of bone.
2. Dip in flour, pepper, salt, egg or milk, and bread crumbs.
3. Fry in hot fat for 15 minutes, turning twice.
4. Slice tomatoes; sprinkle with salt and pepper; fry and serve with cutlets.

MEAT PATTIES.

Materials—For pastry: ¼ lb. dripping or lard; ½ lb. flour; 1 teaspoonful baking-powder; ½ teaspoonful salt; ¼ cup water; yolk of 1 egg or 1 tablespoonful milk. For filling: ½ lb. cooked mince meat; salt and pepper.

Utensils—Bowl; sieve; teaspoon; board; rolling-pin; cutter; brush.

Method—

1. Sieve all dry ingredients into a bowl.
2. Rub dripping through with tips of fingers.
3. Add water; make into a dry dough.
4. Place on board; roll out thinly.
5. Cut out with a round cutter; line pie tins.
6. Add meat; cover with a smaller round of pastry.
7. Brush over with egg or milk; make a hole in centre of each patty.
8. Bake in a hot oven for 20 minutes.

   Sufficient for 1 dozen pies.

BOILED POTATOES (OLD).

Materials—1 lb. potatoes; 1 teaspoonful salt; water.

Utensils—Saucepan; knife; bowl; skewer.

Method—

1. Wash and peel potatoes thinly; cut into even-sized pieces.
2. Put into a saucepan; add salt; cover well with cold water.
3. Put lid on; boil till tender.
4. Strain; dry; dish in hot dish.

   Note.—Put new potatoes into boiling water; boil for 20 to 25 minutes.

BAKED CUSTARD.

Materials—1 egg; 1 cup of milk; 1 teaspoonful butter or dripping; grated nutmeg; ¼ teaspoonful vanilla; 1 tablespoonful sugar.

Utensils—Bowl; whisk; pie dish; baking-tin.

Method—

1. Break egg into a bowl; whisk well; add sugar.
2. Add milk and vanilla.
3. Strain into a greased pie dish; add butter in small pieces and grated nutmeg.
4. Stand pie dish in a baking-tin; add water till it reaches half-way up the pie dish.
5. Bake in a very slow oven for half an hour.

JAM TARTS.

Materials—¼ lb. dripping or lard; ½ lb. flour; 1 teaspoonful baking-powder; ½ teaspoonful salt; ¼ cup water; ½ tin jam; yolk of 1 egg or 1 tablespoonful milk.

Utensils—Bowl; sieve; teaspoon; board; rolling-pin; cutter; brush.

Method—

1. Sieve all dry ingredients into a bowl.
2. Rub lard in with the tips of the fingers.
3. Add water; make into a dry dough.
4. Place on a board; roll out thinly.
5. Cut out with a round cutter; line patty tins.
6. Put in centre of tart half a teaspoonful of jam; brush edge of tart with yolk of egg or milk.
7. Bake in a hot oven for 20 minutes.
   Sufficient for 2 dozen tarts.

LEMONADE.

Materials—1 lemon; 1 dessertspoonful sugar; 1 pint boiling water.

Utensils—Knife; squeezer; jug; strainer.

Method—

1. Peel rind off lemon in thin strips.
2. Strain juice of lemon into a jug.
3. Add rind, sugar, and boiling water.
4. Cover; strain when cold.

MUTTON BROTH.

Materials—1 lb. neck of mutton or mutton bones; 1 tablespoonful chopped parsley; 1 teaspoonful salt; 1 tablespoonful barley or rice; pepper; 1 onion; 1 pint water.

Utensils—Saucepan; strainer; knife; basin; chopper; board.

Method—

1. Wipe meat; chop bones into small pieces.
2. Put meat and bones into a saucepan; cover well with cold water; allow to stand for 30 minutes.
3. Place on fire; add onion, salt, pepper, and washed barley or rice.
4. Simmer for two hours; remove meat, bones, and fat.
5. Add choped parsley.
6. Boil for two minutes; serve hot.

LAUNDRY WORK.

REMOVAL OF STAINS.

Wine.

Method—

1. Spread the stained part over a basin.
2. Rub with common salt.
3. Pour boiling water through.
4. Soak in clean soft water.

Fruit Stains.

Method—

1. Sprinkle salt on spot; pour boiling water over salt; *or*
2. Plunge stain into boiling milk for a few minutes; *or*
3. Apply to stain a cloth dipped in dilute oxalic acid.
   Note.—In all cases, rinse quickly.

Ironmould.

Method—

1. Stretch stained part over a basin of boiling water.
2. Moisten; rub in salts of lemon.
3. Pour boiling water through spot.
4. Rinse well in warm water.

Blood.

Method—

(*a*) 1. Wet the stained material with peroxide of hydrogen.
2. If the stain is not removed when the spot is dry, repeat.

(*b*) 1. Soak in cold water with a little salt.
2. Wash and squeeze well until stain is removed.
3. Soak in clean soft water.

Note.—Hot water, soap, and soda fasten the stain.

Mildew.

1. Stretch the mildewed material over a hard, firm surface.
2. Dust the surface with chalk; rub it well with a dry cloth.
3. (*a*) Rub in salt and lemon juice; *or*
   (*b*) Make a paste of French chalk and water; spread over stained part.
4. Dry slowly in the sun; repeat either process if necessary.
5. Soak in warm soft water.

Notes—

1. Mildew is one of the most difficult stains to remove without injuring the fabric.
2. Clothing and household linen become mildewed quickly in damp weather.
3. Materials become mildewed if put away damp; hence the importance of airing every article thoroughly.
4. Whiting may be used instead of French chalk.

Wet Paint.

1. Rub the stained part with turpentine.
2. Hang the garment or material in the sun.

Dry Paint.

1. Mix together equal quantities of ammonia and turpentine.
2. Rub the stained part with the mixture.
3. (*a*) If the material is wool, hang it out in the sun.
   (*b*) If the material is linen, cotton, or silk, wash well in warm soft water.

Tar.

1. Rub the stained part with mutton fat or dripping.
2. Wash in warm water.

Grease or Oil.

(*a*) 1. Soak the article in cold water.
2. Add borax.
3. Wash in warm water.

(*b*) 1. Make a paste of fuller's earth and water.
2. Spread over stained part.
3. Allow to remain for 30 minutes; brush off the fuller's earth.

FRUIT PRESERVING.

Various Methods.

Canning.—Fruit, vegetables, meat, and fish are sterilised at 160 deg. to 212 deg. Fahr. and sealed in jars or cans.

Preserving.—Fruit sterilised with or without sugar are sealed or covered in jars or bottles.

Vegetables are sterilised in water to which salt has been added, and sealed in jars.

Jam-making.—Fruit are broken up, or in the case of berries used whole, sterilised, sugar is added, the mixture is boiled till a certain degree of thickness is attained, the jam is then bottled and sealed.

Jelly-making.—Fruit-juice is obtained by gentle cooking and thorough straining. it is then boiled with sugar, bottled and sealed.

Pickling.—Fruit and vegetables are sterilised; vinegar, spices, and sugar are the preservatives used.

Drying.—Fruit and vegetables, protected from dust and insects, are slowly dried by the sun's heat or artificial heat.

Crystallising.—Fruits are peeled, stoned if necessary, or otherwise treated, reheated in heavy syrup, and drained, as often as necessary for the special fruit being treated.

Note.—Vegetables should be prepared according to kind. After preparation they should be plunged into boiling water (asparagus requires modified treatment) and left in it for two minutes; the water must then be poured off and replaced by cold water; after pouring off the cold water vegetables are packed into jars, covered with cold water to which salt has been added, the cover should be screwed down tightly and then unscrewed half a turn. Rubber rings must not be adjusted till after sterilisation. Jars are put into steriliser or boiler and covered with cold water, brought to the boil very slowly and kept at boiling point for 1½ to 2 hours; jars after removal from boiler should be filled up with boiling water, sealed, allowed to stand for two days, and tested for a vacuum. A little sugar may be added to the water for white vegetables to improve the flavour.

Jam-Making.

In order to get the best results, good fruit in the best condition must be used.

The fruit must be ripe but not over-ripe; jam made from green peaches or imperfect fruit of any kind may be fit to use, but it does not keep well, and cannot be compared with a preserve made from properly developed and fine fruit.

All fruits must be thoroughly cleaned. Best results are obtained when fruits are prepared the day before the jam is made.

Apricots, nectarines, and peaches must be carefully peeled and stoned; the kernels of about one-quarter of the stones should be blanched and added to the fruit after the sugar has been added.

Plums should not be peeled; the stones may or may not be removed. Berries, such as gooseberries, mulberries, raspberries, and strawberries should be washed and dried carefully. Fruit prepared the previous day must be kept in earthenware dishes; pie-melons should be sprinkled with a small amount of sugar and allowed to stand for twelve hours; citrus fruits when cut up should be kept in earthenware dishes; a small quantity of water should be added; the seeds and stalks of rosellas are removed and kept in one dish; the remainder of the fruit is placed in another dish. To all fruits sufficient water is added to prevent the fruit sticking to the preserving pan. The bottom of the pan should be buttered; two or three glass marbles may be used to prevent the fruit sticking to the pan.

Berries and sugar are placed in the pan together; these fruits should not be stirred in such a way that they are mashed or broken. In making jam from apricots, citrus fruits, melons, peaches, pears, pineapples, plums, quinces, and rosellas, the fruit must be boiled till tender before the sugar is added. The cooking must be slow.

The amount of sugar to be used varies from half a pound to one pound to the pint of cooked pulp; it depends upon (*a*) the kind of fruit, (*b*) its condition.

Scum rises freely while some fruits are being cooked; if it forms a thick toughish layer it must be removed. The time required for cooking varies; in the case of berries the time must not exceed thirty minutes; apricots, damsons, and firm peaches require one hour; melons, pears, pineapples, and quinces may require two hours before the sugar is added, and from half an hour to one hour afterwards. Cooking is completed if a small portion of the fruit sets when dropped from a spoon on a cool surface.

If jam or jelly is boiled too long it will not set. Most jams should be bottled and sealed down while hot; jams made from berries should be allowed to cool before bottling; if bottled while hot the berries rise to the top of the bottle.

Bottles may be covered with white paper dipped in white of egg or boiled starch; if corks are used, they should be dipped in melted wax and forced into the bottle, the top should then be covered with wax. If the bottles have lids, care must be taken to screw them down tightly.

In dry sunny weather jam made from first-class fruit, after bottling, may be allowed to stand for twenty-four hours before being sealed; the bottles should be covered with cheese-cloth to keep off dust; a layer of melted parowax should then be poured over the surface in each bottle; the bottles may be covered with paper; preserves treated in this way should keep for months.

It is advisable to make preserves from fruit gathered in wet weather or after heavy dew.

CABBAGES.

To grow cabbages well plenty of manure should be used. There is no manure to which this crop responds so well as animal. For heavy lands horse manure, and for light soils cow or pig are respectively the best when they can be obtained. If the soil is of a poor quality, dig the ground two spits deep, and put a good layer of manure between the two spits. This is especially necessary in the case of autumn or summer crops, which have to stand a dry spell. Spring cabbage—that is, those that are planted in the autumn for use in the spring—do well if planted on ground that has been well worked and manured previously for peas or onions, and on such ground cabbages can be planted without any fresh manure being added. Of other manures lime is an important factor in successful cabbage culture; it is chemically and mechanically beneficial to the soil and the cabbage tuber. It should be applied at the rate of about 2 lb. to the square yard, and is particularly necessary to heavy soils and those rich in humus. Superphosphate at the rate of 2 oz. to the square yard is good, but should not be applied at the same time as lime or to soils that are infected with club root. When the crop is nicely established, apply 1 oz. of sulphate of ammonia to heavy, damp land, or 1 oz. of nitrate of soda per square yard in the case of light or sandy soil. Nitrate of soda is a splendid fertiliser for the cabbage family. When especially fine heads are required, water the plants once or twice during the growing season with the following mixture:—1 oz. of iron sulphate and 2 oz. of sulphate of ammonia dissolved in 1 gallon of water.

KITCHEN GARDEN.

Now is the time when the kitchen garden will richly repay all the labour bestowed upon it, for it is the month for sowing many kinds of vegetables. If the soil is not naturally rich, make it so by a liberal application of stable manure and compost. Manure for the garden during summer should be in the liquid form for preference. Failing a sufficient supply of this, artificials may be used with good results. Dig or plough the ground deeply, and afterwards keep the surface in good tilth about the crops. Water early in the morning or late in the evening, and in the latter case stir the soil early next day to prevent caking. Mulching with straw, leaves, or litter will be a great benefit as the season becomes hotter. It is a good thing to apply a little salt to newly-dug beds. What the action of salt is is not exactly known, but when it is applied as a top dressing it tends to check rank growth. A little is excellent for cabbages, and especially for asparagus, but too much renders the soil sterile and causes hardpan to form. French or kidney beans may now be sown in all parts of the State. The Lima bean delights in the hottest weather. Sow the dwarf kinds in drills 3 ft. apart and 18 in. between the plants, and the climbing sorts 6 ft. each way. Sow Guada beans, providing a trellis for them to climb on later. Sow cucumbers, melons, marrows, and squash at once. If they are troubled by the red beetle, spray with Paris green or London purple. In cool districts peas and even some beetroot may be sown. Set out egg plants in rows 4 ft. apart. Plant out tomatoes 3½ ft. each way, and train them to a single stem, either on stakes, trellis, or wire netting. Plant out rosellas. Sow mustard and cress, spinnach, lettuce, vegetable marrows, custard marrows, parsnips, carrots, chicory, eschalots, cabbage, radishes, kohl-rabi, &c. These will all prove satisfactory provided the ground is well worked, kept clean, and that water, manure, and, where required, shade are provided.

THE HOME VEGETABLE GARDEN.

Fresh vegetables, especially vegetables containing vitamins, are essential to good, robust health, and medical men are now advising people to "eat more vegetables."

The growing of vegetables not only means a saving of money, but educates the children by inculcating a desire to have their own gardens in later life, and so help to keep down the costs of living.

Vegetable-growing is not only a healthy occupation, but it also provides exercise and recreation. In the suburbs it has a tendency to keep young people contended at home, and to trouble less about going to horse races and places of gambling. With country people who, perhaps, are less in need of exercise, gardening is a delightful hobby.

It enables private gardeners to improve the strains of vegetables by a careful selection of seed, much in the same way that a flockmaster improves his sheep; and much satisfaction, and, not unusually, generous reward, are to be gained from this work.

The home garden enables the testing out, in a small way, of the newer varieties of vegetables, which work is not always possible, or, if it is possible, not payable with the professional or commercial gardener. The amateur gardener will find this work both fascinating and health-giving.

Farm Notes for September.

With the advent of spring, cultivating implements play an important part in farming operations.

The increased warmth of soil and atmosphere is conducive to the growth of weeds of all kinds, particularly on those soils that have only received an indifferent preparation.

Potatoes planted during last month will have made their appearance above the soil, and where doubt exists as to their freedom from blight they should be sprayed with either Burgundy or Bordeaux mixture as soon as the young leaves are clear of the soil surface.

Land which has received careful initial cultivation and has a sufficiency of sub-surface moisture to permit of a satisfactory germination of seeds may be sown with maize, millets, panicum, sorghum, melons, pumpkins, cowpeas, broom millets, and crops of a like nature, provided, of course, that the areas sown are not usually subjected to late frosts.

Rhodes grass may be sown now over well-prepared surfaces of recently cleared forest lands or where early scrub burns have been obtained, and the seed is sown subsequent to showers. More rapid growths, however, are usually obtainable on areas dealt with, say, a month later.

In connection with the sowing of Rhodes grass, farmers are reminded that they have the Pure Seeds Act for their protection, and in Rhodes grass, perhaps more than any other grass, it is necessary that seed of good germination only should be sown. A sample forwarded to the Department of Agriculture will elicit the information free of cost as to whether it is worth sowing or not.

Where the conditions of rainfall are suited to its growth, paspalum may be sown this month.

The spring maize crop, always a risky one, requires to be sown on land which has received good initial cultivation and has reserves of soil moisture. Check-row seeding in this crop is to be recommended, permitting as it does right-angled and diagonal cultivation by horse implements, minimising the amount of weed growth, and at the same time obtaining a soil mulch that will, with the aid of light showers, assist to tide the plant over its critical period of "tasselling."

Although cotton may be sown this month, it usually stands a better chance if deferred until October. The harvesting of cotton during the normal rainy season is, if possible, to be avoided.

The sowing of intermediate crops prior to the preparation of land for lucerne sowing should be carried out in order that early and thorough cultivation can take place prior to the autumn sowing.

The following subsidiary crops may be sown during the month:—Tobacco and peanuts; plant sweet potatoes, arrowroot, sugar-cane, and cow cane (preferably the 90-stalked variety), and in those districts suited to their production yams and ginger. Plant out coffee.

Orchard Notes for September.

THE COASTAL DISTRICTS

September is a busy month for the fruitgrowers in the coastal districts of this State, as the returns to be obtained from the orchards, vineyards, and plantations depend very largely on the trees, vines, and other fruits getting a good start now.

In the case of citrus orchards—especially in the southern half of the State—it is certainly the most important month in the year, as the crop of fruit to be harvested during the following autumn and winter depends not only on the trees blossoming well but, what is of much more importance, that the blossoms mature properly and set a good crop of fruit.

This can only be brought about by keeping the trees healthy and in vigorous growth, as, if the trees are not in this condition, they do not possess the necessary strength to set their fruit, even though they may blossom profusely. The maintenance of the trees in a state of vigorous growth demands—first, that there is an adequate supply of moisture in the soil for the requirements of the trees; and, secondly, that there is an adequate supply of the essential plant-foods available in the soil.

With respect to the supply of moisture in the soil, this can only be secured by systematic cultivation, except in seasons of good rainfall or where there is a supply of water for irrigation. As a rule, September is a more or less dry month, and when it is dry there is little chance of securing a good crop of fruit from a neglected orchard.

If the advice that was given is the Notes for August regarding the conservation of moisture in the soil has been carried out, all that is necessary is to keep the soil stirred frequently, so as to prevent the loss of moisture by surface evaporation. If the advice has been ignored, then no time should be lost, but the soil should be brought into a state of good tilth as quickly as possible.

Where there is a supply of water available for irrigation, the trees should receive a thorough soaking if they require it. Don't wait till the trees show signs of distress, but see that they are supplied with an adequate supply of moisture during the flowering and setting periods.

It is probable that one of the chief causes why navel oranges are frequently shy bearers in the coastal districts is that the trees, though they produce a heavy crop of blossoms, are unable to set their fruit, owing to a lack of sufficient moisture in the soil at that time, as during seasons when there is a good rainfall and the trees are is vigorous growth, or where they are grown by irrigation, as a rule they bear much better crops. The importance of maintaining a good supply of moisture in the soil is thus recognised in the case of this particular variety of citrus fruit.

When the trees show the want of sufficient plant-food—a condition that is easily known by the colour of the foliage and their weakly growth—the orchard should be manured with a quick-acting, complete manure, such as a mixture of superphosphate, sulphate of ammonia, and sulphate of potash, the plant-foods which are soluble in the water contained in the soil and are thus readily taken up by the feeding roots.

Although the foregoing has been written mainly in respect of citrus orchards, it applies equally well to those in which other fruit trees are grown. Where the land has been prepared for bananas, planting should take place during the month. If the plantation is to be made on old land, then the soil should have been deeply ploughed and subsoiled and brought into a state of perfect tilth prior to planting. It should also receive a good dressing of a complete manure, so as to provide an ample supply of available plant-food. In the case of new land, which has, as a rule, been scrub that has been recently fallen and burnt off, the first operation is to dig the holes for the suckers at about 12 ft. apart each way. Good holes should be dug, and they should be deep enough to permit the top of the bulb or corm of the sucker to be 6 in. below the surface of the ground.

Care should be exercised in the selection of suckers, butts, or bits. Either of the two latter are preferable, and in the case of suckers which have broken into leaf, these should also be cut hard down to the butt. Before planting, all roots should be cut off closely and the surface pared or scraped, excepting over the buds or eyes which are allowed for development. Where the butts are split into sections (up to four) according to the number and placements of eyes, these are planted with the eye or eyes facing downwards. In the case of butts, two to three eyes are left spaced around the butt, and surplus ones being removed, the top having previously been cut down to the corm and the centre scored out. Better growth is evidenced in each case, and as no cut surface is made available (each "plant" being covered by a few inches of soil immediately) beetle borer infestation is not shown.

In old banana plantations keep the ground well worked and free from weeds and remove all superfluous suckers; also all bases of plants which have fruited.

When necessary, manure—using a complete fertilizer rich in potash, nitrogen, and phosphoric acid, such as a mixture of meatworks manure and sulphate of potash—two of the former to one of the latter.

Pineapples can also be planted now. The ground should be thoroughly prepared—viz., brought into a state of perfect tilth to a depth of at least 1 ft.—more if possible—not scratched, as frequently happens; and when the soil requires feeding, it should be manured with a complete manure, which should, however, contain no superphosphate, bonedust or Nauru phosphate being preferable.

Old plantations should be kept in a good state of tilth and be manured with a complete fertiliser in which the phosphoric acid is in the form of bonedust, basic phosphate, or finely ground phosphatic rock, but on no account as superphosphate.

The pruning of custard apples should be carried out during the month, leaving the work, however, as late in the season as possible, as it is not advisable to encourage an early growth, which often means a production of infertile flowers. If the weather conditions are favourable passion vines can also be pruned now, as if cut back hard they will make new growth that will bear an autumn crop of fruit instead of one ripening during the summer.

Grape vines will require careful attention from the time the buds start, and they should be regularly and systematically sprayed with Bordeaux mixture from then till the time the fruit is ready to colour, in order to prevent loss by downy mildew or anthracnose. Sulphuring may be required against powdery mildew.

Where leaf-eating beetles, caterpillars, or other insects are present, the trees or plants on which they are feeding should be sprayed with arsenate of lead. All fruit-fly infested fruit must be gathered and destroyed and on no account be allowed to lie about on the ground, as, if the fly is allowed to breed unchecked at this time of the year, there is very little chance of keeping it in check later in the season.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

Where not already completed, the winter spraying with lime-sulphur should be finished as early in the month as possible. Black aphis should be fought wherever it makes its appearance by spraying with a tobacco wash, such as black-leaf forty, as if these very destructive insects are kept well in hand the young growth of flowers, leaves, wood, and fruit will have a chance to develop.

The working over of undesirable varieties of fruit trees can be continued. The pruning of grape vines should be done during the month, delaying the work as long as it is safe to do so, as the later the vines are pruned the less chance there is of their young growth being killed by late frosts. Keep the orchards well worked and free from weeds of all kinds, as the latter not only deplete the soil of moisture but also act as a harbour for many serious pests, such as the Rutherglen bug.

New vineyards can be set out, and, in order to destroy any fungus spores that may be attached to the cuttings, it is a good plan to dip them in Bordeaux mixture before planting. The land for vines should be well and deeply worked, and the cutting should be planted with one eye only out of the ground and one eye at or near the surface of the ground.

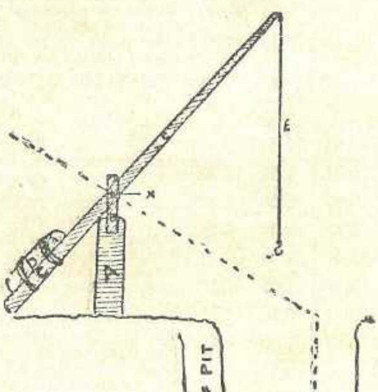
In the warmer parts, which are suitable for the growth of citrus fruits, the land must be kept well cultivated, and if the trees need irrigating they should be given a good soaking, to be followed by cultivation as soon as the land will carry a horse without packing.

In these parts fruit fly should be systematically fought, as it will probably make its appearance in late citrus fruits and loquats; and if this crop of flies is destroyed, there will be every chance of the early crops of plums, peaches, and apricots escaping without much loss.

SILO PIT ELEVATOR.

"I have found the following contrivance successful for elevating ensilage from a pit," writes a correspondent of a South African paper:—

This device has been in use for very many years for raising water, especially in Egypt.



All that is necessary is a long pole, a length of rope, a short stout pole, old wagon tyre, and a few bolts; also a heavy stone.

A short pole partly burned; CC the long pole; D the stone; E the rope; B piece of wagon tyre bolted to "A"; X is the pivot. Dotted lines show the position of pole when down.

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON, F.R.A.S., AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	August, 1931.		September, 1931.		MOONRISE. Aug., 1931.	MOONRISE. Sept., 1931.
Date	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					p.m.	p.m.
1	6.38	5.18	6.10	5.34	7.47	9.7
2	6 38	5.18	6.9	5.34	8.38	10.2
3	6.37	5.19	6.8	5.35	9.30	10.58
4	6.37	5.19	6.7	5.35	10.21	11.56
5	6.36	5.20	6.6	5.36	11.15	...
						a.m.
6	6.35	5.20	6.5	5.36	...	12.54
					a.m.	
7	6 35	5.21	6 4	5.37	12.11	1.53
8	6 34	5.22	6.3	5.37	1.8	2.50
9	6.33	5.22	6.2	5.38	2.7	3.45
10	6.32	5.23	6.0	5.38	3.5	4.32
11	6.31	5.23	5.59	5.39	4.7	5.14
12	6.30	5.24	5.58	5.39	5.5	5.50
13	6.29	5.24	5.56	5.40	5.58	6.26
14	6 28	5.25	5.55	5.40	6.45	7.2
15	6.27	5.25	5.54	5.41	7.23	7.40
16	6.26	5.26	5 53	5.41	7.58	8.16
17	6 26	5.26	5 52	5.42	8.23	9.1
18	6.25	5.27	5 51	5.42	9.7	9.52
19	6.24	5.27	5.50	5.43	9.41	10.49
20	6.23	5.28	5.48	5.43	10.19	11.46
						p.m.
21	6.22	5.28	5.47	5.43	11.6	12.43
22	6.21	5.29	5.46	5.43	11.57	1.41
					p.m.	
23	6.20	5.29	5.45	5.44	12.54	2.41
24	6.19	5.30	5.44	5.44	1.52	3.35
25	6.18	5.30	5.43	5.45	2.50	4.28
26	6.17	5.31	5.42	5.45	3.47	5.20
27	6.16	5.31	5.40	5.46	4.47	6.11
28	6.15	5.32	5.39	5.46	5.43	7.1
29	6.14	5.33	5.38	5.47	6.32	7.56
30	6.13	5.33	5.37	5.47	7.25	8.51
31	6.12	5·34	...	...	8.15	

Phases of the Moon, Occultations, &c.

7 Aug.	☽	Last Quarter	2 28 a.m.
14 ,,	●	New Moon	6 27 a.m.
20 ,,	☾	First Quarter	9 36 p.m.
28 ,,	○	Full Moon	1 10 p.m.

Apogee, 3rd August, 5.48 p.m., and 31st August, 7.24 p.m.
Perigee, 15th August, 7.54 p.m.

A daylight spectacle for owners of a telescope or binoculars will be afforded by the Moon and Mars on the afternoon of the 17th August. By shading off the Sun it will be possible to observe an occultation of Mars when the dark edge of the Moon reaches it, about 2.30 p.m. About an hour later the planet will be seen on the opposite or bright side of the Moon, but not quite so clearly visible. On the following morning the Moon will be passing from west to east of the first magnitude star Spica, an occultation being visible only at places further north than Cairns, such as Darwin.

The best occultation for general observers will be early in the evening of the 21st, when, throughout Australia and Tasmania, Antares, the first magnitude star in the Scorpion, will be hidden by the Moon for more than an hour in the far north, but for a much shorter time in Tasmania.

On the night of the 31st of August, Venus will be passing from west to east of Neptune, which will be little more than a Moon's breadth to the south and invisible to the naked eye.

Mercury will set at 7.17 p.m. on the 1st, and at 7.26 p.m. on the 15th.

Venus will rise at 6.1 a.m., thirty-seven minutes before the Sun, on the 1st; on the 15th it will rise at 6.9 a.m., eighteen minutes before the Sun.

Mars will set at 9.16 p.m. on the 1st, and at 9 p.m. on the 15th.

Jupiter will rise at 6.23 a.m., only fifteen minutes before the Sun, and set at 4·57 p.m., or twenty-one minutes before the Sun, on the 1st; on the 15th it will rise at 5.38 a.m., forty-nine minutes before the Sun, and set at 4.16 p.m., sixty-nine minutes before the Sun.

Saturn will rise at 3.48 p.m., and set at 5.28 a.m. on the 1st; on the 15th it will rise at 2.49 p.m. and set at 4.28 a.m.

The Southern Cross will be upright about 4 p.m. on the 1st of August, at 3 p.m. on the 15th, and at 2 p.m. on the 31st. It will, therefore, be bending downwards to the right, and will reach the horizontal position at 10 p.m. on the 1st, at 9 p.m. on the 15th, and at 8 p.m. on the 31st.

5 Sept.	☽	Last Quarter	5 21 p.m.
12 ,,	●	New Moon	2 26 p.m.
19 ,,	☾	First Quarter	6 37 a.m.
27 ,,	○	Full Moon	5 44 a.m.

Perigee, 13th September, 3.24 a.m.
Apogee, 27th September, 12.42 p.m.

Mercury will be passing from east to west of the Sun, between the Earth and the latter on the 5th. On this occasion it will avoid a transit of the Sun's disk by rather more than 3 degrees; Mercury being on the southern side or above the Sun at midday. It will then be more than 55 million miles from the Earth. Three days later Venus will be passing the Sun from west to east on its far side and apparently closer to the Sun, but its distance from the Earth will be about 160 million miles.

For places west of Warwick and nearly in the same latitude, 28 degrees 12 minutes S., add 4 minutes for each degree of longitude. For example, at Inglewood, add 4 minutes to the times given above for Warwick; at Goondiwindi, add 8 minutes; at St. George, 14 minutes; at Cunnamulla, 25 minutes; at Thargomindah, 33 minutes; and at Oontoo, 43 minutes.

The moonlight nights for each month can best be ascertained by noticing the dates when the moon will be in the first quarter and when full. In the latter case the moon will rise somewhat about the time the sun sets, and the moonlight then extends all through the night; when at the first quarter the moon rises somewhat about six hours before the sun sets, and it is moonlight only till about midnight. After full moon it will be later each evening before it rises, and when in the last quarter it will not generally rise till after midnight.

It must be remembered that the times referred to are only roughly approximate, as the relative positions of the sun and moon vary considerably.