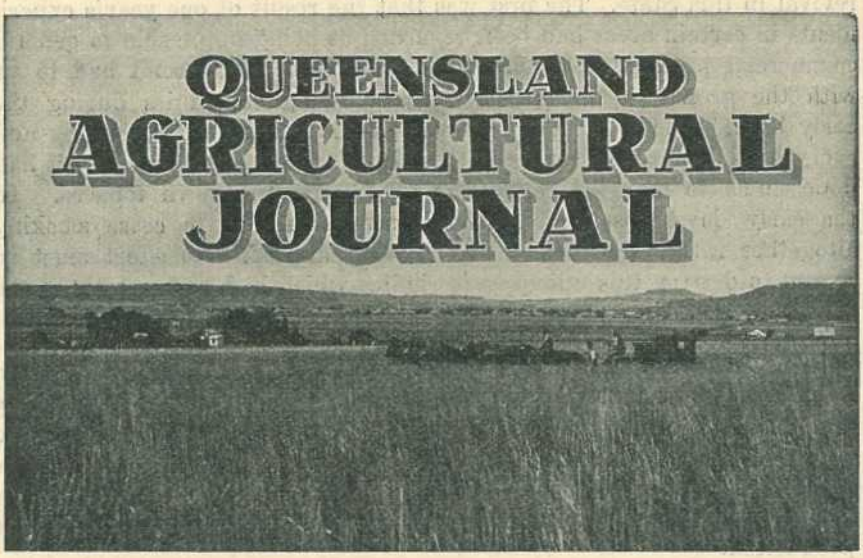
ANNUAL RATES OF SUBSCRIPTION.

Farmers, Graziers, Horticulturists, and members of Agricultural Societies, **Five Shillings,** including postage. Schools of Arts, **One Shilling.** General Public, **Ten shillings,** including postage.



VOL. XLVI. 1 AUGUST, 1936. PART 2

Event and Comment

The Future of the Tobacco Industry.

"I AM hopeful that this Conference represents something more than the mere coming together of officers to discuss the problems of tobacco production without suitable co-operative action being taken to ensure the co-ordination of our separate efforts. I am hoping that the old phrase 'mine and thine' is going to totally disappear from the higher branches of agricultural science, and that a greater degree of close co-operation among the various States will be observed." As expressed by the Minister for Agriculture and Stock, Hon. Frank W. Bulcock, that was the keynote of an interstate conference of scientific and technical officers specialising in tobacco problems, which was held at Brisbane during the last week in July. Dr. T. B. Dickson, chief of the Division of Plant Industry, Commonwealth Council of Scientific and Industrial Research, presided.

Continuing, Mr. Bulcock said that it was considered that of all the technical workers in the Queensland Department of Agriculture, the tobacco staff was engaged in the solution of some of the most complex problems and were employing the most scientific methods in their scheme of research. At this early stage no one could actually say that he had gauged the full value of soil types, and it was hoped that a period of careful experimentation would lead to the full exploitation of soil resources in the production of different qualities of leaf which would produce the blends palatable to Australian tastes.

The Minister referred to certain regrettable things which had hindered the development of the tobacco industry during the recent period of revival in this State. The first was that the result of one year's experiments in certain areas had been regarded as being applicable to general commercial production throughout Queensland; the second had to do with the growth of mushroom manufacturing companies during the early boom period. These small concerns handled practically any and every kind of leaf and supplied the market with a product which had done much to mar the reputation of Australian grown tobacco. In the early days most people would have preferred to cease smoking altogether rather than smoke the Australian leaf. No effort must be spared to destroy this unhappy prejudice which had been set up in the average smoker's mind.

In the matter of soil type determination there was a large amount of work to do, and Queensland could be depended upon to do her share. Already two officers had been sent overseas to investigate tobacco culture in its various phases, and the data collected as a result of these expeditions had been made available to the C.S.I.R. Other officers had devoted their attention to the more or less domestic side of tobacco production.

The Pooling of Brains.

WHILE there were many problems which had to be tackled by research workers in tobacco, there were certain items of particular importance which would have the first attention, Mr. Bulcock added. One difficulty which had to be contended with in Australia was the shortage of trained man power, and in using that man power it not infrequently happened that, through overlapping and duplication of services, a certain amount of effort was dissipated. The fact that it was possible for members of all the research organisations in Australia to meet and discuss relevant matters, with the idea of rendering mutual assistance, indicated that it might be possible to pool our big tobacco problems and have them distributed among the different bodies in a way that would enable one State to devote itself to a particular problem, another State to another, and so on, as was done in the case of the dairying industry. This would be a big step towards obviating the dissipation of scientific effort.

In the field of legislation Mr. Bulcock suggested to the Conference that a suitable resolution should be framed which would have this matter included on the agenda for the next meeting of the Australian Agricultural Council with the idea of bringing about some degree of uniformity of enactments giving a greater measure of protection to the industry as a whole. Legislation was especially necessary to cope with the problem of seed imports. This matter was of pressing importance, and he rather favoured the idea of all importations being handled by some central body such as the Council of Scientific and Industrial Research.

So far as Queensland was concerned, there was nothing insular about the attitude adopted to agricultural research, and no work was undertaken purely for the benefit of our own State. We were ever willing to make available the data which were being accumulated in the various fields of research. All other States were equally anxious to exchange reports and opinions and in this way a fair measure of co-ordination was attained.

An All-Australian Industry.

REVERTING to the matter of prejudice against Australian tobacco, Mr. Bulcock pointed out that, although most smokers were ignorant of the fact, a very large quantity of Australian leaf was being included in a goodly number of the popular brands on the market at the present time. He again stressed the necessity for the thorough exploitation of our soil types so that a wide range of leaf type would be produced, enabling the manufacturers to put out quality blends. This matter presented constant scope for effort, and the future of the industry depended upon what results accrued. We should not be content to have merely a percentage of our home grown leaf on the market, but should strain every effort to make tobacco an all-Australian industry. Only co-operation among all the States would achieve this end.

Special tribute was paid to the work of the C.S.I.R. by Mr. Bulcock, who stated that the work of this body was proving of invaluable assistance to the development of agriculture in Australia. By reason of the fact that their efforts were in no way spectacular much that they did went unrecognised and unlauded by the people. The evolving of the vapour treatment for the control of blue mould in seed beds was an especially meritorious performance.

Mr. Bulcock extended to delegates a hearty welcome to Queensland. He felt sure that the visitors would share his opinion that Queensland was a very progressive State, which would probably one day be the most important tobacco producer in the Commonwealth. He assured them that any matter touching Queensland which they cared to refer to him as a result of their discussions would receive his most careful consideration.

The Meat Industry—A Correction.

IN a paragraph on the meat industry on this page of the July issue, the Premier, Hon. W. Forgan Smith, was quoted as saying in the course of a Press interview at Fremantle that "one thing was quite certain: there is now a future for the frozen meat industry...." In the original message from which the quotation was made the word "frozen" was substituted in error for the word "chilled." The actual words used by the Premier were:—"One thing is quite certain; there is now a future for the *chilled* meat industry, and we must improve the quality. We must produce a better type."

Agricultural News Service to the Country Press.

MATTERS agricultural develop so quickly at times that it has been deemed necessary, in order to give a last-minute service, to issue a weekly Bulletin to the Country Press.

It is the aim of the Department to give an efficient service, and consequently matters of immediate and outstanding importance will be dealt with through the columns of the "Weekly News Bulletin." It is not intended that the Bulletin shall supersede the "Agricultural Journal," but rather that it shall be complementary to it.

Highly-trained agricultural scientists, who can speak with definite authority upon the questions with which they deal, will be regular contributors to its columns, and I hope that our new venture will prove to be another link in the chain of co-operation between the Producer and the Department of Agriculture and Stock.

The task of preparing a weekly Bulletin, without addition to our staff, is a big one, but it is felt that the value of a weekly agricultural information service will fully justify our efforts.

Newspaper editors are cordially invited to reprint the information contained in the "Weekly News Bulletin," and their co-operation in this practical form of agricultural extension work will be greatly appreciated.

Frank. W. Bulcock

Minister for Agriculture and Stock.

The Tobacco-growing Industry in the United States of America.

L. F. MANDELSON, B.Sc.Agr., Plant Pathologist.

[*Continued from July*, 1936.]

TOBACCO DISEASES.

ALTHOUGH blue mould is not at present a very serious factor in tobacco production in the United States, several other diseases, some of which have not as yet become established in Australia, are causing increasing concern.

The disease situation is summarised in the United States "Year Book of Agriculture, 1934," as follows:—

"Omitting mention of relatively minor troubles our growers at present must contend with no less than four serious root diseases—root knot (*Heterodera radicicola*), black root rot (*Thielavia basicola*), brown root rot, and Granville wilt (*Bacterium solanacearum*). There are also five destructive leaf diseases—mildew or blue mould (*Peronospora* sp.), blackfire (*B. angulatum*), wildfire (*B. tabacum*), drought spot, and mosaic."

Some of these troubles are most difficult to control, and there is evidence that the areas involved are gradually increasing. Consequently, it is at present realised that diseases as a factor limiting tobacco production are yearly becoming more important, and the problem of their control is receiving considerable attention. As evidence of this it may be noted that special conferences of tobacco pathologists from various parts of the United States were held in August, 1934, and in August, 1935, for the purpose of discussing and co-ordinating disease control work and stimulating further research. Subsequently, in November, 1935, a permanent organisation known as the "Tobacco Disease Council" was formed with the object of co-ordinating the work of the Experiment Stations, Federal Government, and other research agencies.

Furthermore, the tobacco pathological staff of the United States Department of Agriculture has been considerably strengthened recently, and problems of disease control are being vigorously investigated. Special efforts are being made to develop resistant strains of tobacco for one or more of the major diseases with suitable characteristics for specific districts. The soil-borne diseases are receiving particular attention. The Chief of the Division of Tobacco and Plant Physiology has expressed the opinion that "the importance of the disease problems in tobacco production can hardly be over-estimated." Tobacco pathology in the United States is possibly receiving more attention than any other field of tobacco research at the present time.

At the Interstate Tobacco Research Conference held in August, 1935, the pathologists present expressed the opinion that "one of the most important fundamental problems relating to agriculture upon which present scientific information is entirely inadequate deals with the ecological relations affecting soil-borne plant parasites." In future probably more attention will be given to soil compositions and characteristics, reaction, flora, temperature, prior crops, &c., as they influence soil pathogens, than has been the case in the past.

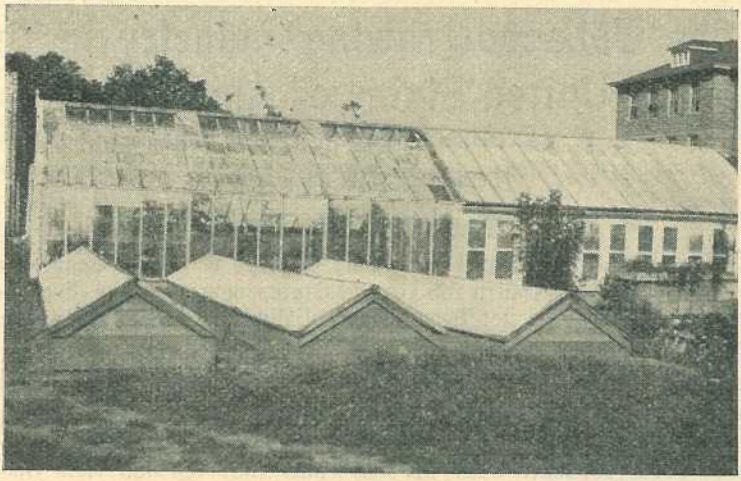


Plate 47.

BLUE MOULD INVESTIGATIONS.—Glasshouses and tobacco seed-beds used for blue mould investigations at the Virginia Polytechnic Institute.

Blue Mould.

Blue mould (*Peronospora tabacina*) first made its appearance in the United States in 1921, when it was observed in Florida and Southern Georgia. The authorities, realising the importance of blue mould in Australia, built the North Florida Experiment Station in 1922 for the specific purpose of studying the disease. Blue mould, however, did not reappear until 1931. The following year it was apparently the major factor in reducing the area under crop by some 300,000 acres. Since then, although it has caused considerable anxiety and has been apt to delay the setting-out of plants, it has not been responsible for any serious damage. At the present time growers plant extra seed-bed areas, and usually succeed in setting out the area anticipated.

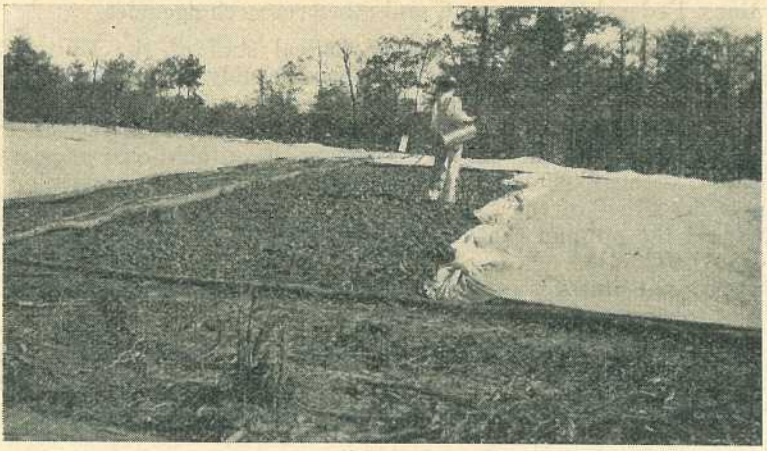


Plate 48.

SPRAYING EXPERIMENTS.—Experimental blocks in a large seed-bed in North Carolina being sprayed with various fungicides for the control of blue mould. Note the size of the cheese-cloth cover which has been partly removed.

Plate 49.

Spraying Experiments.—Seed-beds at the Coastal Plain Experiment Station being sprayed with fungicides in blue mould control experiments.

Blue mould generally makes its appearance in seed-beds when plants are almost large enough to set out and when mild weather conditions are being experienced. The seedlings are rarely killed. Generally most of the leaves may be destroyed, but the growing point survives and in due course the plants completely recover. Growers tend to encourage this recovery by the systematic application of nitrate of soda, together with ample sunlight. Under American conditions fungicides have not given satisfactory results. They have the effect of delaying the advent of the disease, but eventually the plants become affected and lose their leaves. Consequently, sprayed plants develop the disease later and recover later than those which receive no treatment, and under such conditions spraying is obviously detrimental.

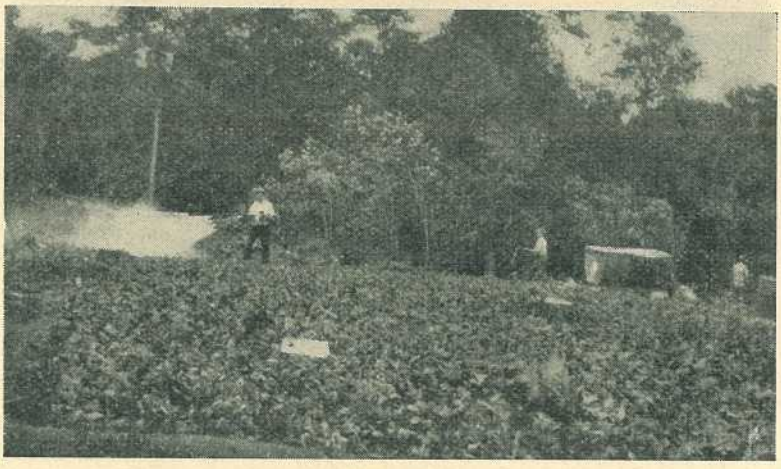


Plate 50.

Power Spraying.—A large-scale spraying experiment in Maryland being carried out by the United States Department of Agriculture, using a high-pressure power sprayer for applying fungicides to control blue mould and bacterial diseases.

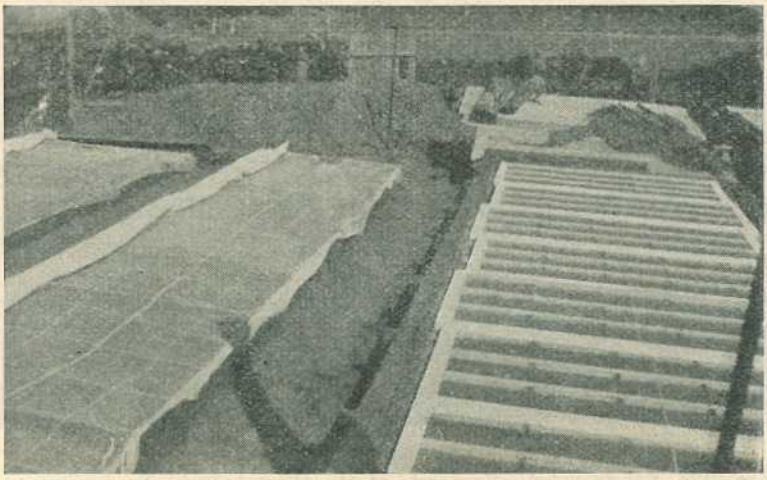


Plate 51.

HEATED TOBACCO SEED-BEDS.—Experimental seed-beds for the control of blue mould at the Coastal Plain Experiment Station, Georgia. The air above the bed on the left was heated with a charcoal fire. The soil of the other two was heated with hot air from wood fires. Materials for seed-bed covers were also being investigated.

The United States Department of Agriculture and several research institutions (Plates 47, 48, 49, 50) are, nevertheless, investigating the possibilities of numerous fungicides as well as other control methods, since it is realised that effective methods for the control of the disease would be very desirable should a repetition of favourable conditions, such as those of 1932, occur. Copper sprays, such as cuprous oxide with cotton seed oil emulsion and colloidal copper with soap appear to be as effective as any. Very satisfactory results have been obtained by

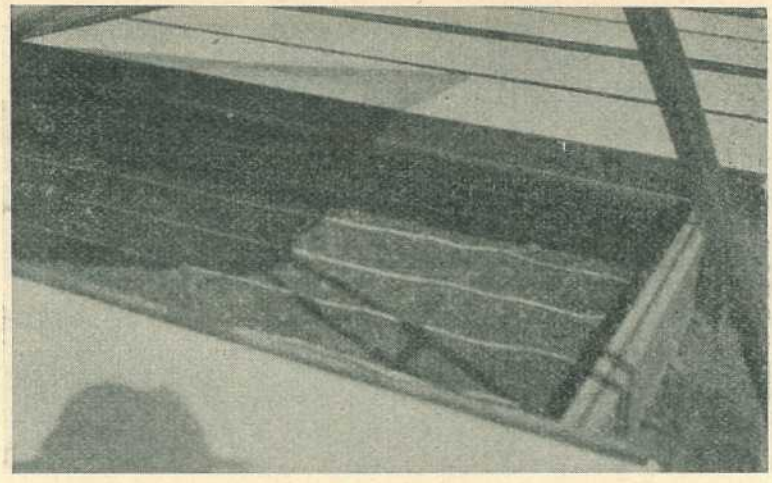


Plate 52.

ELECTRICALLY HEATED SEED-BEDS.—A seed-bed at the Coastal Plain Experiment Station for the control of blue mould, where heat was supplied by a lead-covered electric cable running over the surface of the soil.

growing seedlings in beds which are artificially heated so as to maintain a minimum temperature about 70 deg. Fahr. Various methods of heating the beds and various sources of heat, such as wood, oil, and electricity, have been investigated. (Plates 51 and 52.) It would seem, however, that such methods are at present too costly to warrant adoption. All commercial varieties appear to be equally susceptible to the disease. Numerous exotic types, however, have been introduced and tested for resistance. Of these an Argentine variety appears to have the greatest degree of resistance, but it is by no means totally resistant, and does not have the characteristics of a flue-cured tobacco.

At the present time the official recommendations involve the following measures:—The use of new sites for seed-beds or sterilizing old ones, the selection of a warm, sunny situation for the bed and allowing ample sunlight and air to the plants, destroying hold-over plants from the previous season, early sowing of seed, sowing reserve bed space, avoiding

Plate 53.

Investigating Blue Mould Dispersal.—An investigator in North Carolina removing a glycerine-covered plate used for catching fungus spores. A metal vane which keeps the plate facing the direction of the prevailing wind may be seen to his left. Self-recording meteorological instruments for air and soil data are housed in the wooden boxes in the foreground.

overcrowding of beds, only working in beds when plants are dry, avoiding the dissemination of spores on clothing by moving from infested to non-infested beds, the use of nitrate of soda to increase the rate of growth of diseased plants, if necessary, and avoiding the setting-out of diseased plants until they have recovered.

At the Duke University fundamental information on the epiphytology of blue mould is being collected by means of careful seed-bed surveys, the use of self-recording meteorological instruments (Plate 53), and the periodic examination of spore-traps in the vicinity of seed-beds. The data so far indicates that initial infection develops in seed-beds which have been used during the previous season. Consequently, Dr. F. Wolf has expressed the opinion that blue mould could be eliminated in the United States if new beds were used entirely throughout the tobacco belt. In this connection it should be noted that the severity of

the winter in America tends to effectively eradicate tobacco plants between seasons, and even if the above procedure were successful in the United States it would not necessarily be so under Australian conditions. Work of this nature which accurately correlates disease outbreaks with prevailing weather and soil temperatures should be most helpful as a foundation for further research. Generalising the work at this institution on the occurrence of blue mould it would seem that an outbreak of the disease might be expected when a period of heavy sporulation is followed by a few days of windy weather with low relative

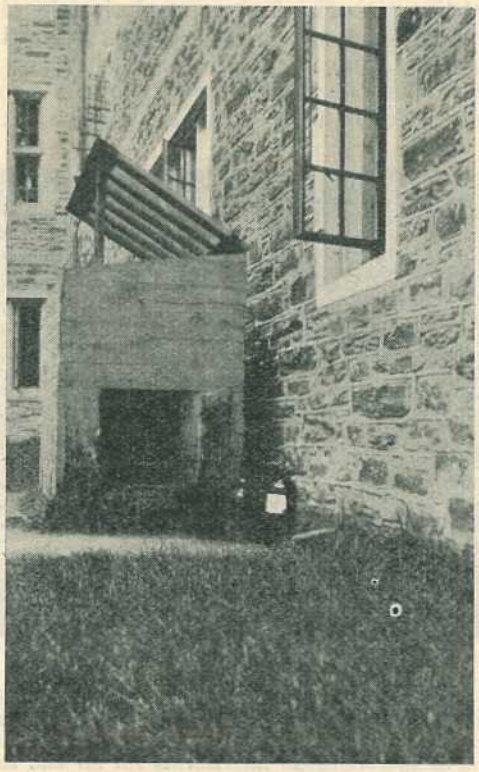


Plate 54.

A CONSTANT TEMPERATURE AND HUMIDITY CABINET.—This apparatus is in use at the Duke University, North Carolina, for keeping tobacco plants throughout the year under optimum conditions for blue mould studies.

humidity. An outbreak may occur when night temperatures vary between 45 deg. Fahr. and 60 deg. Fahr., and day temperatures do not exceed 84 deg. Fahr. These conditions are usually associated with showery weather.

For the purpose of studying the disease throughout the year special constant temperature and humidity cabinets are used at several institutions for growing plants affected with blue mould. (Plate 54.) Studies on the causal organism indicate that spores are not produced at temperatures above about 70 deg. Fahr., but infection may take place up to 86 deg. Fahr.

In the United States blue mould has so far been a seed-bed trouble entirely, and damage in the field is practically unknown. This may possibly be correlated with the fact that during the summer months, when the crop is growing, the minima temperatures recorded are consistently high.

Blue mould has been reported from Florida, Georgia, South Carolina, North Carolina, Virginia, Southern Maryland, and Tennessee. Although it has been present in Tennessee since 1933 it has not caused as much damage in the Burley crop of that State as might be anticipated. Under Australian conditions Burley is most susceptible to blue mould. However, although seed-beds of Burley tobacco in Tennessee are possibly more seriously damaged than is flue-cured tobacco in other States, the disease is by no means as severe as it is in Australia, and tobacco is not affected in the field.

Hence, with the exception of 1932, blue mould has not been a serious trouble in the United States, but it is considered a potential menace to the industry, and every effort is being made to evolve successful control measures.

Root Knot.

The root knot nematode (*Heterodera marioni*) is most destructive at relatively high temperatures in light soils, and consequently is a serious factor in the production of flue-cured and cigar tobaccos in the Southern States. A special resolution of the recently formed "Tobacco Disease Council" indicated "that nematodes constitute the biggest plant problem in the South, and urges that more intensive study of nematode problems be conducted, and that it be carried out on a co-ordinated basis as far as possible." As indicative of the importance of the nematode problem in general, the United States Department of Agriculture maintains a special Division of Nematology, with a staff of approximately twenty research workers and two field stations. Investigations are also being carried out by the Division of Tobacco and Plant Physiology, as well as by various State Agricultural Experiment Stations.

Root knot is not a problem on the heavier tobacco soils or in the more northern States where seasonal conditions are cooler and soils are heavier. It does, however, frequently cause serious losses in the South, although, apparently, in 1935 the weather experienced was not conducive to severe infestation, and the damage observed was not as extensive as usual. An additional factor involved in the control of nematodes in the cigar wrapper district of Florida is the high cost of the artificial shade tents under which this class of tobacco is grown, and which, consequently, makes control by rotations very expensive. Frequently commercial "shades" can only be successfully used for tobacco cultivation for two years owing to root knot. Nevertheless, it has been demonstrated at the North Florida Experiment Station that it is possible to grow tobacco on the same land continuously for thirteen years with success. The method adopted there is to maintain a thoroughly bare fallow for the ten months of the year that tobacco is not in the field. The time of planting is an important factor in regard to the degree of nematode infestation. When plants are set out late in the season high temperatures stimulate nematode activity, and consequently such plants are more seriously affected than earlier plantings. Nematode damage is most serious if plants are infested when they are young. Growers are advised to encourage the rapid growth of the crop in order to mitigate nematode injury.

The most intensive field experiments observed, consisting of rotational and cultural investigations, are being carried out at the Coastal Plain Experiment Station, in Georgia. (Plate 55.) Some of these experiments were commenced in 1925. So far the most effective control measure consists of growing tobacco after two years of bare fallow. A promising rotation, both from the viewpoint of root knot control and tobacco quality, consists of growing peanuts the first season, oats and weeds the second, and tobacco in the third year. Where runner peanuts are used the leaf of the subsequent tobacco crop may be coarse, and consequently the amount of nitrogen in the tobacco fertilizer should be reduced. Spanish or bunch type peanuts, which are usually dug, are considered preferable, as they do not have the same tendency to result in rough leaf. The success of a weed rotation depends on the nature of the weeds grown, since some are susceptible to nematodes. In Florida a weed known as Florida pursley (*Richardia scabra*) is prevalent, and is desirable. In other States the most successful weeds in rotations are

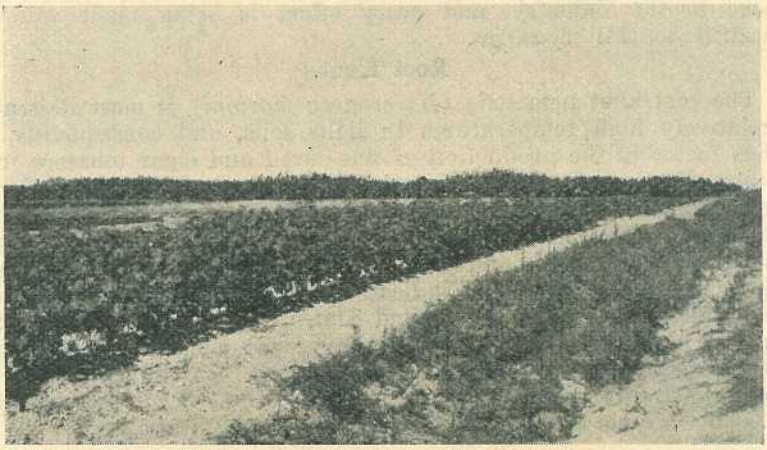


Plate 55.

TOBACCO ROTATIONAL EXPERIMENTS.—A general view of some of the rotation plots at the Coastal Plain Experiment Station in Georgia.

horseweed (*Erigeron canadensis*) and rag-weed (*Ambrosia artemisiifolia*). Where soils are not heavily infested a two-year rotation may be practised with some success. Promising crops for this purpose over the past three years have been peanuts, *Crotalaria retusa,* Laredo soybeans, or a combination of oats followed by a late crop of Crotalaria. Velvet beans were not as effective in rotations as those crops already discussed.

Corn, Brabham cowpeas, and cotton have not been found consistently successful. Serious nematode damage may result when tobacco is grown after sweet potatoes, Clay cowpeas or field peas, or after tobacco.

The effectiveness of rotations depends on the specialisation of nematodes for feeding on certain crops. As a control method rotation is not always satisfactory, possibly due to susceptible weeds growing with the resistant crops, and so carrying the nematodes over, or, possibly, nematodes may in time adapt themselves to resistant hosts. It is known that nematodes have not been eradicated on a soil even after it had been cropped with peanuts for ten years. However, at the present

time rotations offer the most practical method of control, and the use of resistant crops adapted to local conditions is recommended. In practice crops such as velvet beans, corn, and Brabham cowpeas frequently give reasonable control as rotation crops, although, apparently, they are not immune. The sterilisation of seed-bed soil, the early setting-out of plants in the field, the encouragement of vigorous growth by appropriate cultural methods, are all found to be helpful in the control of root knot. It is recommended, furthermore, to avoid badly infested soil for tobacco culture.

Plate 56.

Black Shank in Florida.—A plant of cigar wrapper tobacco severely wilted as a result of black shank infection. Prior to the development of resistant varieties black shank threatened the shade tobacco industry in Florida with extinction.

With the possible exception of Faucett's Special, which is said to be moderately resistant, all commercial varieties are quite susceptible to root knot. A recent foreign introduction known as White Honduras also has some degree of resistance.

Black Shank.

Black shank (*Phytophthora parasitica* var. *nicotianæ*) is another soil-borne disease which is causing increasing concern in the United States. It was first observed in Southern Georgia, and quickly spread to Florida, where at one time it threatened the valuable cigar wrapper industry with extinction. (Plate 56.) It was investigated from 1922 to

1929 by Tisdale, who, as a result of his brilliant plant-breeding work, developed resistant strains of cigar varieties of satisfactory commercial quality. These varieties are not immune, although some are highly resistant. Nevertheless, long rotations, omitting tobacco for five or six years, are at times practised in conjunction with them for the control of the disease. Black shank is still being investigated in Florida with the object of developing more satisfactory strains, to ascertain the nature of inheritance of resistance, and also to obtain fundamental knowledge on the pathogen and environmental conditions associated with the development of the disease.

Plate 57.

PLANT-BREEDING FOR DISEASE RESISTANCE.—Resistant and susceptible strains of tobacco growing on black shank infested soil in North Carolina.

In 1930 the alarming discovery was made that this destructive organism was present in the Old Belt of North Carolina, near Winston Salem, where it had possibly been present for some time and confused with Granville wilt. In 1935 it was found that its geographic range had been extended considerably, and was established in most of the Old Belt, where it was causing serious damage. It is not known to what extent it may eventually spread into the New Belt of that State.

Fortunately, tobacco is apparently the only host plant of this disease, but it can survive more or less indefinitely in the soil, and land has been known to remain infested for at least eight years. Long rotations with crops other than tobacco are being practised in the flue-cured areas at present. All commercial flue-cured varieties are quite susceptible to the disease, but there is hope, as a result of recent plant-breeding work in North Carolina (Plate 57), that hybrids may shortly be produced which may successfully be used for the control of black shank.

This disease is of particular interest, since one isolated case of its occurrence has already been reported from Queensland.

Granville Wilt.

Granville wilt is a serious soil-borne disease caused by *Bacterium solanacearum*. It was first recorded from Creedmore, in North Carolina, several years ago. Apparently it is spreading rapidly, and is one of the most menacing diseases in the flue-cured tobacco areas of that State at present. Control is extremely difficult, since many weeds are host plants and their presence, consequently, tends to nullify rotations with resistant crops. The use of resistant varieties is probably the most hopeful line of attack (Plate 58), but the development of such varieties with acceptable quality is not yet in sight.

Plate 58.

GRANVILLE WILT RESISTANCE STUDIES.—A plant pathologist in North Carolina hybridising tobacco with the object of producing a resistant variety with acceptable quality. Note the wilted plants in the foreground.

Fundamental knowledge on many aspects of the disease is rather scanty, but research work on this subject is now being vigorously undertaken. During 1935 an extensive experimental area, with a comprehensive series of experiments to investigate host range, varietal resistance, and control by soil treatments, was established in North Carolina. One hundred and twenty-five selections of tobacco were tested for resistance at Washington, D.C., and Creedmore. It was found that all domestic varieties were highly susceptible. Some introductions were moderately resistant, the most promising being a non-flue-curing type from Java. Thirty-five species of cultivated plants and weeds were tested for susceptibility (Plate 59), and valuable information on the host range of the pathogen was thus obtained. Chemical treatments of the soil were not promising, and in many cases were detrimental to plant growth. Laboratory and greenhouse investigations are also in progress, but such work is difficult owing to the fact that the causal organism very rapidly loses its viability in culture.

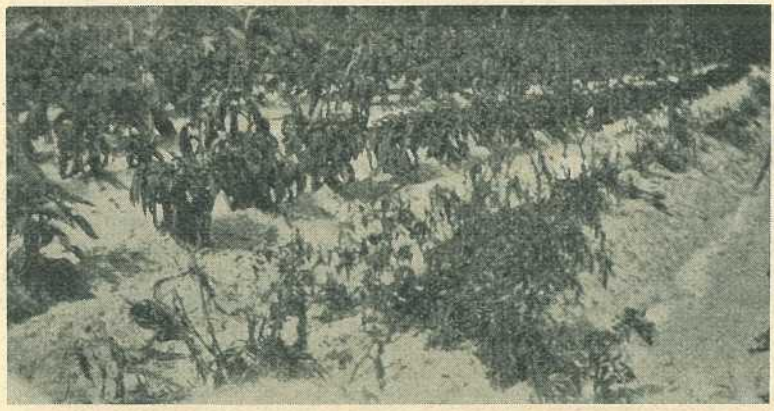


Plate 59.

Host Range Investigation.—An experimental plot in North Carolina to investigate the host range of Granville wilt. In the foreground may be seen rows of tomatoes and peppers.

It would seem that by practising a five-year rotation with resistant crops severe infection can be reduced to about 10 per cent. infection. There is, however, generally some infection which is apparently carried over by weeds. Once the degree of infection has been reduced in this fashion it is safe to practise a three-year rotation. Corn, cotton, sweet potatoes, and velvet beans are frequently used in such rotations with tobacco. Success with rotations depends largely on the thoroughness with which weeds are eliminated in cultivation.

Granville wilt occurs in South Carolina and Virginia, as well as in North Carolina. It is most destructive on light soil types (Plate 60), such as are most desirable for the production of flue-cured tobacco. In some cases it is found in widely separated and relatively small areas. The fact that it is apparently gradually spreading and is so difficult to control is being viewed with some alarm.

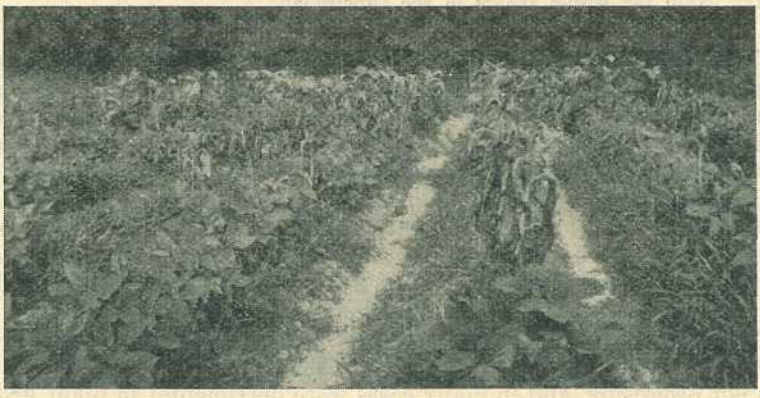


Plate 60.

Granville Wilt.—A field of tobacco growing on a light soil type in North Carolina severely affected with Granville wilt. Legumes have been planted (to make use of the fertilizer) where the tobacco has been killed.

Black Root Rot.

Unlike other soil-borne diseases already discussed, black root rot (*Thielavia basicola*) does not cause a spectacular collapse of the crop in the field, but may, under favourable conditions, appreciably reduce yields. It is one of the most widely distributed tobacco diseases in America. A considerable amount of plant-breeding and investigations along other lines have been carried out for several years past in the United States in connection with it, and recently this work has been greatly stimulated. In the past James Johnson and also Valleau developed satisfactory strains of resistant Burley and cigar tobacco. In the flue-cured tobacco belt Bullock is now obtaining promising results with three selections of flue-cured tobacco (Plate 61), one of which (No. 400) is being grown commercially. Similar investigations are also being carried out with various classes of tobacco by State Agricultural Experiment Stations and the United States Department of Agriculture in Tennessee, Virginia, Maryland, and New England.

Plate 61.

Black Root Rot Resistance.—A black root rot resistant selection (No. 400) shown on the right. Note contrast in height with control row on left, although black root rot was not severe in North Carolina during the 1935 season.

Black root rot is greatly influenced by environmental conditions, such as temperature and soil acidity. It is particularly severe at low temperatures, and consequently may be a serious trouble in the more northern States. Nevertheless, in seasons favourable for its development it may also be an important factor in tobacco production in the southern flue-cured tobacco districts, especially during the early part of the season. It was not, however, a serious factor during 1935 in the flue-cured tobacco districts, but did cause damage in the Burley-growing States. The development of black root rot is limited by soil reaction, and alkaline soils are conducive to infection. Some years ago liming was recommended as a cultural practice for tobacco soils, but owing to this disease it is now realised that more or less permanent damage may be caused by so doing, and consequently it is no longer recommended. Acid soils are found most satisfactory for tobacco culture, and a reaction of pH 5·4 is considered to be on the danger line. Quite recently preliminary investigations indicated that nutrition may also influence the degree of black root rot infection.

Black root rot has caused considerable concern in the past in many States, but now the problem of control has been more or less solved by the use of resistant varieties and the better management of the soil. Nevertheless, in some sections, particularly where Burley tobacco has been grown for a number of years, the soil is so heavily infested that it is practically impossible to grow ordinary varieties of tobacco (Plate 62). Black root rot also has had a tendency to become more prevalent in recent years in some of the dark tobacco and flue-cured tobacco areas.

Mosaic.

Mosaic, which is caused by plant viruses, has been more intensively investigated than any other tobacco disease, and an immense bibliography has been built up on the subject. Numerous research workers are now engaged on this and other virus problems in the United States.

Plate 62.

BURLEY TOBACCO AFFECTED WITH BLACK ROOT ROT.—Burley tobacco growing on black root rot infested soil in Tennessee. Note extreme stunting and wilting in susceptible control row.

Some interesting work is at present being carried out at several centres on the mode of transmission of these diseases, on resistance thereto, and on the nature of the viruses involved, as well as their rate of movement in plant tissue.

Mosaic is very generally distributed throughout the various tobacco-growing areas, and careful studies have indicated that it may cause considerable losses. In some States, such as Virginia, it is claimed to be of more importance than any other disease. Its severity apparently varies from year to year, and is possibly associated with the weather conditions which are experienced between seasons.

Investigations in North Carolina have shown that it is not carried over to any great extent in the soil, particularly when stalks and roots are removed from the land. Lehman estimates that from twenty-three plots of contaminated soil only an average of 1·5 per cent. of the plants were infected from the soil during a four-year period of experiments. He states that "apparently a large part of the virus of mosaic added to the soil by a crop of diseased tobacco is inactivated by physical, chemical,

or biotic processes going on in the soil during the fall, winter, and spring months." Nevertheless, although only a small number of plants may be infected in this manner, it is realised that the disease may be rapidly carried through the crop subsequently unless precautions are taken. The amount of initial infection from contaminated soil has been correlated with the time and method of disposing of diseased plants. Substantially similar results are being obtained in Kentucky. The technique used by Valleau in that State was rather ingenious. A specific strain of yellow mosaic, the symptoms of which can be readily distinguished from those of other mosaics, was used as soil inoculum. Consequently, in the event of plants becoming accidentally infected, they could be easily observed and discarded. It is claimed by Johnson, however, that contaminated soil is quite an important factor in the transmission of mosaic in Wisconsin. This may possibly be due to differences in climate, since Wisconsin is much further north than most of the tobacco areas.

Mosaic is probably not transmitted to any great extent by insects. The field occurrence of the disease, where affected plants are usually found in rows rather than in broad patches, suggests that infection is carried mechanically down the rows rather than disseminated widely by insects. A few years ago Miss Hoggan demonstrated that aphids did not transmit the tobacco mosaic virus from one tobacco plant to another, although they may transmit the same virus from infected tomatoes to tobacco.

Investigations in Kentucky and North Carolina indicate that the mosaic virus may survive in manufactured tobacco, and that the disease is frequently introduced into tobacco beds through the habit of chewing or handling such tobacco. Subsequent spread of the disease is the result of weeding and handling plants in the seed-bed, and by cultivation and other field operations after the crop has been set out. Wolf maintains that "the virus is introduced by the grower and that manufactured forms of tobacco constitute the most probable source."

It is fairly generally agreed that mosaic as it occurs in the field may be caused by any of several viruses. Kunkel and his co-workers have separated some fifty such viruses. At present Valleau is developing an interesting theory that certain virus diseases may have two phases of symptoms, which may be described as "invasive" and "occupative." He considers that mosaic mottling may occur as the "occupative" phase of some twenty-five different virus diseases. "Burning" or "scalding" is usually regarded as an aspect of ordinary green tobacco mosaic, brought about by the weakening of tissue invaded by that virus. Valleau, however, is of the opinion that it is the "invasive" phase of a specific virus which subsequently develops mottling or mosaic symptoms as its "occupative" phase.

The most intensive research in the United States on virus diseases is being carried out at the Rockefeller Institute for Medical Research. In recent years the scope of this institution was broadened to embrace plant problems, with the object of establishing closer co-operation between medical and plant pathologists. Investigations at present under way involve the nature of the virus, the separation of mosaic viruses, and immunology studies. In 1935, Stanley, at that institution, made the important preliminary announcement that he had isolated a crystalline protein possessing the properties of tobacco mosaic virus. He regards this virus as being an autocatalytic protein which it is assumed requires

the presence of living cells for multiplication. Should the virus ultimately be definitely proved to be a crystalline protein, it will profoundly affect disease investigations in general. This investigation is causing considerable interest amongst plant pathologists in the United States. White has developed a technique for the continuous culture of plant root tips in artificial media. It has a practical application in the storage of plant viruses which cannot be kept *in vitro,* and several virus cultures are now being maintained by means of root tip cultures. Interesting investigations are also under way on the seriological method of grouping virus diseases.

Plate 63.

MOSAIC-RESISTANT TOBACCO.—A row of Ambalema tobacco, which is practically immune to mosaic.

Until recently all types of tobacco were found to be susceptible to mosaic. The only exception is a Porto Rican variety known as Ambalema (Plate 63), which is practically immune. This discovery had stimulated research into the possibility of breeding for mosaic resistance in various classes of tobacco. The United States Department of Agriculture is now crossing Ambalema with flue-cured, Burley, Maryland, and cigar types, and the progeny are being propagated at appropriate centres.

Recommendations for the control of mosaic involve clean or sterilized soil in the seed-bed, the avoidance of the careless use of manufactured tobacco, the elimination of solanaceous weeds, some of which may carry the virus without showing mosaic symptoms, care in handling seedlings

and in cultural operations, and the elimination of diseased plants at the first cultivation. Where the disease is severe a rotation for a year or two with corn is desirable.

Ringspot.

Ringspot is another virus disease which is being investigated to some extent, particularly in Kentucky and Virginia. An important aspect of the disease, and one in which it differs from mosaic, is that it is seed-borne. It was noted mostly in the Burley and in some cigar tobacco districts. In Pennsylvania it was quite severe in 1935, and was more general than mosaic. Two distinct types of ringspot, yellow and green, have been isolated. The variety Ambalema is not resistant to this virus disease.

Bacterial Leaf Spots.

The bacterial leaf spots, wildfire (*Bacterium tabacum*) and angular leaf spot (*B. angulatum*) have been reported from most of the tobacco-growing areas. They were once prevalent in the Southern States, but apparently are not very common there now. These diseases were observed causing extensive damage only in Tennessee, Maryland, and Pennsylvania.

Angular leaf spot and blackfire have been used as synonymous terms. Investigations in Kentucky, however indicate that angular leaf spot has in the past been confused with a physiological trouble, probably caused by unsuitable soil conditions. The name blackfire is suggested for this non-bacterial disease.

Valleau's work suggests that these diseases are not actually carried on cleaned seed, but may be on seed trash, and that angular leaf spot in the seed-bed may be readily controlled with Bordeaux Mixture. Clayton has shown that these pathogenic bacteria are most apt to cause infection through water-soaked tissue, and has developed a technique for artificial inoculation by which water suspensions of the bacteria are sprayed on to the plants with pressure. As was actually observed in Maryland, these diseases very rapidly spread with driving rain, and the above inoculation method tends to reproduce such conditions.

Wildfire, which is more destructive than blackfire, is the only one of these diseases in Pennsylvania. It has been established there since 1919, and is probably more general in that state than elsewhere. Beach is engaged in investigating methods for the control of the disease. This work involves host range studies, rotations, means of over-wintering, effect of rain, chemical treatment of the soil, and seed-bed spraying.

Miscellaneous Diseases.

Southern root and stem rot (*Sclerotium rolfsii*) was observed to some extent in the southern tobacco areas, and it was stated that it has become more prevalent there during the past three or four years. Previously it has been more of a trouble with ornamentals, but apparently now it is becoming increasingly prevalent on field crops. It will probably be the subject of future investigations. At present corn, cotton, and small grains are recommended as rotation crops to be used for its control.

"Frenching" is the oldest known disease of tobacco, and although it has been investigated for many years its cause is not yet understood. It is frequently of considerable importance on the heavy soils of the

Burley-growing areas (Plate 64), but is of minor significance on the light soils of the flue-cured belt. Recent investigations by Shear in Virginia suggest that "frenching" is the result of some toxic substance or organism in the soil.

Plate 64.

FRENCHING.—Burley tobacco affected with an obscure disease known as "frenching."

Drought spot is also being investigated, by Shear, and apparently he is the only worker on this subject. Results so far from nutritional investigations indicate that drought damage is mitigated when a balance between the nitrogen and potash elements in the soil is maintained. Excess nitrogen increases susceptibility to leaf breakdown and excess potash increases resistance. The presence of chlorine also tends to lessen drought injury. Low topping on the other hand renders the plants more susceptible to damage.

Fusarium wilt was observed to some extent on Burley and Maryland tobacco. It has seldom been recorded from the flue-cured tobacco areas. However, in 1935 severe infection, up to 100 per cent. (Plate 65) was observed in a few fields in North Carolina. It may eventually develop into a major problem in that section.

In some sections of eastern North Carolina "drowning" as a result of heavy rains late in the season also caused some damage (Plate 66).

Plate 65.

Fusarium Wilt.—Flue-cured tobacco in North Carolina severely affected with Fusarium wilt.

General Observations.

The most striking development in tobacco pathology at present is an attempt to develop resistant varieties for most of the major diseases. The nature of many of the diseases involved makes this mode of attack the most logical for practical control. However, it is largely dependent on imported varieties of no commercial value as parents in breeding work, and it will consequently be most difficult to produce strains which will have resistance and yet satisfactory quality. The latter complicates the problem considerably, since there is no physical or chemical method

Plate 66.

"Drowned" Tobacco.—Illustrating the disastrous effect of heavy rain on tobacco late in the season in North Carolina.

available of quickly determining the quality or value of tobacco. Research of this nature will probably take many years of effort before tobacco resistant to disease and also with satisfactory smoking quality is developed. It is fully realised in certain quarters that the introduction of new resistant varieties of low quality would do more harm than good unless absolutely necessary for disease control. The influence of nutrition as a factor in disease resistance is also receiving increasing attention in the United States. It is being applied to some extent in the investigation of drought spot, blue mould, and black root rot.

The alteration of environment, in an attempt to escape infection, as exemplified by the use of heated seed-beds in blue mould control, is a new development in tobacco pathology. It is doubtful whether this method in its present form would be generally adopted if the necessity arose, partly because of the expense involved and also the constant care necessary for its successful operation.

Plate 67.

DUSTING TOBACCO.—Dusting flue-cured tobacco by means of sacks.

Marked progress is also to be noted in the field of virus disease investigations. The intensive study of particular aspects of these diseases by specialists, as at the Rockefeller Institute for Medical Research, should result in valuable fundamental knowledge.

TOBACCO PESTS.

The principal insects affecting tobacco crops in the United States are hornworms (*Phlegethontius quinquemaculata* and *P. sexta*), flea beetle (*Epitrix parvula*), budworm (*Heliothis virescens*), thrips (*Thrips tabaci*) and wireworms. Of these, hornworms are the most serious problem.

Hornworms and Arsenical Insecticides.

The general practice is to use lead arsenate for the control of hornworms in the flue-cured tobacco areas. It is applied in numerous ways as a spray or dust, with hessian sacks (Plate 67), and with sprayers and dusters of various kinds (Plate 68), and hand picking is also employed. Applications of lead arsenate are made at about weekly intervals wherever it is necessary to control a generation of worms.

Frequently, a variable amount of Paris green is added to the lead arsenate, and this mixture may be greatly diluted with lime. One formula consists of 50 lb. of lime, to which is added 2 lb. of a mixture consisting of 4 or 5 lb. of lead arsenate and 1 lb. of Paris green; this is applied at the rate of 150 lb. per acre. In this case quite a white coating of the leaves may be readily observed. There are, however, numerous formulæ used. An application of 4 to 6 lb. per acre of lead arsenate alone is frequently employed. Dusting is considered preferable to spraying, and the practice of making heavy dustings with materials excessively diluted with lime is not favoured by entomologists. Successful control depends to a large extent on the efficiency of the duster employed. Autumn ploughing has been found to be very effective in reducing the number of overwintering hornworm pupæ, and is helpful as an additional control measure. Some progress has been made in experiments whereby poison baits, containing tartar emetic, with amyl salicylate as an attractant, have been used for trapping hornworm moths.

Plate 68.

Spraying a Field of Tobacco.—This rather novel spray outfit consists of a barrel of spray material mounted in a sledge drawn by a mule. A negro on the sledge works the pump, and the insecticide is applied from a hose on either side.

The United States Department of Agriculture recognises the possibilities of poisoning to the consumer by the use of lead arsenate applied late in the season, and does not recommend its use then. In this connection it should be noted that chewing and snuff tobaccos are largely used in the United States, and consequently the presence of toxic substances on such tobaccos is more apt to prove harmful than on flue-cured tobacco. At present, for flue-cured tobacco, Paris green at the rate of 4 lb. to 6 lb. per acre, depending on the size of the plants, is officially recommended. The use of Paris green does not eliminate the arsenical residue factor, but it does obviate the more subtle lead poisoning. It is not, however, entirely satisfactory, since severe burning of the leaves frequently results from its use. Entomological research is chiefly concerned at the present time in finding a suitable substitute for lead arsenate which will not be toxic to human beings. Apparently hornworms are not susceptible to insecticides containing rotenone and pyrethrum.

In Tennessee, Marcovitch first drew attention to the use of cryolite (sodium aluminium fluoride) some ten years ago as an insecticide. He is now investigating a new product known as "Artificial Cryolite," which has good physical properties and which he found to possess a high degree of efficiency. He considers it a suitable substitute for lead arsenate for hornworm control. The American health authorities, however, do not favour the use of fluorides on tobacco or products for human consumption. In this connection, Marcovitch is of the opinion that the arbitrary fluorine tolerance limit set is far too conservative and could safely be increased ten times. He is at present investigating the toxicity of fluorine with certain plants, and anticipates working with animals later.

There is apparently little tobacco entomological work being carried on in state institutions, although the problem of obtaining a suitable lead arsenate substitute for general purposes is being investigated in some cases. Possibly derris root is the best available substance at present.

Budworm.

Budworm is considered the second most important tobacco insect pest. A control method which appears to be quite efficient was developed at the Quincy Tobacco Insect Field Laboratory in Florida. It consists of applying a small pinch of a mixture of corn meal and lead arsenate well into the bud of the plant. The mixture consists of 1 lb. of lead arsenate and 75 lb. of corn meal. About eight applications at an estimated cost of 2 dollars 16 cents per acre is considered sufficient for control. The greater part of the injury caused by budworms is produced by the small larvæ feeding on the immature bud leaves of the tobacco. Hence an important aspect of the method is to open the bud and drop some of the mixture into it rather than sprinkling it over the plant. Corn is universally used with the bait as it is attractive to this insect. With some types of tobacco, corn is considered an expensive item, and consequently some tests are now in progress to endeavour to find an acceptable substitute for corn meal with this bait.

Miscellaneous Insects.

In practice, growers apparently do not take active measures for the control of other insect pests. However, flea beetles may cause appreciable damage, particularly with flue-cured tobacco. Investigations by the United States Department of Agriculture have indicated that flea beetles can be satisfactorily controlled by dusting barium fluosilicate on the seed-beds at the rate of ½ lb. per 100 sq. ft., and on larger plants in the field at the rate of 3 to 5lb. per acre. Derris dust mixtures, containing 1 per cent. of rotenone, with sterilized finely-ground tobacco dust as a diluent, also has given good control in the seed-bed, when applied at ½ lb. per 100 sq. ft. Further investigations are in progress with this method for control in the field. No satisfactory methods of control have yet been developed for wireworms or thrips.

Insect Pests of Stored Tobacco.

Cigarette beetle (*Lasioderma serricorne*) and tobacco moth (*Ephestia eleutella*) are important insect pests of stored tobacco, and the United States Department of Agriculture has made considerable progress in the problem of their control by fumigation. While in Virginia, the operation of fumigating the closed stores of the American

Export Company with hydrocyanic acid gas was observed. Prior to fumigation all openings are sealed with brown paper or a paste made of asbestos and calcium chloride. Cylinders containing hydrocyanic acid gas are mounted on scales (Plate 69) in order to measure the amount of gas used, and the gas is pumped into a permanent installation of pipes with which these stores are equipped. A company which specialises in this type of work fumigates tobacco stores by contract.

Plate 69.

Fumigating Tobacco Stores.—Fumigating a closed tobacco store with hydrocyanic acid gas. Note the cylinder of gas mounted on scales to measure quantity used. Electric current to actuate the pump is taken from the overhanging light fitting.

A more recent development is to partially control insect pests by refrigeration. Cool stores were inspected, at which a temperature of 63 deg. Fahr. was being maintained, for the purpose. During ageing, tobacco tends to lose its colour by seasonal "sweating." Hence this method, by obviating seasonal changes, has the advantage of preserving the bright colour of tobacco. Owing to the expense of the process, however, only the best grades are so treated.

A considerable amount of tobacco is stored in open sheds which permit free air circulation through the sides (Plate 70). In this case, it is not possible to control tobacco insects by the usual fumigation method. The problem of controlling insect infestation under these circumstances is at present under investigation.

General Observations.

The tobacco pest control situation does not appear to be so acute in America as in Australia. The budworm, although differing in species, is common to both places, and leaf-eating caterpillars in Australia are rather similar in effect to the American hornworm. However, leaf miner, which is extremely destructive in Queensland, and stem borer are not important tobacco pests in the United States. The control methods at

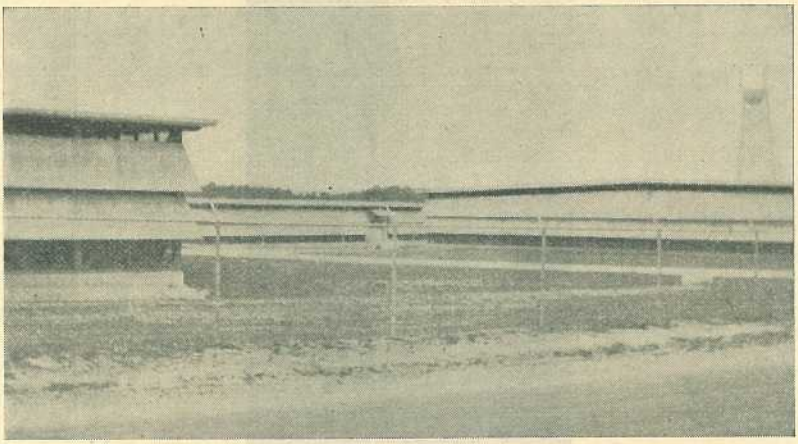


Plate 70.

TOBACCO STORAGE SHEDS.—It is not possible to fumigate open sheds of this type by the usual method. The illustration shows a few of the thirty sheds in this one storage area. Several similar areas are usually located in the vicinity of tobacco manufacturing towns.

present employed in the United States appear to be quite effective in regard to pests of major importance. The main difficulty, however, lies in the objectional nature, from the toxic residue viewpoint, of the materials used. In Australia these substances could not be used late in the season, and the problem of control is consequently more difficult here.

The present situation regarding the use of lead arsenate in the United States appears to be somewhat as follows. In order to grow tobacco successfully, growers are absolutely obliged to use lead arsenate at any time during the season when hornworms are developing, and this frequently occurs when the plants are reaching maturity. Due care is taken not to market leaf which is obviously coated with insecticide, and buyers do not object to the leaf as it is found in the market. Although there is no Federal or State legislation at present regulating the nature or manner of application of insecticides, health authorities do not favour the use of lead arsenate, fluorides, and other substances which might be toxic to human beings. The Department of Agriculture realises the desirability of finding acceptable substitutes and future investigations will largely be concentrated on this subject.

Entomological research generally in regard to tobacco pests in the United States appears to have been rather neglected up to the present. The United States Department of Agriculture has maintained field laboratories in Tennessee for fire-cured tobacco and in Florida for cigar tobacco, as well as in Virginia for the study of stored-tobacco insects. It has, however, in the past entirely neglected the flue-cured tobacco belt. This situation is now being remedied by a laboratory which was established as recently as July, 1935, for the study of pests of flue-cured tobacco. At the latter end of last season the officers of this station were engaged in making a detailed survey of the pest situation in the flue-cured tobacco areas.

MISCELLANEOUS RESEARCH ACTIVITIES.

One of the greatest difficulties in tobacco research consists of devising a suitable estimate of quality. The value of a new variety of tobacco or of tobacco grown in a new area cannot be estimated by casual examination, but is actually arrived at finally by the favour it finds with the smoking public. For plant improvement work, as well as for manufacturing purposes, a quick and accurate test for quality is very desirable. There have been several attempts in the past to evolve such a test. A very promising investigation along these lines is now in progress at the Duke University, where an effort is being made to develop a "Composition Index." Through the courtesy of the Chemistry Department of this institution, it was possible to peruse unpublished manuscripts there, and to discuss this important subject. By chemical analysis it aims at the comparison of various types of tobacco, as well as various crops, in regard to value, quality, maturity, and various other crop characters. It is arrived at by taking the difference of certain nitrogenous portions of an analysis (e.g., total nitrogen, soluble nitrogen, amino nitrogen, and nicotine) and the sugar-acid portions.

The Division of Tobacco and Plant Physiology of the United States Department has done and is still doing excellent work on tobacco nutrition. The tobacco plant is particularly sensitive to variations of nutrition and environment generally, and consequently is very suitable for such studies. McMurtney has published extensively on the role of the main elements nitrogen, potassium, and phosphorus in tobacco nutrition. Recent glasshouse and field work has been largely concerned with the so-called secondary elements calcium, magnesium, chlorine, and sulphur. At the Marlboro Experiment Station, where certain plots have received the same treatment for a considerable time, rare nutritional disorders, such as calcium starvation, could be readily observed.

Fundamental studies are also being made in Washington by Steinberg on general plant nutrition. He is using the fungus *Aspergillus niger* in this work, and is investigating the effect of such elements as iron, magnesium, copper, and zinc.

Some years ago it was found that Maryland Mammoth tobacco would not set seed in Maryland unless grown in winter in a glasshouse. A celebrated research by Garner proved that the length of day to which the plant was exposed was the limiting factor involved, and, consequently, yields of seed of this variety can now be successfully obtained by growing the tobacco in lower latitudes than Maryland. This work is now being extended in Washington, and some very elaborate apparatus is being used in studying the effect of length of day on the development of various plant species.

Field trials are being carried out at agricultural experiment stations in various States on various sources of plant-food materials, fertilizer formulae, rates of application, split applications of fertilizers, and rotational crops. The Bureau of Agricultural Engineering of the United States Department of Agriculture is co-operating with several State Agricultural Experiment Stations in investigating the most desirable situation in the soil for placing artificial fertilizers. This work commenced some five years ago with cotton, and is now being applied to tobacco. Such fertilizer placement trials were observed in several states. A special machine is used for applying the fertilizer and setting the plants (Plate 71). In most cases it has been found detrimental to set tobacco over a band of fertilizer. An exceptional case obtains in Maryland, probably due to the rosette habit of this tobacco type and the shortness of shank which tends to keep the roots of the seedlings above the fertilizer layer.

Plate 71.

FERTILIZER PLACEMENT EXPERIMENTS.—A special plant setter used in fertilizer placement experiments. Water is carried in the barrel and fertilizer in the vertical cylinder. The plants are set by two operators seated midway along the machine. It is possible with this machine to regulate the depth and lateral position of the fertilizer bands.

Boron toxicity and the detrimental effect of sulphur in tobacco nutrition were observed in some experiments. At the Pee Dee Experiment Station symptoms of potash starvation were accentuated where large amounts (180 lb. per acre) of sulphur were included in the fertilizer.

In Tennessee a huge scheme under the control of the Tennessee Valley Authority involves the construction of several dams and the development of tremendous electric power. One aspect of this project is the manufacture of various phosphatic fertilizers with the electric current so generated. An extensive research programme is in progress in that State and elsewhere to test the efficiency of these products with various crops, including tobacco. Treble superphosphate and dicalcium phosphate are being found preferable to superphosphate for tobacco owing to their value in the manufacture of low sulphur content fertilizers.

At the Virginia Truck Experiment Station and the Windsor Tobacco Experiment Station rapid methods for the chemical analysis of plant tissue and soil for essential nutrients were noted with interest. At the latter station Swanback is evolving rapid colorometric micro-chemical tests which should be very helpful for the investigation of tobacco deficiency problems.

An excellent institution, which was resuscitated in 1935 after having lapsed for some years, is the holding of annual meetings of a Tobacco Research Committee. At these meetings, which are held at the latter end of the tobacco season, technical workers from various States, specialising in problems of tobacco production, assemble to discuss the past season's experimental results, to plan future work, and to make general recommendations for the future. Meetings of this nature tend to stimulate enthusiasm, have great educational value, and enable investigators to obtain a true perspective of their problems from a national viewpoint. Meetings are to be held in different tobacco-growing states each year, and will probably become a permanent annual function in the future.

[CONCLUDED.]

PRESERVATION OF BIRD LIFE—AN APPEAL.

To say that birds are the "farmers' best friends" is not an exaggeration. It is impossible to estimate the vast amount of good done by birds of all descriptions. That there has been an alarming decrease in the numbers of birds during the last few years, is obvious to anyone who is the least observant. That this decrease in bird life is due to needless and wanton destruction, together with the gradual clearing away of all undergrowth, which is most suitable for protection and nesting, is also evident to anyone who cares to take the trouble to notice it. Especially is this decrease due to the first-mentioned fact. Boys—and in many cases adults, who ought to know better—with catapult, air rifle, and pea-rifle, not to speak of those who rob the nests, are continually waging war on the birds, and it must be admitted that the harmless bird is fighting a losing battle.

These, among other things, were the subject of a lengthy discussion, which took place at the monthly meeting of the Merlwood L.P.A. We believe that much good would be done if the right kind of propaganda were kept before the public. We commend the work done by the "Bird Lovers' League." A vast amount of good has been done in the direction of the preservation of bird life—but we are of the opinion that much more could and should be done to educate the general public regarding the value of birds to the whole community, and particularly to those engaged in agriculture and other rural pursuits.

While we appeal for wholehearted support in this matter we would also appeal to all farmers to see to it that bird life on their own properties at least is preserved in its entirety.

We also appeal to all branches of the L.P.A. to take this matter up in their respective districts.—Bern. C. Shelton (Secretary, Merlwood L.P.A.), in the "South Burnett Times."

Queensland the "Queen State."

Prosperity out of a Tropic Jungle.

The "Daily Telegraph" (London) Supplement received in Brisbane recently features an article by the Premier of Queensland, Hon. W. Forgan Smith, headed—"Reaping Prosperity out of a Tropic Jungle." "Queensland, the 'Queen State' where every known Crop is Produced." "Wool Clip Doubled in Three Years."

The article reads—

"QUEENSLAND is the Queen State of the Australian Commonwealth. It has more than 500,000 square miles of country, exceeds the combined areas of France, Italy, Sweden, and Norway, has land producing every known crop, and, in addition, the Great Barrier Reef, a world wonder scenically and economically.

"In a short half-century Queensland has been converted from a tropic jungle to a smiling paradise. Primary production is the principal activity, but secondary industries are increasing gradually.

"Queensland produces 20 per cent. of the Australian wool production, 41 per cent. of the total cheese, 27 per cent. of the butter, 95 per cent. of the sugar-cane, and 56 per cent. of the total maize production.

"More than half the State is within the tropics, but the climate is extraordinarily mild and equable. There is almost perpetual sunshine, no snow, and a winter climate which makes the State the holiday land of Australia.

"The normal annual production of all industries is between £50,000,000 and £60,000,000, as follows:—

Pastoral, £15,000,000;
Manufacturing, £14,750,000;
Agricultural, £14,000,000;
Dairying, £7,000,000;

and the balance is distributed among various primary activities.

"Queensland possesses a larger area of first-class pastoral land than any other State. It has a belt of 1,000 miles of rich tropic land between Mossman and Point Danger, from which is produced 90 per cent. of Australia's sugar.

"Inland, agriculture, for a distance of 100 miles or so from the coast, holds sway, but still further inland sheep hold court. Wool is king.

"Since 1932 Queensland has made record progress towards prosperity. In 1931 the State's wool clip was worth only £5,000,000; in 1934, £10,000,000.

"The greatest proof of progress is the improvement in the Savings Bank accounts. Depositors at 10th January, 1935, had £25,878,000 to their credit—an increase of 7·6 per cent. for the year.

"Brisbane, the State capital and commercial centre, is picturesquely situated. It has civic control of the largest city area in the world.

"The population of the State is bordering on 1,000,000. Brisbane has more than 300,000 people.

"Queensland holds the premier position among the States in the Commonwealth in beef cattle raising.

"The beef cattle industry aims at producing meat of the quality wanted in Britain. To that end the herds have recently been built up by pedigree stock imported from Britain to ensure that the "baby beef" so popular on the English market will be in supply.

"As chilled beef is now more popular than frozen, the Queensland meat trade has made special efforts to improve chilling facilities on steamers. It has been proved that meat can be landed in excellent 'bloom' in England forty-five days after shipment.

"Great Britain normally imports about 500,000 tons of meat a year. Of that quantity 400,000 tons is foreign and 100,000 Empire production.

"Australia's share of the 100,000 tons is about 63,000 tons. Most of this comes from Queensland, where cattle stations are larger than some of the countries of Europe.

"Queensland also produces 40 per cent. of the Australian butter exported to Britain. This butter, under the Australian Government name of 'Kangaroo,' has won many prizes.

"Leading scientists in London recently made elaborate experiments with butter from all parts of the world, and Australian butter was proved to be the richest in health-giving qualities.

"During the year ended 30th June, 1935, Queensland manufactured 2,325,402 boxes of butter—a record. For the whole of 1934 production totalled 133,402,841 lb.

"Nearly 100,000 people of British parentage are engaged in the dairying industry in this State alone.

"Queensland, the northernmost State in Australia, produces nearly half the continent's cheese. Each year the State makes 12,000,000 lb. of cheddar, of which nearly 8,000,000 lb. are sent overseas."

The illustrations in the number include a picture of a sunset on the Great Barrier Reef, together with a wide range of pictures of Australian industries and scenery generally.

A panel draws attention to the Barrier Reef under the heading of "Coral Reef and Its Marvels," which reads:—

"Queensland possesses one of the marine wonders of the globe—the 1,200-mile Great Barrier Reef, the largest continuous mass of coral.

"The reef varies considerably in width. So does its distance from the coast. In the north it is within 20 miles of land, but to the south is 120 to 150 miles away.

"On the outer face the reef is often composed of nearly perpendicular walls rising from 20 to 25 fathoms to within a short distance of the sea-level. After 1,000,000 years of building the reef is still growing.

"The depths and shoals teem with fascinating marine life. The shape and colour have to be seen to be believed.

"Palm and mangrove and other vegetation grow on the atolls that dot the reef. Turtle, seabirds, and gaily-coloured fish abound."

The White Australia policy is very fully set forward by an article by Lt.-Col. T. W. White, Commonwealth Minister for Trade and Customs, whilst there is a special message to Britain from Mr. J. A. Lyons and also from the Treasurer, Mr. Casey, and Dr. Earle Page.

Mr. Malcolm MacDonald contributes a special message stressing Empire unity, and in which he says:—

"I, myself, retain the happiest recollections of my visits to Australia, when I not only enjoyed her justly famed hospitality, but obtained in my journeys through her varied countryside, from the vineyards and goldfields of Western Australia to the sugar plantations of Queensland, from the wide sheep country of New South Wales to the apple orchards of Tasmania, an invaluable insight into her problems, and some knowledge of their extent. It is for these reasons that I am happy to commend to all readers of the "Daily Telegraph" the articles in these Supplements.

"There can be no doubt that the Empire, and in a special degree Australia, offers splendid opportunities for mutually beneficial trade, and these papers, written by men of acknowledged authority, should help to encourage trade and develop communications between the United Kingdom and the Commonwealth. They should, and I hope they will, help even more to strengthen that consciousness of unity and comradeship, based on sympathetic understanding, which is the ideal of Empire inspiring all our aims."

DOWN WITH DIRT.

Down with dirt should be the slogan of all dairymen. Remember that milk is easily susceptible to contamination, and so affected loses its value with the resultant loss to the supplier. Be not content with the cleanliness of your milk cans and machines without, but see that every part within is also cleansed of all infectious matter, however minute. All deposits of manure in close proximity to any receptacle wherein milk is contained should be removed, lest flies and insects, after feeding therefrom, cause contamination. See that the rubbers of your milking machines before use are thoroughly cleansed of all particles of dirt; that the milk lines, air lines, and the releaser are scalded in case contamination result. Be sure to wash your separator with hot water, twice daily immediately after use. Before separating take particular care to have the separator bowl well swilled. Cleanliness of the individual is of no less importance than that of the machine; neither is everything that is clean outside an indication that everything is clean inside. When milking by hand, even an accumulation of dirt secreted under the nails should be removed, lest such dirt become moist and drop into the milk. Clean machines; clean containers for, and clean handling of, milk safeguard purity; pure milk makes a good quality product; a good quality product finds a ready market and fetches a better price than that of an inferior quality product; good quality products establish a high trading reputation to manufacturers. So important is cleanliness to the community that Government and civic authorities appoint inspectors that they might take precaution against infectious diseases caused through uncleanliness. The gospel of cleanliness has been preached since Biblical times, and still is. Remember Franklin's precept: "Tolerate no uncleanliness in body, clothes, or habitation." Take notice: "Cleanliness is next to godliness."—"The Unity Co-operator" (Toowoomba).

Studies on the Biology and Control of the Large Roundworm of Fowls, Ascaridia galli (Schrank 1788) Freeborn 1923.

F. H. S. ROBERTS, D.Sc., Animal Health Station, Yeerongpilly.

[*Continued from p. 50, Part I., Vol. XLVI.—July*, 1936.]

PART II.

3. THE PARASITIC PHASES IN THE LIFE CYCLE.

I. Technique Employed.

FOR the purposes of determining the parasitic life cycle and pathogenicity of *Ascaridia galli* incubated day-old white leghorn chickens were secured. For the first month the chickens were confined to a disinfected brooder battery or to thoroughly disinfected pens with concrete floors. Thereafter and until the termination of the experiments the birds were kept in compartments with batten sides and wire mesh floors. These compartments, the wire mesh floors, and trays beneath were thoroughly cleansed daily. When seven days old all chickens were numbered by means of aluminium wing bands.

Throughout the period of the investigation a dry mash was kept constantly before the birds. During the first month the composition of this mash was as follows: —

Maizemeal	63 parts
Pollard	13·5 parts
Bran	13·5 parts
Dried buttermilk	7 parts
Meat and bonemeal	3 parts

To this 1 per cent. common salt and 1 per cent. cod liver oil were added as supplements.

After the first month the quantity of dried buttermilk was reduced to 2·5 parts. The meat and bonemeal was increased to 5 parts, and an additional 2·5 per cent. of lucerne meal included. Small quantities of green lucerne were fed daily.

The dosages of eggs were computed by suspension following incubation of female worms at 37 deg. C. in physiological saline. The infective stage was secured by incubating fresh eggs in 2 mm. of 1 per cent. formalin at 30 deg. C. to 33 deg. C. The doses of infective eggs were delivered into the œsophagus on pellets of filter paper, which were then worked into the crop by means of the fingers.

Examination of the intestine, liver, &c., for larvæ was carried out in the following manner:—The intestine after being disengaged from the mesentery, gizzard, &c., was straightened out and cut into suitable lengths. Preliminary investigations showed the most suitable places for these incisions, in order to avoid cutting through any larvæ, to be in the vicinity of the entrance of the bile duct and just posterior to the yolk sac remnant. The contents of these sections were then forced out under pressure with warm physiological saline. The intestine was finally opened and thoroughly washed in saline.

The Baermann apparatus proved very efficient for the isolation of larvæ from the ingesta provided the larvæ were older than four days, the washings being placed in the usual stoppered funnel and placed at 37 deg. C. for approximately four hours. This method of isolation for newly-hatched and very young larvæ, however, was found to be unreliable, as it was observed in preliminary investigations that such larvæ appeared to a very large extent unable to free themselves from the mucous and ingesta, and only small percentages appeared in the liquid drawn off from the bottom of the funnel.

The body cavity was flushed out with warm saline, which was then centrifuged and examined for larvæ. The liver and lungs were examined both by means of pressed sections and the Baermann apparatus. The intestine wall was examined also by means of pressed sections.

II. The Parasitic Life Cycle.

(i.) PREVIOUS INVESTIGATIONS.

The first endeavour to ascertain the life cycle of *Ascaridia galli* appears to have been made by Scott.[95] Scott showed that this nematode may be transmitted to chicks by means of earthworms obtained from infected runs. He was not certain, however, whether earthworms acted as true intermediate hosts or simply as mechanical transmitters. A further report in 1915, however, indicated that Scott was inclined to consider that earthworms were not true intermediate hosts. Le Roux[72] has also shown that this roundworm may be disseminated by earthworms.

In 1920 a short note published by Ackert[1] showed that the life cycle of *A. galli* was direct. Ackert found that when the eggs are incubated at 28 deg. C. the larva is fully formed in nine days. Such embryonated eggs when fed to chicks hatch normally in the digestive tract, and twenty-eight hours after infestation numerous larvæ can be recovered from the small intestine. After thirty days the worms are about half grown. Examination of various organs for evidence of any larval migration outside the alimentary tract revealed only one larva in the lungs and one in the trachea, respectively, of two of the many chickens infested.

A report issued by the Oklahoma Experiment Station[84] in 1921, however, claimed mortalities among chicks fed infectious eggs due to a pneumonia, following a marked migration of the young larvæ to the lungs.

Two years later Ackert[3] published details of a further series of experiments, and with the exception of two larvæ isolated from the livers and six from the lungs of three chicks he could find no evidence of any migration from the intestine. The eggs were found to hatch in the duodenum, the larvæ preferring that portion of the intestine about one-fourth of the distance between the gizzard and base of the caeca, where the intestinal contents are slightly acid. Within a week after hatching the larvæ were observed to move deeply among the villi, and some were noted to penetrate the intestinal glands. During the next few days the penetrations of the mucosa by the larvæ increased in number and depth, and in the case of heavy infestations Ackert reported that the inner wall of the intestine may become studded with larvæ with their anterior ends buried in the wall tissues. On about the twentieth day the larvæ were observed to withdraw into the lumen of the intestine, where they remained till maturity, which was reached in about two months after infestation.

Guberlet[58] confirmed Ackert's work, and showed that normally the larvæ were found in the small intestine where for a short period they may become partially embedded in the mucosa. A few larvæ may penetrate the mucosa and reach other organs, as larvæ were occasionally found in the spleen, kidney, lungs, and body cavity, but this was regarded as an abnormal condition.

Danheim[46] was also unable to find any evidence of a general migration of larvæ from the intestine in a series of experiments in which infectious eggs were fed to rats.

In 1927 Itagaki[67] read a paper before the World's Poultry Congress at Ottawa on the life cycle of *Ascaridia galli* (*A. perspicillum*) in Japan. Itagaki recorded that during the hottest part of summer the egg becomes infective in seven days. Hatching occurs either in the glandular or muscular stomachs. The life cycle followed by the larvæ thereafter, Itagaki noted, was dependent upon the season of the year. During the spring and autumn the larvæ remain in the lumen of the intestine till maturity. During midwinter and midsummer, however, the larvæ penetrate the intestinal mucosa and nine to twelve days after infection are to be found in the mucous membrane and circular muscle layer, causing the formation of fibrous nodules which are distributed mainly throughout the lower third of the small intestine. In these nodules larvæ are to be found in early stages of development. The younger nodules are reddish and transparent, but in about thirty-six days after infection the nodules have become fibrous in nature, and may attain the size of a pin's head. The larvæ eventually return to the lumen and reach maturity after about thirty-seven days. Itagaki could find no evidence of any migration outside the intestine. In a further paper[68] Itagaki again drew attention to nodule formation extending into the cæca associated with the development of the larvæ of this roundworm.

Further work by Ackert[7, 8] supplied more detail, and the life history of *Ascaridia galli* was considered to be as follows:—At 33 deg. C. the eggs become infective in ten days. Hatching occurs mainly in the duodenum, the larvæ congregating in that portion a few centimetres posterior to the entrance of the bile duct in a practically neutral medium. For the first nine days the larvæ live in the lumen and in the inter-villar spaces. On the tenth day they commence to penetrate the mucosa between the villi, and during the next eight days may be seen with their heads buried in the mucosa and the rest of the body floating freely in the lumen. A few during this period may occur in the muscle layers or may even burrow through the intestine wall and be seen in the liver, lungs, and other organs. On the eighteenth day the larvæ move back into the lumen and remain there till maturity, which, in white leghorn chicks given a single dose of fifty eggs at one month old, is reached in fifty days. Ackert has recorded three moults, the first on the sixth to eighth day, the second on the fourteenth to fifteenth day, and the third on about the twenty-second day. At no time was any nodule formation as noted by Itagaki observed. Finally, Alicata[23] has shown that before the egg becomes infective the embryo moults, making four moults in all during the course of the life cycle.

(ii.) Experimental Infestations of Chickens.

A total of sixty-five chickens was used in these investigations to determine the parasitic life cycle of *Ascaridia galli*. The first lot of birds included under the numbers 1 to 37 consisted of cockerels which,

with the exception of Nos. 11, 13, and 15, were thirty days old when infested. These three birds were forty-five days old. Five control birds were autopsied at various periods before the experiment was commenced, and six others during the duration of the experiment. The infested birds were given a single dose of eggs from a culture held at 30 deg. C. to 31 deg. C. for twenty-one days, and for a further twenty-two days at room temperatures. These studies were conducted during November, 1934.

A second lot of birds, Nos. 190 to 217, all pullets and also thirty days old, were infested with a single dose of eggs during April, 1935. The eggs fed were portion of a culture incubated at 31 deg. C. to 32 deg. C. for sixteen days. Fourteen control birds accompanied this second study, being autopsied at various times prior and subsequent to infestation of the remaining birds.

As no worms were found in any of the control birds examined it was assumed that up to the time of infestation the birds used in these studies had remained entirely free from worms and that during the course of the investigation no accidental reinfestations had occurred.

The individual dosages of eggs fed and periods between infestation and autopsy are given in Table VII.

From the observations made in these studies the parasitic life history of *Ascaridia galli* is considered to be as follows:—

The First Stage Larva.

At a temperature of 31 deg. C. to 32 deg. C. the first movements of the embryo in the egg occur after four days. On the fifth day the early first-stage larva is considered to be present. At this stage of development the larva is comparatively stout, densely granulated in the middle two-thirds portion, and clearer in the region of the œsophagus and tail. After a further three days' incubation the larva is more slender in appearance, with a more definite intestinal region. The details of the œsophagus are difficult to make out, but it appears to be of the rhabdidoid type usual in first-stage nematode larvæ. After a total incubation period of eight days at these temperatures some of the larvæ commence to moult, which procedure becomes more generalised on the ninth day. This moult marks the appearance of the second stage larva, which remains in the egg shell enclosed in the moulted skin of the previous stage. At a higher temperature of 33 deg. C. the first moult was observed as early as the seventh day.

The Second Stage Larva.

The Infectivity and Hatching of the Embryonated Egg.

That the second-stage larva is the infective stage was demonstrated by feeding eggs which had been incubated for six, seven, eight, and nine days at 31 deg. C. to 32 deg. C. to chickens fourteen days old. Hatched larvæ were recovered only from chicks to which eggs nine days old had been fed. That is, the larva becomes infective shortly after it has completed its first moult.

When infectious eggs are fed to chickens many of them remain unhatched, and may be recovered from the fæces. The majority, however, hatch successfully, and observations have shown that although a few free larvæ may be found in the gizzard the greater number occur in the small intestine. As early as one and one-half to two hours after

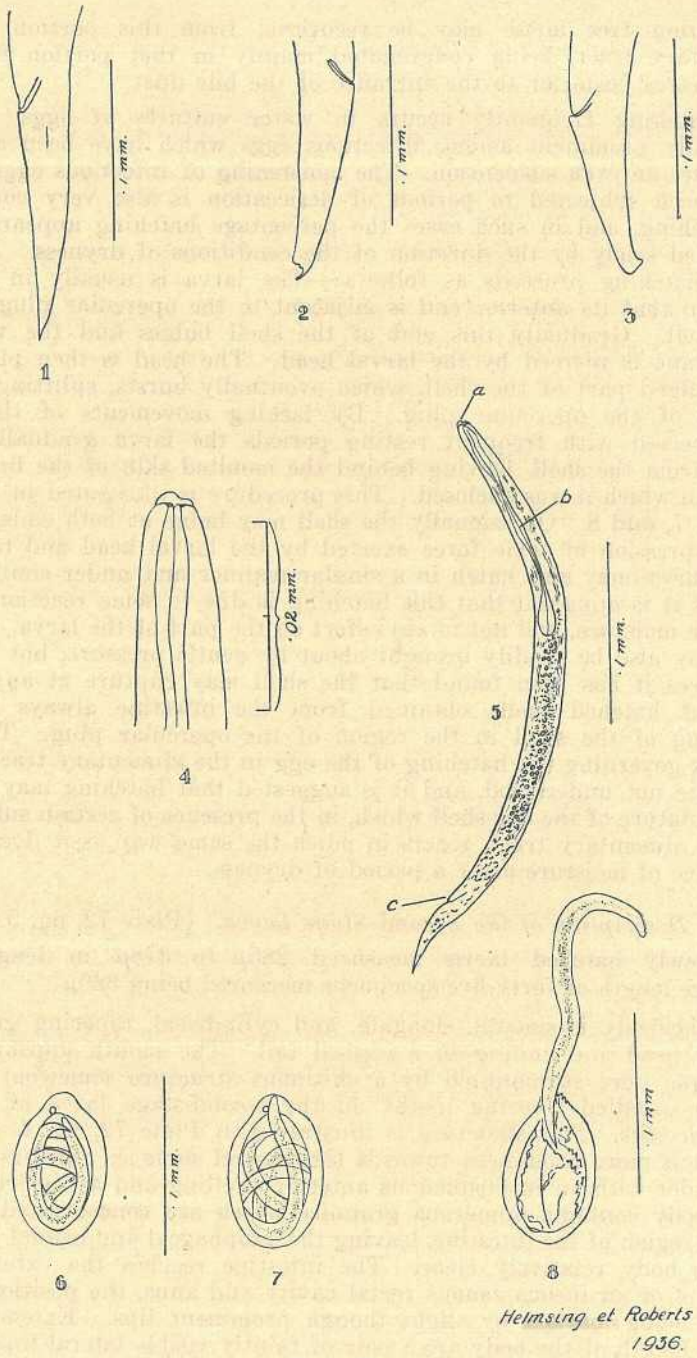


Plate 72.

Fig. 1. Normal tail of second stage larva.
Figs. 2 and 3. Abnormal tails of second-stage larva.
Fig. 4. Cephalic extremity of second-stage larva, showing oral prominence.
Fig. 5. Second-stage larva, newly hatched.
(*a*) Oral prominence. (*c*) Anus.
(*b*) Oesophagus.
Figs. 6, 7, and 8. Hatching of larva, following moistening after desiccation.

infestation free larvæ may be recovered from this portion of the alimentary tract, being congregated mainly in that portion 6 to 12 centimetres posterior to the entrance of the bile duct.

Hatching frequently occurs in water cultures of eggs, and is especially prominent among infectious eggs which have been agitated to secure an even suspension. The moistening of infectious eggs which have been subjected to periods of desiccation is also very conducive to hatching, and in such cases the percentage hatching appears to be governed solely by the duration of the conditions of dryness. In such cases hatching proceeds as follows:—The larva is usually in such a position that its anterior end is adjacent to the opercular plug of the egg shell. Gradually this end of the shell bulges and the vitteline membrane is pierced by the larval head. The head is then placed in this bulged part of the shell, which eventually bursts, splitting in the region of the opercular plug. By lashing movements of the body interspersed with frequent resting periods the larva gradually frees itself from the shell, leaving behind the moulted skin of the first-stage larva in which it was enclosed. This procedure is illustrated in Plate 1, figs. 6, 7, and 8. Occasionally the shell may bulge at both ends, giving the impression of some force exerted by the larval head and tail. As dead larvæ may also hatch in a similar manner and under similar conditions it is apparent that this hatching is due to some reaction of the shell to moisture, and not to any effort on the part of the larva. Hatching may also be readily brought about by gentle pressure, but in such instances it has been found that the shell may rupture at any point, whereas hatched shells obtained from the intestine always show a splitting of the shell in the region of the opercular plug. The conditions governing the hatching of the egg in the alimentary tract of the host are not understood, and it is suggested that hatching may be due to the nature of the egg shell which, in the presence of certain substances in the alimentary tract, reacts in much the same way as it does in the presence of moisture after a period of dryness.

Description of the Second Stage Larva. (Plate 72, fig. 5.)

Newly hatched larvæ measured 285μ to 378μ in length, the average length of forty-five specimens measured being 323μ.

The body is smooth, elongate, and cylindrical, tapering gradually to the head and ending in a conical tail. The mouth appears to be a simple pore surmounted by a chitinous structure somewhat similar to the so-called "boring tooth" of the second-stage larva of *Ascaris lumbricoides*. This structure is illustrated in Plate 72, fig. 4, showing that it is more prominent towards the ventral surface. The œsophagus is slender with an inconspicuous anterior swelling and a posterior bulb. The body contains numerous granules which are concentrated mainly in the region of the intestine, leaving the œsophageal and caudal portions of the body relatively clear. The intestine reaches the exterior per medium of an inconspicuous rectal cavity and anus, the position of the latter being marked by slight though prominent lips. Extending the entire length of the body are a pair of faintly visible lateral lines.

Measurements.—Length 378μ, œsophagus 128μ, anus 58μ, maximum width 20μ.

As mentioned in the above description the tail of the second-stage larva is conical and straight (Plate 72, fig. 1), but on rare occasions larvæ with tails as in Plate 72, figs. 2 and 3 have been seen, not only among larvæ hatching in water cultures, but also among larvæ up to

five days old in infested chickens. The significance of these different types of tails is not understood.

During the next few days the larvæ are to be found in the lumen of the intestine and in the intervillar spaces. Growth during the early portion of this period is comparatively slow. At the end of twenty-four hours larvæ may measure up to 385μ long, and the excretory pore and genital rudiment have appeared. At this stage the genital rudiment is a colourless ovoid body, and in a larva 328μ in length is situated at about 117μ from the tail. After three days the larvæ have reached 555μ (average 435μ) in length by about 30μ in width. The body is now more heavily cuticularised, the lateral lines are more distinct, and the nerve ring can be made out with difficulty.

After five days there are distinct changes in structure. The body is more slender and the œsophagus is relatively shorter. The intestinal cells are more compact and the intestinal lumen and body cavity are apparent. The genital rudiment now consists of a number of cells, and the nerve ring can be readily made out. At this time larvæ may measure ·85 mm. to 1·17 mm. in length, averaging ·98 mm. The following measurements were taken from a larva 1·17 mm. in length:—Length, 1·17 mm.; œsophagus, ·185 mm.; nerve ring, ·084 mm.; anus, ·122 mm.; genital rudiment, ·462 mm. (from tail).

Among the five-day larvæ examined several were almost hyaline in appearance, indicating that a moult had just taken place, and on the sixth day fully 75 per cent. of the larvæ recovered had either completed the second moult or were enclosed in the moulted skin of the previous stage. The third-stage larvæ measured up to 1·86 mm. in length, and the second-stage larvæ up to 1·2 mm. in length, respectively. By the ninth day all larvæ were in the third stage, with a maximum length of 5·22 mm. (average 3·6 mm.).

A description of the third-stage larva is given below: —

The body is now very elongate and slender. The oral prominence has disappeared, and the mouth is now surrounded by three very shallow lips—one large dorsal lip and two equal sub-ventral lips, each of which is conspicuously lined with cuticle along its edge. The œsophagus is relatively small and slender in appearance (Plate 74, fig. 2). The nerve ring is prominent. The genital rudiment now consists of an elongate, ovoid mass of cells which in some larvæ may continue anteriorly and posteriorly for varying distances as a single row of cells lying ventrally between the intestine and body wall. The lateral membranes have also increased in size, and their width, 8μ to 12μ, makes them very conspicuous.

The sexes may now be readily distinguished. In both male and female third-stage larvæ the tail is somewhat sickle-like in shape, the curvature being more pronounced in the male. (Plate 73, figs. 1 and 2.) In the male there is also a pre-anal swelling, the rudiment of the pre-anal sucker. (Plate 73, fig. 1.) In the female thereis a rudimentary genital opening in the region of the genital primordium.

The measurements of a female larva nine days old and 4·06 mm. in length are given.

Length, 4·6 mm.; œsophagus, ·34 mm.; nerve ring, ·16 mm., anus, ·19 mm., genital rudiment, 1·8 mm. (from tail); rudimentary genital opening, 1·83 mm. (from tail); width in region of posterior portion of œsophagus, ·075 mm.; width of head, ·033 mm.

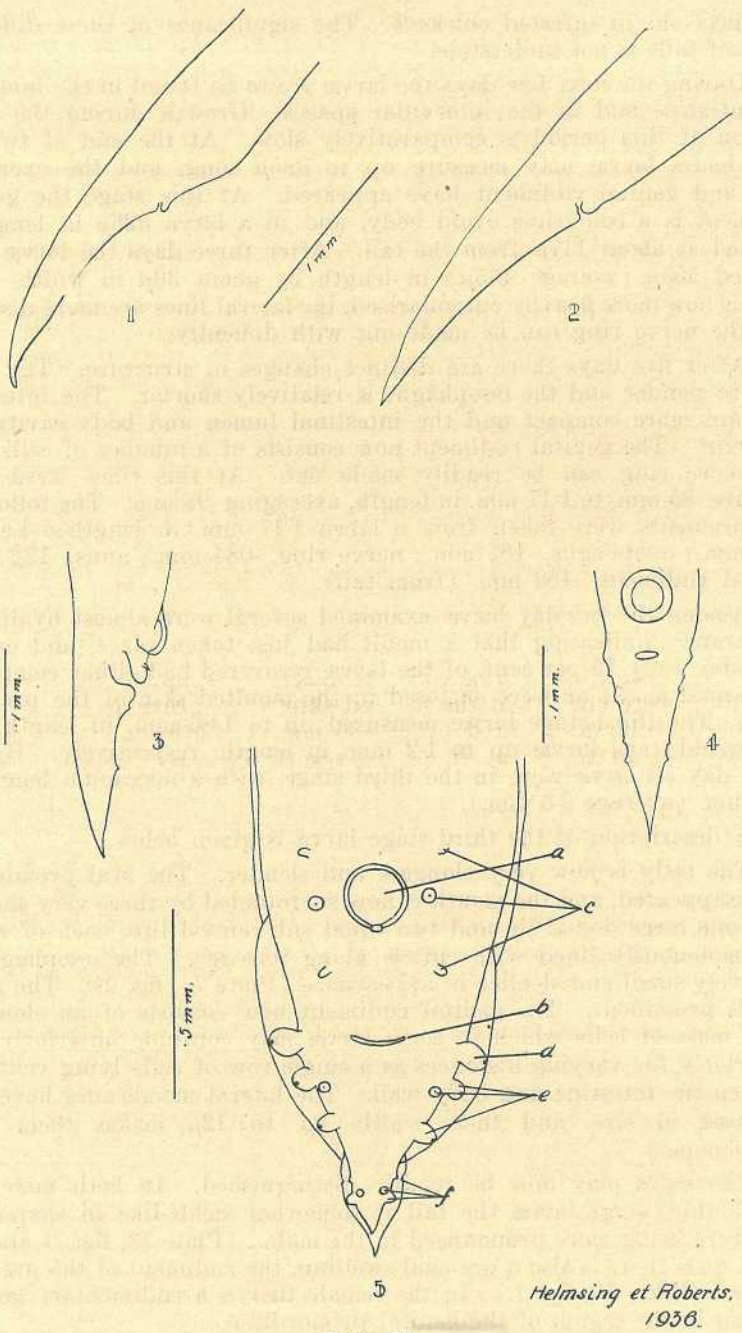


Plate 73.

Fig. 1. Tail of third-stage male larva showing pre-anal swelling.
Fig. 2. Tail of third-stage female larva.
Fig. 3. Tail of fourth-stage male larva.
Fig. 4. Tail of fourth-stage male larva at a later stage of development.
Fig. 5. Tail of adult male.

(*a*) Pre-anal sucker.
(*b*) Anus.
(*c*) Pre-anal papillæ.
(*d*) Anal papillæ.
(*e*) Post-anal papillæ
(*f*) Sub-terminal papillæ.

Larval Migration.

Observations made on chickens infested during November and autopsied ten to nineteen days after infestation show that during this period the larvæ attack and may penetrate the intestine wall to varying degrees.

An examination of chicken No. 9, autopsied ten days after infestation, showed that although after flushing the intestine with warm physiological saline numerous free larvæ could be recovered, other larvæ were present with their heads buried into the intestine wall between the villi and with the remainder of the body floating freely in the lumen. (Plate 75, fig. 1.) Whilst such attached larvæ were being examined in warm physiological saline under the binocular microscope the majority readily freed themselves and swam away.

During the next eleven days eleven chickens were autopsied. Up till the nineteenth day after infestation larvæ were observed attacking the intestine wall, though of the two chickens killed on this day only one gave evidence of larval penetration, two larvæ being detected in pressed sections of the intestine wall of chicken No. 18.

In the birds slaughtered after the nineteenth day all larvæ appeared to be living freely again in the lumen of the intestine.

In all birds examined between the tenth and nineteenth days the relations of the larvæ to the intestine wall were essentially the same as those recorded for the larvæ observed in chicken No. 9 (ten days' infestation). The liver, lungs, and body cavities of all these birds were carefully examined for any evidence as might suggest a normal larval migration outside the alimentary tract, but with the exception of one larva recovered from the abdominal cavity of chicken No. 10 (twelve days' infestation), two larvæ from the lungs of chicken No. 13 (thirteen days' infestation), and one larva from the lungs of chicken No. 15 (fifteen days' infestation), no such evidence was secured.

Microscopic examination of the intestine wall showed the majority of the larvæ lying between the villi with their anterior ends buried into the crypts of Lieberküln. (Plate 75, fig. 2, and Plate 76, figs. 1 and 2.) In a few sections larvæ were observed which had penetrated the wall more deeply and were lying in the muscle layers (Plate 77, fig. 1) and in a mesenteric fold (Plate 77, fig. 2.)

In the experiments conducted in April-May, 1935, no larvæ were recovered at any time outside the alimentary tract. It was also observed that among these birds the tendency for the larvæ to attack the intestine wall during the period subsequent to the ninth day after infestation appeared less obvious than among the birds infested in November. No larvæ at any time were observed completely buried in the mucosa or submucosa, and although an occasional larva was seen with its anterior end shallowly buried into the wall between the villi, the majority of the larvæ appeared to be free in the intestinal lumen. No evidence of larvæ attacking the intestine wall, moreover, was observed in the series after the seventeenth day.

Among the ten-day larvæ it was observed that the female larvæ were in general larger than the male larvæ. In the females the genital cells are now more extensive in their distribution, and the genital opening is marked by a vulva and short vagina. In the males the pre-anal swelling is more conspicuous, and in some of the males there is a tendency for the old cuticle to split away in this vicinity.

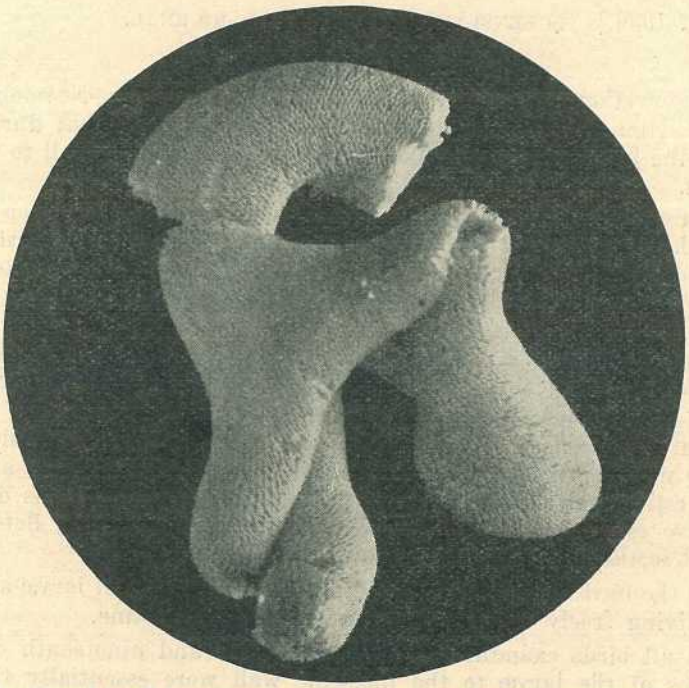


Fig. 1. Portion of small intestine showing larvæ attacking the intestinal wall.

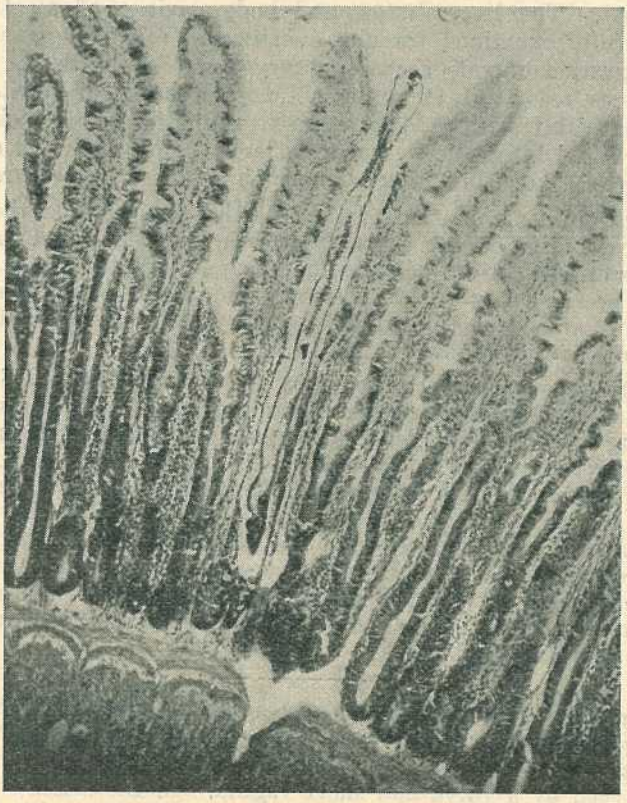


Fig. 2. Longitudinal section of larva in glandular crypt.

Plate 74.

The third moult was observed to occur on the twelfth day, when two female larvæ, 5·8 mm. and 6·1 mm. long, respectively, were noticed completely enclosed in the moulted skin of the third stage. On the thirteenth day many third-stage larvæ were still present, but 70 per cent. of the larvæ examined were either in the fourth stage or moulting. Larvæ at this stage measured:—

Third Stage—

Males, 3·6 mm. to 5·4 mm., average 4·9 mm.

Females, 4·5 mm. to 6 mm., average 5·3 mm.

Fourth Stage—

Males, 5·9 mm. to 8·2 mm., average 7·2 mm.

Females, 5·6 mm. to 11·1 mm., average 8·06 mm.

Description of the Fourth-Stage Larva. (Plate 74, fig. 3.)

The following description is taken from fourth-stage larvæ thirteen days old.

The cuticle is now showing numerous very fine transverse rings. The lips are of the adult type, being rather deep and strongly lined with cuticle with dentigerous ridges. The lip papillæ have appeared. The œsophagus is relatively short and somewhat club-shaped. (Plate 74, fig. 4.) The lateral membranes are now greatly reduced in prominence.

The Female.—The female genital opening is now marked by a prominent vulva. There is a short muscular vagina which leads into the uterus which in some specimens is well developed and conspicuous. The tail is straight and much shorter in comparison to the rest of the body than in the third stage.

Length, 10·48 mm.; œsophagus, ·84 mm.; nerve ring, ·24 mm.; anus, ·25 mm.; vulva, 4·3 mm. (from tail); width of head, ·05 mm.

The Male.—In the male the pre-anal sucker is now apparent, and there are three pairs of caudal papillæ. The first pair are situated just in front of the anus, the second pair immediately posterior to the anus, and the third pair midway between the anus and the tip of the tail. (Plate 73, fig. 3.)

Length, 7·48 mm.; œsophagus, ·76 mm.; nerve ring, ·23 mm.; anus, ·24 mm.; width of head, ·045 mm.

On the fifteenth day females measured 9·7 mm. to 13·23 mm. in length, with an average length of 11·7 mm., and males 9·48 mm. to 12·9 mm. in length, with an average length of 9·48 mm. In the males of this age it was observed that the spicules were appearing and that in a few of the specimens examined traces of two more caudal papillæ were apparent, one between the pre and post-anal papillæ, and a further subterminal papilla. (Plate 73, fig. 4.)

By the sixteenth day larvæ measured up to 14·2 mm. in length. Eighteen days after infestation several larvæ were observed undergoing their fourth moult. Males at this time measured 16·2 mm. to 22·5 mm. in length (average 18·5 mm.), and females 18·5 mm. to 25·6 mm. in length (average 21·7 mm.). In the chicken autopsied on the twenty-first day, No. 214, all the worms were young adults, and ranged in size from 27·4 mm. to 35 mm.

The Young Adult.

The following description is taken from larvæ twenty-three days old.

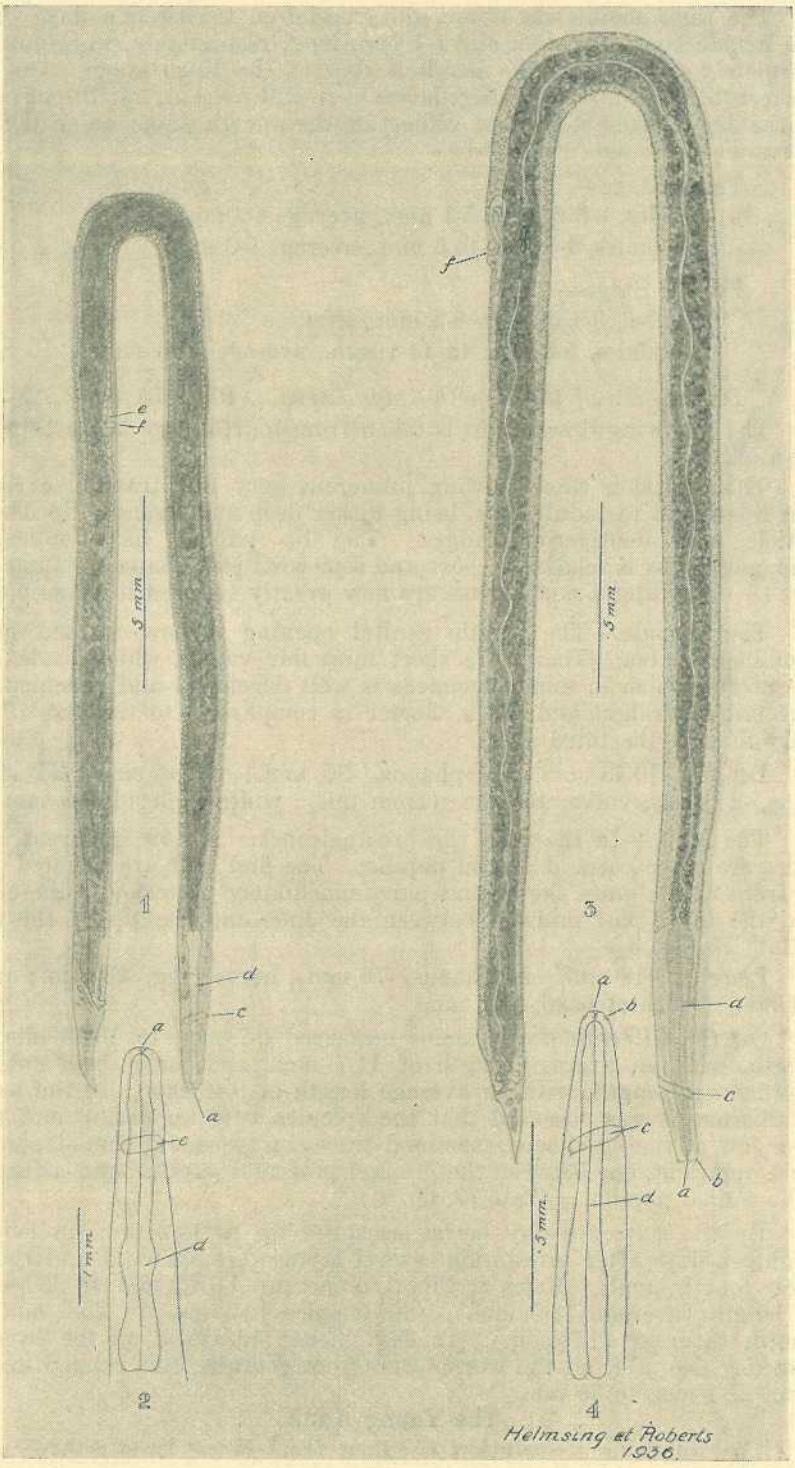

5 mm.
1
b
d
c
a
c
1 mm.
d
2
f
5 mm.
3
a
b
a
c
c
d
5 mm.
a
b
4
Helmsing et Roberts
1936.

Plate 75.

Both sexes are now similar in general characteristics to the mature adult. In the females the vulva, vagina, uteri, and ovarian tubes are all well developed. The male genitalia is also well advanced in development, and the caudal alæ, ten pairs of caudal papillæ, and the spicules are all prominent. (Plate 73, fig. 5.) In both sexes the body cuticle is now encircled by very definite rings more widely spaced than in the previous stage.

A female 37·5 mm. long gave the following measurements:—Length, 37·5 mm.; œsophagus, 2·1 mm.; nerve ring, ·5 mm.; vulva, 18·6 mm. (from tail); width of body at posterior end of œsophagus, ·42 mm.; width of head, ·17 mm.

Maturity Period.

In chicken No. 23, infested during November with 100 eggs, and autopsied on the twenty-sixth day after infestation, female worms had attained a length of up to 51·5 mm., and in a female of this length fertile eggs were observed in the uteri, but no eggs were recovered from the fæces. Another bird in this series also given 100 eggs and autopsied on the twenty-eighth day (No. 25) yielded only four worms, the largest female being 52·6 mm. in length. This female contained many fertile eggs in the uteri, and an examination of the fæces showed that fertile eggs were being passed. By the thirtieth day females in a bird given fifty eggs had attained a length of 65·2 mm., and fertile eggs were very numerous in the droppings (No. 26).

Observations made in May with chickens fed 100 infective eggs revealed a few fertile eggs in the droppings of a bird autopsied on the twenty-seventh day (No. 217). The infestation consisted of three females, 50·2 mm., 51·6 mm., and 53·2 mm. and four males, 35·1 mm., 46·3 mm., 47·4 mm., and 48 mm. in length, respectively.

Discussion.

Reviewing the work of previous investigators we find that the life history of *Ascaridia galli*, as given by the Oklahoma Experiment Station, Ackert, and Itagaki differs in several points. As determined by the writer, the life history is not entirely in agreement with that recorded by Itagaki or Ackert, but there was certainly no evidence of a consistent extra-intestinal migration analagous to that occurring in the life history of *Ascaris lumbricoides*, as recorded by the Oklahoma Experiment Station.

Hatching appears to take place chiefly in the small intestine, though as a few newly-hatched larvæ were found in the gizzard some eggs may also hatch in the crop or in the glandular or muscular stomachs. Until the tenth day the larvæ live freely in the lumen of the intestine or in the intervillar spaces.

The experiments conducted in November, 1934, showed very definitely that from the tenth to the nineteenth day the larvæ attack the intestine wall. During this period, as determined by macroscopic

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DESCRIPTION OF PLATE 75.

Fig. 1. Third-stage larva.

Fig. 2. Cephalic extremity of third-stage larva.

Fig. 3. Fourth-stage larva.

(*a*) Mouth
(*b*) Oral papillæ.
(*c*) Nerve ring.
(*d*) Oesophagus.
(*e*) Genital cells.
(*f*) Female genital opening.

Fig. 4. Cephalic extremity, fourth-stage larva.

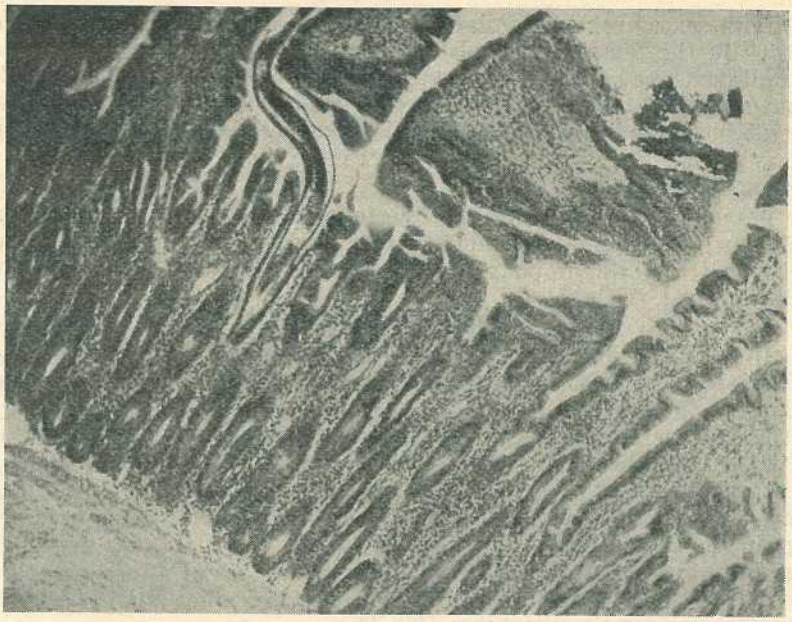


Fig. 1. Section of small intestine showing larva.

and microscopic observations, many of the larvæ are to be seen with their anterior ends buried into the crypts of Lieberküln and with the remainder of the body floating freely in the lumen. That this penetration is usually very shallow is denoted by the fact that many of these larvæ can readily withdraw from the intestine wall and become free.

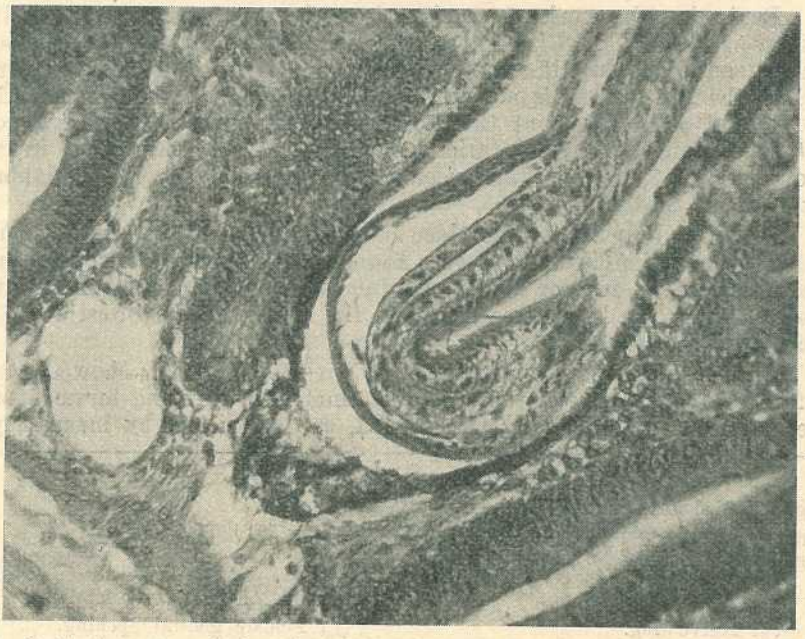


Fig. 2. Section of small intestine showing destruction of glandular epithelium by larva.

Plate 76.

The occurrence of free larvæ in the lumen of the intestine during this period, together with the above observation, may possibly indicate that the larvæ are not confined to any one spot on the intestine wall—that is, they do not become fixed, but may attack the intestine wall in several places. A few may penetrate through to the longitudinal muscle layer, and rarely some of these may continue their burrowing activities to reach organs lying in the body cavities.

In the chickens autopsied in the May series of experiments evidence of larval penetration of the intestine wall was not so striking. The majority of the larvæ in chickens autopsied during the tenth to the seventeenth day were apparently free in the lumen occurring among the ingesta. A few were observed up till the seventeenth day with their anterior ends buried into the mucosa between the villi, but in most cases such larvæ quickly became free whilst under observation. No larvæ in any bird were detected deeply buried in the wall tissues.

It will be remembered that Itagaki recorded that during the extremes of summer and winter in Japan the larvæ attack the intestine wall, whilst during spring and autumn they remain throughout their life cycle free in the intestinal lumen. It appears most improbable that any parasitic worm with a direct life cycle should be dependant upon the season of the year to an extent as would involve some alternation in the life cycle, yet the observations by the writer made on birds infested in November and May appear at first sight to indicate that during the autumn (April, May) the tendency for the larvæ to attack the intestine wall is less striking than during the summer (November). These observations, however, are somewhat confused by the wide variations in the number of eggs used as the single dose. In the November experiments, for example, it was noticed that the greater the number of eggs fed the more evident was the behaviour of the larvæ during the tenth to the nineteenth day. For example, in chickens Nos. 13, 15, and 11, which received dosages of 10,000 to 15,000 eggs, some hundreds of larvæ were observed attacking the intestine wall, and portions of intestine were able to be fixed with the majority of these larvæ still *in situ*. With those chickens fed 1,000 eggs comparatively few larvæ were observed actually attacking the intestine wall, and many of these quickly detached themselves whilst under observation. It is therefore considered that the observations made on the comparatively few larvæ recovered from the April-May series of chickens, which were fed a single dose of 100 eggs only, may not have been conducive to a true interpretation of larval behaviour during the tenth to nineteenth day.

As further evidence that the behaviour of the larvæ in the host is probably identical during summer and autumn, it will be observed, if Table VII. is consulted, that after the tenth day there is a sudden and conspicuous decrease in the number of larvæ present. This is true of both the November and April-May experiments. This decrease is considered to be due (this will be discussed in greater detail later) to a resistance on the part of the bird developed as a result of larval attack on the intestine wall.

After the nineteenth day the larvæ live freely in the lumen of the intestine, and favour that portion of the intestine in the vicinity of which the majority of the newly-hatched larvæ had congregated.

When the egg is incubated at 33 deg. C. in 2 mm. of 1 per cent. formalin the first larval moult occurs after seven days. The second moult was observed as early as the fifth day after infestation, the third

on the twelfth day, and the fourth on the eighteenth day. These various periods for the respective moults are somewhat earlier than those recorded by Ackert.

The minimum maturity period established was twenty-seven days, mature females measuring 51 mm. to 53 mm. In his work on the life history published in 1931 Ackert[7] used white leghorns, which were infested with a single dose of fifty eggs when one month old. The minimum maturity period observed by him was about fifty days. The maturity period of twenty-seven days was obtained by the writer in birds of the same breed and age, and given a single infestation of 100 eggs. Itagaki[67] recorded maturity in thirty-seven days, but did not state the age of the birds nor the number of eggs with which this figure was obtained. In the light of the very similar conditions governing both Ackert's and the writer's experiments it is very difficult to find an explanation for this discrepancy. Similar discrepancies have been noted by Baker[27] in the figures given by various workers for mature growth of the cæcum worm of fowls, *Heterakis gallinæ,* namely twenty-four to sixty-one days. Baker has noted, however, that the presence of blackhead may retard the development of this roundworm, and thinks that this may partly explain the variations observed.

Summary.

1. When the egg of *Ascaridia galli* is incubated at 31 deg. C. to 32 deg. C. the second-stage larva appears after eight days. This is the infective stage. At 33 deg. C. the first moult occurs after seven days.

2. These infective eggs when fed to chickens hatch mainly in the small intestine, the larvæ for the most part inhabiting that portion of the small intestine a few centimetres posterior to the entrance of the bile duct. A few eggs may hatch in either the crop, glandular stomach, or gizzard.

3. For the first nine days the larvæ live freely in the lumen of the intestine or in the intervillar spaces.

4. From the tenth to the nineteenth day the larvæ attack the intestine wall. The majority make their way into the crypts of Lieberküln, burying their heads shallowly into the tissues, with the remainder of the body floating freely in the lumen. During this period numbers of larvæ may also occur freely in the lumen. A few larvæ may burrow more deeply into the wall tissues, and some may completely penetrate it to occur eventually in the liver, lungs, &c. There is some slight evidence that this migration tendency is associated to some extent with the number of larvæ present, being most conspicuous where a very large dose of eggs has been administered.

5. After the nineteenth day the larvæ withdraw from the intestine wall, and are to be found only in the lumen.

6. Four moults have been observed. The first moult occurs in the egg in the minimum period of seven days. The second, third, and fourth moults take place in the small intestine at about five, twelve, and eighteen days after infestation, respectively.

7. The minimum period of maturity in white leghorn chicks infested at thirty days of age with a single dose of 100 eggs is twenty-seven days.

8. Nodule formation, as recorded by Itagaki,[67, 68] was not observed.

Fig. 1. Section of small intestine showing the migration of larva into the muscle coat.

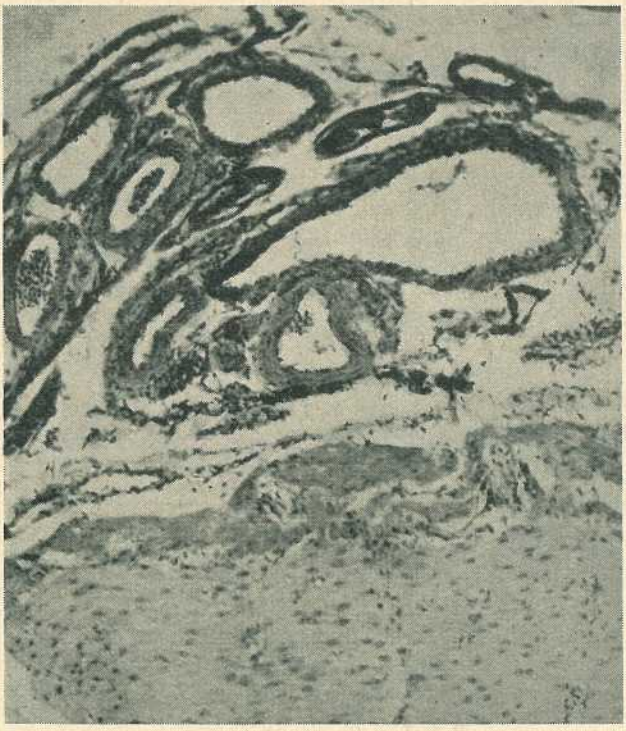


Fig. 2. Section of small intestine showing larva in mesenteric fold.

Plate 77.

In Table VII. set out below is summarised the number of worms and their respective lengths, as obtained from each bird used in these life history studies.

TABLE VII.

No. of Bird.	No. of Eggs Fed.	Period of Infestation.	Month Observations Made.	No. Worms Secured.	Lengths.		
					Minimum.	Maximum.	Average.
1	10,000	2 hours	October ..	Hundreds	285μ (Newly hatched larvæ)	378μ	323μ
2	2,000	24 hours	November ..	356	300μ	380μ	328μ
203	100	24 hours	April ..	72	305μ	385μ	332μ
3	2,000	2 days	November ..	712	310μ	396μ	350μ
204	100	2 days	April ..	57	310μ	415μ	385μ
4	2,000	3 days	November ..	316	437μ	555μ	490μ
5	2,000	5 days	November ..	230	·85 mm.	1·17 mm.	·98 mm.
6	2,000	6 days	November ..	180	·97 mm.	1·5 mm.	1·11 mm.
205	100	6 days	April ..	44	·9 mm.	1·86 mm.	1·22 mm.
206	100	7 days	April ..	37	1·98 mm.	2·81 mm.	2·4 mm.
7	2,000	8 days	November ..	150	1·73 mm.	3·85 mm.	2·9 mm.
207	100	8 days	April ..	42	2·39 mm.	4·06 mm.	3·39 mm.
8	2,000	9 days	November ..	140	3 mm.	5·22 mm.	3·6 mm.
9	2,000	10 days	November ..	125	1·75 mm.	4·08 mm.	3·35 mm.
208	100	10 days	April ..	34	4·12 mm.	6·35 mm.	4·94 mm.
10	1,000	12 days	November ..	65	3·1 mm.	6·46 mm.	4·6 mm.
11	10,000	12 days	November ..	Numerous	..	..	..
12	1,000	13 days	November ..	168	5·6 mm.	11·1 mm.	8·06 mm.
13	15,000	13 days	November ..	Numerous	..	..	..
209	100	13 days	April ..	6	4·48 mm.	5·62 mm.	5 mm.
210	100	13 days	April ..	14	5·21 mm.	9·9 mm.	8·31 mm.
14	1,000	15 days	November ..	16	3·06 mm.	6·06 mm.	4·3 mm.
15	10,000	15 days	November ..	Numerous	..	..	..
211	100	15 days	May ..	10	9·48 mm.	13·23 mm.	11·27 mm.
212	100	16 days	May ..	4	9·72 mm.	14·2 mm.	11·7 mm.
16	1,000	17 days	November ..	23	7·2 mm.	13·8 mm.	10·9 mm.

213	100	18 days	May ..	14	16·2 mm.	22·5 mm.	18·5 mm.
17	500	19 days	November ..	14	14·5 mm.	19·3 mm.	16·4 mm.
18	500	19 days	November ..	28	12·8 mm.	19·4 mm.	17·2 mm.
214	100	21 days	May ..	16	27·4 mm.	35 mm.	31·2 mm.
19	500	21 days	November ..	3	16·8 mm.	20·4 mm.	18·3 mm.
20	500	21 days	November ..	25	15·4 mm.	18·6 mm.	17 mm.
21	500	23 days	November ..	8	21·6 mm.	37·5 mm.	27·3 mm.
215	100	23 days	May ..	30	23·5 mm.	40·2 mm.	30·4 mm.
22	500	26 days	November ..	3	12·8 mm.	19·2 mm.	16·1 mm.
23	100	26 days	November ..	21	28·2 mm.	51·5 mm.	46·4 mm.
216	100	27 days	May ..	3	22·6 mm.	34·1 mm.	28·4 mm.
217	100	27 days	May ..	7	35·1 mm.	53·2 mm.	47·4 mm.
					Eggs in fæces		
24	500	28 days	November ..	23	24·5 mm.	28·2 mm.	26·6 mm.
25	100	28 days	November ..	4	38·4 mm.	52·6 mm.	49·7 mm.
					Eggs in fæces		
26	50	30 days	November ..	16	44·2 mm.	65·2 mm.	52·8 mm.
					Eggs numerous in fæces.		

Recent Developments in the Treatment of Tick Fever.

C. R. MULHEARN, B.V.Sc., Animal Health Station, Yeerongpilly.

FOR many years it was considered that all cases of tick fever in Australia were caused by a single organism, but it is now well known that there are five distinct organisms each capable of causing a distinct type of tick fever in this country. Two of these organisms give rise to a mild form of the disease, and probably never cause any mortality in stock. The other three give rise to the very serious forms of the disease known as Babesiellosis, Piroplasmosis, and Anaplasmosis.

Anaplasmosis is frequently not recognised as a type of tick fever, for the symptoms come on slowly, and are in the form of gradual emaciation accompanied by fever and sometimes jaundice. Red urine is never passed, even in fatal cases. In the present state of our knowledge no specific drug treatment is known for this disease, and it is not intended to discuss it further in this article.

The other serious types of tick fever are closely related, and both attack the animal very suddenly, displaying symptoms of loss of appetite, high fever, and distress. The climax is reached in less than a week, so that death occurs or signs of recovery are noted soon after this period. Red urine is always passed in serious cases of piroplasmosis, and usually also in babesiellosis, although occasional fatal cases of the latter disease have occurred without red urine being evident.

It is not possible to distinguish between these two types of tick fever without the aid of a microscope, consequently only a general diagnosis of tick fever can be made in the field. However, an examination of specimens at the Animal Health Station, Yeerongpilly, received from natural cases indicates that babesiellosis is by far the most common form encountered in Southern Queensland.

It has long been known that the true form of piroplasmosis can readily be controlled by trypanblue and its derivatives, but that these drugs are of no value in the treatment of babesiellosis.

Treatment of Piroplasmosis with Piroblue.

The piroplasmosis type of the disease is one of two that is regularly used and recommended for the protective inoculation of stock against all forms of Queensland Tick Fever (for this aspect of tick fever advisory leaflets Nos. 15 and 17 should be consulted).

In carrying out such inoculations it frequently happens that severe reactions are produced, particularly in stud animals, for as a general rule they are very susceptible, and it becomes necessary to check such reactions by drug treatment. For this purpose piroblue, a derivative of trypanblue, has been used with great success during the last few years. The dose rate of this drug is 100 c.c. of a 1 per cent. solution, and in order to be most effective it must be injected directly into the jugular vein. To carry out this treatment 1 gram of the drug, which is supplied in a powder form, must be dissolved in 100 c.c. (about half an ordinary breakfast cup) of clean water which has been boiled and allowed to cool to blood heat. This solution should be made up immediately before

use, for the drug does not keep well in the liquid form. A stout hypodermic needle, preferably about 3 inches long, and a syringe are necessary to inject the solution into the vein. Before this is attempted the animal should be well restrained and a piece of cord is attached around the lower portion of the neck and twitched tightly so that the jugular vein will stand out prominently. The needle is then inserted into the vein, and when this is successfully carried out the blood will flow readily from the free end of the needle. The cord should be then released and the piroblue solution injected into the vein. This operation presents no difficulty to the trained person, provided that the animal is well restrained and the necessary instruments are available, and it is usually completed within a few minutes. However, considerable difficulty may be experienced in attempting this operation in the field when conditions are not the most desirable. If it is not possible to inject the drug into the vein it should be injected into several places under the skin, but this method is not nearly so effective in controlling the disease as the intravenous method.

If the disease is well advanced it is essential that the drug should be injected into the vein, for otherwise the animal may die before it could be absorbed into the circulation. Red urine must always be looked upon as a very serious symptom, and treatment should be carried out without delay when it is observed.

When the drug is successfully injected the animal usually shows considerable improvement in from twelve to twenty-four hours, the temperature drops to normal, and the parasites disappear from the circulating blood. In occasional cases this improvement does not follow the first treatment, and it then becomes necessary to give a second treatment. This second treatment should be carried out if the animal is not considerably improved within twenty-four hours of the first treatment. Piroblue, like trypanblue, is only effective in the treatment of piroplasmosis, and it has no value in the treatment of babesiellosis, consequently, when cases of redwater are encountered in the field and no microscopic diagnosis is available, disappointing results may follow its use.

The Aciron Treatment of Tick Fevers.

During the past few years considerable success has been obtained in other countries in the treatment of tick fever with a preparation known as Aciron. This drug has been specially prepared for this purpose, and early in the present year supplies were obtained in order that it might be tested on the Queensland strains of tick fever at the Animal Health Station, Yeerongpilly.

The drug is put up in tablet form, each tablet weighing 0·25 grams, which is the dose for a small animal. It is also obtainable in a liquid form, being prepared in sealed ampoules each containing 6 c.c. of a 5 per cent. solution, which is the dose for an average-sized cow. The liquid form of the drug, which has the trade name of Acaprin, is undoubtedly the most convenient for the farmer, who in cases of emergency is frequently called upon to treat cases of redwater without the aid of expert veterinary advice. When Acaprin is used all that is necessary is to break the neck off the ampoule, draw the liquid into a clean syringe, and then inject it under the skin of the sick animal, whereas when the tablet form is employed water has to be sterilised by boiling, allowed to cool to blood heat, and then one or two tablets are

dissolved in 5 to 10 cc. of water, according to the size of the animal to be treated. When this is done the dose is injected under the skin as with Acaprin.

The Treatment of Piroplasmosis with Aciron.

Several experimental cases of piroplasmosis have been treated at the Animal Health Station, Yeerongpilly, with Aciron. The results obtained have been most satisfactory, and suggest that the drug is equally as effective as piroblue in the treatment of this type of tick fever. Within twenty-four hours of treatment there has always been a marked improvement in the general condition of the animal, the temperature has come down considerably, in most cases returning to normal, and the organisms have become markedly diminished or have completely disappeared from the circulating blood. In those cases in which redwater was present the urine had returned to its normal colour overnight. In one case a large dose of the drug killed out the organisms completely from the animal, so that it was unable to transmit the disease; however, it still retained its immunity and proved resistant to reinfection fifty days later.

Treatment of Babesiellosis with Aciron.

Prior to the advent of Aciron no satisfactory drug was available for the successful treatment of this type of tick fever, consequently the results of this experiment were awaited with considerable interest. In order to carry out the experiment aged cows of a susceptible type were obtained from clean country and transported to the Animal Health Station, where they were infected with and developed babesiellosis. Different animals were treated with Aciron at various stages of the disease, and the results in all cases were very satisfactory. In one case in which treatment was carried out in a late stage of the disease a second treatment approximately twenty-four hours after the first was necessary before improvement and signs of recovery became evident.

As a general rule the animals were much improved on the morning following the treatment, and their temperatures were much lower. The organisms do not disappear from the blood following Aciron treatment in this disease as they do in piroplasmosis, and they may still be present several days later.

In addition to the cases treated at the Animal Health Station, Yeerongpilly, between thirty and forty cases of tick fever were treated in the field. A large proportion of these were definitely diagnosed as babesiellosis by the aid of microscopic slides, and the remainder were undiagnosed other than being types of redwater—i.e., either piroplasmosis or babesiellosis. All of these animals with the exception of one recovered following treatment. The animal that died was in a very advanced stage of the disease when treatment was carried out, and little hope was held out for its recovery.

Both the liquid and tablet forms of the drug were employed in obtaining the above results, and in all cases the dose was from 5 to 10 c.c. of a 5 per cent. solution given subcutaneously—i.e., under the skin. The method of using the drug is similar to that of inoculating cattle with blood for tick fever. The site of injection is not important provided that the drug is delivered under the skin, although perhaps the most convenient place is behind the shoulder. Aciron should *not* be given into the jugular vein, as is necessary with piroblue. It has been stated that occasionally alarming symptoms such as salivation,

muscular tremors, &c., may follow within half an hour of the use of Aciron, but they can be controlled by an injection of up to 10 c.c. of another drug known as Rephrin. However, in all cases treated with the normal dosage under our control no such symptoms have developed.

It should be thoroughly understood that the earlier treatment is carried out the greater will be the chances of recovery. When the disease is suspected the animal's temperature should be taken by means of a thermometer, and if it is in the vicinity of 105 deg. treatment should be carried out without delay. The temperature should be taken regularly three or four times per day, and if it has not dropped to under 104 deg. in twenty-four hours the treatment should be repeated. Owners should not wait until red urine is passed, for then the animal is in an advanced stage of the disease and treatment is more difficult.

In addition to the above treatment, it is essential to ensure that the animals are comfortably housed, where practicable, and the appetite should be tempted with palatable food such as bran mashes and green stuff given in small quantities at frequent intervals. Where there is any evidence of constipation an opening drench should be administered.

In view of the difficulty in arriving at a correct diagnosis of the type of tick fever with which an animal may be affected, owners are advised to treat all suspected cases with Aciron or preferably the liquid form, Acaprin. This drug is recommended because, besides being a specific against piroplasmosis, it is the only drug that has given good results in the treatment of babesiellosis, by far the most common form of tick fever encountered in natural cases in Southern Queensland. The dose rate is comparatively small, being from 5 to 10 c.c., and the method of administration is simple and can be carried out by any person who has a suitable syringe and needle.

WORLD'S CHAMPION COW.

It was stated in "The Australasian" recently that for the first time in thirty years the world's record for milk and butter-fat production are both held by one cow, Carnation Ormsby Butter King, a Holstein, owned in the United States of America. Several correspondents have written to that journal stating that this cannot be correct, as the Australian Illawarra Shorthorn cow Melba 15th of Darbalara produced a greater quantity of butter-fat. The claim made for the American cow is a record for both milk and butter-fat production in the one lactation, and not for milk or butter-fat production. Her figures are 38,606 lb. milk and 1,402 lb. butter-fat, while those of Melba 15th of Darbalara are 32,522½ lb. milk and 1,614.10 lb. butter-fat. In both cases the tests are for 365 days. Although Carnation Ormsby Butter King produced 6,083½ lb. more milk than Melba 15th, her yield of butter-fat was 212.10 lb. less. It is, however, not improbable that Carnation Ormsby Butter King has justified her right to hold the world's record for simultaneous milk and butter-fat production.

The occasion is fitting to give the complete record of Melba 15th of Darbalara, which was one of the greatest producers in the world. Junior two-year-old, 1918—milk 8,844 lb., average test 4.5, butter-fat 395.07 lb. in 273 days. Senior three-year-old, 1919—milk 13,510.50 lb., average test 4.3, butter-fat 587.13 lb. in 273 days. Senior four-year-old, 1920—milk 21,635.5 lb., average test 4.4, butter-fat 954.47 lb. in 365 days. Mature, 1922—milk 29,432 lb., average test 4.5, butter-fat 1,316.81 lb. in 365 days. Mature, 1923—milk 32,522.50 lb., average test 5.0, butter-fat, 1,614.10 lb. in 365 days. Her average for the five tests was:—Milk 21,188.90 lb., butter-fat 973.51 lb.

Principles of Botany for Queensland Farmers.

C. T. WHITE, F.L.S., Government Botanist.

INTRODUCTION.

IN connection with the appointment of inspectors under the Diseases in Plants Act, it has been deemed advisable that the appointees should have some knowledge of the principles of botany. In discussing the matter with the Editor, he suggested that a series of articles should be published through the "Queensland Agricultural Journal," and afterwards issued in book form. Most of the existing text-books deal with the subject of botany in rather too detailed a form for the requirements of the officers concerned, and the Editor thought that it would be possible to publish articles that would be of general interest to the farming community. Parts of the book have been taken from my "Elementary Text-book of Australian Forest Botany," and for the right to reproduce some of the text and many of the illustrations I am indebted to the Commissioner of Forests of New South Wales, Mr. E. H. F. Swain.

I would like to offer to those interested in plants a few words of advice as to the best means of pursuing botanical studies so that they can make most use of them. For the purpose of getting to know the native or commonly cultivated plants, specimens should be gathered and an endeavour made to trace them down by means of a flora. If this is found to be too laborious the specimens should be sent to a State Government Botanist for identification. When the determinations have been received the "flora" should be consulted and the description run over. It is also a good plan to run over the descriptions of the genus and family or order as well. For this work "The Queensland Flora," published by the late F. M. Bailey, in six volumes, will be found necessary for the serious student. In collecting specimens for identification a shoot about 9 inches long and bearing leaves and either flowers or fruits should be gathered. If both flowers and fruits can be obtained, so much the better. Of grasses and small herbs the whole plant can be gathered. It is a good plan to send the whole stem of a grass doubled backwards and forwards so as to fold comfortably in a small sheet of newspaper, and to include several additional seed heads. Of larger herbs it is advisable to send the lower growth so as to show the characteristic leaves of the lower part of the plant, which often differ markedly from those at the top. Plants are more easily worked out or determined when fresh than when dried. A hand lens magnifying from five to ten diameters should be obtained for examining small plants and for critically examining those with a more intricate floral structure. It is obviously impossible to send specimens away any distance in a fresh condition, and in sending specimens for identification a flowering or fruiting shoot should be gathered, pressed flat between sheets of newspaper, and the newspaper changed every day or so till the specimens are dried; several thicknesses should be placed between each specimen. The specimens should be numbered and a duplicate retained. Fleshy fruits and large woody seed vessels should be dried separately. Field notes on the nature of the bark, size of the tree, &c., are of great assistance for determination purposes, and in some Australian trees, such as the Eucalypts and Angophoras, are almost indispensable to correct identification.

Botany is one of the most fascinating and at the same time useful of the natural sciences, a little knowledge of which makes every place of interest, and if the present work in addition to supplying the need of plant inspectors helps only a few people towards a study and proper appreciation of our native plants, it will have fulfilled the desire of the author.

CHAPTER I.

General.

Botany is that branch of natural history which deals with plants, and has for its object the study of their life histories, structure, distribution, classification, economic uses, and general properties.

It is one of the two branches of the great science biology, which embraces the study of all organisms or living objects as distinct from such lifeless objects as rocks and minerals. Zoology, the other division of biology, deals with animals.

The following are some of the chief characters and properties of plants, the definitions, however, being only broadly true, as it is impossible to lay down regular definitions when writing on natural history.

Plants are generally stationary, and have a prevailing green colour, due to the colouring matter chlorophyll.

The living substance of the plant secretes cellulose, which forms the cell walls, and which is, practically speaking, absent from the animal kingdom.

A plant is able to receive nourishment direct from inorganic matter. The large groups, fungi and bacteria, are exceptional as they contain no chlorophyll, and are largely parasitic—i.e., living on and at the expense of other organisms; or saprophytic—i.e., living on decaying organic material.

Notes on General Classification.

Before making a study of the plant and its parts in detail it would be well to acquaint ourselves with the general scheme of plant classification as now in use, and perhaps the following example will serve to explain the main ideas.

The Stringybarks, the Tallow-wood, the Blue Gum, the Flooded Gum, the Bloodwood, and the Ironbarks, though distinct from one another, will be seen to have certain points of similarity. In the words of the systematist, they are all species of a single genus.

According to the binomial system of nomenclature introduced by the great Swedish naturalist, Carl von Linne (better known as Linnaeus), every plant has two names—the generic and the specific—both of which should denote some distinguishing feature of the plant, and which correspond to a personal surname and christian name respectively.

Thus we have the White Stringybark (*Eucalyptus eugenioides*), the Yellow Stringybark (*E. acmenioides*), the Bloodwood (*E. corymbosa*), and so on.

We can easily see that the Apple Trees (*Angophora*), the Scrub Box (*Tristania conferta*), and the Turpentine (*Syncarpia*) are closely allied to the Eucalypts, but differ from them more than one eucalypt differs from another. This is expressed by saying that they belong to different genera of a single Natural Order or Family.

The possession of the embryos of the plants mentioned of two opposite seed-leaves or cotyledons places them in the group Dicotyledons, which includes most of our forest trees.

In most flowering plants the ovule, or young seed, is enclosed in an ovary, and they are termed Angiosperms, which great group includes practically all our cultivated vegetables, fruits, &c., and most of our native forest trees, with the exception of the Conifers, which, having a naked ovule or seed, are called Gymnosperms.

The Angiosperms and Gymnosperms together constitute the Phanerogams, which include all plants forming true seeds. Thus we have—

The Vegetable Kingdom.
Sub-kingdom Phanerogamae or Phanerogamia.
Division Angiospermae.
Class Dicotyledonae.
Family or Natural Order Myrtaceae.
Genus Eucalyptus.
Species E. acmenioides.

After this we have sub-species, varieties, and forms, as will be found explained in the chapters devoted to classification.

After the name of the genus or species we often find placed certain initials or names. These denote by whom the plant was so designated. Thus *Eucalyptus* L'Herit., means that the genus Eucalyptus was first defined by the French botanist L'Heritier, and *E. acmenioides* Schauer means that this species was first defined by the German botanist Schauer. Though seldom used, the authority following the specific name is, strictly speaking, just as much a part of the name of the plant as the genus or species. The authority is generally dropped in books of a popular nature, but is nearly always to be found appended in articles of a technical nature, and in "Floras," as the systematic and descriptive account of the vegetation of any country or district is called, as Bentham and Mueller's "Flora Australiensis," Bailey's "Queensland Flora," &c.

It will commonly be noticed in the following pages that the letters sp. or spp. are often placed after the name of a genus. These abbreviations are used when it is not desired or deemed necessary to particularise any one species of the genus referred to. Sp. implies species in the single sense, spp. in the plural. Thus in the next chapter, when referring to adventitious roots, *Ficus* spp. are given as examples; here it is meant that many species of our native figs form these adventitious roots (*Ficus macrophylla, F. platypoda, F. Watkinsiana,* &c.). It will also be noted that when listing different plants of the one genus, it is not necessary to keep repeating the generic name in full; this can be abbreviated by using the initial letter of the generic name.

In the following pages, Chapters II. to VIII. deal with morphology or the study of the form and external appearance of the plant, Chapters IX. to XI. with the anatomy or internal structure of the plant's organs, and Chapters XII. to XVII. with physiology or the study of the various life processes of the plant, particularly with the two great factors of nutrition and reproduction. These are followed by chapters on classification and systematic botany, and geographical botany and plant distribution.

CHAPTER II.

The Root.

The root may be typically defined as the descending portion of the plant. It has neither leaves nor buds, and is, practically speaking, always protected at the growing point by a layer of tissue known as the root-cap. (Plate 78.) There are a few exceptions to the latter part of this rule—e.g., the primary root of the Dodder (*Cuscuta*) and some other parasitic plants has no root-cap.

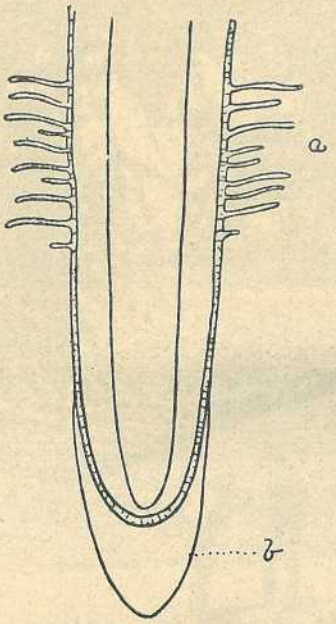


Plate 78.

Longitudinal section of tip of growing root (diagrammatic), much enlarged; *a*, root-hairs arising as outgrowths of epidermal cells; *b*, root-cap.

[The outer layers of the root-cap are continually being worn away by friction with the soil, but are rapidly replaced by fresh layers from within.]

A characteristic of most roots is the possession of root-hairs which are developed from the epidermal cells close behind the growing point. Only a small part of the root is clothed with them, for as the newer ones are formed the older ones die off. They greatly increase the absorption surface of the roots from which they spring. The roots of some plants, many aquatic species and some small-leaved conifers, for example, are unprovided with root-hairs. The character of the soil largely affects the production of root-hairs, and in certain crops it has been found that their development is retarded either in very wet or very dry soils, their greatest development being in moderately damp soils.

The chief functions of the root are—

(*a*) To anchor the plant firmly in the earth.

(*b*) To help maintain the life of the plant by absorbing water and nutritive substances held in solution in the soil.

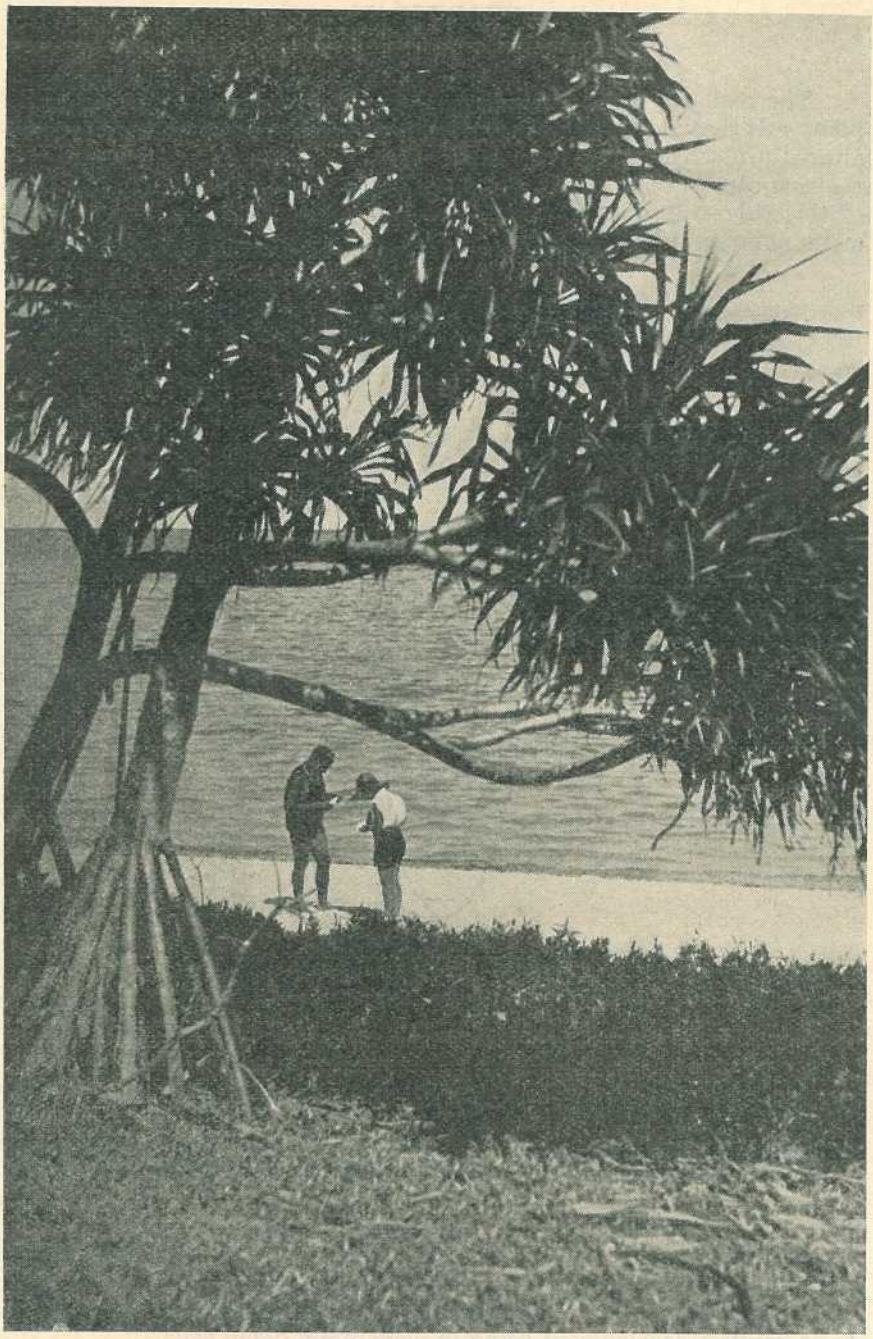


Plate 79.

Pandanus on sea-shore, Green Island, near Cairns, showing prop roots.

[*Photo. by Queensland Government Tourist Bureau.*

They may also take on special functions, such as climbing organs (as in the Creeping Fig, the Ivy, &c.), as reservoirs or storehouses of nourishment (as in the radish, carrot, beet, turnip, dahlia, &c.), as props to keep the plant in position, as in *Pandanus* (Screw Pine) (Plate 79), in the Red Mangrove (*Rhizophora mucronata*), and on a smaller scale in the maize and other large grasses. In floating aquatic plants, such as the Water Hyacinth and Duck Weed, they act as a keel or ballast to keep the leaves and other floating parts in position.

The first root developed by any plant is termed the primary root. All roots subsequently developed from the primary root or any other part of the plant are termed secondary roots.

If we examine a young seedling tree we will usually find—

(*a*) A root growing straight down into the soil; this is the first root formed by the seedling, and is the primary root. In most cases this grows rapidly, elongates, and forms the tap-root of the older plant.

(*b*) Roots given off laterally from the main descending root, and branching and rebranching, these being termed the secondary roots.

New roots, when developed so that the youngest are always nearest to the growing point are said to be developed in acropetal succession,

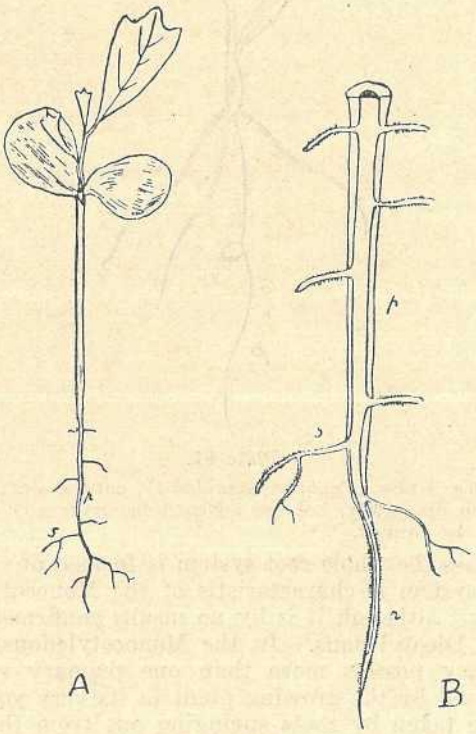


Plate 80.

A. Seedling, Wheel of Fire (*Stenocarpus sinuatus*), natural size.

B.—Longitudinal section of root (enlarged), somewhat diagrammatic, showing endogenous origin of the secondary roots; *p*, primary root; *s*, secondary roots; *r*, root hairs.

and are termed normal. All roots developed otherwise are said to be adventitious. The total root growth made by a plant is termed its root system.

All roots, except the primary root or roots, are formed from the inner tissues of the parent root or other member from which they originate, and as they grow break through the outer tissues. (Plate 80.)

In many plants the tap-root dies off, and an extensive adventitious root system is formed, numerous roots springing out from the base of the stem at successively higher and higher points; these, although they often arise from the stem at some distance above the surface of the soil, eventually travel down until they reach the earth and help to anchor the plant more firmly in the soil. This is well illustrated in the maize and other large grasses such as maize, sorghum, sugar cane, &c.

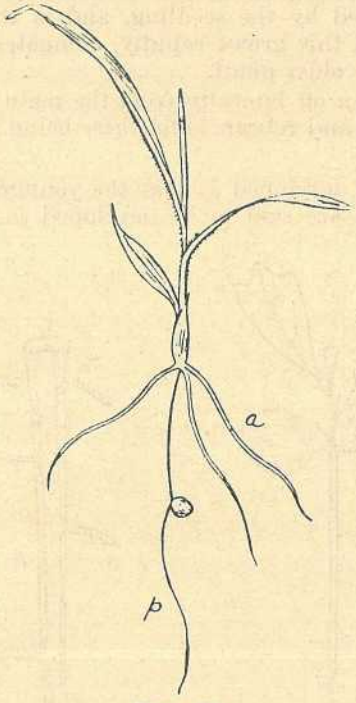


Plate 81.

Seedling Summer Grass (*Panicum sanguina'e*), natural size; showing a primary root (*p*); this soon dies away, but the adventitious roots (*a*) continue to develop and fresh ones to be formed.

In many cases the whole root system is formed of these adventitious roots. Such a system is characteristic of the Monocotyledons (grasses, palms, lilies, &c.), although it is by no means confirmed to them, being found in many Dicotyledons. In the Monocotyledons, the embryo, or young plant, may possess more than one primary root. These are, however, only used by the growing plant in its very young stages, their place soon being taken by roots springing out from the lower parts of the stem. (Plate 81.)

Adventitious roots are usually fibrous, as in the grasses, but sometimes they act as storehouses for nutriment, as in the dahlia, sweet potato, and some Australian vines of the grape family, yam family,

&c. Roots, tuberous or otherwise, which become swollen and act as storehouses of nourishment, are termed tuberous roots or root-tubers.

Although true roots bear neither buds nor leaves, the roots of some trees are capable, under certain circumstances, of sending up leafy shoots termed root-suckers. These are specially characteristic of trees with a wide-spreading and shallow root system. Root-suckers are most frequently formed after injury to the parent tree, as when it has been cut down or severely cut back or pruned. The character is especially well developed in the Poplars, in the Tree of Heaven (*Ailanthus glandulosa*), in the English Elm, and in certain varieties of pears and plums.

In nursery work the formation of root-suckers is sometimes taken advantage of, as in the propagation by means of root-cuttings of the well-known horticultural plants *Dracæna* and *Cordyline* spp., of the horse-radish, blackberry, &c.

These root-suckers are not to be confused with the stool shoots or coppice shoots of ecualypts and other trees to which the term sucker shoots and sucker leaves are popularly applied. Stool or coppice shoots spring from the main trunk mostly after it has been injured, and especially from the butt or stump after the main trunk has been cut down.

With the object of making a dense, bushy head, it is a common practice to cut off the trunk of a tree some 6 feet or more above the ground. The shoots that spring from just below the cut surface are termed pollard shoots to distinguish them from ordinary stool shoots which arise from a low stump. The practice of pollarding is often resorted to by gardeners to improve the symmetry of and appearance of Eucalypts and other trees which do not ordinarily bear dense foliage. It is seen in commercial practice where willows are topped or pollarded for the purpose of producing numerous shoots suitable for basket-making.

Tropical and subtropical mixed forests contain a number of trees whose uppermost roots and basal portion of the trunk form large plank-buttresses. In the rain-forests of tropical and sub-tropical Australia this habit is well developed in many species; for instance, in the different species of Figs (*Ficus* spp.), Stavewoods or Crowsfoot Elms (*Tarrietia* spp.) (Plate 82), the Carrabin (*Sloanea Woolsii*), the Marara (*Weinmannia lachnocarpa*), &c.

In rain forests or heavy jungles, in Queensland misnamed "scrubs," the absence of much direct sunlight on the ground surface and the fertility of the humus-containing upper layers of the soil both tend to develop surface roots; owing to the high humus content of the surface soil and its avidity for oxygen, oxygenation of the subsoil is retarded, and this acts still further to develop extensive surface root systems, often including large plank-buttresses.

The old, hard, woody roots and root buttresses probably serve the very useful purpose of stays, helping the tree to resist the lever-like strain exerted by the stem with its crown of branches and foliage as it is swayed by the high winds. Increased resistance to wind is rendered necessary in the rain forests, because the saturation of the soil by the excessive rainfall increases the liability to windfall.

When roots are developed in the earth they are termed subterranean, when in water aquatic, when in the air aerial. Some aerial roots—as in many Figs (*Ficus* spp.), are formed on the main branches and travel

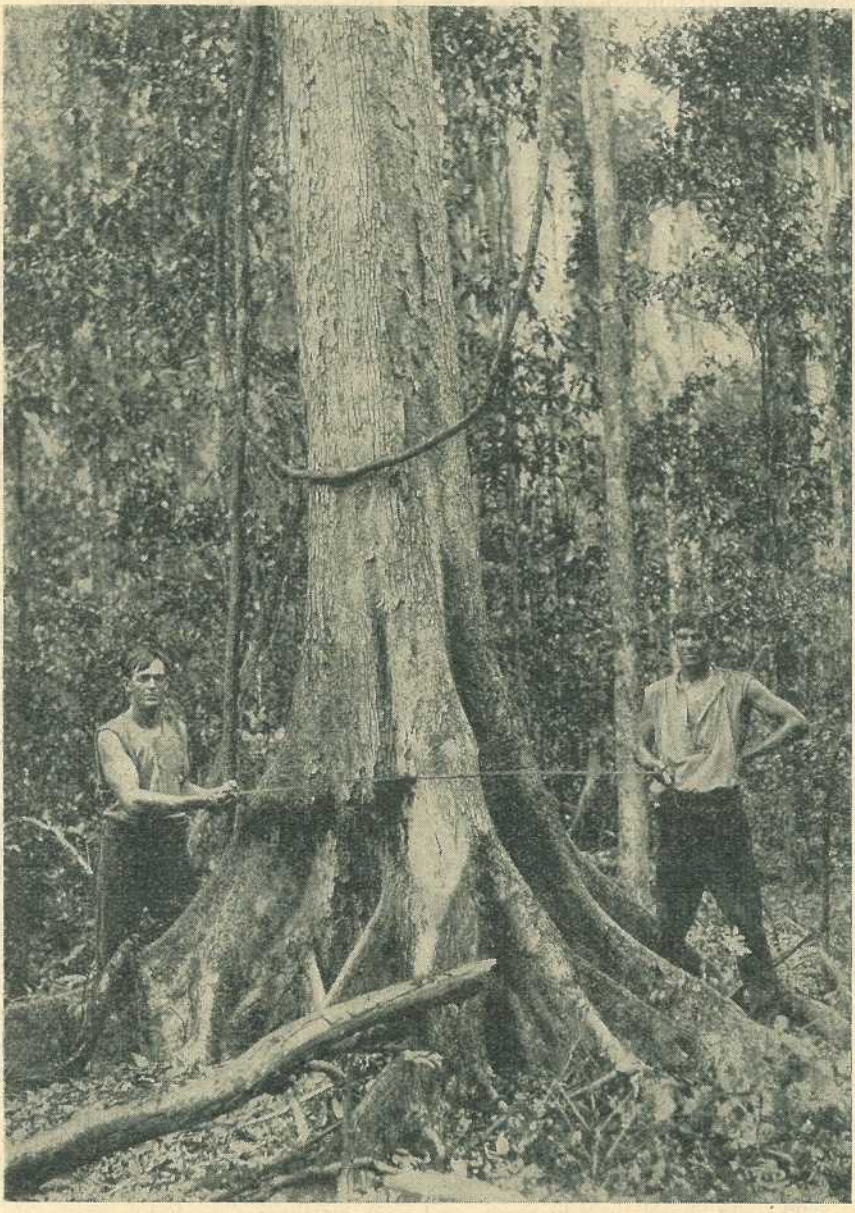


Plate 82.

Crow's-foot Elm or Booyong (*Tarrietia argyrodendron*), showing typical buttresses, Imbil State Forest, Mary Valley.

[*Photo. by A. H. Chisholm.*

down till they reach the earth, and help to support the member from which they originate, besides supplying the tree with additional nourishment. In this way a single tree may eventually cover several acres, as in the well-known Banyan type of fig-trees. In the majority of figs the whole trunk is often formed from aerial roots (Plate 83).

In many mangroves the aerial roots developed from the stem form stilt-like processes which serve not only to fix the tree firmly in the soft, muddy substratum in which these plants grow, but also to ensure a supply of oxygen for the rest of the root system. In the Black Mangrove (Plate 84), found along the whole Queensland coast, in the White Mangrove (*Avicennia*), in one form or another one of the most widely distributed of trees round the coasts of the world, and in some other mangroves and swamp trees, the roots send up breathing processes or aerating roots which serve to give the plant additional communication with the atmosphere, and thus ensure a sufficient supply of oxygen for the roots, there being no supply of free oxygen in the mud in which these trees grow. New roots are formed below the processes, and these serve to prevent the mud being washed away from the root system and to keep a new root system always in conformity to the mud level. Some aerial roots, those of epiphytes, plants which live on trees but are not parasitic on them—very many orchids, for example, do not reach the ground, but mainly serve as means of attachment; they frequently contain chlorophyll, the green colouring matter of plants, and perform in part the functions of leaves.

The roots of epiphytic orchids are enclosed in a spongy sheath, termed the velamen. It is the velamen which gives the white, corky appearance to orchid roots, especially when dry. It is a many-layered, spongy tissue, whose function it is to soak up rapidly and afterwards hold moisture. A similar sheath is developed in the epiphytic members of another family of plants, the aroids or *Araceæ*.

CHAPTER III.

The Stem.

In its typical form the stem may be defined as the ascending leaf-bearing portion of the plant.

The first stem formed by a seedling is termed the primary stem. All stems, with the exception of the primary stem, are developed from the superficial tissues of the member from which they originate, and not from the internal tissues as are roots.

The forms taken by stems are of infinite variety, some trailing along the surface of the soil, some slender and climbing, and some extending underground, when they can only be distinguished from roots by the absence of a root-cap and the presence of scale-like leaves or the possession of leaf-buds.

In plants of annual duration the stems are usually somewhat succulent in texture, and are said to be herbaceous.

When the primary stem persists for some years, as in trees, it becomes hard and woody, and is termed the trunk.

Nodes and Internodes.—The point at which one or more leaves is given off is termed a node, and the portion of stem lying between two successive nodes an internode. In many plants the nodes are swollen

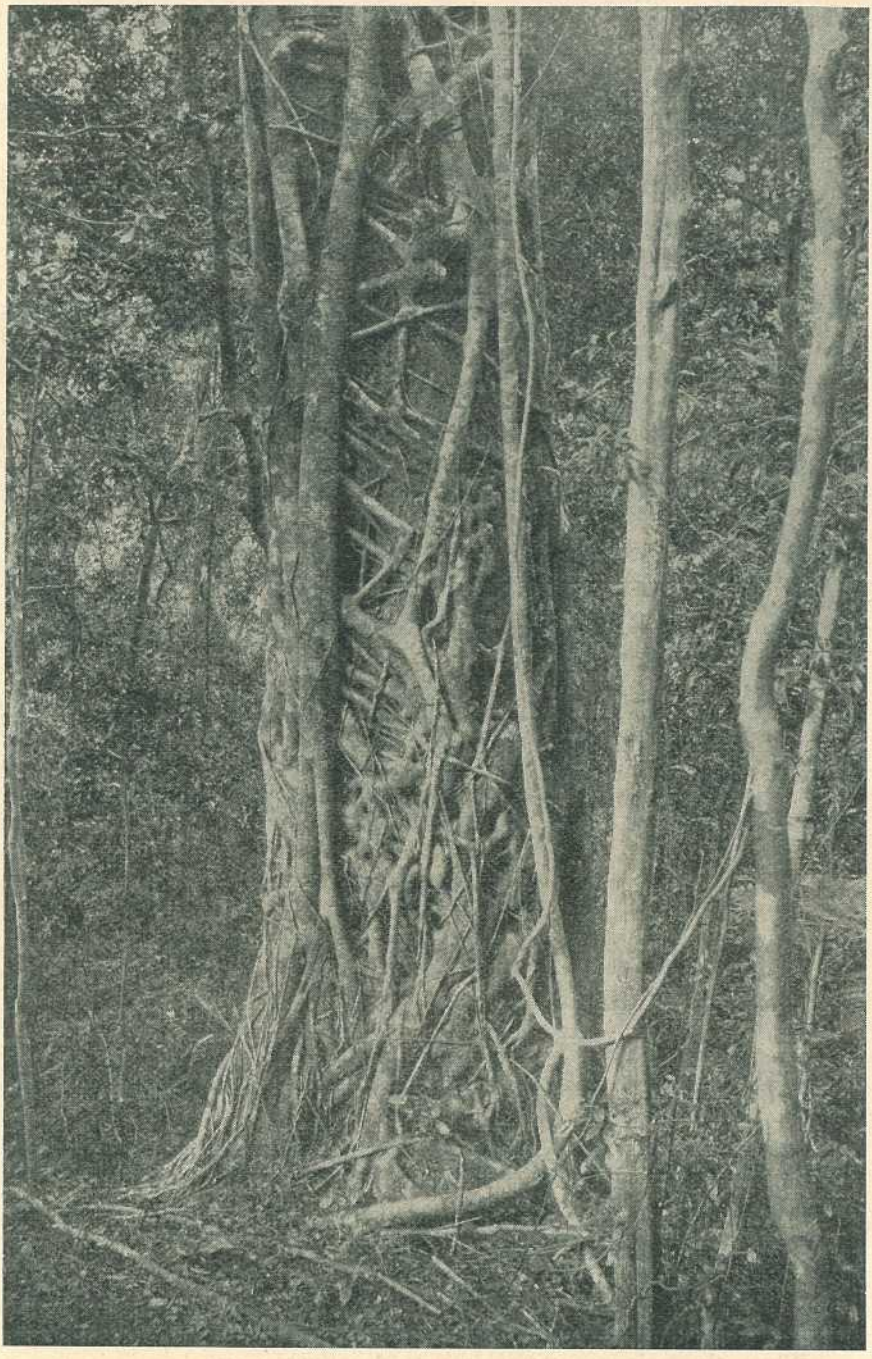


Plate 83.

Roots of a Native Fig (*Ficus Watkinsiana*), Lamington National Park, South-Eastern Queensland. The roots are gradually crushing the life out of the host tree, and will eventually feed on the decaying wood. The whole trunk of the fig tree will thus eventually be formed of root tissue.

[*Photo. by Queensland Government Tourist Bureau.*

or marked by a well-developed line around the stem. This is well seen in grasses, especially in the bigger sorts, such as the bamboos, sugar-cane, maize, &c.

General Descriptive Terms.

When stems are seen to be circular in transverse section they are said to be cylindrical, when possessing several prominent angles to be angular, when marked longitudinally with more or less prominent ribs to be costate or ribbed, or they may be furrowed or striate if the furrows are small and line-like, and so on.

Plate 84.

Black Mangrove (*Bruguiera Rheedei*), showing mangrove knees. Russell Island, Moreton Bay.

[*Photo. by C. T. White.*

Commonly stems or branchlets are angular in a young state, becoming more or less cylindrical with age, as the young branchlets of Queensland Black Wattle (*Acacia Cunninghamii*), the young coppice stems of some eucalypts, &c.

Climbing Plants.—The forms assumed by climbing stems and the special organs adapted for climbing are various. They may cling by means of adventitious roots, as in the Ivy and Tecoma radicians, by means of special organs called tendrils, which are slender, thread-like bodies, simple or branched, and which twine in a loose or tight coil round some stronger-stemmed plant or other support. They may be specially modified branches, as the cucumber, melon, passion vine, grape vine, &c.; modified parts of the flowering branches, as in *Antigonon*. In some species of *Ampelopsis* (Virginian Creepers) the tendrils form

flat, adhesive discs at their tips. Some climb by means of hooks and recurved spines, as in the Lawyer Vines (*Calamus* spp.). When a plant climbs by spirally twisting round a support it is termed a twiner, as in the Morning Glory.

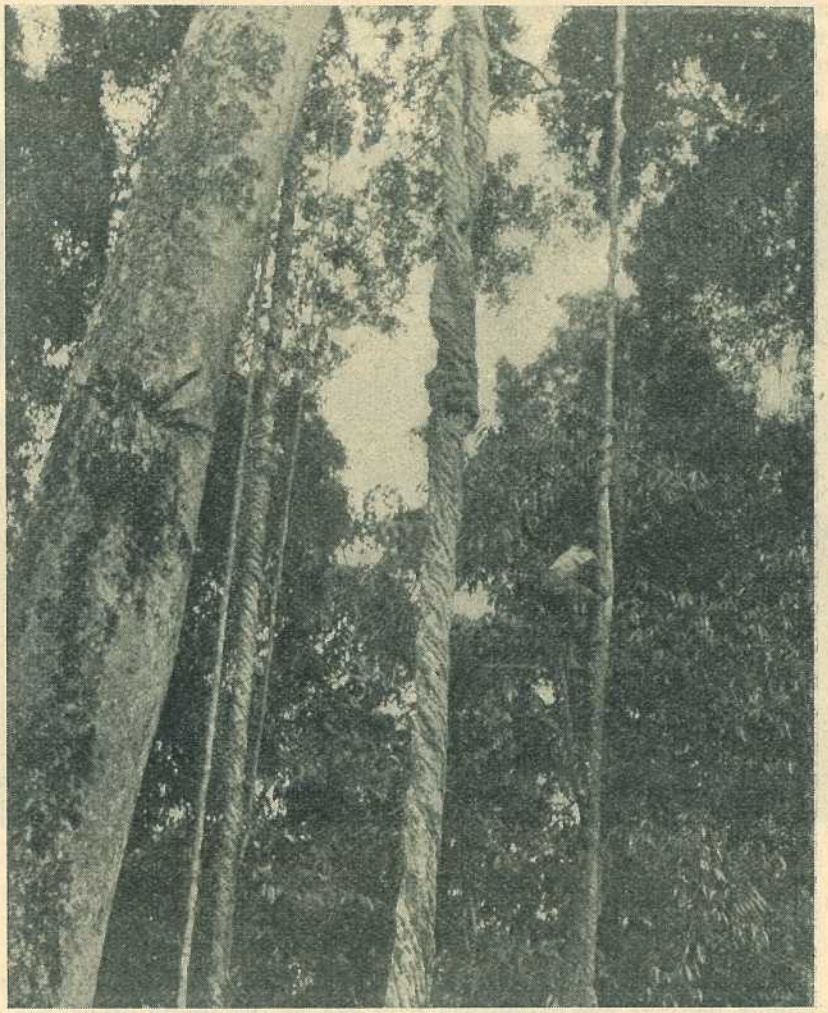


Plate 85.
Lianes in a tropical rain-forest or scrub, Malanda, North Queensland.

[*Photo. by Queensland Government Tourist Bureau.*

Some plants, though not distinctly climbers, may often be found with their stems resting on or entangled among the branches of stronger-growing plants, and are said to be rambling or straggling, as in the well-known garden plant Bougainvillea. When growing in the open such plants take the form of rambling shrubs, but when growing in the mixed, dense forest often climb to a considerable height among the tops of the trees, as in the Cockspur Thorn (*Cudrania*), and Lantana (*Lantana Camara*).

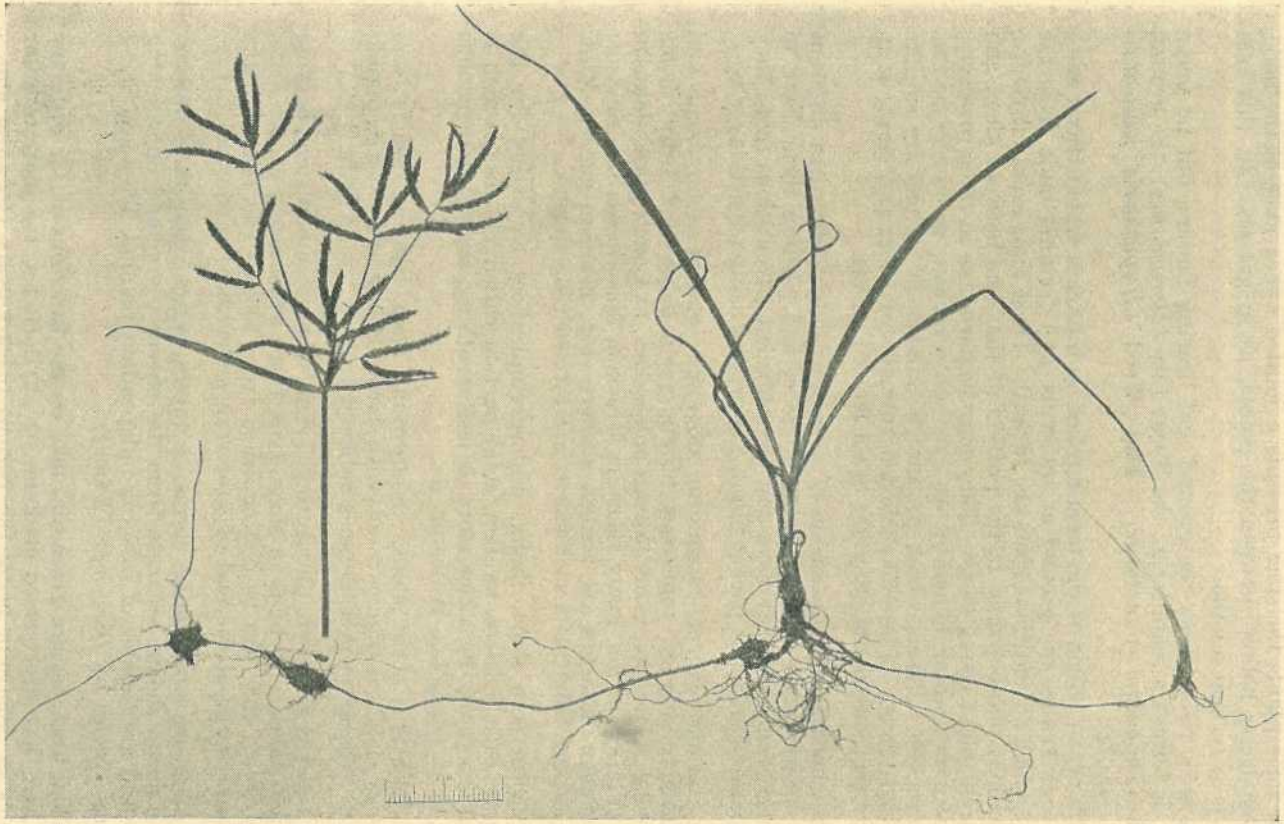


Plate 86.
Nut Grass (*Cyperus rotundus*), a plant with underground runners or stolons.
[*Photo., Department of Agriculture and Stock, Brisbane.*

A large climber with a woody stem is called a liane, as the Water Vines and Monkey Vine or Monkey Ropes of the coastal scrubs or jungles. (Plate 85.)

In some plants the stem presents a jointed appearance at the node, the stem being hollow between the points, as in grasses. In this case the stem is termed a culm.

A stem rising from the ground and bearing flowers, but no green leaves, is termed a scape—e.g., the Spear Lily (*Doryanthes*), the ground orchid (*Dipodium punctatum*), Flat Weed (*Hypochœris radicata*) Dandelion, &c.

Runner or stolon is the term applied to branches which travel some distance, reaching the ground at intervals, and forming buds from the base of which adventitious roots are formed. These buds eventually form independent plants owing to the portion of the stem between them and the parent plant dying away. They may be aerial, as in the strawberry, Rhodes grass, water hyacinth, &c., or subterranean, as in the potato, nut grass &c. Plants which produce a number of stolons are said to be stoloniferous. (Plate 86.) When runners are short and stout, as in some garden succulents, they are often termed offsets.

This method of propagation is often artificially induced in different plants by gardeners by taking the branches and pinning them down to the soil where, when they have sent out sufficient adventitious roots, they are separated from the parent plant, the process being termed layering.

A rhizome is a root-resembling stem more or less subterranean and horizontal, giving off numerous fibrous roots below and leafy shoots above—e.g., Cunjevoi, many grasses and sedges, as Couch grass, Johnson grass (Plate 87), &c., many ferns, as Bracken, &c. Shoots arising from subterranean branches are termed suckers—e.g., common garden Mint. When arising from roots such shoots are termed root-suckers.

A corm is a short, fleshy, underground shoot consisting for the most part of a massive, swollen, solid portion called the disc, which is covered externally by a few more or less sheathing, scaly, inconspicuous leaves, as in Gladiolus, Watsonia, &c.

A bulb is a short, stout, underground stem, but the disc is comparatively small, being covered with large, fleshy scales—e.g., onion, lily, &c. The corm is sometimes referred to as a "solid bulb."

A tuber is a swollen, underground stem, or portion of a stem, bearing scale-like leaves with buds in their axils from which leafy shoots arise, and by which they can be distinguished from roots. The tubers of the potato are borne at the end of subterranean runners or stolons.

Bulbils are small bulbs, corms, or tubers, which make their appearance on aerial shoots, separate from the parent plant, and on reaching the ground are capable of forming independent plants. They are found in many species of *Dioscorea* (Yams).

When branches are green and take on the functions of the ordinary green leaf they are termed cladodes or phylloclades, the most familiar examples in Australia being the various prickly-pears (*Opuntia* spp.). In these plants the flowers and fruits are borne on the edge and flat surface of the cladodes. The true leaves borne on the young shoots are quite small, and soon wither or drop off the cladode as it increases with age.

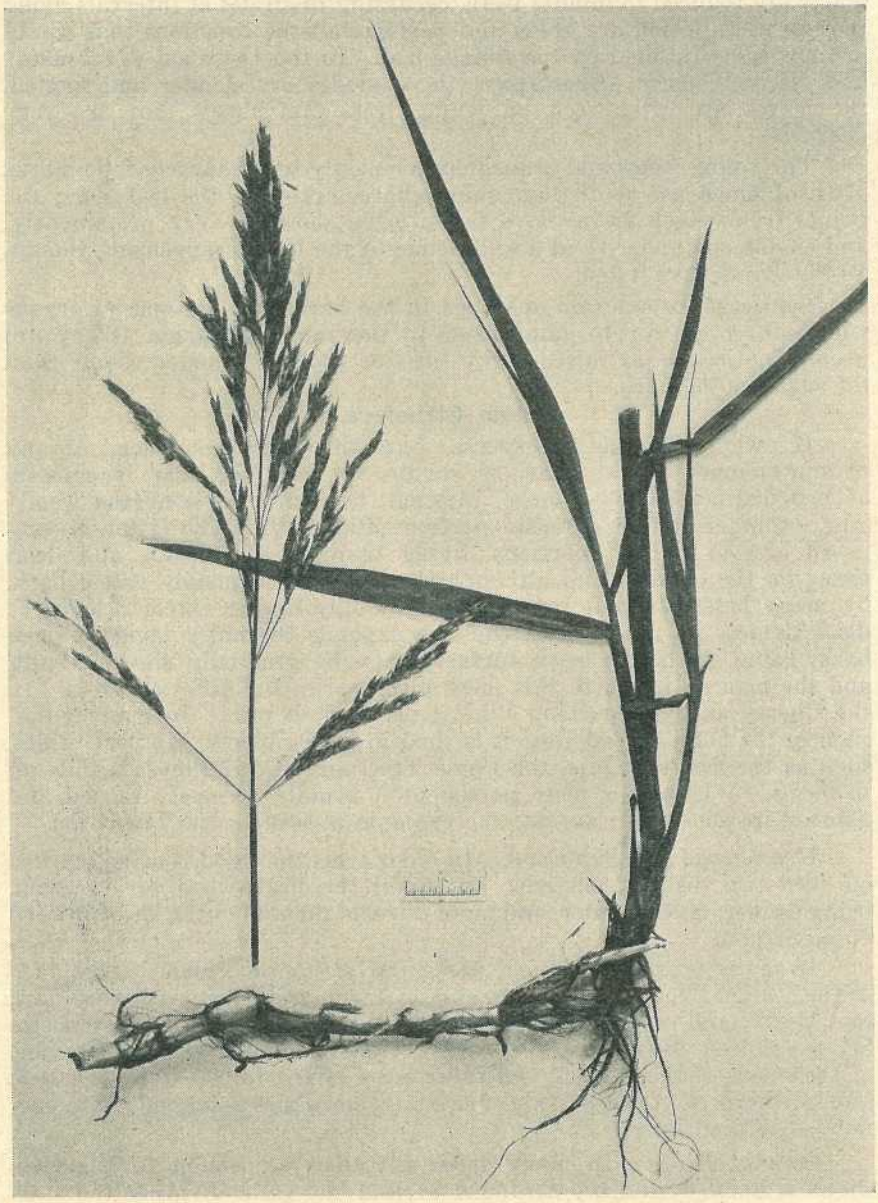


Plate 87.

Johnson Grass (*Sorghum halepense*), a grass with large white underground rhizomes.

[*Photo., Department of Agriculture and Stock, Brisbane.*

Cladodes are not always flat. In the She Oaks (*Casuarina*) the leaves are reduced to minute teeth, occurring in circles at intervals along the branches, which are green and perform all the functions that would ordinarily be fulfilled by the foliage leaf. In the Dogwood (*Jacksonia*) and Native Cherry (*Exocarpus*) the cladodes are slender and angled, the leaves are often seen on young trees and shoots, but are very deciduous.

The young stems and branchlets commonly bear characteristic marks often of much use as distinguishing characters—e.g., the leaf-scars, the points from which leaves have fallen often show up very prominently, and enable one to arrive at a knowledge of the leaf arrangement, though all the leaves have fallen.

Lenticels are external openings in the bark, and are special organs which allow the air to gain access to the internal tissues. They are usually noticeable as raised corky lines or spots of a paler colour than the surrounding bark.

Stem Structure.

If we make a transverse cut through the stem of any of our common forest trees or shrubs we will see that it consists of two distinct parts—a large, internal, hardened portion (the wood) and a thinner, softer, external portion (the bark). The latter is composed of two distinct portions, living tissue on the inside and dead tissue on the outside, and although the whole is commonly called bark, by many botanists that term is applied only to the exterior layer of dead tissue. As the stem of the tree expands the outer layer of dead bark, being unable to grow further, must be gradually shed or split, and the manner in which this takes place varies for different trees. In the Cherry and young Hoop Pine it peels off in rolls. In many gums, such as the Gum-topped Box, it is shed in long ribbons. In other trees, such as the Spotted Gum, the Plane Tree, and Kauri Pines, it falls off in flakes. Where it is more persistent it usually becomes cracked and fissured in some way; an extreme example is seen in the Ironbarks.

Heart-wood and Sap-wood.—In older trees the wood is often marked off into two distinct portions, an inner, the heart-wood or duramen, being darker, much harder, and more durable than an outer, the sap-wood or alburnum.

In many wattles (*Acacia*), particularly those of inland parts, such as the Mulga, Bendee, Boree, &c., and eucalypts the duramen is very dark and heavy, and occupies the greater portion of the stem, the alburnum being reduced to a narrow border of paler-coloured wood. In some of the woods of the tropical and subtropical mixed forests of Queensland and northern New South Wales distinctive hard and softwood zones may not be differentiated.

Annual Rings.—In many trees a transverse section of the stem shows a number of lines arranged around the pith, dividing the stem into successive concentric layers known as the annual rings, so called because, as a rule, one ring is formed each year, so that by counting the number of rings the age of the tree can be ascertained.

In plants of colder countries, where the seasons are well marked and growth is practically at a standstill during the winter, the annual rings are usually very pronounced, the cause being that wood formed in spring is of less density than that formed in the autumn or later in the year. The change from spring wood to autumn wood is frequently a gradual one, but the difference between the autumn wood of one year and the spring wood of the next year lying outside it is quite sharp.

In the majority of trees and plants of tropical countries the annual rings may be ill defined or even entirely absent. Two native trees in which the annual rings are particularly well defined and reliable are the Red Cedar and the White Cedar, which, being deciduous, have a well-marked period of rest.

Medullary Rays.—Running from the centre out towards the bark can generally be noticed a number of radiating strands known as medullary rays. The presence or absence of these rays, their relative size and prominence, distance apart, and other characters that can be noticed are important points in timber identification. Seen on a longitudinal radial section of the wood these rays appear as shining bands, more or less marked, giving the well-known silver grain to wood "cut on the quarter."

A section through a palm stem shows no medullary rays or annual rings, but shows up a number of hard, usually black areas, the vascular bundles.

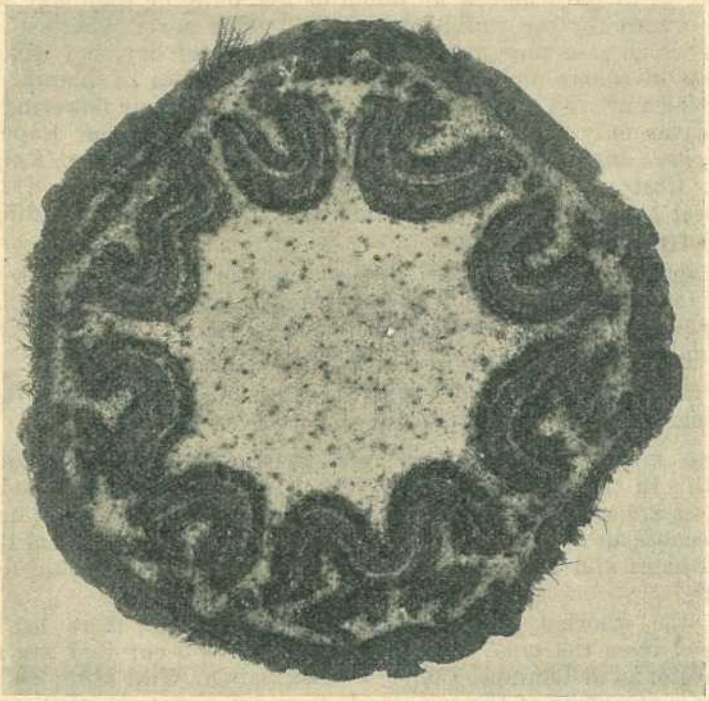


Plate 88.

Transverse section through stem of a Tree Fern (*Alsophila excelsa*). The main vascular bundles are seen as eight large, curved bodies round the edge. Each is surrounded by a band of hard, strengthening tissue. The small black dots scattered over the centre are very small accessory vascular bundles.

[*Photo., Department of Agriculture and Stock, Brisbane.*

In a transverse section of a tree fern (Plate 88) these vascular bundles show up surrounded by large, elongated, black, hard areas; also no distinct bark is formed, the trunk, which in this case is really a very large, erect rhizome, being clothed with a mass of adventitious roots

and, usually, the bases of fallen fronds. The structure of the wood and bark is dealt with in more detail in the chapters devoted to anatomy.

CHAPTER IV.

The Leaf.

Leaves are lateral outgrowths from the stem from which, usually speaking, they differ considerably in form and structure.

Under leaves are included (*a*) the cotyledons or seed-leaves; (*b*) the foliage leaves, which are the ordinary green leaves of the plant and which in a popular sense are the only members regarded as leaves; (*c*) the scale-leaves, which are generally protecting organs to more tender parts and are often devoid of chlorophyll, and may be regarded in some cases as leaf-bases, the broad, green, spreading portion of which (the lamina or blade) has not developed, or as entire leaves which have remained in a rudimentary condition; they are usually found on subterranean stems, and may be thick and fleshy and serve as storehouses for food, as in the scales of an onion or lily bulb, or they may be protecting organs for the rudimentary and tender parts contained in the bud, in which case they are commonly brown and dry, but differ considerably in colour and texture in different species of plants. Some plants which are not green, produce, in addition to their flowering parts, scale leaves only; the root parasites *Orobanche* (Broom Rape) and *Balanophora* afford examples, as do some ground orchids—e.g., *Epipogum nutans, Gastrodia sesamoides, Dipodium punctatum*, &c.; (*d*) bracts and floral leaves, which will be dealt with in the chapters dealing with the inflorescence and the flower.

In the present chapter we will confine our attention to the foliage leaves; these are concerned with nutrition, being organs of respiration, and for converting the raw material absorbed by the plant into various compounds that can be utilised in the building up of its tissues.

Arrangement.—The mode of arrangement of the leaves on the stem as a general rule is constant in the same species of plant.

Two kinds of arrangement are recognised (*a*) spiral and (*b*) whorled. In the former only one leaf is developed at each node, and the leaves are said to be alternate; it is spoken of as the spiral arrangement because an imaginary line supposed to pass round the stem through the leaf-bases and following their order of development would describe a spiral.

In the whorled or cyclic arrangement two or more leaves are developed from the same node; when two leaves occur they are said to be opposite, as in Lantana, Coffee, Coleus, Salvia, Wild Mint, &c.; when three or more occur at the same node they are said to verticillate, as in some races of the Australian nut (*Macadamia ternifolia*), Oleander (*Nerium Oleander*), &c.

Sometimes the arrangement may vary on different branches or at different stages of growth, as in certain Eucalypts where the leaves on coppice shoots or young trees may be opposite, whereas on the ordinary shoots of the older trees they are alternate.

Opposite leaves are said to be superposed when they are arranged in two ranks; that is, in any one whorl the opposite leaves are in the same plane as those immediately above or below them, and their arrangement is said to be distichous or bifarious. In the majority of plants

with opposite leaves, however, the different pairs are generally placed at right angles to the immediate neighbouring ones, and are said to be decussate, though sometimes, as in the Apple Trees (*Angophora* spp.), by the twisting of the leaf-stalk and consequent alteration of the position of the blade the arrangement may appear distichous.

If in the same species of plant the leaves are opposite, sub-opposite, or even alternate, they are said to be scattered.

Leaf Axil.—The upper angle formed between the leaf-base and the stem or branchlets is termed the leaf axil.

Leaf Buds.—Buds may contain only rudimentary foliage leaves, or may develop into leaf-bearing and flowering shoots. When buds arise at the apex of the stem they are said to be terminal, when in a leaf axil axillary, while those formed in any other position are adventitious.

Buds may be covered with a series of dry scales which fall off as the bud opens and which act as a protection to the delicate, immature parts within—e.g., Brush Box (*Tristania conferta*); in some cases the young parts are protected by a coating of gum or resin, sometimes by a coating of wax, at other times by a covering of wool or hair. The various ways in which buds are protected can best be observed by gathering those of a number of easily accessible plants. Often the buds are unprotected by any of the means noted, when they are said to be naked.

Vernation.—The arrangement of leaves in the bud is termed vernation, and varies in different, but not in the same species.

The leaves in the bud stage may not be folded at all, as in Eucalypts;

May have the edges rolled inwards, i.e., when the edges of the leaf are rolled in on the upper surface towards the midrib, as in the Scrub or Brush Wilga (*Geijera salicifolia*);

May have the edges rolled outwards, or rolled in towards the midrib of the leaf on the under surface, as in the Brush or Scrub Stringybark (*Rhodamnia trinervia*);

May be rolled upon themselves so that one edge covers the other, as in the Figs (*Ficus* spp.);

May be coiled inwards from the apex, as in fern fronds;

May simply have the two longitudinal halves folded in face to face, the midrib acting as a hinge, as in the Red Ash (*Alphitonia*), Australian Nut (*Macadamia*); or

May be folded between the nerves in longitudinal or oblique pleats, as in the Cabbage-tree Palm (*Livistona*) and other Fan palms.

All these arrangements have different terms with which one becomes more or less familiar after some experience in descriptive botany.

Parts of a Leaf.—If a leaf be examined it will generally be seen that it consists of two distinct parts (Plate 89), (*a*) the expanded green portion, the lamina or blade, and (*b*) a more or less cylindrical stalk or petiole. In many plants the petiole is absent, in which case the leaf is said to be sessile, whereas a leaf with a distinct petiole is petiolate. Typically the petiole is of a cylindrical shape, but with the upper surface flattened and very often grooved or channelled, especially towards the base, serving to drain off water from the leaf-blade; it is sometimes

winged, as in the orange. Sometimes the base of the petiole is expanded into a sheath—the leaf-sheath or vagina—which partly or completely embraces the stem; this is well exemplified in most palms, in the Banana (*Musa* spp.), grasses, &c.

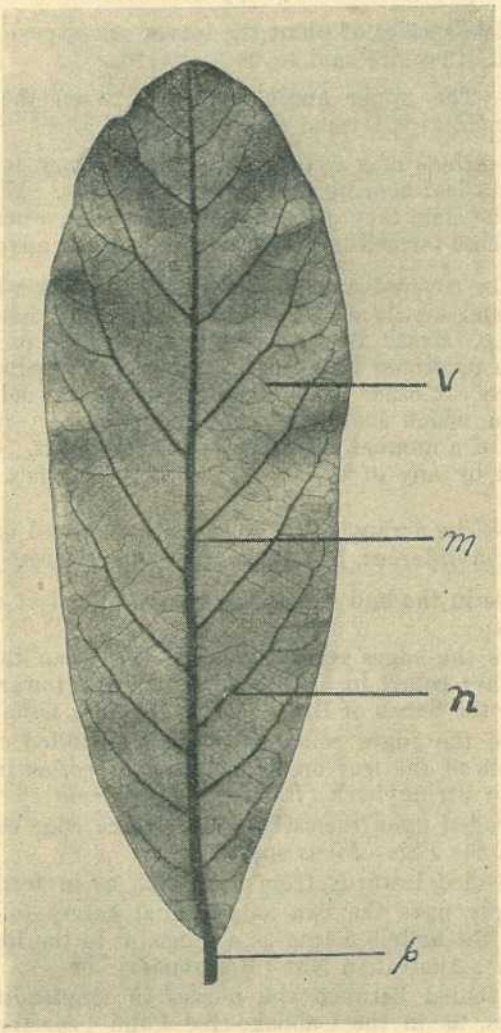


Plate 89.

Leaf of a Native Laurel (*Cryptocarya*). *m*, midrib; *n*, a main lateral nerve; *p*, petiole or leaf-stalk; *v*, veins and veinlets. The whole of the leaf apart from the petiole is called the lamina or blade.

Venation.—Looking at our leaf again, a continuation of the petiole will be noticed running up the centre of the leaf; this is termed the midrib (Plate 89 *m*), and given off from it on either side are a number of strands—the ribs, nerves, or veins (Plate 89 *n*)—and between these, again, a great number of smaller strands—the veinlets (Plate 89 *v*).

The manner in which the strands are arranged on the blade of the leaf is known as the venation, and varies considerably in different plants.

Two main forms are recognised:—

(*a*) Parallel veined leaves.

(*b*) Reticulate or net-veined leaves.

In parallel venation the stronger veins run parallel to one another, as in grasses, lilies, &c.

The term is also applied where there is a distinct central strand stronger than the others—the midrib—and veins running from it to the edge of the leaf and approximately parallel to one another, as in the Banana (*Musa* spp.), in Wild Ginger (*Alpinia* spp.), &c.

In both cases a number of veinlets connect the veins and run at right angles to them, but do not form a network, and are not sufficiently strong to prevent the leaf being torn in strips between the main nerves. Where there is a distinct main strand with lateral nerves given off every here and there either side of it the leaf is said to be penni-veined.

Generally speaking, as in Plate 89, the midrib divides the lamina of the leaf into two approximately equal longitudinal portions, but when the division is obviously unequal the leaf is said to be oblique, as in the Tree Tobacco (*Nicotiana glauca*).

Margin of the Leaf.—The margin of the leaf is said to be—

entire, when it is perfectly even and is not indented in any way;

serrate, when it shows a number of sharp, saw-like teeth directed upwards, as in the Wallum (*Banksia serrata* and *Banksia æmula*);

dentate, when the teeth are directed outwards;

crenate, when the teeth are rounded, as in several species of *Elæodendron;*

toothed, a term commonly used where perhaps the leaf cannot be described as distinctly serrate, dentate, &c., as the leaves of the Sassafras (*Doryphora*), which may be described as coarsely toothed;

sinuate, when deeply indented, with broad, irregular teeth, as in the British Oak (*Quercus Robur*);

spiny, when bearing a number of hard, spiny processes, as in the Holly (*Ilex*), in the Native Holly (*Alchornea*), &c.

Lobed or Divided Leaves (Plate 90). A penni-veined leaf may be lobed half-way down to the midrib or more, when it is said to be pinnatifid. If incised almost or quite to the midrib, as in the Silky Oak (*Grevillea robusta*), the Bangalow or Piccabeen Palm (*Archontophœnix*), the Burrawang or Zamia (*Macrozamia*), &c., it is said to be pinnatisect.

When there are several nerves radiating out from the base of the lamina the leaf is said to be palmately nerved, and the corresponding terms of palmatifid (Plate 90, figs. 4 and 5) and palmatisect (Plate 90, fig. 6) are used, according to the degree of lobing of the laminia; sometimes the leaf is simply said to be palmate or palmately divided.

The parts divided off by the incisions cannot be readily detached or pulled off without tearing from the midrib, and are called segments or lobes.

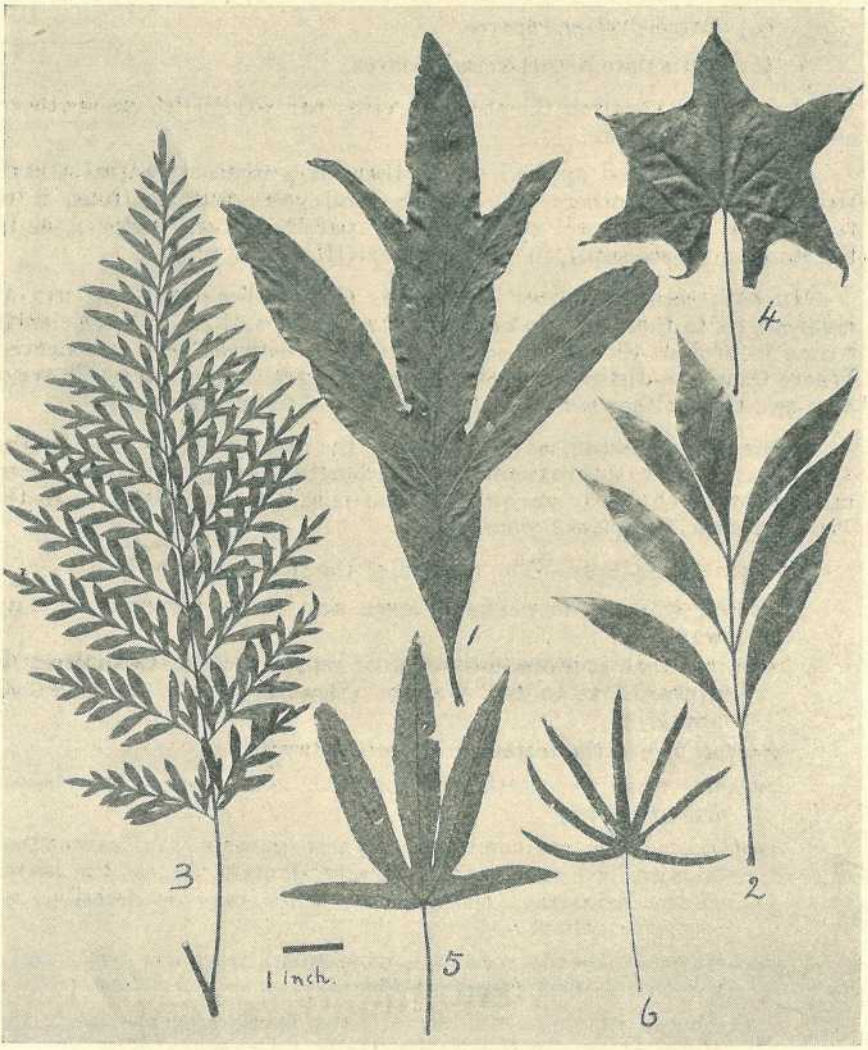


Plate 90.

LOBED LEAVES.—1. White Yiel Yiel Leaf (*Grevillea Hilliana*), deeply pinnatifid. 2. Red Oak or Queensland Waratah (*Embothrium Wickhami* var. *pinnata*), pinnatisect. 3. Leaf from young tree of Silky Oak (*Grevillea robusta*) doubly or twice pinnatisect. 4. Scrub Bottle Tree (*Brachychiton discolor*), palmatifid. 5. Native Rosella (*Hibiscus heterophyllus*), deeply pinnatifid. 6. Bottle Tree (*Brachychiton rupestris*), palmatisect leaf from a young tree. The leaf on adult trees is usually different.

[*Photo., Department of Agriculture and Stock, Brisbane, from "Elementary Text-book of Australian Forest Botany."*

Sometimes the lobing is once or more repeated, as in young plants of the Silky Oak (*Grevillea*), species of *Petrophila* and *Isopogon*, when the leaf is simply described as pinnately divided, once or twice pinnately, palmately, or ternately divided, as the case may be.

Compound Leaves.—When, as in the case of Red Cedar, Rosewood, &c., the leaf is further divided so that each division has a distinct insertion of its own, and each of them can be separated from the common petiole, as the whole can be separated from the stem, the leaf is said to be compound, all other forms being known as simple. The divisions of a compound leaf are called leaflets. As with leaves, a leaflet may be sessile, nearly sessile, or provided with a leaf-stalk, the petiolule, when the leaf is said to be petiolulate.

The terms already given as to the margin, venation, &c., of a leaf can be applied in the same sense to a leaflet.

Shapes of Leaves (Plate 91).—The shapes of leaves are innumerable, but the following is a selection of terms employed in descriptive botany to the commonest forms of outline presented by the lamina of simple leaves. In the case of leaves with a cut margin the general shape is described by imagining a line passing through the base and apex of the lamina and passing through the outermost points of all the principal teeth or divisions of the lamina.

A leaf is described as—

acicular, needle-shaped, elongate, with sharp edges, and tapering to a point, as the Pine leaf (*Pinus* spp.). (Plate 91, fig. 1);

terete, elongate and round in cross-section, as the needle-leaved species of *Hakea* (Needle Woods or Needle Oaks). (Plate 91, fig 2);

linear, flattened and narrow, several times longer than broad, with parallel margins. (Plate 91, fig. 4);

subulate, narrow and tapering from base to apex, as the leaves in seedling trees of the Cypress Pine (*Callitris* spp.), Hoop Pine (*Araucaria Cunninghamii*). (Plate 91, fig. 6);

lanceolate, if elongate and tapering at both ends, as in Cabbage Gum (*Angophora lanceolata*). (Plate 91, fig. 7);

ovate, egg-shaped, with a broad rounded base and narrowed towards the apex, as in the coppice leaves of Spotted Gum and some other eucalypts. (Plate 91, fig. 17);

orbicular, circular or nearly so, as in the common garden Nasturtium (*Tropœulum majus*);

cuneate, wedge-shaped, broad and blunt at the apex and gradually tapering to the base, as in *Dodonœa cuneata.* (Plate 91, fig. 18);

triangular, the reverse to cuneate, broad at the base and gradually tapering to the apex;

spathulate or *spatulate,* shaped like a spatula, broad and rounded at the apex, long and narrow in the lower part, as the basal leaves of some herbaceous plants—e.g., the common Daisy, Flat Weed (*Hypochœris*), Cudweed (*Gnaphalium*), &c.

reniform, kidney-shaped, as in *Viola hederacea* (Native Creeping Violet);

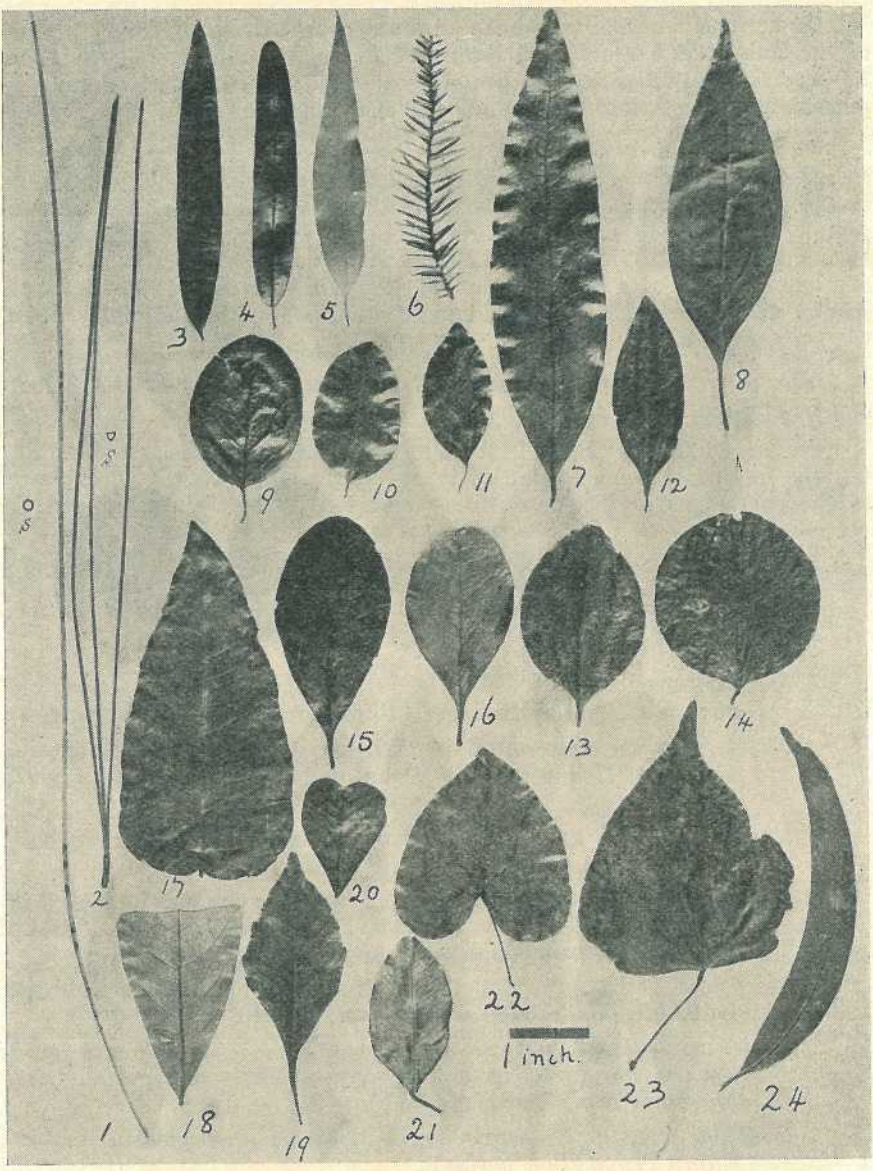


Plate 91.

SHAPES OF LEAVES.—1. Cat-o'-nine-tails (*Hakea lorea*) (*s*) section (terete). 2. Pine (*Pinus*) (*s*) section (acicular). 3. She Pine or Brown Pine (*Podocarpus*) (linear-lanceolate). 4. *Hovea longifolia* (linear). 5. Cabbage Gum (lanceolate). 6. Hoop Pine Seedling (subulate). 7. Black Sassafras or Oliver's Bark (lanceolate). 8. *Litsea dealbata* (elliptic-lanceolate or broadly-lanceolate). 9, 10, 11. Quinine Berry (9 and 10 oblong, 11 elliptic). 12, 13, 14. *Exocarpus latifolia* (elliptic, oval, and orbicular, respectively). 15 and 16. River Mangrove (obovate). 17. Spotted Gum coppice leaf (ovate). 18. *Cupania Wadsworthi* (cuneate). 19. *Pittosporum rhombifolium* (rhomboid). 20. Scrub Leopard Wood off young branches (obcordate). 21. Scrub Leopard Wood off flowering shoot (oblong-elliptic). 22 and 23. *Barklya syringifolia* (cordate and deltoid, respectively). 24. Spotted Gum off flowering shoot (falcate). All the above leaves with the exception of No. 2 are from more or less common native Queensland plants.

[*Photo., Department of Agriculture and Stock, Brisbane, from "Elementary Text-book of Australian Forest Botany."*

falcate, sickle-shaped, as the leaves of many eucalypts, *Persoonia falcata,* the phyllodes of many wattles, &c.;

cordate, heart-shaped, with two broad, rounded lobes at the base and a gradually tapering apex, as in the Stinging Tree and Gympie Nettle (*Laportea*).

Plate 92.

Compound Leaves.—1. Simply pinnate, leaflets opposite (*Cassia*). 2. Simply pinnate, leaflets alternate (*Murraya*). 3. Trifoliolate (Coral tree, *Erythrina*). 4. Bi-pinnate (*Cæsalpinia*). 5. Digitate (*Heptapleurum*).

When following the descriptions of a plant in a "Flora," it is seen that many intermediate forms are described and the degree of variation in leaves in the same species taken notice of; thus we may have the leaves of a plant described as varying from "lanceolate to ovate-lanceolate or ovate," and we get such compounds as cordate-ovate, elliptic-oblong, and so on, to denote intermediate forms between those described above. A greater range of terms than given above is illustrated in Plate 91.

Apex of the Leaf.—The following are the descriptive terms applied to the apex of the leaf:—

acuminate, drawn out into a fairly long point, as in the leaf of the Deciduous Fig (*Ficus Cunninghamii*), which is abruptly acuminate, or in the leaves of the Bleeding Heart, *Homolanthus populifolius,* and most Eucalypts, which are gradually acuminate;

acute, distinctly pointed at the apex but the point not very prolonged, as in the leaves of many eucalypts (Plate 91, fig. 5);

obtuse, blunt or rounded (Plate 91, figs. 15 and 16);

truncate, terminating very abruptly as if a piece had been cut off, as in *Dodonæa cuneata,* a Native Hop Bush (Plate 91, fig. 18);

retuse, terminating with a rounded apex with a slight depression in the centre;

emarginate, blunt, with a distinct notch in the centre (Plate 91, fig. 20);

mucronate, blunt, with a sharp, stiff, projecting point in the centre, as in Red Mangrove (*Rhizophora mucronata*);

cuspidate, tapering gradually into a sharp, rigid point, as in the Bunya Pine.

Insertion of the Leaf.—Various terms are in use to describe the method of insertion on the stem, which varies considerably in different species of plants. The terms *petiolate* and *sessile* have already been explained.

With respect to the mode of attachment, leaves are—

peltate, when the petiole is fixed to some point of the leaf distinctly within the margin, as in *Tropæolum* (garden Nasturtium);

auriculate, when sessile with two rounded lobes at the base, as in the Milk Thistle or Sow Thistle (*Sonchus*);

decurrent, when the blade is continued down the stem so as to give the latter a winged or angled appearance, as in the native Cypress Pines (*Callitris*);

connate, when the bases of two opposite, sessile leaves are united together so that the stem passes through them, as in the upper leaves of some species of Honeysuckle or *Lonicera* (common garden plants).

Parts of a Compound Leaf (Plate 92).—The continuation of the petiole in a compound leaf which corresponds to the midrib of a simple leaf is called the *rhachis,* and when the leaflets are arranged along each side of it, the leaf is said to be *pinnate.*

When the leaflets are opposite and the rhachis ends in an odd leaflet, as in the rose, the leaf is said to be impari- or odd-pinnate, or when there is no odd leaflet at the apex it is said to pari- or abruptly pinnate, as in the leaves of different species of *Cassia* (Plate 92, fig. 1).

Often a compound leaf is described by the number of leaflets it possesses, and is said to be 2-, 3-, 4-*foliate,* and so on.

In many plants with compound leaves the leaflets are themselves completely divided in a pinnate manner, in which case the leaf is said to be *bi-pinnate* (Plate 92, fig. 4); the leaflets are called *pinnæ* and their segments or secondary leaflets *pinnules;* such cases are seen in the feather-leaved sorts of wattles (*Acacia decurrens, A. spectabilis, A. Baileyanan,* &c.), in the *Poinciana, Jacaranda,* different species of *Caesalpinia,* &c. If again these are completely incised, the leaf is said to be *tri-pinnate,* as is sometimes found in the White Cedar (*Melia*) and and in the fronds of some ferns.

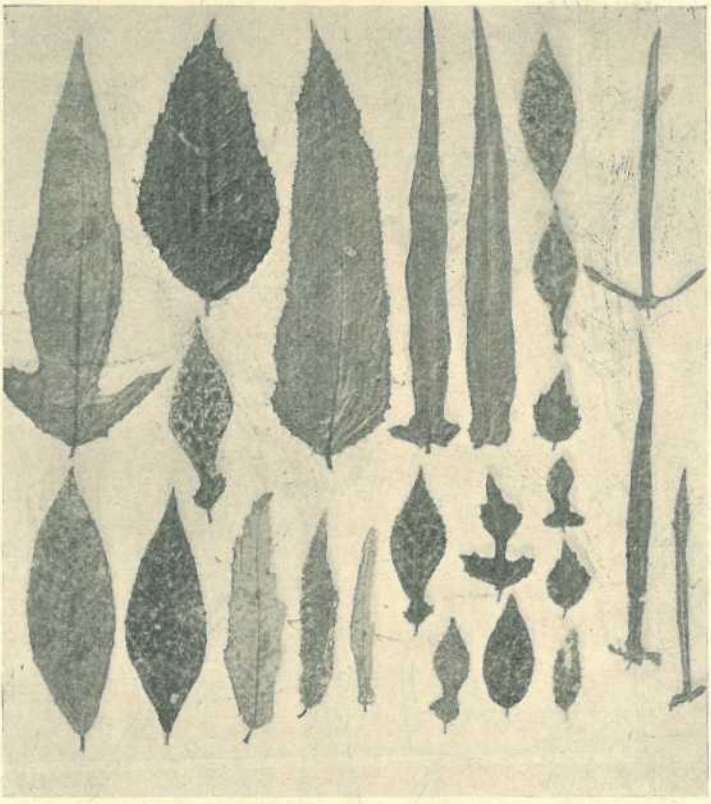


Plate 93.

Heterophylly in coppice leaves (stump shoots) of Whalebone Tree or Axehandle Wood (*Pseudomorus Brunoniana*) (⅓ nat. size).

[*Photo. by A. G. Hamilton.*

In a palmately compound leaf the leaflets come off at one point, which in the case of stalked leaves is the apex of the common petiole. When a compound palmate leaf is composed of three leaflets it is said to be *ternate.*

A compound palmate leaf, as in the Black Jack (*Tarrietia actinophylla*), Umbrella Tree (*Brassaia actinophylla*), &c., with four or more leaflets is often described as *digitate* (Plate 92, fig. 5).

Generally speaking, beginners or persons not possessing any knowledge of botany look upon a leaflet of a compound leaf as a complete leaf, and the rhachis as a leaf-bearing stem.

Very often, in the same way, the simple leaves of certain plants are looked upon by beginners as leaflets of a compound leaf.

Many of the leaf-bearing branches of certain *Euphorbiaceæ* and other simple-leaved plants simulate pinnate leaves, the common creek-side tree *Glochidion Ferdinandi* furnishing an example.

If we examine a shoot of this tree we will notice—

(*a*) That small buds may often be found in the axils of the leaves—no bud is normally found in the axil of a leaflet or its rhachis.

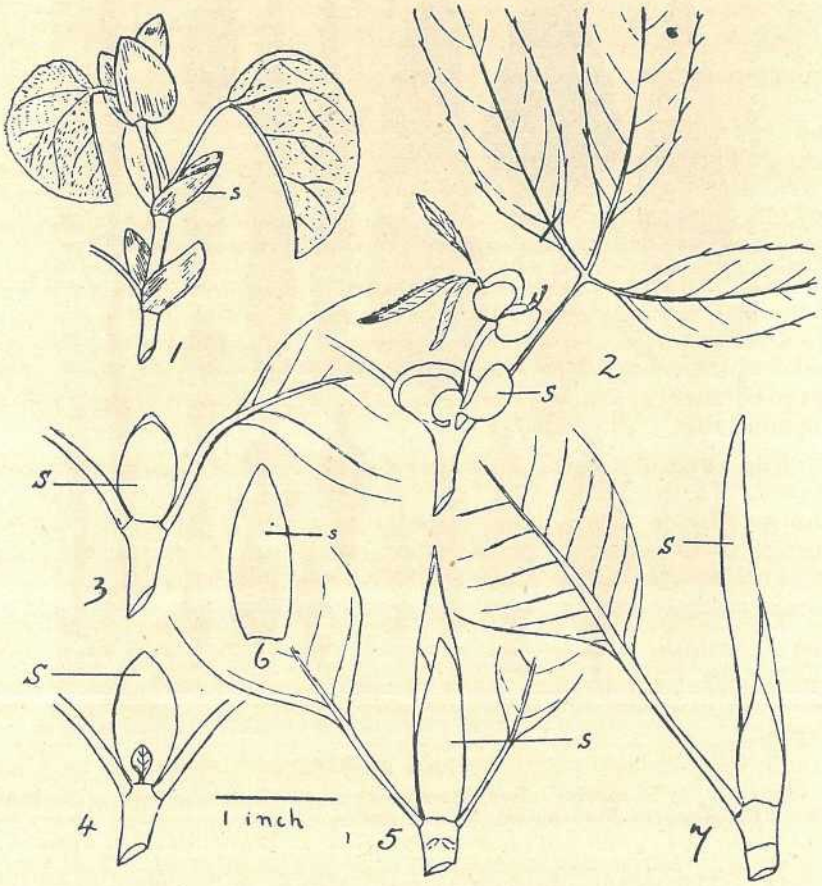


Plate 94.

STIPULES (*s*) OF SOME EASTERN AUSTRALIAN TREES.—In the cases here figured the stipules are soon deciduous, being only found on the young branches, and their main function is to act as a protection to the young and growing bud.

1. Cotton Tree (*Hibiscus tiliaceus*). 2. Red Carrabin (*Geissois Benthami*). 3. Leichhardt Tree or Canary Wood (*Sarcocephalus*). 4. The same, one interpetiolar stipule removed to show the bud within. 5. Black Mangrove (*Bruguiera*). 6. The same, an enfolding stipule removed and flattened out to show the shape. 7. Moreton Bay Fig (*Ficus macrophylla*).

(*b*) Clusters of small flowers and fruits are found here and there along the shoot—no flowers or fruits are ever normally found on the petiole or leaf-rhachises.

(*c*) It may have an apical bud—no compound leaf normally bears an apical bud.

Some plants bear compound leaves composed of a single leaflet; the Orange furnishes a familiar example of what is called a *unifoliolate* leaf. It can be distinguished from a simple leaf by the fact that the expanded lamina is articulate on the winged petiole, which in this case is not continued as the midrib of the blade.

When leaves vary considerably in size and shape on the same plant they are said to be *polymorphic,* and the plant itself is said to be heterophyllous; *Hibiscus heterophyllus* (Native Rosella), *Solanum aviculare* (Kangaroo Apple), *Brachychiton acerifolium* (Flame Tree), many of our Proteaceae (Plate 93), &c., furnish examples of heterophylly in trees and shrubs. Where a plant bears leaves of two distinct types the leaves are said to be dimorphic; thus the leaves of seedling Hoop Pines, Cypress Pines, Moreton Bay Fig, Narrow-leaved Bottle Tree (Plate 90, fig. 6), and others, are very different from those in the adult trees, and the same is seen in the seedling and coppice growths of Eucalypts.

Most aquatic plants exhibit noted dimorphism, the submerged leaves and floating or ordinary exposed leaves, where both are present, often present marked differences. In some climbing plants the flowering and fruiting branches bear leaves markedly different from those of the barren branchlets; this is well seen in the Ivy (*Hedera Helix*) and the Creeping Fig (*Ficus pumila*).

The leaves of young plants are often larger than those of the mature growth. In the Wheel of Fire (*Stenocarpus sinuatus*), the leaves of young trees or of coppice shoots are large and pinnately divided, whereas in the mature tree, generally speaking, not always, the leaves are much smaller and only once or twice lobed, or entire.

The reverse happens in many cases, especially in compound-leaved plants; thus the first few leaves in seedlings of the Tulip Tree (*Harpullia*), the Native Tamarind (*Diploglottis*), and other Sapindaceae, Meliaceae, &c., are quite simple and entire, but are all pinnate on older plants.

Pulvinus.—The base of the leaf in many plants becomes thick and fleshy, and forms a cushion-like mass of tissue known as the *pulvinus;* this is especially well marked in many leguminous plants *Poinciana, Cæsalpinia, Mimosa* (or Sensitive Plants), *Acacia* (bi-pinnate species), &c. It is an irritable organ, and is very sensitive to light and various external stimuli, and by it the leaf can alter its position and so can not only protect itself from various external influences as hot and dry atmospheric conditions, but can place itself to the best advantage for receiving light.

Stipules (Plate 94).—Many leaves bear at their base two more or less noticeable bodies, one on either side of the petiole; these are known as stipules, and a leaf which bears them is said to be *stipulate,* and one which does not *exstipulate.* When these lateral outgrowths are found at the base of a leaflet they are called *stipels* or *stipellae.*

Stipules may be large and conspicuous, as in the young leaves of Carrabin (*Geissois*) (Plate 94, fig. 2) and Leichhardt Tree (Plate 94 figs. 3 and 4), or they may be small, as in many species of Tick Trefoil (*Desmodium*). Stipules often fall away before the full development of the leaf, as in the Moreton Bay Fig, &c. (Plate 94, fig. 7), the Flame Tree, &c.), and the Cotton Tree (*Hibiscus tiliaceus*) (Plate 94, fig. 1), in which they act as protecting organs to the young leaf.

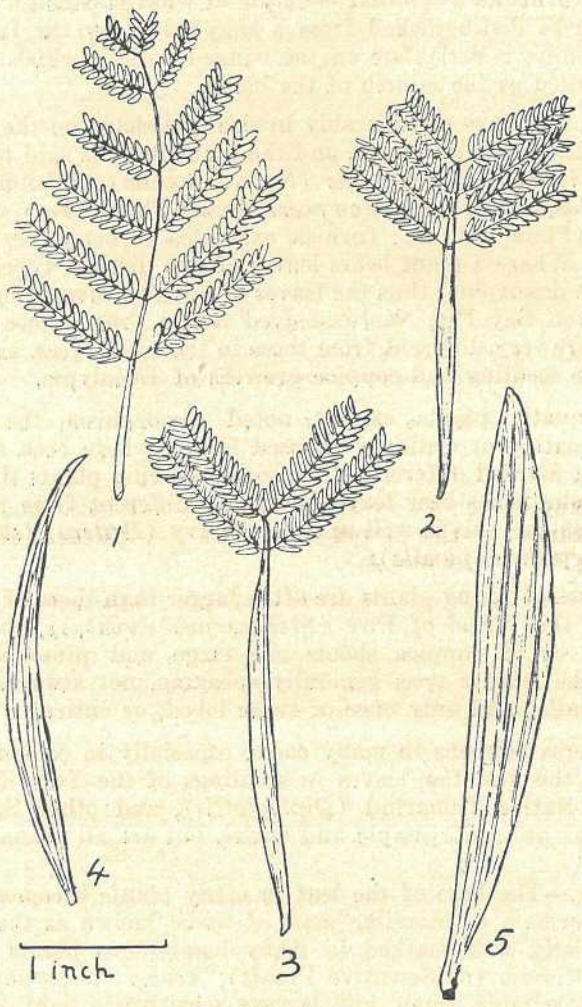


Plate 95.

EVOLUTION OF THE PHYLLODE IN WATTLES.—*Acacia implexa*—1, 2, 3, and 4. Specimens taken from a fair-sized tree showing reversion shoots. In fig. 1 the leaf rhachis is terete or slightly angular, and is in all respects a typical pinnate leaf. In figs. 2 and 3 the rhachis is flattened and bears several pairs of pinnæ in the upper portion. In fig. 4 the rhachis is flattened, the pinnæ have been dropped and a typical Acacia phyllode formed. Fig. 5. Phyllode taken from large trees bearing typical phyllodes only.

Stipules may be free, only adhering by the base to the petiole as in the Moreton Bay Fig, or they may adhere by their inner margins for nearly their whole length to the petiole, in which case they are said to be *adnate*, as in the common garden rose.

In many plants with opposite leaves the stipules of one leaf become more or less united to the stipules of its opposite neighbour, so that there seem to be two large stipules, one on either side of the stem; they are termed *interpetiolar stipules,* and are well seen in the Leichhardt Tree (*Sarcocephalus*) (Plate 94, figs. 3 and 4), the Coffee, and many other plants of the family *Rubiaceae.* Interpetiolar stipules are often caducous, their main function being to protect the young immature leaves.

In many species of *Capparis* (Capers), the stipules are developed as small thorns, which are often hooked and aid the plant in climbing, as in *Capparis lasiantha* (Mulpup or Nipang) and *C. sarmentosa.* In several other plants they are also metamorphosed into spines, probably to repel herbivora. This may be seen in the Mimosa Bush and other certain species of *Acacia* (e.g., *A. farnesiana, A. horrida, A. Bidwillii, A. arabica,* &c), in *Robinia pseudacacia,* and in the Algaroba Bean (*Prosopis juliflora*).

In the Bumbil Tree or Native Pomegranate they are present on the young trees on lower branches, but disappear from the adult branches on larger trees.

Leaf-base.—Sometimes the leaf base is differentiated considerably from the rest of the leaf. This is particularly noticeable in a grass leaf, the base of which generally enfolds the stem in a sheath often of considerable length; at the top of this leaf-sheath is borne a small structure known as the *ligule* or *ligula,* the character of which—whether ciliate, jagged, or truncate, and so on—is an important feature to record when differentiating species of grasses, and if not present its absence should be noted, as in Japanese Millet and White Panicum.

Leaf Metamorphosis.—Leaves or their parts are often modified in various ways in order that they may be able to serve other functions than those of the ordinary foliage leaf.

(*a*) *Leaf Tendrils.*—Leaves or parts of leaves may form *tendrils* which cling round other bodies for support, fixing the plants and helping their upward growth to the air and light.

In *Flagellaria,* a "Supple Jack" of the coastal "brushes" or scrubs, and in *Gloriosa,* cultivated as an ornamental climber, the end of the leaf forms a spiral coil, which acts as a tendril; in the common garden Pea (*Pisum sativum*) several of the end leaflets form tendrils.

(*b*) *Pitchers.*—In certain plants the foliage leaves are modified into remarkable traps for catching small insects or collecting water.

In different species of *Nepenthes,* plants fairly common in the extreme north of Queensland, New Guinea, and Tropical Asia, and many of which are cultivated in hothouses, the lamina is metamorphosed into a *pitcher* or *aecidium,* bearing at its top a lid which is a development of the apical portion of the lamina, while the petiole in its lower portion is winged, and has a resemblance to and performs the functions of a typical leaf blade in addition to those of a petiole. The pitchers contain a certain amount of water, and a digestive ferment (pepsin) is secreted so that insects falling into the water in the bottom of the pitcher are first drowned and then digested. Other Australian plants forming leaf pitchers are the West Australian Pitcher Plant (*Cephalotus follicularis*), and certain species of *Dischidia,* epiphytic plants found growing on trees in tropical Queensland.

(*c*) *Leaf Spines.*—Occasionally leaves are metamorphosed into spines; the Gorse (*Ulex europæus*), a European plant naturalised in many places in Australia, provides an example. In this case the young seedling bears trifoliolate leaves, but in the older plants the branches, as well as the leaflets, are metamorphosed into spines. Many thistles and other plants bear spines as outgrowths of the margins, and the modification of stipules into spines has already been referred to.

(*d*) *Phyllodes.*—In some plants, the leaf-stalk is flattened to resemble and perform all the duties of a leaf blade—when it is known as a *phyllode*. Most of the Australian Wattles possess phyllodes in place of true leaves. In their case the phyllode is formed not only of the flattened leaf-stalk but the leaf-stalk and rhachis.

If a seedling wattle is examined the leaves will be seen to consist of two distinct parts, (1) a flattened leaf-stalk or petiole, and (2) a bi-pinnate leaf-blade or lamina, but as the plant develops these latter are shed, and in older plants they may not be developed at all. Some species, however, retain them much longer than others, and many carry them even when quite large plants. This is true of the great majority of Australian Wattles, although a few, such as *Acacia decurrens* and *A. Baileyana* (the Cootamundra Wattle), bear only typical foliage leaves throughout their whole existence.

That the Acacia phyllode is not the flattened leaf-stalk alone is proved by the fact that numerous transition forms between it and the ordinary bi-pinnate leaf occur. As the bi-pinnate leaves are generally conceded to represent the primitive type of foliage of the wattles and the phyllodes have simply been evolved in response to the dry conditions prevalent in Australia these intermediate forms between the bi-pinnate leaves and the phyllodes are spoken of as *reversion foliage*, and the shoots on which they are borne as *reversion-shoots*. Reversion-shoots are often seen on adult trees, but are absent from seedlings. Another fact is that the average petiole of the bi-pinnate leaf of a wattle is comparatively short—in the longest not being 3 inches, whereas euphyllodes up to 20 inches occur, while ones of 5-9 inches are very common—perhaps an average. The evolution of the Acacia phyllode is shown in Plate 95.

An interesting case in which a species—*Acacia rubida*—typically phyllodineous bore flowers and ripe pods on plants bearing bi-pinnate leaves only has been recorded. In a few wattles, such as the Blackwood (*A. melanoxylon*), and the Broad-leaved Sally Wattles (*Acacia implexa* and *A. maidenii*), though ordinarily dropping the pinnate leaves and forming phyllodes only when a few inches high, in moist sheltered positions may attain a height of 5 feet before producing any phyllodes.

[TO BE CONTINUED.]

Some Pasture Problems of Western Queensland.

Dr. E. HIRSCHFELD and R. S. HIRSCHFELD.

(*Read before the Royal Society of Queensland.*)

TO make grass grow where grass did not grow before is a noble aim. Wherever the soil is quickened into a heavier yield more men and women find new homes.

Plate 96.

Virgin Country on Bybera, the Property of Dr. E. Hirschfeld, in the Inglewood District.—Standing Brigalow and Belah scrub.

Plate 97.

Similar country after ringbarking prior to its being fired and put under grass.

Mitchell grass is the greatest of our pastoral grasses; but a Mitchell pasture has one great drawback—it is not heavy carrying country. Though most nourishing in themselves, the clumps of grass, except in an unusually good season, grow far apart, leaving bare patches between them.

In 1933, 5 acres were ploughed in one of the experimental paddocks of Bybera, and about sixty different plots were sown with imported and native grasses. They were then left entirely to themselves. It was obvious that in these experiments, if they are to be of any practical use, the pastures cannot be pampered, or else the test would not hold good for our large western grazing properties. So the grasses were left to fend for themselves, except that the stock was shut out or admitted, according to our discretion. It must be mentioned that the last good rains we had were in December, 1934, and January, 1935. Since then we have had a severe dry spell, being short by more than 12 inches in our rainfall over a period of twelve months. The deficiency of rain, though unwelcome to our stock, was of great value in testing the endurance of the grasses.

Plate 98.
A paddock of sown Mitchell grass on Bybera, Brigalow scrub in background.

Three years have gone. Of the imported grasses all have disappeared except one. Of the native grasses Mitchell, Flinders, and Brigalow have not only survived but flourished. A number of other native grasses are also growing but not flourishing. On the other hand the Mitchell is spreading over the paddock in the direction from south-west to north-east, and there beating the local native grasses. Westerly winds prevail when the seed is falling, and carry it in an easterly direction. The most remarkable feature about the stands of Mitchell is that they have thickened year by year, getting closer to each other, until, at the present time, they have become almost a continuous stubble covering the former bare patches. As mentioned before, the rain during the last season has been 12 inches short of our average.

We do not wish to weary you with all the "ins and outs" of our experiments, but will try to give you a connected story of our findings.

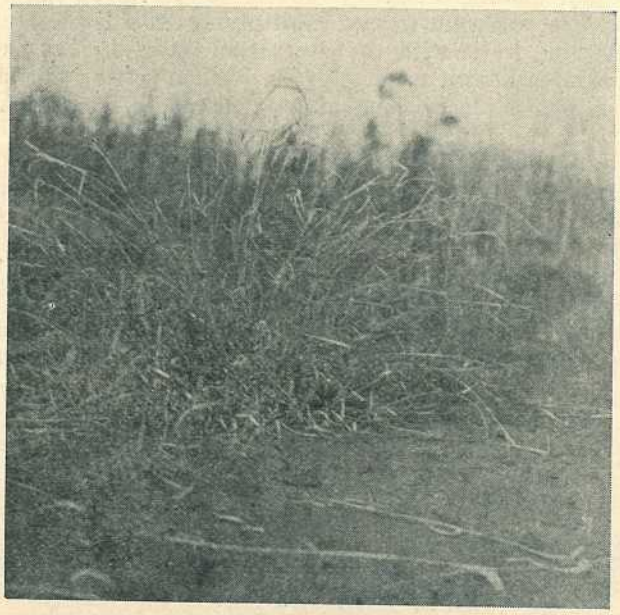


Plate 99.
Close view of Mitchell grass tuft or stool.

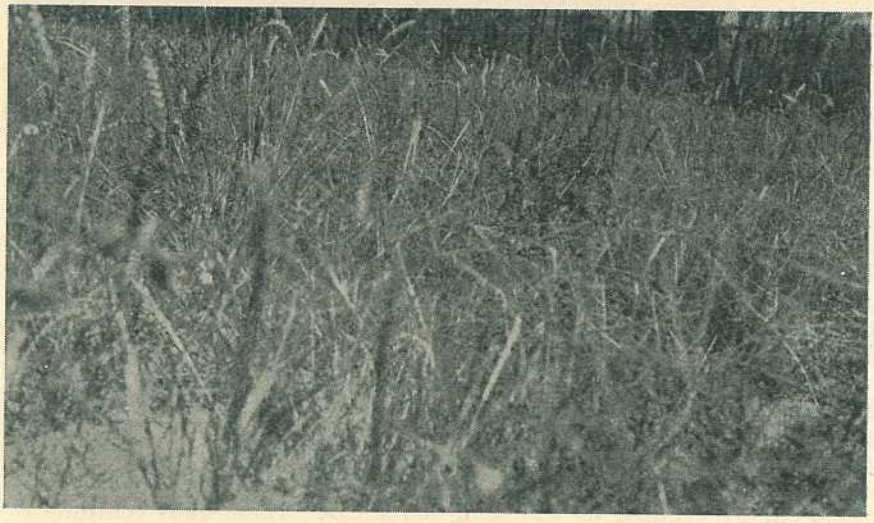


Plate 100.
A fine stand of sown Mitchell grass showing well-filled seed-heads.

Beasts and plants breed by means of fertilized seed. Plants, however, have yet a second way of multiplying; this is the asexual way, which has nothing to do with the generation by seed. Let us quote an every-day example known to most of us. When setting out strawberry plants the gardener places them at long distances from each other so that they may have sufficient space to send out runners over the intervening ground. From these runners, at short intervals, roots spring and enter the soil, forming new and independent strawberry plants. Many grasses show a similar habit of sending out runners and striking root at each joint. The lawn of buffalo grass is due to its asexual way of propagating. Rhodes grass owes its reputation as a quickly-growing pasture to its vigorous runners, and so does kikuyu. As a matter of fact the virtue of these plants as pasture grasses lies far more in the asexual way of multiplying than in the "legitimate" sexual generation from seed.

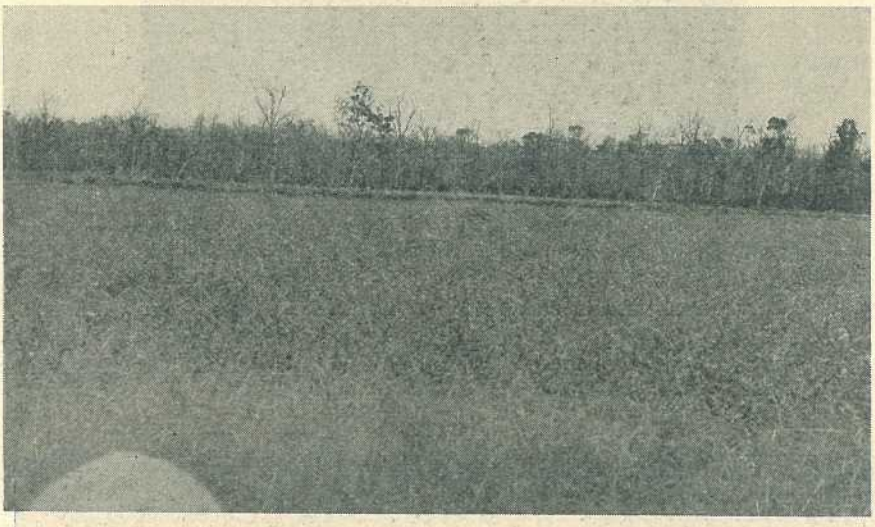


Plate 101.
A paddock of sown Flinders grass on Bybera.

Mitchell grass does not send out any runners. For the secrets of its growth we have to search in the roots. A Mitchell grain is planted; after a few weeks a single stalk emerges from the root. Soon the stalks increase in number and form a clump. When digging up such a clump of Mitchell three or four months old, or the older the better, we find a dense network of fibrous roots striking downwards deep into the ground. But within an inch or two below the surface a mass of buds becomes visible. These buds surround the roots like links of a chain, each being packed close upon the other; they are always arranged concentrically, the youngest buds outside, the older ones inside. From each bud springs a stalk; as the number of buds increase so increases the number of stalks and, of course, the size of the plant. In one clump several (three) years old we counted no less than 136 stalks. These buds continue to form and send forth stalks while the grass is growing. As the stalk is eaten off by the stock the bud to which that stalk belonged gradually shrinks and dies, making room for the newer buds.

Now the summer comes to an end; the grass above the ground dies off. It requires a continuance of cold weather to stop the growth of Mitchell. We had several frosts as low as 23 deg. F., and yet, as the weather warmed up again in this mild season, the Mitchell started to shoot again.

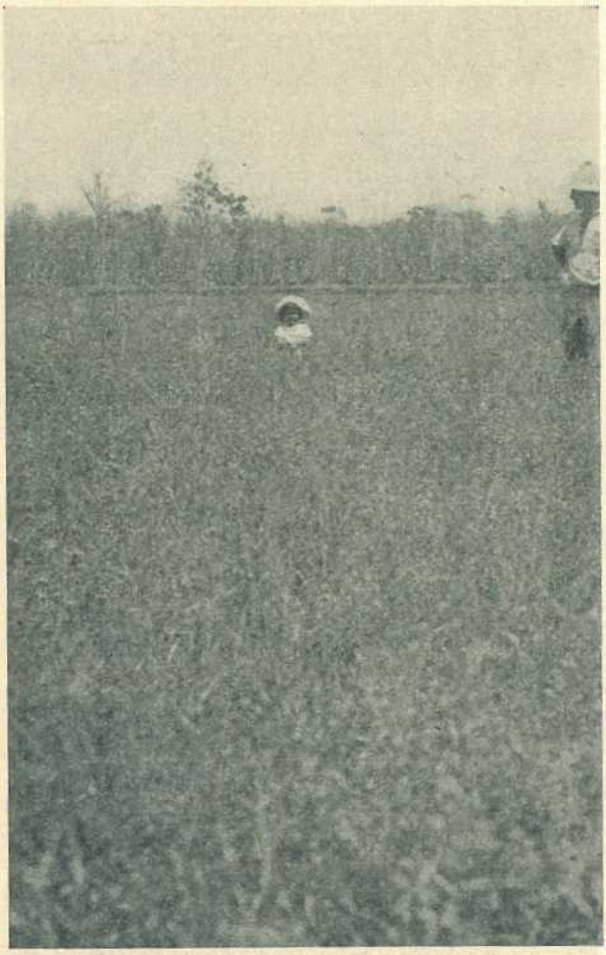


Plate 102.

How Flinders Grass flourishes in its new Environment.—A well-covered paddock on Bybera.

The live buds below the ground do not die with the coming of the winter; but they are no more capable of sending forth stalks. Some of them gradually enlarge into decent-sized kernels shaped almost like a bean except that they taper towards the free end. The biggest we measured was ¾ inch in length. The kernel itself when cut open lengthwise consists almost entirely of whitish nutritious matter encased in several sheaths of thin, fibrous tissue. The arrangement of these sheaths reminds one of the membranes with which important organs in man are clothed for their protection. It is another instance of the jealous care

with which Nature watches over all the means of reproduction. These close-fitting sheaths envelop the kernel as a number of coats do a man in rough weather. They shield it against the cold, against the wet, and against drying; thus they safeguard our most valuable fodder plant. If it had not been for these kernels with their protecting sheaths the crop of Mitchell after the breaking of the drought would have been disappoint-

Plate 103.
Saltbush on Bybera 7 feet high.

ing. When the winter rains came in the West twelve months ago it was these protective sheaths which prevented the moisture from gaining access to the kernels; otherwise they would have rotted or sprouted, and either would have been disastrous, for the cold following would have nipped and killed the tender shoots that had ventured above the ground.

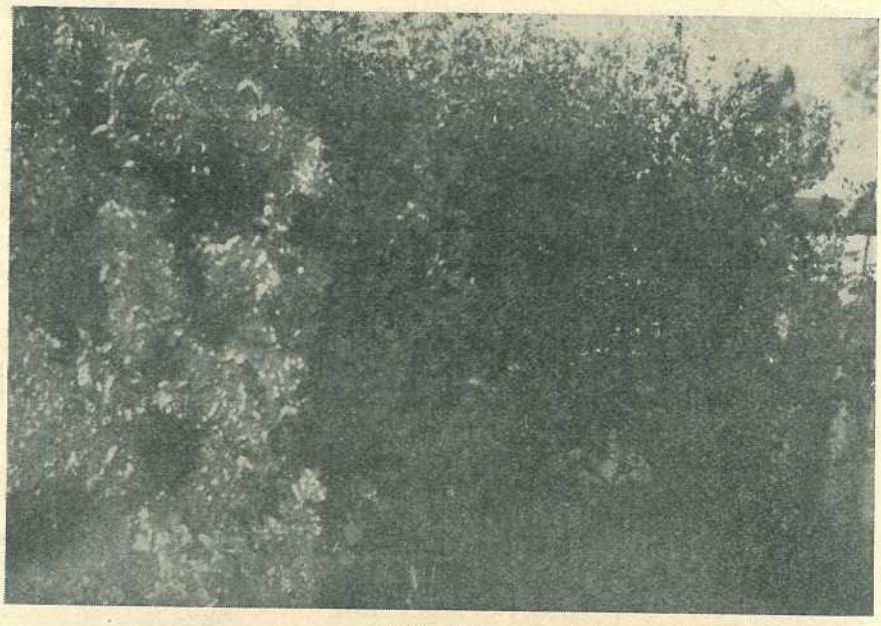


Plate 104.
A saltbush hedge bordering the Bybera homestead garden.

Plate 105.
Apple Trees on Bybera.—Cool shade for stock is provided by the apple tree family.

But the kernels are not only the source from which a new plant springs in the coming summer, but they are also the winter storehouse of the Mitchell plant.

If science was not aware of these kernels, sheep certainly knew of their existence; they burrow for them and maintain life on them when the ground above is apparently bare of feed. Cobb and Co. were another party that must have known something about these buds and kernels. An old pastoralist with whom I discussed these matters informed me that Cobb and Co. used to buy Mitchell grass roots at so much per bag. The men who looked after the horses at the stopping places are said to have made a good thing out of collecting and selling Mitchell roots.

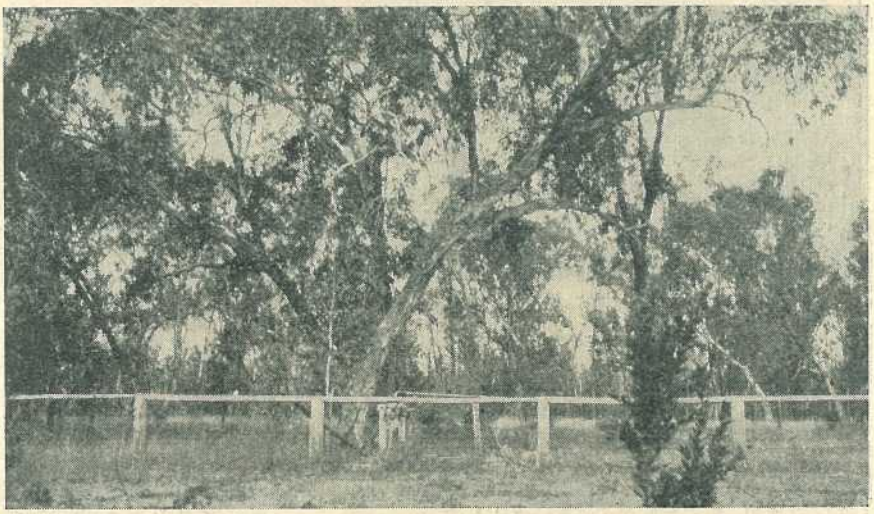


Plate 106.
"Leatherjacket" clump on Bybera.

Now we come to the practical application of these purely biological observations. We vision the Mitchell grass as it is growing in the summer. When a herd of bullocks are grazing in the paddock the first thing they pay attention to are the tender green shoots coming up from the buds surrounding the root. They are more succulent than the older stalks, which bear the seed heads. This stimulates the plant into forming new chains of buds and the new buds into sending forth more green shoots. An old plant that has been frequently fed off stools out into a larger and larger clump, with a dense mass of buds, the new ones at the outside being, of course, the youngest. Horses are partial to the seed heads, which are the plums in the pudding. But as horses do not chew the cud many of the seeds encased in glumes pass undigested through the intestines; hence horses become distributors of the seed. Sheep mostly confine their attention to the young shoots, bullocks eat shoots, seed heads, and also the stalks as feed gets scarcer.

But all this stooling out cannot go on indefinitely. If all the shoots are eaten off and not allowed to come to maturity no seed heads would form. In this case we should be deprived entirely of the sexual way of

propagating the Mitchell by the seed. In shutting up the paddock about the middle of February we allow the stalks to grow up, form seed heads, and provide the seed for next year's grass. It is not necessary to keep the stock out till all the seed has fallen. The stock may be admitted while a good deal of the seed is still on the ear. The stock in breaking off the blades shakes the seed out of the ear and makes it fall to the ground. At the same time it tramples the seed into the soil, and in this way acts like a harrow.

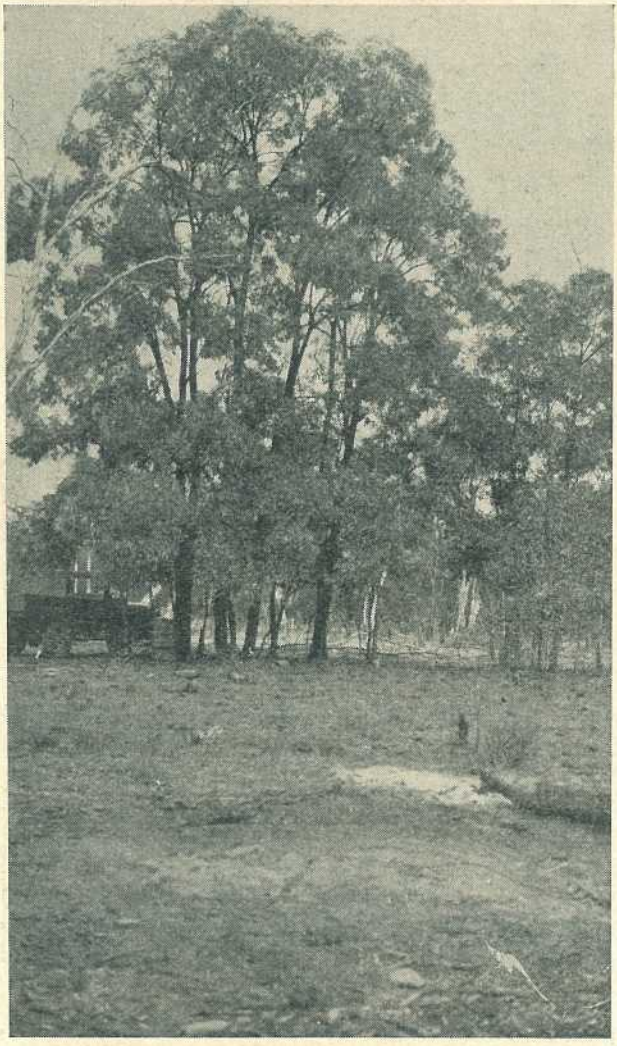


Plate 107.

A Brigalow grove retained as a future cattle camp on Bybera. Where clumps of Brigalow have been retained in the course of clearing on similar country a beautiful park-like landscape has been obtained.

You will thus see how we obtained our denser growth of Mitchell grass by making use both of the sexual and asexual method of propagation. We increased the size of the individual clump by allowing the

stooling plant to be fed off to the stock and thereby stimulating the asexual growth. In observing a brief close season while the grass was seeding we aided the sexual propagation by means of the fertilized seed.

A close season for grasses whilst they are seeding is as necessary as a close season for animals whilst they are breeding.

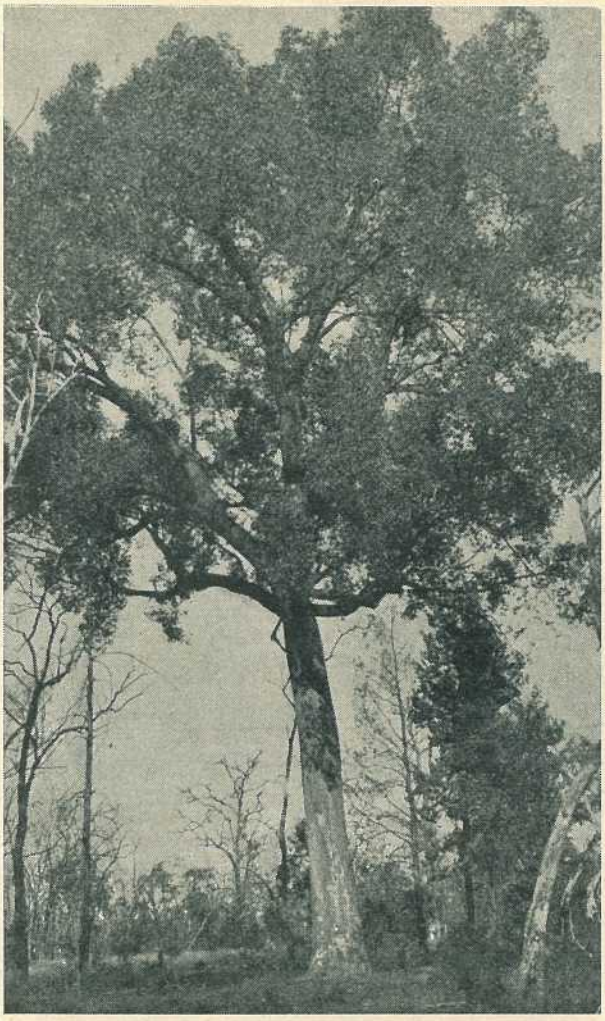


Plate 108.

A fine specimen of Kurrajong, one of the most useful of our native trees. The bole from the base to the first limb is about 30 feet in height.

No farmer could afford to feed his seed wheat to his stock. Neither can the grazier afford to kill the goose before it lays the golden eggs. He must protect his Mitchell grass whilst it is coming into maturity. To shut up paddocks in rotation at seeding time is really not a very great hardship, as February and March are the months when grass, as a rule, is most abundant in Queensland.

It is the close season for grasses which enables us adequately to provide for the next year's crop of Mitchell grass, and also for a denser growth of our best fodder plant.

RE-MINERALISATION OF THE SOIL.

We breed Aberdeen-Angus cattle on Bybera. The black poll is an early-maturing beast, which means that he has to build up his frame mainly in the first twelve months of his life. During the nine months the cow is carrying its offspring and whilst the calf is being suckled by its mother the soil has to furnish through its plants an unusually large amount of lime salts, phosphorus, and a number of other minerals. For mineral salts are builders of bone and builders of tissue.

Plate 109.

The butt of the same Kurrajong, 21 feet in circumference at the base.

Bybera is principally brigalow and belah country just ringbarked, and therefore practically maiden ground. It is rich in lime, but like all our western country, carries but a moderate amount of phosphorus. Although the mineral exhaustion of our soil was not a danger likely to threaten us for many years to come, we began seriously to consider whether and what steps were advisable to counter it. Going into this opened up a very large subject which we believe to be of far-reaching importance for the whole of the State.

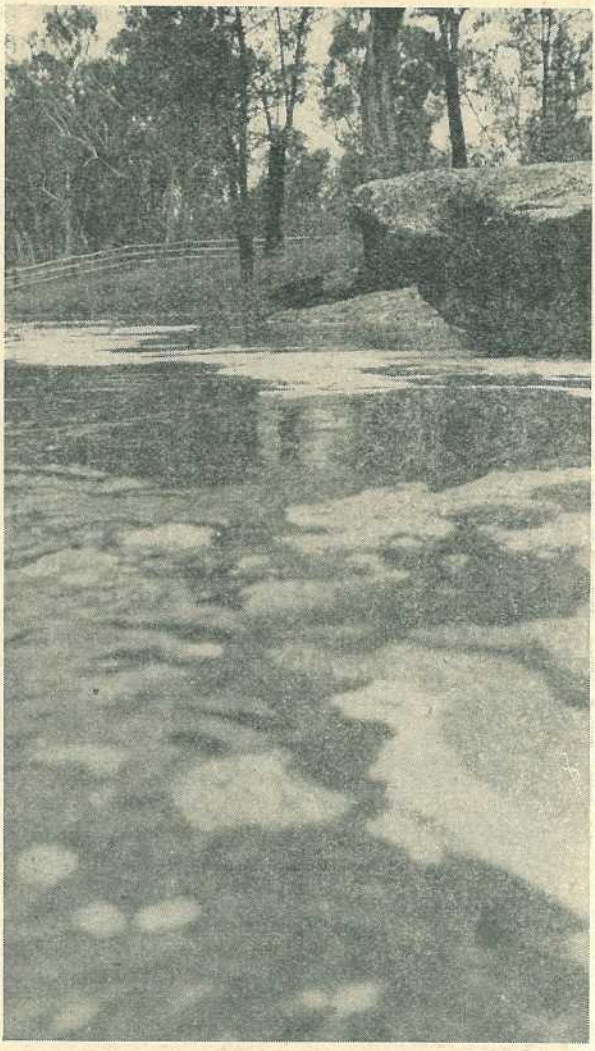


Plate 110.
A fresh in Commorin Creek, on Bybera.

Queensland has turned off its pastures annually during the last twenty-five years more than 500,000 head of cattle. Taking each bullock at an average of 6 cwt. it is easy to compute how much this country has been losing each year in mineral salts. Five per cent., or the

twentieth part of a beast, is represented by mineral matter, mostly phosphates of lime, contained in its bones and to a small extent in the other organs. This means that Queensland loses yearly at least 15,000,000 lb. of mineral salts. This does not take into account the mutton we send away, nor the butter, nor numerous other products of the soil. Without piling up the agony and overwhelming you with numbers, just keep in mind these 15,000,000 lb. of mineral matter being lost each year to the Queensland soil. It is true that the figure is becoming gradually lower, as we go back beyond 1910, right up to the beginning of the pastoral industry, but we have been grazing our country for the greater part of 100 years; during all that time it has always been a loss, and never anything put back. No soil, no matter how rich it is to begin with, can stand such a continuous drain. The consequences have been slow in coming, but they have come.

Plate 111.
Water supply at No. 2 bore, on Bybera.

Our better grasses, such as Mitchell, Flinders, browntop, and others, all of which require a high standard of living, are giving way to the poorer sorts, which are content with an impoverished soil. In the far West, where the soil was poor to start with and the rainfall less, even the poorer grasses are losing their roothold. They die. As they perish the desert creeps on and buries beneath its sand dunes what had been once a pasture.

A property devoted to breeding stands in need of pastures rich in phosphorus. *A cow carrying her calf, during part of that time requires fourteen times as much phosphorus as a bullock does of the same age.* Hence Nature provides that a sufficiency of phosphorus favours reproduction, whilst lack of it makes animals less fertile.

It was this consideration mainly which induced us to experiment with licks of varying composition. These licks were exposed close to where the stock was watering, and the animals that felt the need of it could use it. Man chooses his food according to his desires, and these desires are shaped by the instinctive needs of his body. A beast is not

so fortunate; it has to be satisfied with what his pasture has to offer. The pasturage may be wanting in some ingredients, yet the beast has to put up without it, just as sailors of 100 years ago had to put up with scurvy because they lacked fresh vegetables and fruit. The animal lives, grows, and breeds, yet it does not thrive. In a poor season, be that due either to less rain or a severe winter, the older cows will die before their time.

The experiments will not be complete for some time to come. The only obvious result, so far, is that we realised this season an exceptionally good price for our weaners, though we had been 12 inches short in our rainfall.

Plate 112.

The delivery pipe at No. 3 bore. When first tested the flow was 960 gallons an hour. It has since increased to 1,100 gallons. Water couch grass is growing on the batter of the tank, and as the water rises it spreads over the surface to some distance from the bank, thus probably reducing evaporation to an appreciable extent.

Some years ago a Belah tree had been cut down; the cattle left the grasses upon which they had been feeding, and devoted their attention to the fallen tree, which they picked clean of the leaves. Wondering why the stock should have preferred the leaves to the grasses, I surmised that probably they were desirous of a change of food, perhaps on the principle that the grass on the other side of the fence was always greener. Last April, while walking along the banks of Commorrin Creek which runs through our property, it was brought home to me, as it is probably brought home to everybody at one time or the other, how deep the roots of a tree can go down into the ground, and what an opportunity a tree has of feeding upon strata not accessible to an ordinary plant. In their search for food the roots spread and penetrate in all directions, even splitting up rocks and leaching out the nutriment they stand in need of.

Thus the tree would be able to tap a supply of minerals not available in the surface and subsoil. These minerals would mount through the sapwood and be used for the building up of the leaves. As the leaves fall to the ground and decay the minerals would be set free, enriching the surface soil quiet apart from the humus they form. *The living*

tree would thus be the means of re-mineralising our soil. Whether this train of reasoning was correct or otherwise could be easily settled by experiment.

A pound of leaves was collected from a number of trees well known as fodder trees—the Wilga, the Belah, and the Bulloak; also from a shrub which is known to be deep rooted—Old Man Saltbush. These leaves were submitted to the Agricultural Chemist for analysis.

Plate 113.

Windmill over a sub-artesian bore on Bybera. A recently burnt brigalow falling in the foreground.

The result is arresting. The Wilga leaves carry from three to ten times as much lime and at least as much phosphorus as the Mitchell grasses; the Belah about four times as much lime, but not as much phosphorus; the Bulloak, of which only the young shoots were collected, as they are greatly favoured by sheep, is still rich in lime and fairly rich in phosphorus. The most surprising result, however, is furnished

by Old Man Saltbush, which is richest in phosphorus and also abounds in lime; it shows nearly as much lime as the Belah, which was the starting point of our investigation.

Mr. Gurney, the Chief Agricultural Chemist, with whom I discussed the result, went through his records, containing the analysis of past years, which fully confirm the above results. Boree and Gidyea leaves from the Blackall district exceed even the Wilga in lime, though they were not so good in phosphorus. Mulga leaves from Charleville made quite a respectable showing. Many more may be quoted.

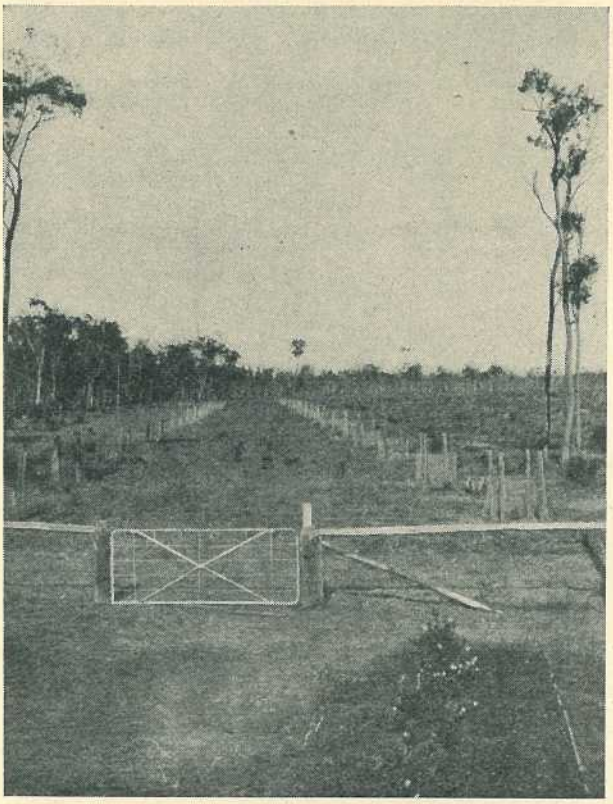


Plate 114.

A newly-planted avenue of native trees leads to the entrance to the Bybera Homestead.

I do not suggest that all these trees can take the place of grasses in feeding stock continuously. Some contain other substances which ultimately prove injurious. The Belah leaves, for instance, are rich in fibre which, after a while, tend to form into a ball in the stomach—especially in sheep, who, like cattle, are eager for them at first on account of the mineral ingredients. But all this does not lessen the value of trees, even of those that cannot be called fodder trees. **Many, if not all of them, act as re-mineralisers of the soil.**

On the basis of our experiments we wish to make the following proposals:—

First: In ringbarking country exceptionally large trees should be spared. The Forestry Department rightly exempts trees economically valuable, like ironbark, pine, and others. A grazier in his own interest will save all fencing timbers. But even apart from those, fine shade-giving trees should not be rung. Good trees furnish good seeds should they ever be required.

Second: A great portion of our western plains is treeless. The Forestry Department, with its staff of experts and experience, is in a position to conduct experiments to find out which trees can be made to grow there. It has been declared that the thing could not be done. When a man asserts that a certain thing can't be done it often amounts to no more than this particular man can't do it. Others might. It is unreasonable to expect the leaseholding grazier to put improvements on his country which are of more profit to his successor than himself. This is the business of the State, who is the owner and landlord, and has a lively interest in realising a better paying return in the shape of rent.

Third: *We urge the systematic planting of Old Man Saltbush.*

Trees are slow to grow, and the man who plants them often derives no benefit during his own lifetime except the delight at seeing them grow. In the saltbush, however, we have a plant that will spring up in a few years. For he is no immigrant, but a native of the Australian soil, tested by the droughts of a thousand years. It grows up to a good height—some of those we planted on Bybera are over 6 or 7 feet high. Its virtues are many, its faults hard to find. Its greatest drawback is that, like the Mitchell grass, it is so eagerly sought by the stock that it is eaten and destroyed before it can come to seed. Hence you cannot grow saltbush without fencing it off. To help it along the ground should be broken up. *If a strip of country is thus fenced in several places on the run the saltbush will not only grow but the seed will spread to the adjoining portions.*

Mr. Gurney's analyses prove that the leaves of Old Man Saltbush abound in flesh-forming substances containing no less than 21½ per cent. of protein, and with it very little indigestible fibre which makes the Belah undesirable as a continuous feed.

The outstanding virtue is the wealth of mineral matter in the leaves —lime, phosphorus, potash, and others. Mr. Gurney became so interested in the subject that he completed for me a differential analysis. *He found 46 milligrams of iron in 100 grams of leaves. This meant that saltbush carries more iron in proportion than spinach, or strawberries, or even the yolk of an egg.* My son's wife prepared sandwiches of saltbush leaves between bread and butter for afternoon tea. With a little enthusiasm they taste quite good. There is little doubt but that vitamins will be found in green leaves carrying such a high percentage of mineral matter. What that means to men, women, and children living in the West, and unable to grow vegetables, I need not dwell upon. But the stock is also in need of vitamins, particularly in a dry season, when the dried-up grasses have lost most of their vitamins.

Apart from the vitamins, the grazier who cultivates his saltbush will find that he has a live lick on his pastures.

The Artesian Waters of Queensland.

H. I. JENSEN, D.Sc.*

IN a very interesting paper on the above subject Mr. P. C. Tibbits, A.M.I.E. (Aust.), of the Queensland Irrigation Commission, advanced many new facts as well as many new ideas on the subject of the artesian water supply. The paper is a marked help to geologists.

Mr. Tibbits advances the view that instead of one great artesian basin we have in this State at least eight distinct artesian basins, separated by buried ridges. The notion is not absolutely new, although it is quite novel among writers on artesian questions. In my articles and contributions on the oil question, I have myself suggested a subdivision of the artesian basin into a number of basins through buried ranges dividing the artesian horizons.

Mr. Tibbits gives strong evidence that such subdivisions exist. That these separate artesian basins have outlets into the Gulf of Carpentaria on the north, and into the mound spring regions of the Lake Eyre district, and other parts of South Australia, on the west, is admitted by geologists. Mr. Tibbits's conclusions on this matter are not likely to be disputed.

In regard to the query, "Is the water plutonic or meteoric?" Mr. Tibbits leaves the problem as it was—hanging in the air. His evidence is absolutely inconclusive. One of the most interesting and important statements he advances under this heading is that the "equal pressure lines are approximately parallel to the north-west south-east direction." Important as this conclusion is it is what would be expected on either the plutonic or meteoric hypothesis.

Mr. Tibbits contends that the "*replenishment theory is sound,*" with which I think all geologists agree; but whether replenishment is due to meteoric, plutonic, or fossil waters is still left as a problem for future researches. Mr. Tibbits shows his open mind in recording some of the main objections to the meteoric theory, which he favours, rather than the plutonic.

There is one point in particular on which I cannot concur with Mr. Tibbits, that is, where he says "serious objection to theories which support a replenishment by plutonic water, is the fact that there is practically no evidence of similar supplies outside the artesian (cretaceous) area." My experience as a geologist in New South Wales, Queensland, and the Northern Territory is that whenever I am on plutonic, other igneous, or metamorphic formations I find numerous true deep-seated springs, especially numerous in volcanic regions, like the Buckland Tableland in Queensland, the Nandewar and Warrumbungle Mountains in New South Wales. In sedimentary areas such springs are very rare indeed.

Mr. Tibbits admits that buried ranges of igneous and metamorphic rocks subdivide the artesian basin. Why should these buried formations not emit juvenile waters just the same as the formations that outcrop, and why should the escaping juvenile waters not spread laterally in porous sedimentary strata capping the buried ranges emitting them?

The main object of these notes is, however, to point out that geological facts support Mr. Tibbits's conclusion about the definition of basins to a large extent. I cannot as yet see geological evidence of eight

* In a Paper read before the Royal Society of Queensland.

basins, although deep bores in the future may bring in facts corroborating Mr. Tibbits's hydrographic evidence. I do, however, recognise five distinct basins in Queensland separated by buried ridges and unconformities, viz.:—

1. The Surat Basin.
2. The Charleville Basin.
3. The Great Western Basin.
4. The Burketown Basin.
5. The Barkly Tableland Subartesian Basin.

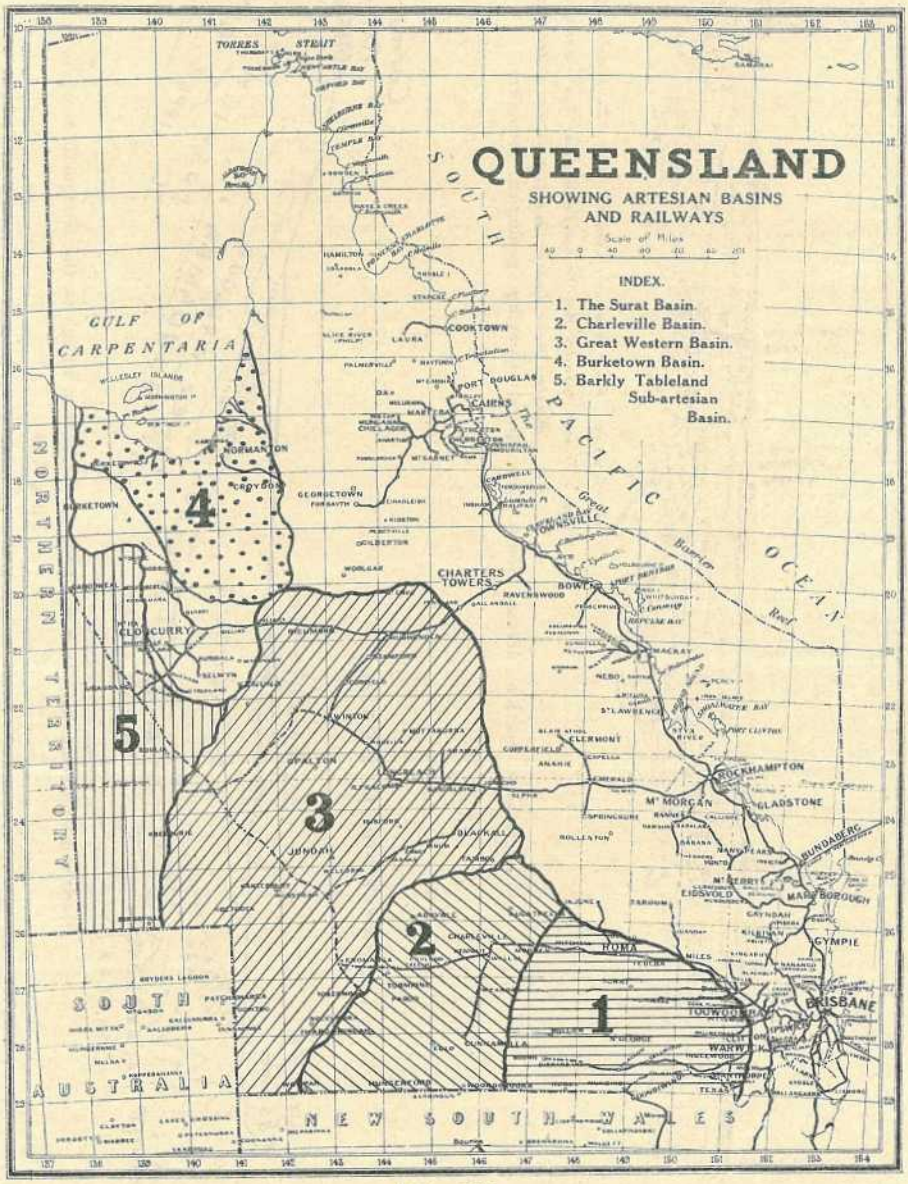
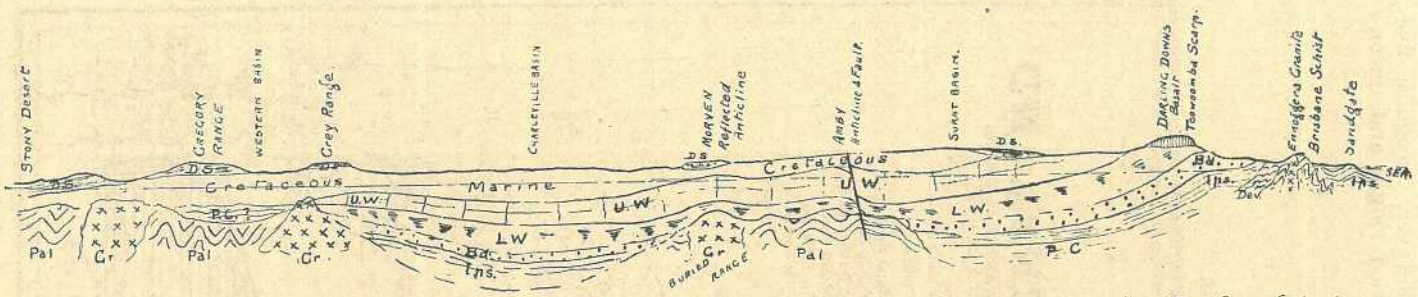


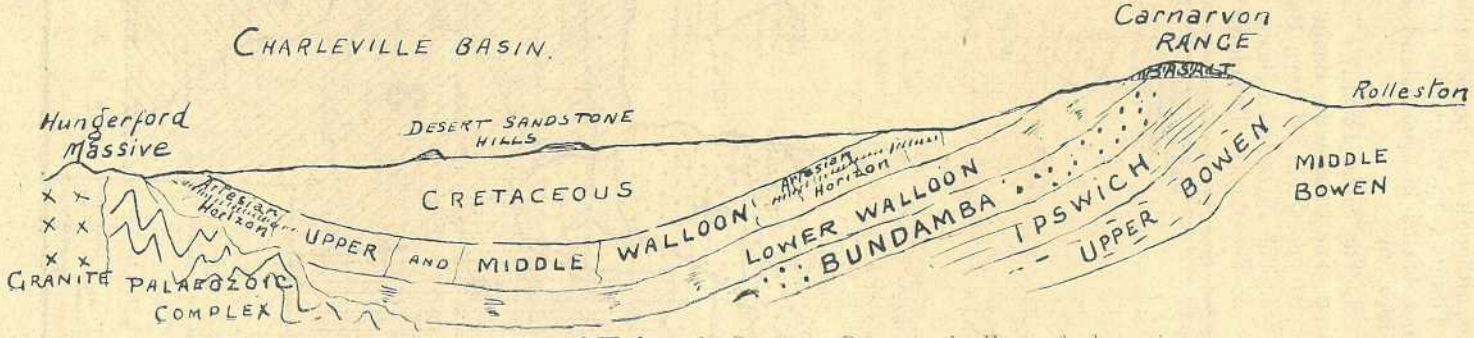
Plate 115.

Map of Queensland showing five artesian basins (including the Barkly Subartesian) divided by buried ranges.



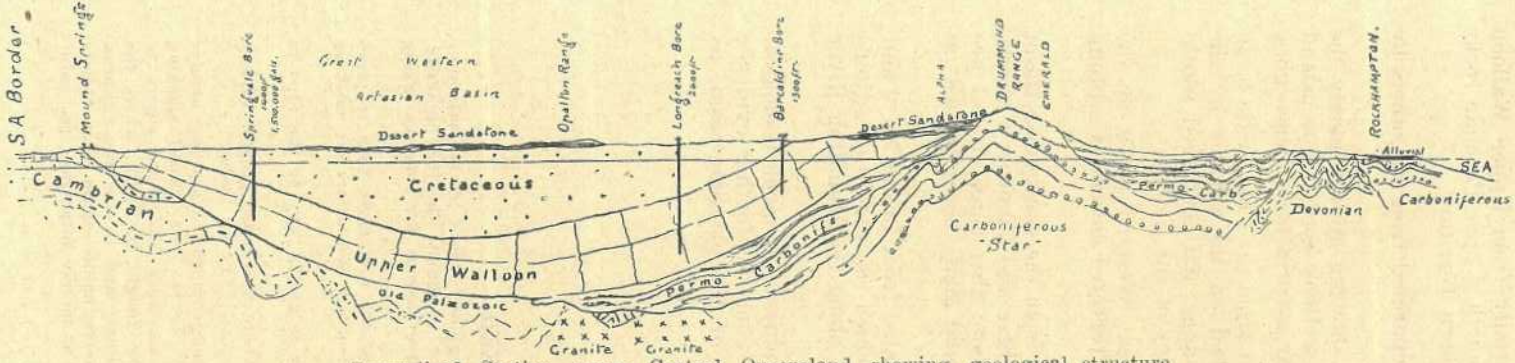
Gr - Granite ; Pal - Palaeozoic Complex ; Dev - Devonian ; P.C. - Permo-Carboniferous ; Ips - Triassic Ipswich Bd - Triassic Bundamba ; L.W - Basal - Lower Jurassic (Walloon) ; U.W - Middle - Upper Jurassic (Wallon) ; DS - Desert Sandstone (Cretaceo-Tertiary).

Generalised Section across South Queensland showing geological structure.

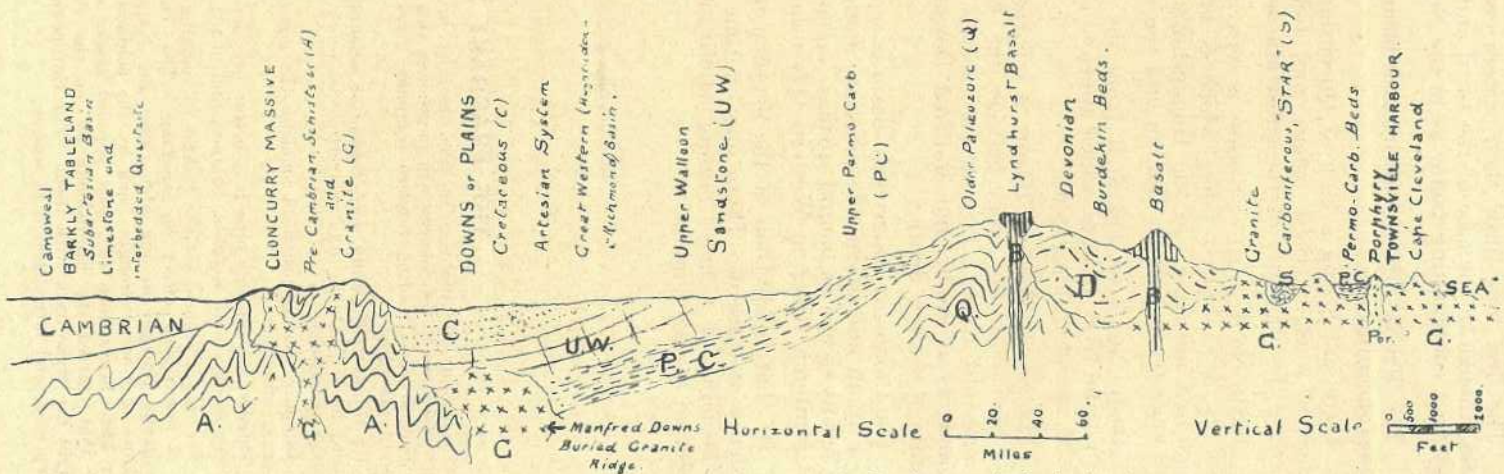


Generalised Section N.E. to S.W. from the Carnarvon Range to the Hungerford massive.

Plate 116.



Generalised Section across Central Queensland showing geological structure.



Generalised Section through North Queensland showing geological structure.

Plate 117.

The first four draw their waters essentially from Upper Walloon rocks, though in the case of the third and fourth, Upper Permian rocks may be a contributing factor as in the Northern Territory.

The fifth is purely a subartesian basin separated from the others by a big unconformity.

I am submitting a map of Queensland showing approximately the extent of each of these basins, and four sections across Queensland showing the structure of the substrata as far as present evidence goes.

Basin No. 1—that of Surat—is separated from the Charleville basin (No. 2) by a buried range which is marked on the surface by the "reflected anticline" of the Hoganthulla Range and continued south-west therefrom through Morven and the valley of the Nebine.

Basin No. 2 is separated from the Great Western Basin by the Gowan and Grey Ranges, which appear to be reflected anticlines capping buried metamorphic ranges.

The No. 3 (Western Basin) is separated from the Burketown Basin by a buried granite range between the Woolgar and Cloncurry masses of very old rocks. The artesian waters along this ridge or col are shallow, as at Saxby and Manfred Downs, and many bores bottom on granite at shallow depth.

The Cambrian subartesian basin is separated from Basins No. 3 and No. 4 by an unconformable junction, along which the waters of adjoining basins escape as mound springs—namely, along the Hamilton River and Mulligan River in Western Queensland.

Of that subdivision of the artesian basin there is much geological evidence at present. There may in time to come be further evidence forthcoming of a more minute subdivision of the artesian basin, as suggested by Mr. Tibbits.

THE FRAGRANT WEED.

Discussing the increase in pipe-smoking in England, where, it is estimated, 10,000,000 more lb. of tobacco will be smoked this year as against the 1935 quantity, the director of a leading tobacco company gives three reasons for smokers taking more to the pipe.

He thinks that young men, taking to smoking for the first time, turn to pipes as being less effeminate than cigarettes—which their mothers and sisters are smoking in large quantities.

Secondly, among practised smokers the cigarette is giving way to the pipe in the cause of economy.

Thirdly, the modern pipe is a better product. There is a much greater variety of pipes to-day, with weights, balance, and mouth-pieces to suit all tastes.

The war is blamed for the fashion of smoking among women. Wars have always had a remarkable effect on smoking. The Thirty Years War spread smoking throughout Europe for the first time; the Napoleonic wars introduced cigars to Britain—they were brought back by the soldiers who fought in Spain, where the cigar has always been the most popular smoke medium; and it was the Crimean War that started the Englishman off on the cigarette habit—again the soldiers brought the craze back with them. The European War merely intensified the habit among men, and introduced it to women.

Shade Trees.

W. D. FRANCIS, Assistant Government Botanist.

[*Continued from p. 58, July, 1936.*]

PART II.

TREES ON THE FARM—THEIR PRACTICAL VALUE.

PROVISION for shade in forested areas is most conveniently and economically made when a farm area is being cleared. In clearing a farm on forest country a few trees of the most desirable types may be left at intervals to serve as shade for stock. It often happens that while clearing this class of country, in the eagerness to get rid of the trees, the matter of shade is entirely forgotten. Very much of the clearing of forest farms is done by ring-barking. When arranging for ring-barking stipulations should always be made for the preservation of the requisite number of the most suitable types of trees to serve as shade and shelter for stock.

In clearing a scrub or jungle farm it is more difficult to preserve trees. The scrub fire, a very necessary part of clearing, mostly kills the trees with which it comes into contact. In rain forest or scrub areas, to prevent the destruction of any particular tree, it is necessary to leave a considerable area of the standing scrub around the tree. To this procedure there are certain objections. It is often claimed that such isolated areas of scrub harbour wallabies and bandicoots, which live on the young grass and bananas. Although this is found to be true in actual practice, there still remains the problem of providing shade and shelter for stock. This is not a pressing need at the beginning of a scrub settlement, when clearing is going on. But in later years, when all the scrub has gone, it becomes an acute problem. Money has to be laid out in the purchase of trees, and much more money and labour have to be expended in erecting guards to protect the young trees from browsing stock. It is surely more economical to leave selected areas of standing scrub in different parts of the farm as shelters and shade for stock and sanctuaries for native birds.

It often happens that in clearing scrub farms in some places the fire is less intense than others, and some of the tree stumps escape contact with the fire. Some of these stumps shoot, and, if left alone, develop gradually into shapely trees. One of the most useful and beautiful collections of shade trees I have ever seen was produced in this way. Several common scrub trees, such as the Booyong and Axe-handle Wood, are represented in this collection of native scrub trees. It was of particular interest to me, for I had never seen these different kinds of scrub trees growing in the open, although their long stems were quite familiar in the dense, crowded jungle. It is evident that these scrub trees, when allowed to develop in the open, form particularly graceful types, with rounded heads of dense foliage, providing excellent shade for stock.

Figs as Shade Trees.

On farms which have been cleared of the forest growth the planting of shade trees is necessary. The months of July, August, and September are the most suitable for planting most of our shade trees. There is a very wide range of choice of trees to plant in most parts of the State, except in very dry far-western areas. Fig trees are recommended.

They provide excellent shade, are comparatively fast growers, and the leaves and fruit of some varieties, when they fall to the ground, are readily eaten by stock. Their spreading habit makes them especially suitable for planting in the vicinity of stockyards.

As a group the fig trees are exceptionally numerous. There are over 700 different kinds. They are found in the tropics and subtropics, but most of them are native to Malaya. Queensland has over fifty varieties of native fig trees, of which the best known is the Moreton Bay fig. This tree is found growing naturally in the jungle lands from the Shoalhaven River, in New South Wales, to Rockingham Bay, in North Queensland. Its round fruit is about an inch in diameter, and is almost purple when ripe. Other well-known native fig trees are the green-leaved Moreton Bay fig, the small-leaved Moreton Bay fig, the small-leaved fig, and the white fig. Seedlings and very young trees of the different figs are often found in the rain forest or jungle.

In nature most of the native figs grow on or around other trees. Occasionally they root and grow straight out of the ground, but much more commonly they start life on the bark of other trees, which they envelop with their roots and eventually kill by pressure. Advantage of this peculiarity is often taken by growing these trees for shade on old stumps on the farm. Peat from the base of staghorn ferns is placed on the top of the stump. Loose soil may be used where peat is not available, but peat is preferable. The young fig tree is planted in the peat or soil on the stump. Eventually the young tree sends its roots down to the ground on the surface or through cracks in the stump. This method of planting makes the use of tree guards unnecessary, and the young trees start off with the advantage of having attained a certain height without growing upwards to it. Hollow logs are especially suitable as stages for planting fig trees on the farm. A hollow log can be cut to any suitable length, say 8 feet. Some peat or rich vegetable mould is placed in the hollow of the log and the log is placed upright and held in position by three or four stays. A young fig is planted in the hollow at the top of the log. In the course of time the roots of the fig tree pass down through the pipe of the log and split it apart. When this has occurred the tree is supported by its own roots. Very suitable hollow logs for this purpose can often be obtained in places where posts and rails have been split. The discarded inner parts of logs with a pipe or hollow in them form excellent "pots."

Other Trees of the Jungle.

In addition to the native fig trees many other native scrub* trees may be used for shade. Some of the most attractive foliage trees of Queensland jungles are the Crow's Ash, the Cudgeree, the Yellow-wood, and the Tulip-wood. All, or most of these trees, may be obtained from Queensland nurserymen. Some of the native jungle trees serve as flowering trees as well as shade trees. Among them are the Silky Oak, the Flame tree, Wheel-of-Fire tree, and Native Frangipanni. Most of these may also be obtained from Queensland nurserymen. The Kurrajong and the Bottle tree are two excellent trees which serve the dual purpose of shade and fodder. They are grown in the dry western parts of the State as well as on the coast. In coastal areas, however, they are often slower in growth than many of the trees mentioned previously.

* The term "scrub" is really a misnomer. Early settlers in Queensland described rain forest wrongly as "scrub," and the designation persists, although obviously misapplied.

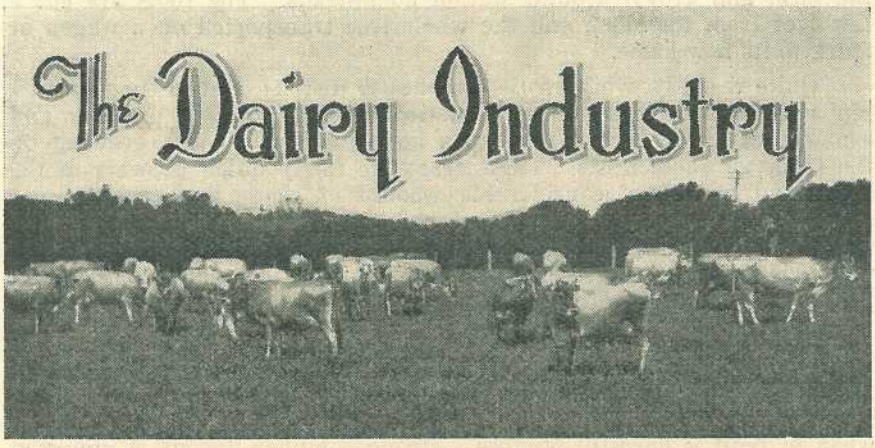
In Western Queensland, fairly large bottle trees are transplanted from the bush and grown around station homesteads. The roots are cut a few feet from the stem, and the whole tree transported on a wagon or truck to its new home.

Quite recently, while in the Peachester district, and in the Currumbin and Tallebudgera valleys, I noticed the remarkably pleasing and ornamental effects of the numerous hoop pines which are growing on the farms of these areas. These trees are fairly quick growers in the open, and provide a considerable amount of shade for stock. Quite apart from their economic value for shade purposes, these trees, with their symmetrical form, impart a park-like effect to farm lands. In this way their presence on a farm should enhance the value of the land purely through their attractive effect.

Several other well-known shade trees include the common Camphor Laurel, the Black Bean, or Moreton Bay Chestnut, the Bunya Pine, and the White Cedar. They have not been specially recommended, because there are certain objections to their use. The Camphor Laurel when in fruit is harmful because a strong camphor flavour is imparted to the eggs of fowls which eat the fruit. The seeds of the Black Bean are reputed to be poisonous to stock, although so far as I am aware instances of stock eating the seeds are very rare. The Bunya Pine has been accused of unsuitability for shade purposes because the prickly leaves on the branchlets shed by the trees render the ground unsuitable for stock to lie on. The yellow berries of the White Cedar are poisonous to pigs.

TANNING SKINS.

To tan skins in wattle bark liquor fill a kerosene tin about three parts full with well-bruised green wattle bark taken just off the tree, clean and free from gum. Fill the tin quite full with water, and boil slowly for one hour; strain into vessel (wooden or earthenware preferable). The liquid will be a very dark colour. Leave the same bark in the tin and fill up again with water, boil slowly for another hour for a second brew. Pour this in with the first lot. The second lot will not be so dark as the first, and the two mixed together will make the proper strength. Wait till cold, and immerse the skins, taking care to place fur to flesh, which enables the liquid to surround them better. All skins should be pegged out before placing them in the tanning water. Keep them as square as possible by stretching them well out under the shoulders. This saves a lot of trouble afterwards. Some people tan them as soon as skinned, but there are objections to this plan. They are apt to curl up in the liquid, which produces unequal tanning. They are difficult to dress, and no amount of stretching afterwards will give them a nice flat surface. It is very necessary to attend to the skins every day for the first week. Take each one out of the tan water separately, hold it up by the head with one hand, and with the other run the liquid off into the vessel. Lay the skins on a flat board—a kerosene case will do—flesh side up, and scrape downward with a blunt knife. Squeeze all the liquid out by repeating this process all over the skin. Any places which appear white need extra dressing, as they contain fat, which should be thoroughly removed to ensure perfect tanning. Three or four minutes is time enough to spend upon each skin. During the second week every second day will do for attending to them, until they are finished, which will be in from eighteen to twenty days. When finished lay them out on the grass to dry or hang them suspended on a clothes-line with a piece of string through the eyeholes of the head. Do not put them across a line because this forms a ridge and is hard to flatten out. Do not dry them in the sun. If on the grass keep turning them occasionally and rubbing them between the hands.



FOOD FLAVOURS OF MILK AND CREAM.

E. B. RICE, Dairy Research Laboratory (Dairy Branch).

OFF flavours in milk and cream arising from the food consumed by the animals are very prevalent in Queensland at certain times of the year, particularly in the spring, when a profuse growth of weeds follows the first of the seasonal rains and is assisted by the warmth. Volatile or non-volatile compounds which pass from the food through the bloodstream into the milk give the off flavours to the milk.

Food flavours can be distinguished by smell and the impression which they convey to the sense of taste when first placed on the palate. The characteristic flavours of the different foods enable the experienced grader to state accurately which plant is responsible. In passing, it may be mentioned that any food flavour in milk will be more pronounced in the cream separated therefrom on account of the ease with which flavours and odours are taken up from the surroundings by milk fat.

The defects of this type may be subdivided into feed flavours and weed flavours, respectively, according to whether their mode of origin is from plants of economic value or otherwise. Depending upon whether the taint is completely or partly removed by the factory treatment, or is carried through in undiminished intensity into the resultant butter, cream affected with a feed flavour may be classed as choice, first, or second grade, but weedy cream is always graded lower than choice on account of the impossibility to completely eliminate the objectionable flavour.

FEED FLAVOURS.

Brief reference will be made to some of the feeds commonly used in Queensland which are known to taint milk.

Silage when fed in large quantities one hour prior to milking imparts a taint to the milk. Small quantities in the ration do not have any noticeable effect.

The result of feeding green lucerne and green clover is generally well known. Lucerne hay and clover hay behave in a similar manner, but lesser amounts of these more concentrated feeds will give tainted

cream. Cream having a pronounced lucerne or clover taint is sometimes graded as low as second quality because of the impossibility to manufacture it into a high-grade product.

Rank pasturage materially affects the flavour of the milk produced by animals consuming it abundantly, but the experience in factories where the cream is subjected to treatment in a partial vacuum after pasteurisation is that the butter made from such cream is improved in grade by one to two points since the adoption of this method of treatment.

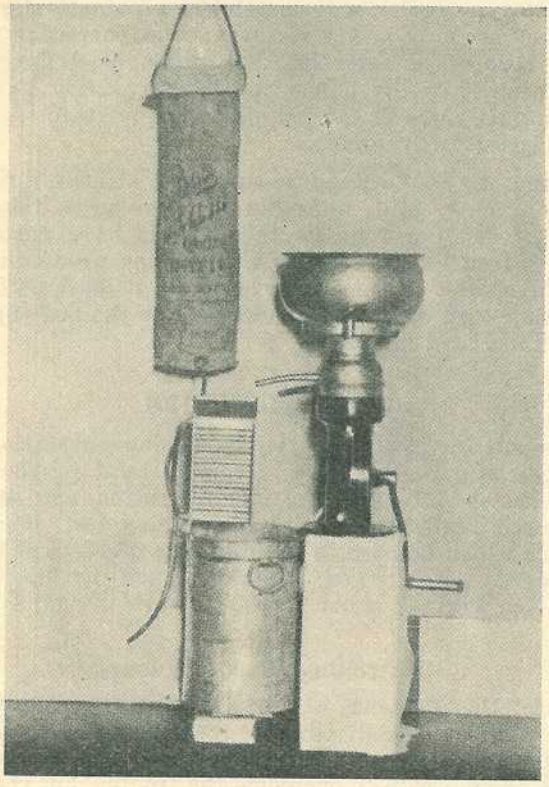


Plate 118.
An Efficient and Inexpensive Cream Cooler.
[*Illustration by courtesy of the Tasmanian Journal of Agriculture.*

A musty flavour can sometimes be discerned in cream, and is often traced back to the feeding of musty or mouldy hay or chaff, although the defect may be of bacterial origin. The bacterial type is the worst, for it is intensified by the processing in the factory.

Cream from cows which have been fed on green barley may be graded down by the factory, but this flavour is usually removed by factory treatment. Green rye and green cowpeas produce slight flavours which are not usually looked upon with disfavour in cream to be used for butter making.

Turnips, onions, and garlic seriously taint the milk of any animals consuming them, while pumpkins, potatoes, and cabbage will also give a distinct taste which is objected to by city milk consumers.

Time Required for a Feed Flavour to Appear.

With most feeds it is found that the time which must elapse after ingestion until the undesirable flavour and odour appear in the milk is about one hour. However, the action of garlic is so rapid that its flavour is discernible one minute after it has been consumed.

Control of Feed Flavours.

Aeration of the cream on the farm, by passing it after separation over a surface type cooler will completely eliminate slight taints, but if stronger they are only partly removed. Pasteurisation in the factory will further reduce the intensity, but pronounced flavours may still persist. Treatment of the cream immediately after pasteurisation in a partial vacuum, which is carried out in many factories in this State, will renovate most feedy cream.

By feeding any of the fodders suspected at least three hours prior to milking, or, better still, immediately afterwards, the cream is not likely to be graded down unless the animals have partaken of large quantities of a feed like lucerne. So far as the production of milk for the city retail market is concerned, however, it must be borne in mind that feed flavours can sometimes be detected in the milk up to five hours after the feed has been ingested.

WEED FLAVOURS.

The non-volatile nature of the flavouring substance acquired by milk and cream which are affected by weed taint prevents its removal by aeration, pasteurisation, or vacuum treatment, and so the resulting butter is reduced in quality and depreciated in value. Some of the milk-tainting weeds which flourish in the dairying districts of this State are:—Mustard weed, carrot weed, stinking roger, hexham, cress, garlic, pepperwort, New Zealand spinach, pennyroyal, lantana, turkey berry.

Controlling Weed Flavours.

To control the incidence of weed flavours at certain times of the year may be a difficult task. Grazing the animals for a short time on a paddock badly infested with obnoxious weeds, then removing them to a cleaner paddock, will help to overcome the trouble, but the objectionable flavours imparted by some weeds remain in the milk for hours after ingestion. In some countries renewal of the pastures after intervals of two years is advocated as good practice in the control of weeds.

MAKE THE COW COMFORTABLE.

Keep cows' teats in good condition. In cold weather, chapped teats are not uncommon. This is sometimes brought about by washing in hard cold water without properly drying afterwards. Use soft warm water with a little Condy's in it for washing the cows' udders and teats and afterwards dry them carefully. A little vaseline—non-odorous—applied to the teats protects them and also makes for easier milking. Do not wet the teats with milk. It is an insanitary habit. Cow comfort and clean milk are desirable objectives easily secured by a little care and consideration.

FOLLOWING on the satisfactory June rains, further welcome falls were received in all divisions on 4th and 5th July. The registrations were particularly heavy in the Central and Northern districts, while the Western Downs and Maranoa received over an inch. From 6th July to the 17th, unsettled weather prevailed, yielding further beneficial showers which were of great assistance to young growing crops.

Wheat.—Farmers lost no time in taking advantage of the favourable seasonal conditions, so that sowings were practically completed by mid-July. The record demand for seed wheat from the State Wheat Board indicates that a larger area has been placed under crop than in previous years.

The general sowing has been somewhat late, but providing good rains are received during August and September an excellent yield is in prospect.

The Department of Agriculture and Stock has again established breeding and experimental plots at Kincora, Rose Hill, Nobby, Dalby, Brigalow, Roma, and also in the Central district at Theodore and Biloela.

There is every prospect of an increase in world wheat prices, owing to the reduced acreage sown and to the droughty conditions being experienced in Canada and the United States of America. The U.S.S.R. have now displaced the U.S.A. as the world's greatest producers of wheat, oats, and barley. The British Empire's production of wheat, barley, oats, maize, and rice comprises 23 per cent. of the world's crops.

At present India is the Empire's greatest producer of rice, maize, wheat, and barley.

Sugar.

Cool, somewhat unsettled weather conditions have prevailed in the tropics north of Townsville, with cool, dry weather southward. Cane growth has been at a standstill and in the Northern areas the planting of the 1937 crop has been seriously delayed. There continues to be an almost complete freedom from frost.

Practically all mills are now crushing; the sugar content of the cane is uniformly low, but is improving slightly under the influence of cool, drier conditions.

Spring Sowings.

Land prepared for summer-growing crops can now be sown with a variety of fodder, hay, and grain crops, such as maize, sorghum, millet, sudan grass, and cowpeas. The majority of farmers now recognise the necessity of making provision for recurring dry spells and also for the winter months, when the growth of natural pastures is considerably retarded. During favourable seasons, good results can be obtained by the cultivation of winter cereals and legumes, but it is to the more vigorous growing summer crops that stockowners must look for the provision of their chief requirements in hay, fodder, and silage.

Maize can be grown successfully on a great variety of soils within the 30-inch rainfall region, deep alluvial soils being particularly suitable for its full development. Land ploughed deeply during the winter should now be in good condition as a result of cross-ploughing and harrowing, and it is well to remember that no amount of inter-row cultivation will undo the effects of sowing on hastily prepared land.

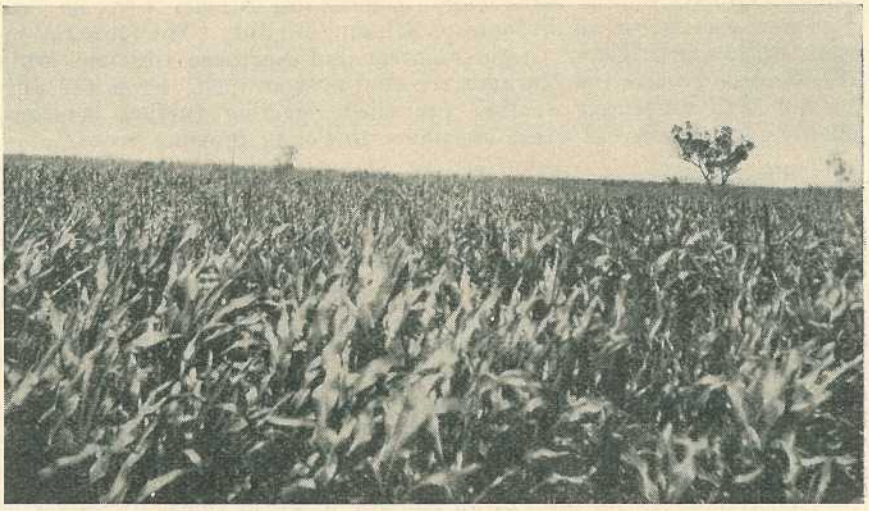


Plate 119.

This field of Sorghum, on Coreena Station, near Barcaldine, at about two months' growth, cut 12 tons per acre. Crop just before harvesting for pit ensilage.

[*Photo. W. C. Miller, Barcaldine.*

Maize crops are usually termed early or late, but as sowings may take place from August to late December, no definite sowing period can be recommended, weather conditions being the deciding factor.

For grain purposes, the chief essential is to assure adequate moisture during the tasselling stage; 9 to 10 lb. of sound seed per acre will be found sufficient, sowing in rows 3 ft. 6 in. to 4 ft. apart, but for fodder or silage purposes double this quantity can be used, choosing a leafy variety, such as Reid's Yellow Dent.

The sweet or saccharine *sorghums* are also widely grown throughout the dairying districts, as they provide a large bulk of nutritious and palatable fodder.

Although slightly less nutritious than maize, the sorghums will withstand dry conditions much better, while they also retain their succulence for a period after maturity, making them specially valuable as early winter feed. In cultural requirements, the crop is somewhat similar to maize, sowing being effected in rows 3 ft. to 3 ft. 6 in. apart, which will be found to utilise approximately 5 lb. of seed per acre. Sorghums are frequently sown broadcast, but although a finer stalk is produced, the total yield is often reduced by this method, besides which weed growth is apt to be troublesome during the early stages of growth.

For silage purposes, sorghum should be cut when the grain is well formed but still in the soft dough stage. Saccaline imphee and White African are popular varieties.

Where a quick-growing summer grazing or hay crop is desired, the *millets* can be confidently recommended, as they will produce fair crops even on the poorer soils.

The seed is usually drilled or sown broadcast, at the rate of 12 to 15 lb. per acre, and under favourable conditions the resulting crop will provide good grazing within five or six weeks. However, it is preferable to exclude stock until the plants are 8-9 in. high, when the roots will have a sufficiently good, strong hold to withstand grazing.

For hay purposes, cut when the grain is in the soft dough stage, and if a binder is used, make small sheaves and stook in windrows. The varieties known as Japanese millet and White Panicum have given the best results.

Sudan Grass is also excellent for grazing or silage purposes, and is considered to be the best possible summer crop for the drier farming areas such as the Western Downs and Maranoa.

It is better to drill in the seed, using approximately 7 lb. per acre, but if broadcasting double the quantity will be required. The risk incurred in allowing stock access to Sudan Grass prior to the flowering stage has been stressed in previous issues of the "Queensland Agricultural Journal." However, the risk is taken by many experienced stock-owners, who have fed the crop during all stages of growth without ill-effects.

The Cowpea is now widely recognised as a valuable green manure crop, resulting in the development of a good trade in locally-grown seed. Its profitable utilisation as a fodder crop is also receiving attention by progressive dairymen, as it is highly nutritious, provides a good bulk of fodder, and is valuable as a rotation crop. Stock can be readily accustomed to green cowpea by sowing in conjunction with maize, either in the maize drills or in alternate rows. The seed varies greatly in size, according to variety, so that when sown in drills 3 ft. apart from 5 to 15 lb. seed per acre will be necessary. Poona, Groit, and Black are popular varieties.

With all spring-sown crops much better results are obtained when inter-row cultivation is thoroughly carried out, although, as previously pointed out, the initial preparation of the land, involving winter fallow, is of primary importance.

No. 10.—THE BULLOCK'S HEART.

S. E. STEPHENS, Northern Instructor in Fruit Culture.

THIS Anona is a poor species of the same family as the Custard Apple, and is known botanically as *Anona reticulata*. Some confusion has been brought about regarding its identity in this country by the unfortunate identical naming of a variety of custard apple some years ago. In many people's minds the confusion thus caused still exists.

Originating in tropical America, the tree has been much more widely distributed and planted than its quality merits.

The tree normally grows up to about twenty feet in height and is of upright habit. It may be distinguished from the Sugar Apple (*A. squamosa*), which it resembles, by its larger leaves and generally coarser appearance. Like the Sugar Apple too, it is deciduous, and usually remains bare of leaves for several weeks.

The fruit is typically heart-shaped, hence the common name applied. The skin is smooth in comparison with the Sugar Apple, the scales being flatter and the interstices less deeply indented. In colour of skin the ripe fruit is reddish-yellow or reddish-brown. The flesh is milky white, rather coarse in texture and usually of very poor flavour. Seeds of dark brown colour are numerous.

The fruit hangs late and may frequently be observed still on the trees when a large proportion of the foliage has been shed. Very fair crops are frequently carried, but the trees are not usually so prolific as the Sugar Apple.

The tree is tropical in requirements of climate, and thrives best under fairly heavy rainfall. In Queensland the best specimens are to be found in the Clump Point and Innisfail districts, where the annual rainfall is between 100 and 150 inches. The soil preferred by it appears to be a rich loam or sandy loam, such as may be found in some of our coastal jungles.

It is very seldom that the Bullock's Heart receives any cultural attention, even when it is grown for its fruit. This is decidedly a mistake, as even the poorest of fruit may be improved by care. A little cultivation of the soil round the tree will assist to maintain its health, while the incorporation of humus and a little complete fertilizer will improve its vigour and cropping capacity. Pruning also will assist in maintaining vigour. It should be carried out in the spring, just as the sap commences to rise.

PRUNING OF GRAPE VINES.

F. L. JARDINE, Plants Inspector, Stanthorpe.

As the subject of pruning will occupy the attention of grape growers for some months to come a few notes dealing with this work may be helpful to intending growers, also to those who from lack of experience are not fully conversant with the work, for, unless the pruner has some knowledge of the habits of the vine and an idea of the rudimentary principals of pruning he can not expect to gain the best results from his work.

Nature intended the vine in its natural state to be a creeper, on fertile soils often covering a wide area and composed of long slender canes producing very little fruit.

The use of the saw and secateurs brought about a radical change in its habits, for, instead of growing as a creeper, it has been forced for commercial purposes to adopt the habits more of a shrub or bush.

Curtailing its liberty to this extent has naturally lowered its vitality, and instead of producing a vigorous growth of canes with little fruit it feels its decline and turns all its energy to the production of fruit.

This point is of vital importance to the pruner, it being an easy matter to produce huge crops of practically no market value at the expense of growth and at the same time undermining the constitution of the vine.

Vines distressed by wrongful pruning and overcropping often take years to recover.

Experience has taught that some varieties of vines are more fruitful on the first and second buds and others on the third and fourth and even more; in the light of this knowledge the pruning of grape vines has been divided into two methods—viz., Short pruning, suitable to those vines that bear on the first buds, and Long pruning, adopted to varieties that produce their bunches further along the canes.

It is to the first system, short pruning, that we will direct our attention in these remarks.

The fruit of the grape vine is produced on the canes of the current year's growth exactly opposite the bud and leaf, these canes develop from buds on the previous years growth which in turn are produced on and form the fruit-bearing spurs situated at intervals along the main permanent arm of the vine.

A vine trained in this manner is usually referred to in this State as a "Unilateral Cordon," or a permanent arm with spurs.

A cutting from a grape vine after its first summer's growth could resemble the drawing shown in Plate 120.

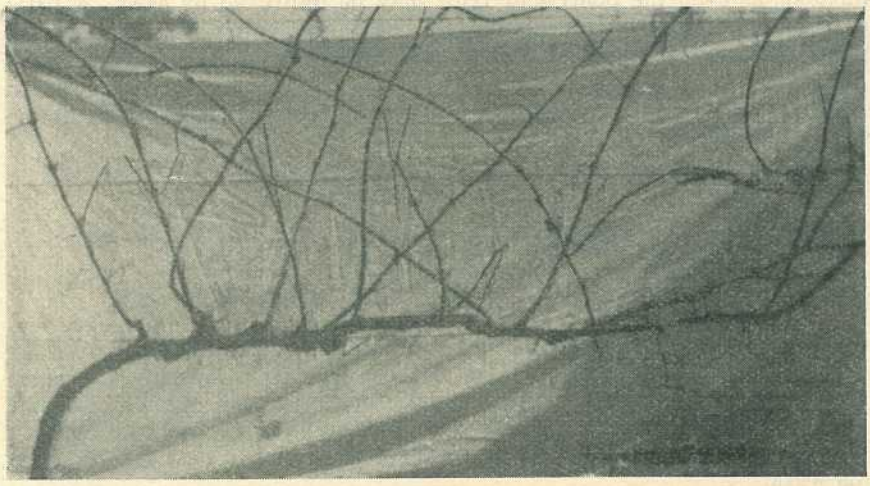


Plate 120.
"Muscat" vine, Stanthorpe District, before pruning, 4 years old.

In Plate 121 it appears, after having received its first pruning. It will be noticed that the most upright growing cane has been selected and all other growth has been suppressed. This main cane will form the trunk of the future vine, but it must be shortened back, usually to two or three eyes, in order to encourage a strong growth the following summer, when again an upgrowing cane is chosen and trained with a graceful curve along the first wire of the trellis, which is usually from 20 to 22 inches from the ground, all other growth from the trunk being cut away..

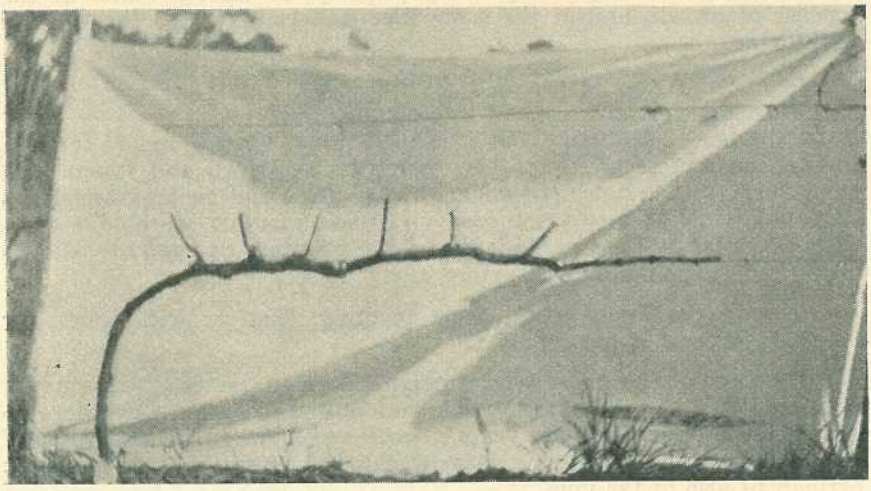


Plate 121.
Same vine after pruning.

The drawing shown in Plate 122 illustrates the young vine after having received the second winter pruning. It will be observed that the main cane has been shortened back along the wire from 1 foot to 2 feet 6 inches according to the vigour of the vine. The end bud should be selected from one placed on the under surface of the cane, the object being to induce the new end growth to lie as flat as possible along the wire instead of growing upwards as would be the case if pruned to a bud on the upper part of the cane. Remove all lateral growth.

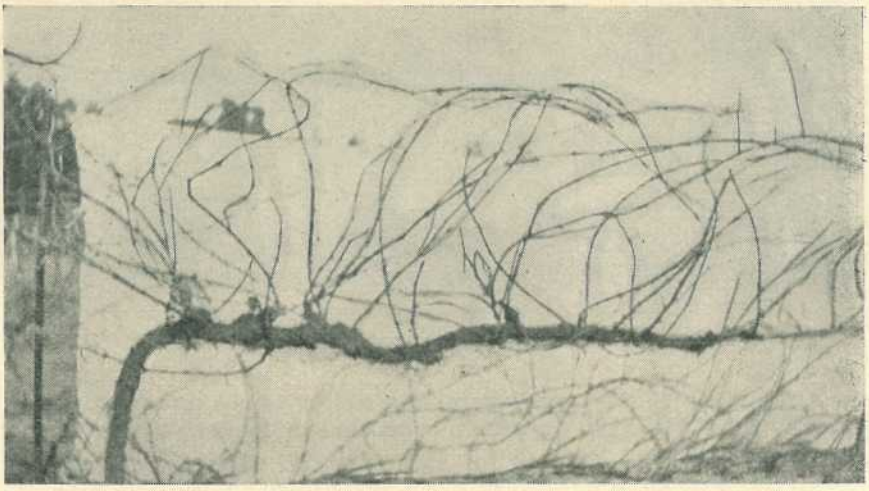


Plate 122.
10-year-old "Muscat," Stanthorpe District, before pruning.

The third pruning (see Plate 123) will consist of spacing the canes on the upper surface of the main arm, usually from 6 to 8 inches apart, and pruning them back to two eyes; remove all other growth except the end cane, which is cut back to a length of 1 foot or 18 inches, treating the terminal bud in the same manner as in the previous pruning.

Assuming the vines are planted 6 feet apart and they have made good growth, the fourth pruning should bring each vine up to meet its neighbour.

The spurs established in the previous pruning should each have produced two canes, one from each eye, and in order to retain the spurs as close on to the main arm as possible the top cane is removed and the lower one pruned to two buds as previously, a section of the extreme end growth is left to join up with the next vine.

During the fifth winter the vine is treated in the same manner so far as the spurs are concerned, *i.e.*, keeping only the lower cane which is cut back to two eyes.

The end spur of the vine receives different treatment, a short section of the top cane is laid down to meet up with the first spur of the adjoining vine, while the lower cane is pruned to two eyes forming the return spur which will furnish two canes the following summer that will be treated in the same manner.

The first spur on the main arm should commence on the wire and just past the curve of the trunk.

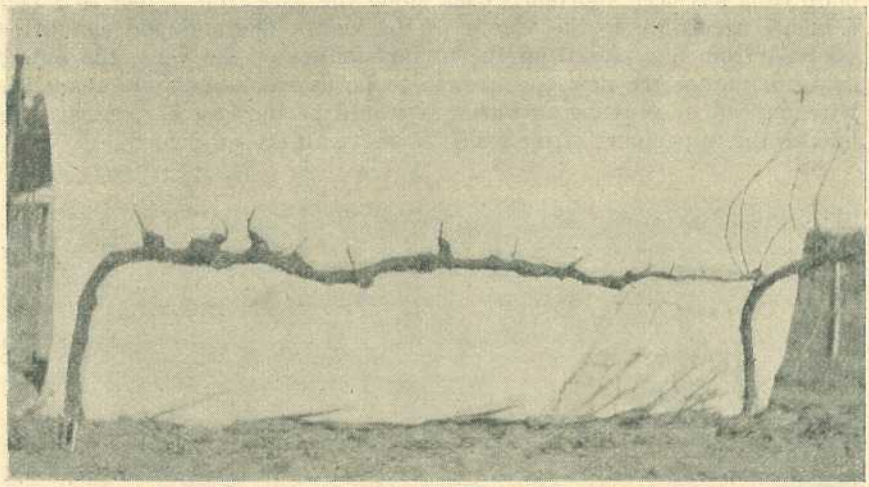


Plate 123.
Same vine after pruning.

It is a recognised procedure when pruning to cut through the node directly behind the bud, the reason being that in doing so a hard surface is exposed, which is less liable to rot or die back past the end bud as when cut through the internode, *i.e.*, the section of cane between the eyes.

BAGGING OF BANANA BUNCHES ON THE PLANTATION.

P. MITCHELL and E. L. MILES, Inspectors, Diseases in Plants Acts.

THE benefits derived from bagging the bunches are not realised by the majority of banana growers, as it is the general opinion that bagging is carried out only by growers whose plantations are subject to either light frost or severe chilling. Such is not the case, however, as from observations during the past five years it has been ascertained that very definite beneficial results can be obtained by the bagging of the bunches during the whole year.

In the first place it is necessary to point out that there is a distinct difference between the results obtained by bagging and those obtained by "cloaking" or wrapping a bag partly round the bunch. It is quite obvious that a bunch completely enveloped in a bag has more protection than one which is only partially covered, hence the improved results.

The only disadvantages of bagging are—

1. The cost of the bags, and the time required for slipping them on to the bunches; and

2. The extra time required when cutting the fruit, as opening the bags takes a little longer. This latter, however, can in time be practically eliminated, as growers with a little practice can estimate quite accurately whether the fruit is full or otherwise by feeling through the bag.

On the other hand, the advantages of the system are as follows:—

1. The production of fruit superior in length and circumference, and uniform in development and flavour;

2. Uniform colour of all the fruit on the bunch;

3. Greater protection of the fruit during transport to the packing shed;

4. The prevention to a very great extent of loss from sun scorching, splitting of fruit, ravages of caterpillars and spotting bugs, undue exposure, and the spotting of fruit which occurs periodically chiefly in low and damp situations; and

5. Growers are enabled to maintain a better control of leaf spot, as all old and useless leaves can be cut off to assist in such control, there being no danger of the bunch being ruined by exposure to sun and cold. It has been observed during the last five seasons on several plantations where leaf spot has been severe and where bagging has been carried out that, in the case of plants (carrying good bunches) which had been totally defoliated, when these bunches were examined the fruit was of a beautiful green colour, practically without blemish, and consisting of fully 95 per cent. of marketable fruit, whereas without bagging this fruit would have been from 75 to 100 per cent. definite loss.

Very interesting figures have been supplied by Mr. E. L. Miles, Banana Board agent, Palmwoods, in his records of the actual results obtained from the bagging of fruit on Mr. W. Ellison's plantation at Bald Knob, Landsborough. This plantation was situated on a very cold slope, subject to high southerly winds.

Unbagged.—(Bunched middle of February, March, and April, 1933)—

Date Cut.	Total Cases.	Waste.	No of Fruit in Case.
26th Sept.	2	¼ box	28 to 31 doz.
3rd Oct.	5	¾ box	28½ to 32 doz.
17th Oct.	2	¾ box	28¾ to 34 doz.

Bagged.—(Bunched end of March and April, 1933)—

Date Cut.	Total Cases.	Waste.	No of Fruit in Case.
26th Sept.	4	4 bananas	20 to 24 doz.
3rd Oct.	6	11 bananas	19¼ to 20¼ doz.
10th Oct.	2	4 bananas	19¼ to 20 doz.
17th Oct.	3	8 bananas	19 to 20 doz.

All bunches for bagging and control were selected for uniformity in size of fruit and bunch. The "box" referred to as waste in the case of the unbagged fruit was a regulation size butter box; the numbers of waste in the bagged trials were single bananas only.

The above figures are for the winter period. No records are available with regard to summer bagging, but bunches on the same plantation bagged during the spring have been cut in ten weeks. However, the above decrease in the loss of fruit can be expected to be maintained practically throughout the year.

The cost of the bags in the first instance is somewhat high. If good-quality bags are obtained the approximate cost is about £10 per acre, but as an offset to this most of the bags will last for two bunches.

FRUIT MARKETING NOTES.

JAS. H. GREGORY, Instructor in Fruit Packing.

THE past month has been a bad one for the fruit industry in so far as the weather has been concerned. Cold and rainy weather has reacted adversely on many lines, citrus fruits particularly being affected. With the advent of warmer weather the market for this fruit should pick up and return better prices to growers.

With the winter months, complaints concerning green papaws and pineapples on Southern markets invariably increase. Owing to the cooler weather at this period of the year, there is very little risk attached to sending these fruits to the interstate markets, and they should be allowed to mature and colour to a more advanced stage. Green fruit at this time of the year is practically unsaleable. It is only by sending good lines to the Southern markets that a demand for tropical fruits can be fostered and increased in Melbourne and Sydney.

Pineapples.

Brisbane prices for Smooths ranged from 3s. to 6s. per case, and for Roughs from 3s. to 5s.; loose, Smooths from 2s. to 5s. per dozen, and Roughs from 1s. to 3s. per dozen. Woodwool is recommended for packing in preference to blady grass.

Sydney prices were from 7s. to 10s. per case, and Melbourne from 8s. to 10s.

Green fruit is unsaleable on all markets.

Bananas.

Brisbane prices: Sixes, from 5s. to 10s. 6d.; sevens, from 7s. to 11s.; eights, from 9s. to 12s. 3d. per case.

Melbourne prices: Sixes, 14s.; sevens, from 13s. to 14s.; eights, from 14s. to 15s. Much undersized fruit is being sent in each grade, many cases being marked down. This should be easy to remedy.

Sydney prices: Sixes, from 10s. to 13s.; sevens, from 13s. to 15s.; eights, from 15s. to 17s.

Papaws.

Brisbane prices for locals ranged from 3s. to 5s. a case, and for Yarwun and Gunalda fruit from 6s. to 10s. Sydney prices were from 12s. to 18s. a case; green fruit unsaleable. Melbourne prices were from 10s. to 14s. a case; green fruit is not wanted at Melbourne, and at present too much of this immature fruit is being sent.

Custard Apples.

Half-bushel cases of fruit are bringing in Brisbane from 2s. to 3s., in Sydney from 3s. to 4s. 6d., and in Melbourne from 4s. to 6s. Only fully matured fruit should be sent. Fruit is matured when the interstices show a rich creamy colour.

Avocados.

This popular fruit is finding a readier sale each year. It is recommended to wrap each fruit.

Tomatoes.

Brisbane prices for local ripe fruit were from 1s. 6d. to 4s. a case, and for green fruit from 1s. to 2s. 6d. Attention is again drawn to the

difference between the prices of ripe and green fruit. Sydney prices ranged from 3s. to 4s. 6d., and for repacked fruit from 4s. to 6s. 6d. per half-bushel case; Melbourne prices for repacked fruit to 10s. per case.

The necessity for discarding green fruit must be stressed. It should be possible for the grower to obtain the difference between the ripe and green prices prevailing, as green fruit is bought by speculators who ripen it to their own advantage. Overmuch green fruit on the market gives the speculator every opportunity of working the market to his own advantage.

Other Tropical Fruits.

A good demand still exists for good granadillas. Unfortunately, many lines of fruit have been placed on the market in too green a condition. The fruit can be left to become coloured before marketing without incurring any risk of loss.

Citrus.

The cold weather has had an adverse effect on the local citrus market. Brisbane prices for navel oranges are—for locals, 6s. to 8s., and Gayndah fruit to 11s., with common oranges bringing from 4s. to 7s.

Many lines of mandarins have been badly affected by the cold windy conditions prevailing during the last month, and are not keeping well. The advent of warmer weather should assist the market to rise to better values. Brisbane prices for Emperors are from 3s. to 6s., and for Glens (local) 3s. to 6s., (Gayndah) to 7s. 6d. The end of July saw a rise for good mandarins to 11s. per case.

Good lines of lemons are not hard to sell, but poor uncured skin-blemished fruit is almost unsaleable. Local uncured fruit brought from 4s. to 6s. per case, while Gayndah fruit brought up to 12s. for special lines.

Common types of grapefruit sold to 6s., and good Marsh type to 8s.

Passion Fruit.

Queensland passion fruit realised in Sydney from 7s. to 9s. per half-bushel. Good fruit was readily saleable in Brisbane at up to 8s. per case.

Strawberries.

In Brisbane heavier supplies have somewhat depressed the market, 5s. to 8s. being obtained for average quality, with specials higher. In Sydney the demand in the latter part of the month was slower, some poor-quality lines depressing the market.

Apples.

Granny Smiths sold freely to 13s. per case, with hail-marked fruit 2s. to 3s. lower. Growers with apples in cold storage would now do well to start to remove and place on the market in regular lots. This will enable the agent to work up a connection for good fruit at payable prices.

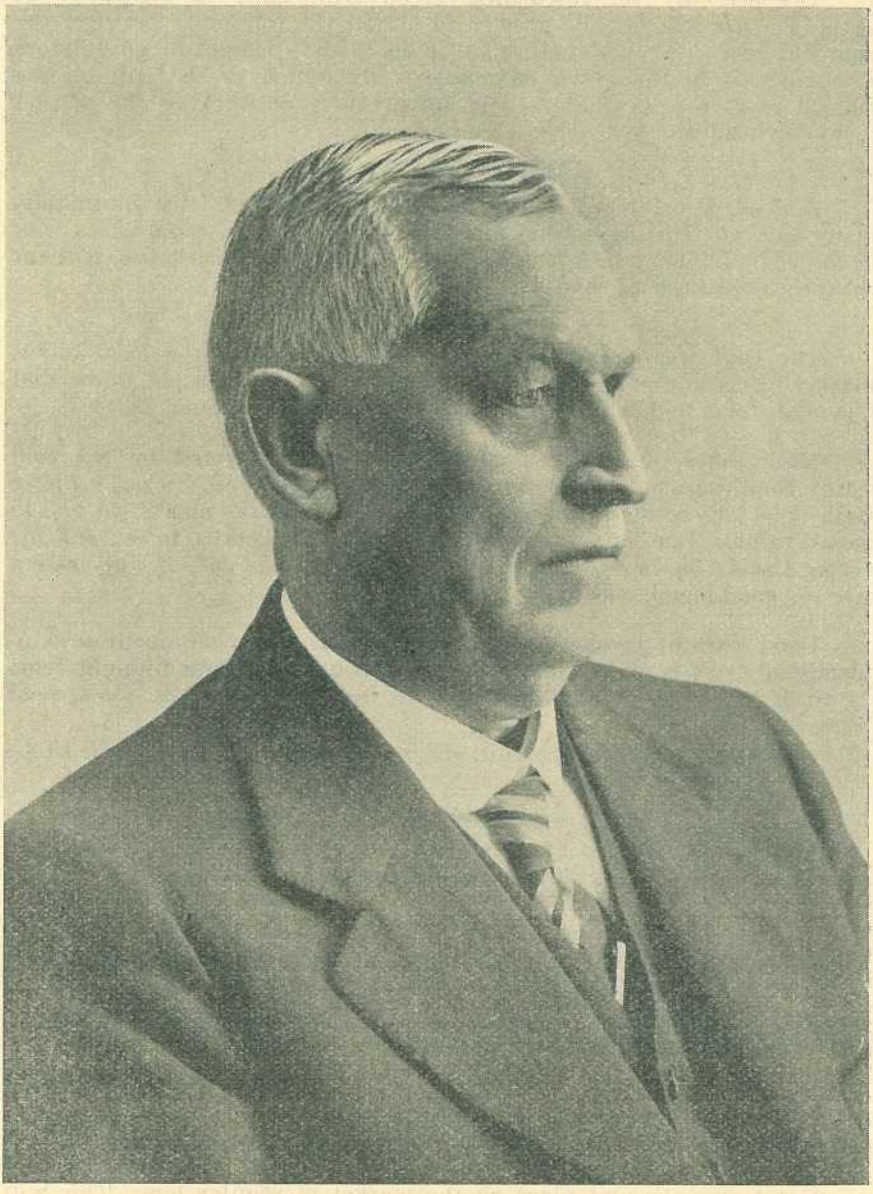


Plate 124.

MR. S. S. HOOPER, FORMERLY ACCOUNTANT, DEPARTMENT OF AGRICULTURE AND STOCK, who has retired after forty-two years' service.

VALEDICTORY.

Retirement of Mr. S. S. Hooper.

AFTER forty-two years as Accountant of the Department of Agriculture and Stock, Mr. S. S. Hooper closed a notable official career on 30th June. Mr. Hooper entered the Public Service of Queensland in 1886, and became Accountant of the Department in 1894, a position which he filled with distinction.

To mark the occasion of his retirement and to express their personal regard for Mr. Hooper, fully 200 of his fellow officers assembled at a social function on the evening of his last day in the Queensland Public Service. The Departmental Sports and Social Club had charge of the arrangements, and the guest of honour, accompanied by Mrs. Hooper, was received by the President, Mr. H. S. Hunter. An excellent programme, marked by originality, versatility and high musical and dramatic talent, was presented by club members.

In his valedictory address, the Minister for Agriculture and Stock (Hon. Frank W. Bulcock) spoke of Mr. Hooper as a man of great capacity and of strong and enduring purpose, who had rendered invaluable service to his Department and to the State during a long and distinguished career. He expressed sincere regret at the severance of an official association, which he and all others present had appreciated most highly, and congratulated him on his very fine record, and on the exceptionally high standard of efficiency in accountancy which he had maintained throughout his period of office. He had been more than a staff officer to the fifteen Ministers under whom he had served—he was that rare type of public officer who was not only the Minister's accountant, but also his guide and friend. Mr. Hooper had contributed very largely to the success of his Department by his skilful financial administration. No other officer in the Public Service had won higher encomiums from successive Ministers, and only that day he had received a telegram from the Premier (Hon. W. Forgan Smith, LL.D.), then on his way home from his important mission in Great Britain, which read: "Desire take this opportunity of extending to Mr. Hooper on eve of his retirement my good wishes for his future happiness. He was capable and loyal officer of Government for many years, whose services I appreciated to the full. Regards. Forgan Smith, Premier."

Their guest, Mr. Bulcock continued, had enjoyed the rather unusual distinction of repeated references in Parliament to the great value of his services as a public officer. For more than forty years he had attended sittings of the Legislative Assembly to assist his Minister in piloting Departmental Estimates through Committee. This was a record unequalled by any other accountant in the State Service. He was leaving the Public Service with the full knowledge that he possessed the confidence of every one with whom he had come in contact, as well as the high esteem and deep and lasting affection of all his colleagues. The Minister expressed the hope of all present that many long and happy years are in store for Mr. and Mrs. Hooper.

Supporting speeches were delivered by Mr. E. Graham (Under Secretary and Director of Marketing), Professor E. J. Goddard (Dean of the Faculty of Agriculture), and Messrs. H. C. Quodling (General Manager, Agricultural Bank), J. S. Hutcheon, A. R. Henry, J. E. England, H. B. Ball, W. J. Copley, M.L.A., and W. T. Gettons.

On behalf of his staff, Mr. Bulcock presented Mr. Hooper with a handsome testimonial and a pictorial history of the Department in beautifully bound volume form. A brief, appropriate, and happily phrased response was made by Mr. Hooper.

Plate 125.

MR. WILLIAM T. GETTONS, A.I.C.A., who has succeeded Mr. S. S. Hooper as Accountant of the Department of Agriculture and Stock.

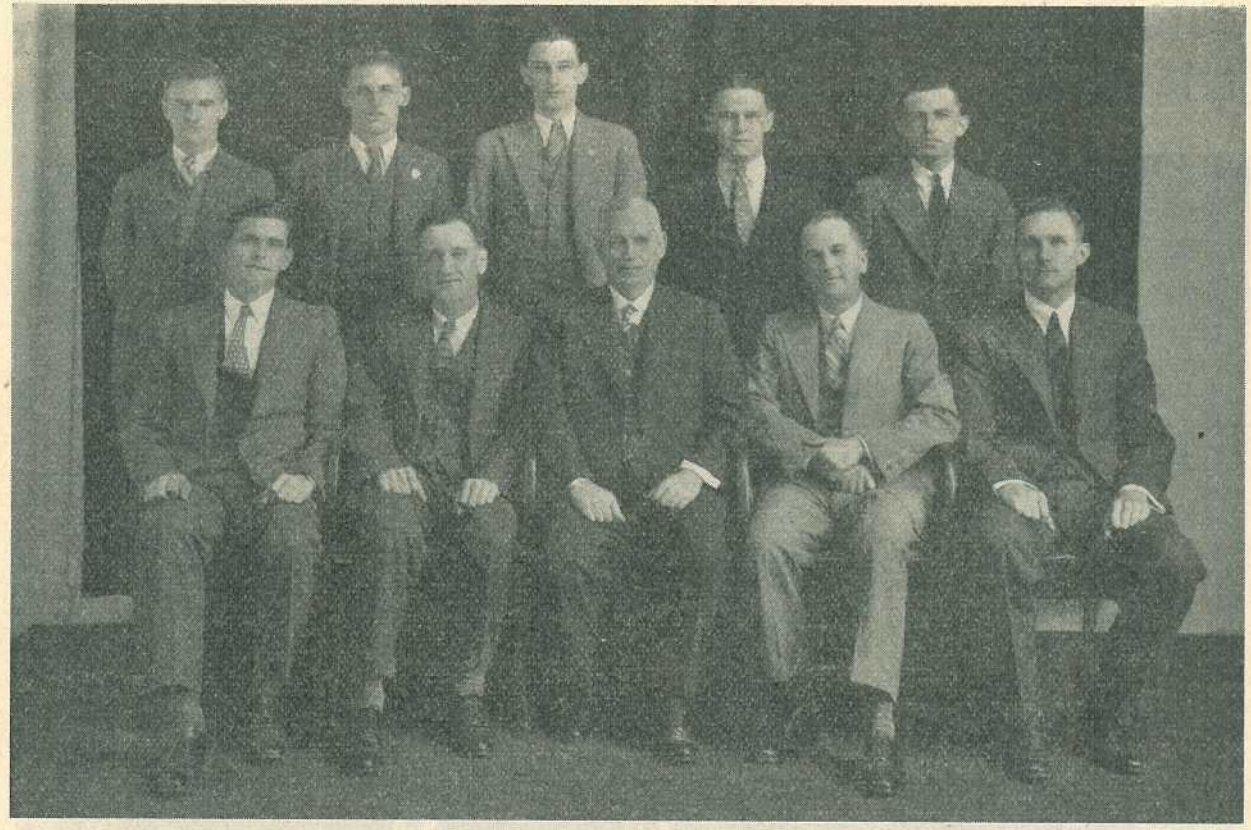


Plate 126.

Officers of the Accounts Branch, Department of Agriculture and Stock.

Back Row: H. J. Evans, J. R. Winders, N. D. Irwin, S. Davis, H. Hooper.

Front Row: E. C. R. Sadler, V. F. J. Bohan (Sub-Accountant), S. S. Hooper (retiring Accountant), W. T. Gettons (Accountant), E. F. Keefer.

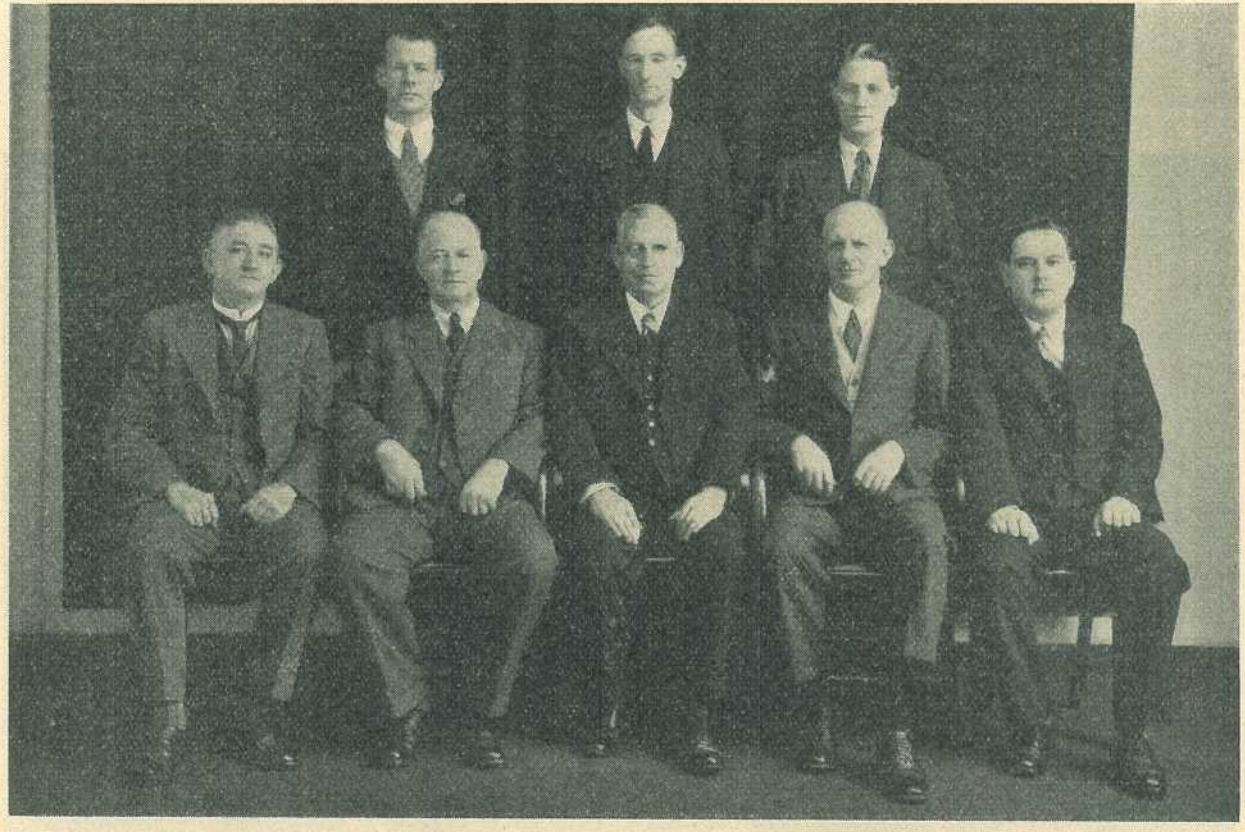


Plate 127.

Group of former Officers of the Accounts Branch, Department of Agriculture and Stock, who received their training under Mr. S. S. Hooper.

Back Row: A. A. Salmon (Photographic Section), J. P. Donnollan (Secretary, Queensland Sugar Board), C. Sheehy (Supervising Inspector, Commonwealth Dairy Produce Equalization Committee, and Secretary of the Queensland Butter Board).

Front Row: W. Giles (Accountant, Department of Public Instruction), A. R. Henry (Secretary and Member of the Central Sugar Cane Prices Board), S. S. Hooper (retiring Accountant, Department of Agriculture and Stock), J. S. Hutcheon (Barrister-at-law, and Chairman of the Queensland Cricket Association), W. J. Copley, M.L.A. (Bulimba).

VETERINARY MEDICINES ACT.

ANNUAL REGISTRATION, 1936.

Second supplementary list, to be read in conjunction with lists appearing on pages 282-285 of March Journal and 408-409 of April Journal.

Registrations effected from 20th March to 30th June, 1936.

	Reg. No.
Animal Health Station, Yeerongpilly—	
First and Second Blackleg Vaccin	333
Contagious Mammitis Vaccine	334
Laboratory Pleuro-Pneumonia Vaccine	335
British Germicide Co., Queen street, Brisbane—	
Drenchsol	1227
Butler and Co., Ltd., Edward street, Brisbane—	
Butler's Worm Powder for Dogs	1135
Buzacotts (Qld.) Ltd., 443 Adelaide street, Brisbane—	
Bio Blister Paste	365
Bio Bot Bombs	366
Bio Bowel Laxative for Dogs	1439
Bio Bronchial and Pneumonic Distemper Mixture	1438
Bio Canker Cure	1436
Bio Condition and Kidney Powders	367
Bio Condition Powders for Pigs	368
Bio Cough Electuary	1036
Bio Cough Mixture for Dogs	1428
Bio Eye Powder	369
Bio Flatulent Colic Drench	370
Bio Flukure	371
Bio Fosfodine	372
Bio Gastric Distemper Mixture	1437
Bio Greasy Heel Ointment	373
Bio Greyhound Tonic	1432
Bio Healing Balsam	374
Bio Laxative Drench for Horses	376
Bio Mange Ointment	377
Bio Painidine	390
Bio Prophylactic Cow Drench	379
Bio Scours Remedy	380
Bio Soothing Liniment	381
Bio Spasmodic Colic Drench	382
Bio Special Colic Drench	383
Bio Stock Drench (Liquid)	1034
Bio Titbalm	384
Bio Urine and Diuretic Powders	1037
Bio Uterine Bombs	385
Bio Vaginol	386
Bio Worm Capsules	1433
Bio Worm Drench for Horses	387
Bio Worm Powder for Pigs	388
BWK Bio Worm Killer for Sheep	389
Stewart's Bio Royal Embrocation	392
Stewart's Liquid Blister	393
Chemical and Tar Products Ltd., Lower Ann street, Brisbane—	
Harton Arsenical Sheep Drench	1377
Veto-cide	394
Cramsie, Dwyer, and Co., Wallangarra—	
Cupiss' Aromatic Physic Balls	326
Cupiss' Condition Powders for Dogs	1123
Cupiss' Condition Balls	327
Cupiss' Embrocation	328
Cupiss' Tonic Powders	320
Dog Constitution Pills (Cupiss)	1124
Cray, O. P., 151 Wickham street, Brisbane—	
Puppy Worm Syrup	25

	Reg. No.
Dalgety and Co., Ltd., Brisbane—	
Kerol	822
Hamilton Pty. (Q.) Ltd., 92 Adelaide street, Brisbane—	
Blakemere Alterative Mixture	182
Blakemere Dusting Powder for Dogs	220
Hamilton Fistula Vaccine	257
Hamilton Strangles Vaccine	256
Hamilton Vaccine (Contagious Mammitis)	183
Metacal	250
Nutrimol	266
Pottie's Blackleg Preventive	1267
Pro-Vet Antiseptic Capsules	184
Pro-Vet Antitoxic Drench	185
Pro-Vet Blackleggine	414
Pro-Vet Black Spot Application	186
Pro-Vet Blighty	187
Pro-Vet Bloat Draught	188
Pro-Vet Calcium Drench	189
Pro-Vet Canine Skin Dressing	415
Pro-Vet Canine Distemper Vaccine (A and B)	190
Pro-Vet Cleansing Drench	191
Pro-Vet Colic Remedy	192
Pro-Vet Condition Powder	416
Pro-Vet Cough Electuary	193
Pro-Vet Diuretic or Staling Powder	194
Pro-Vet Dog Mixture	1262
Pro-Vet Eczema Cure	253
Pro-Vet Embrocation	221
Pro-Vet Emulsion for Cracked Heels	195
Pro-Vet Foot Rot Paste	196
Pro-Vet Gall Cure	222
Pro-Vet Harness Chafe Application	223
Provetine	197
Pro-Vet Laxative Drench for Horses	417
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Pro-Vet Physic Balls for Horses	268
Pro-Vet Pig Powders	254
Pro-Vet Salve	201
Pro-Vet Scour Remedy	202
Pro-Vet Speedo Tonic for Dogs	203
Pro-Vet Stock Drench	255
Pro-Vet Tonic Powder for Horses	204
Pro-Vet Udderlin	205
Pro-Vet Vaginitis Cure	206
Pro-Vet Worm Mixture for Dogs	207
Pro-Vet Worm Powder for Horses	224
Sheeptone	1265
Vermort	1057
Vetnol	395
Happidog Pty. (F. David), Queen street, Brisbane—	
Happidog Alterative Mixture	339
Happidog Puppy Worm Syrup	340
Happidog Trumpit Distemper Mixture	341
Hayes Veterinary Co., Ltd., 351 Queen street, Brisbane—	
Aloetic Ball (Wyleys Ltd.)	276
Cutter Blackleg Antigen	263
Havcol	323
Lovelock and Co. Pty., Ltd., W., Roma street, Brisbane—	
Day, Son, and Hewitt's Black Physic Balls	294
Day, Son, and Hewitt's Broncholine	295
Day, Son, and Hewitt's Colonial Red Drench	307
Day, Son, and Hewitt's Curdolix	297

	Reg. No.
Day, Son, and Hewitt's Diuretic Balls	298
Day, Son, and Hewitt's Easakoff	299
Day, Son, and Hewitt's Eye Wash	300
Day, Son, and Hewitt's Gall Ointment	301
Day, Son, and Hewitt's Gaseodyne	302
Day, Son, and Hewitt's Gaseous Fluid	303
Day, Son, and Hewitt's Globe Disinfectant	304
Day, Son, and Hewitt's Kossolian Blood Salt—Farm	305
Day, Son, and Hewitt's Kossolian Blood Salt—Racehorse	306
Day, Son, and Hewitt's Non-Poisonous Worm Pellets	315
Day, Son, and Hewitt's Red Paste or Condition Balls	308
Day, Son, and Hewitt's Red Worm Mixture	309
Day, Son, and Hewitt's Udder and Sore Teat Salve	310
Day, Son, and Hewitt's Universal Brown Chemical Extract	296
Day, Son, and Hewitt's Universal White Chemical Extract	313
Day, Son, and Hewitt's Vetalenta	311
Day, Son, and Hewitt's Wart Solvent	312
Day, Son, and Hewitt's Worm Balls	314
Day, Son, and Hewitt's Worm Powder for Horses, &c.	322
Day, Son, and Hewitt's Xemos	316
Maclean and Co., D., Elizabeth street, Brisbane—	
Baxter's Alterative Mixture	401
Baxter's Distemper Capsules	402
Baxter's Eczema, &c., Lotion	403
Baxter's Kidney and Bladder Pills	405
Baxter's Puppy Worm Syrup	406
Baxter's Red Tonic	407
Baxter's Skin and Blood Pills	408
Baxter's Stomach and Bile Pills	396
Baxter's Tasteless Condition Powders	397
Martin, B., Charlotte street, Brisbane—	
Timid Joe Dog Tonic	1442
Timid Joe Worm Syrup	1441
Moase, W. E., Wynnum—	
Alterative and Condition Powder	350
Moase's Famous Antiseptic Disinfectant Deodorant	351
Moase's Famous Blister—The Ideal	352
Moase's Famous Dairy Ointment	353
Moase's Famous Diarrhœa or Scour Mixture	354
Moase's Famous Draught for Horses or Cow (Colic)	355
Moase's Famous Drench for Cattle	356
Moase's Famous Eye Specific	357
Moase's Famous Liniment	358
Moase's Famous Ointment for Hard Udders	359
Moase's Famous Special Liniment	361
Moase's Famous Specific for Worms in Calves, Sheep, &c.	360
Nicol Chemical Co. Pty. Ltd., 2 Wickham street, Brisbane—	
Nicol's White Oil Embrocation	1075
Noble and Sinnamon, W. A., Ruthven street, Toowoomba—	
Noble's Colic and Gripe Drench	1391
Noble's Dairy Ointment	1390
Noble's Non-Irritant Fluid Blister	1392
Outridge Chemical Co., Wondai—	
Burnett Worm Drench Powder for Sheep	164
Poultry Farmers' Co-operative Society Ltd., Roma street, Brisbane—	
Merval	1122
Red Comb Vaginitis Powder	1368
Ralston, A. V., Brisbane—	
Vardonia	277

	Reg. No.
Row and Co., East street, Rockhampton—	
Row's Alterative, Diuretic, and Condition Powder for Horses	219
Saunders, J. R., Beerwah—	
San Quentin Ointment	474
Sharkey, S. B., 100 Hill street, Toowoomba—	
Bot and Worm Expeller	424
S. B. Sharkey's Special Physic	425
Smith, H. F., Dundorah—	
Co-Lak	1119
Surgical Supplies Ltd., Queen street, Brisbane—	
A.B.C. Canker Lotion	1304
A.B.C. Tasteless Condition Powders	1234
A.B.C. Worm Mixture	1305
Garget Powder	1050
Warwick Friendly Societies' Dispensary, Warwick—	
Turner's Sheep Drench	1274
Wilkinson (Northern) Pty. Ltd., L. A., Queen street, Brisbane—	
Dog Worm Capsules	287
L.P. Embrocation	281
Vetsalve	282
Wilkinson's Canker Lotion	283
Wilkinson's Cleansing Drench	284
Wilkinson's Condition Powder	293
Wilkinson's Distemper Capsules	285
Wilkinson's Dog Tonic	286
Wilkinson's Eye Ointment for Dogs	288
Wilkinson's Laxative Dog Syrup	289
Wilkinson's Mange Lotion for Dogs	290
Wilkinson's Poultry Tonic	291
Wilkinson's Worm Powder	292

QUEENSLAND SHOW DATES.

SEPTEMBER.

Tully, 11 and 12.
Innisfail, 18 and 19.
Malanda, 30 September and 1 October.
Southport, 26.
Imbil, 4 and 5.
Pomona, 11 and 12.
Beenleigh, 18 and 19.

OCTOBER.

Gympie Bushmen's Carnival, 7 and 8.
Maryborough Bushmen's Carnival, 10 and 12.
Bundaberg Bushmen's Carnival, 17 and 19.

Plate 128.

Citrus Orchard, Tamborine Mountain.—Tamborine is a richly-soiled rain forest plateau, 2,000 feet above sea level, and within a little more than an hour's run of Brisbane.

PRODUCTION RECORDING.

List of cows and heifers officially tested by officers of the Department of Agriculture and Stock which have qualified for entry into the Advance Register of the Herd Books of the Jersey Cattle Society and the Australian Illawarra Shorthorn Society, production charts for which were compiled during the month of June, 1936 (273 days unless otherwise stated).

Name of Cow.	Owner.	Milk Production.	Butter Fat.	Sire.
		Lb.	Lb.	
	JERSEY.			
	MATURE COW (OVER 5 YEARS), STANDARD 350 LB.			
Majestic Queen	W. S. Conochie, Sherwood	10,119·04	564·409	His Majesty of Dalebank
	JUNIOR, 4 YEARS (UNDER 4½ YEARS), STANDARD 310 LB.			
Oxford Dainty 3rd	E. Burton and Sons, Wanora	6,463·25	381·722	Trinity Ambassador
	JUNIOR, 3 YEARS (UNDER 3½ YEARS), STANDARD 270 LB.			
Newhills Dolly's Chance	J. Nicol Robinson, Maleny	4,621·1	281·835	President of Brooklodge
	SENIOR, 2 YEARS (OVER 2½ YEARS), STANDARD 250 LB.			
Dawn Victors Betty	A. L. Walker, Dawn, Mary Valley Line	5,609·7	328·745	Retford Glory's Victor
Nimbrae Esther	F. Nimmo, Rosewood	4,928	277·763	Oxford Tressadore
G.N. Conlisse 4th	Cox Bros., Maleny	4,619·7	264·908	Retford Royal Atavist
Cabulcha Milruth	J. M. Newman, Caboolture	5,037·3	258·328	Grasmere Autocrat
	JUNIOR, 2 YEARS (UNDER 2½ YEARS), STANDARD 230 LB.			
Strathblane Little Wonder	F. Maurer, Darra	7,223·25	388·35	Rosecliff Mariposa
Cabulcha Melasol	J. M. Newman, Caboolture	4,808·5	259·851	Pymble Twilights Paragon
Trinity Dreaming Cinderella (242 days)	G. Harley, Childers	5,383·6	247·388	Trinity Dreaming Pioneer
Carnation of Sunnyview	A. Geritz, Goomeri	4,853·85	233·504	Golden Nobly of Hillview
Patience of Calton	A. Geritz, Goomeri	4,494·8	230·111	Retford Meteor

AUSTRALIAN ILLAWARRA SHORTHORN.

Mature Cow (over 5 Years), Standard 350 lb.

Wunulla Ultimate	A. M. Johnson, Gracemere	10,976·3	436·354	Ryes Toga of Wunulla
Lassie 2nd of Kia Ora	Mrs. J. Weber, Peak Crossing	10,188·25	381·92	Red Knight of Greyleigh
Kia Ora Duchess	Elliott Bros., Kia Ora, Goomboorian, Gympie	8,364·2	371·939	Principal of Blacklands

Senior, 3 Years (over 3½ Years), Standard 290 lb.

Corunna Stripes	G. Gwynne, Umbiram	7,128·56	329·158	Corunna Bruce

Junior, 3 Years (under 3½ Years) Standard 290 lb.

Chilmer Flower	W. G. Marquardt, Wondai	10,503·8	447·845	Thornleigh Lockinvar
Trevor Hill Bluebell	G. Gwynne, Umbiram	9,572·37	375·973	Viceroy of Wilga Vale
Rhodesview Primrose	W. Gurke and Sons, Helidon	7,853·68	302·286	Blacklands Prospector

Senior, 2 Years (over 2½ Years), Standard 250 lb.

Glenore Dairymaid	A. M. Johnson, Gracemere	10,149·65	394·7	Sunnyview Jncle Jack
Blacklands Flower 9th	A. Pickels, Wondai	8,384·15	337·757	Fussy's Monarch of Hillview
Rhodesview Beauty 9th (260 days)	W. Gurke and Sons, Helidon	8,523·37	330·695	Blacklands Prospector
Mountain Home Gem 11th	M. C. Lester, Laidley Creek	6,674·53	277·734	Mountain Home Don
Rhodesview Gypsy 11th	W. Gurke and Sons, Helidon	7,784·30	275·835	Blacklands Prospector

Junior, 2 Years (under 2½ Years), Standard 230 lb.

College Gold 2nd (365 days)	Queensland Agricultural High School and College, Gatton	13,965·14	557·766	Premier of Hillview
Palmetts Coquette	Rex Tweed, Kandanga	8,293·1	347·559	Glengallan Major
Millstream Beryl 3rd	W. J. Barnes, Cedar Grove	8,081·35	311·948	Oakvale Captain
Millstream Meg 3rd	W. J. Barnes, Cedar Grove	7,841·58	286·135	Oakvale Captain
Glenore Myrtle	Mrs. E. B. Graham, Goomeri	6,590·5	255·186	Sunnyview Jnion Jack
Blacklands Fancy 6th	A. M. Johnson, Gracemere	6,886·4	244·373	Emperor of Blacklands

Answers to Correspondents

BOTANY.

Replies selected from the outgoing mail of the Government Botanist, Mr. C. T. White, F.L.S.

Report on specimens collected by Inspector Walker in connection with deaths of sheep, Quilpie district:—

1. *Sida corrugata.*—This is one of the plants suspected of causing paralysis in sheep in Cunnamulla district. See report by Hodge and Francis, "Queensland Agricultural Journal," July, 1932.
2. *Solanum esuriale.*—Potato Bush. Not known to be poisonous.
3. *Indigofera enneaphylla.*—A wild Indigo.
4. *Trianthema crystallina.*—A plant allied to the pig weeds, very common in Western Queensland, and generally regarded as a useful fodder herb.
6. *Cassia desolata.*—Not known to be harmful. Like other Cassias, it might act as a purgative if eaten in any quantity.
7. *Trichinium obovatum.*—A plant of the Amaranth family. Practically all members of this family are harmless, and more or less useful fodders.
8. *Psoralea* sp.—Species of Psoralea are generally regarded as useful fodders.
9. *Malvastrum spicatum.*—This is one of the plants suspected of causing paralysis in sheep in Cunnamulla district. See report by Hodge and Francis, "Queensland Agricultural Journal," July, 1932.
10. *Kochia* or *Enchylæna.*—Saltbush family. Fruit required to determine. Not likely to be harmful.
11. *Alternanthera denticulata.*—A plant of the Amaranth family, generally regarded as a useful fodder.
12. *Tetragonia expansa,* "New Zealand Spinach."
13. *Myoporum acuminatum.*—May be harmful if eaten in quantity.
14. *Euphorbia Drummondii.*—Creeping Caustic. Causes swelling of head and neck. Occasionally this plant is cyanogenatic, and may cause prussic acid poisoning.
15. *Minuria integerrima.*—A plant of the Daisy family, very common in Western Queensland and not known to be harmful or poisonous in any way.

Central Western Plants Identified.

J.F. (Longreach)—

1. *Eragrostis cilianensis.* Stink grass. This grass is so named on account of the peculiar odour emitted by glands on the leaf edges. It is usually left untouched by stock, but we have a record of horses eating it when ploughing, but this is hardly a normal condition.
2. *Echinochloa colona.* Wild millet. This is quite a common grass which is more frequently found as a weed of cultivation, in damp situations, &c., rather than in the ordinary pasture. It is quite a good fodder being allied to and probably one of the wild parents of such well known crops as Japanese millet and white panicum.
3. *Chloris virgata.* Feather top or feather topped Rhodes grass. This grass is widely spread over the sub-tropical regions of the world and is quite common in parts of Queensland. It occurs mostly as a weed of cultivation or where the ground has been disturbed rather than in the ordinary pasture. Generally speaking stock do not seem to care for it, although we have had occasional reports to the contrary. Stock seem to eat it readily enough in the form of hay, however.
4. *Sporobolus elongatus.* Rat's tail grass.
5. *Sarcostemma australe.* Caustic vine. This has been proved to be poisonous to stock by feeding experiments.

Asthma Plant.

F.E.I. (Nerang)—

The specimen is *Euphorbia pilulifera*—Asthma plant. This plant is dried and used to give relief in asthma. It is made the same way as ordinary tea, usually allowed to go cold, and a wine glass full taken for a dose.

Northern Plants Identified.

L.J.W.T. (Townsville)—

Your specimens have been determined as follows:—

1. *Hackelochloa granularis.*—We have not heard a common name for this grass. It should be quite a good fodder. We are very glad to get these specimens, as we have had little native material in the herbarium in the past, most of our specimens coming from New Guinea and further afield.
2. *Trichinium macrocephalum.*—A plant of the Amaranth family. We think most trichiniums are generally regarded as quite good fodders. The purple one is a beautiful plant and at present very common in some of the Western pastures. It is well worthy of garden culture.
3. *Eragrostis australiensis.*—A love grass. This, as you say, is the same as the species on Moreton Island, but most of the Northern plants seem to be of weaker growth.
4. *Iseilema vaginiflorum,* one of the Flinders grasses.
5. *Sporobolus australasicus.*—Very common this year in many of the Western pastures. It is one of the grasses sometimes known as fairy grass.

A Chloris Grass.

G.F.H. (Bobawaba, Bowen Line)—

The specimen represents *Chloris barbata,* a grass widely spread over the tropical regions of the world, generally regarded as a native of tropical America, but now spread elsewhere. It is doubtful if it is a native of Queensland, though it is extremely common. It is closely allied to the Rhodes grass, which is *Chloris gayana,* but is not such a good fodder. We have had various reports about it; most farmers are condemning it, but we have seen it eaten quite freely, especially when kept moderately short by burning or mowing.

Needle Burr.

G.H.L. (Gympie)—

The specimen is the Needle Burr, *Amarantus spinosus,* a common tropical weed that has been naturalised in Queensland over a number of years. It is very common in the North, but is only rarely seen in the more southern parts of the State. Although it seems to grow quite well in southern parts it does not seem to spread to anything like the extent it does in the North. It is not known to possess any poisonous or harmful properties, and like other members of the Amaranth family the young shoots are sometimes eaten, particularly by Asiatics, as a substitute for spinach. We have not tried this particular species, but have tried other amarantaceous weeds in Queensland and found them quite palatable.

An Etna Creek subscriber.—

Your postal note for 3s. (three years' subscription to the Journal) was received on 4th July, but you omitted to add your name to the renewal form. Kindly send your full name and address (written preferably in *block letters*) in order that you may be credited with the amount received.

General Notes

Staff Changes and Appointments.

Mr. R. Veitch, B.Sc., Chief Entomologist, Department of Agriculture and Stock, has been appointed also Director of Research.

Mr. L. F. Mandelson, B.Sc. (Agric.) (Sydney), Pathologist, Department of Agriculture and Stock, has been appointed Agricultural Research Officer.

Mr. C. H. P. Defries, Acting Instructor in Agriculture, has been appointed Instructor in Agriculture, Department of Agriculture and Stock.

An Order in Council has been issued under the Animals and Birds Acts declaring Glendalough Station, Hughenden, to be a sanctuary for the protection of native animals and birds. Mr. McA. Eather, of Glendalough, has been appointed an honorary ranger for this sanctuary.

Mr. J. S. Bramley, of The Gap, Ashgrove, has been appointed an honorary ranger under the Animals and Birds Acts; and Mr. V. Purnell, North Tambourine, an honorary ranger under the Native Plants Protection Act.

The following Forest Officers have been appointed honorary rangers under both the Animals and Birds Acts and the Native Plants Protection Act:—

Messrs. A. G. Smedley (State Forest Reserve, Stapylton), M. R. Jackson, A. Wallace, R. McDowall, J. T. Owen (Forests Office, Beerwah), T. Nicholls, D. A. O'Donnell, W. A. Lacey, G. H. Madsen, F. L. Crain, H. V. Allen, J. F. Marshall, G. Ferrar, A. B. Pearce (Forests Office, Maryborough), W. H. Geissler, L. McGann, and G. Hall (Forests Office, Fraser Island).

Mr. F. A. L. Jardine, Inspector, Diseases in Plants Acts, Stanthorpe, has been appointed also a collector of royalty under the Animals and Birds Acts.

Mr. A. R. Henry, Secretary of the Central Sugar Cane Prices Board, has been appointed temporary chairman of the Central Board on all occasions when the chairman, Mr. Justice Webb, is absent.

Messrs. G. H. Bomford, H. S. H. Wills, J. J. Gerhart, and G. Fisher, of Springsure, have been appointed honorary rangers under the Animals and Birds Acts and the Native Plants Protection Act.

The following transfers of Inspectors in the Department of Agriculture and Stock have been approved:—Messrs. A. F. H. D. Singh, Stock Inspector, from Wondai to Chinchilla; J. Wyvill, Stock Inspector, from Kingaroy to Wondai; J. P. Dowling, Stock Inspector, from Gayndah to Kingaroy; J. Davies, Dairy Inspector, from Chinchilla to Gayndah; A. F. Moodie, Stock Inspector, from Clermont to Mackay; W. A. Kearney, Stock Inspector, from Mount Isa to Clermont; and D. C. Clifford, Stock Inspector, from Brisbane to Mount Isa.

Honorary Rangers under the Animals and Birds Acts have been appointed as follows:—Messrs. V. Purnell (North Tambourine), D. N. Henricks (Rosedale), L. L. Bryant (Victoria Estate, Ingham), and D. G. Smith (Victoria Mill, Ingham).

Constable R. J. Dixon, St. Lawrence, has been appointed also an Inspector under the Slaughtering Act.

Protection of Rhododendron Lochae.

An Order in Council has been issued under "*The Native Plants Protection Act of* 1930" declaring that the native plant *Rhododendron Lochæ* shall be protected throughout the whole State for an unlimited period.

Re-issue of Dairy Produce Regulations.

Executive approval has been given of the revocation of all regulations under the Dairy Produce Acts and to the issue of new regulations thereunder. The regulations have been revised and brought up to date in accordance with recent amendments of the Dairy Produce Acts.

"A B C of Queensland Statistics."

A copy of the 1936 issue of the "A B C of Queensland Statistics" has been forwarded to us by the Government Statistician.

This issue follows the general lines of previous issues, but certain new matter has been introduced. New tables show financial assistance to the States by the Commonwealth Government, interstate trade and total external trade of Queensland, the Queensland business index (with a graph), share prices index, and traffic accidents. Data concerning production (primary and secondary), labour and industrial matters, vital statistics, &c., are included. The revisions and additions carry on the progressive improvements of recent years, and will be continued with the object of informing the public of Queensland as fully as possible each year of the evidence collected through its statistics.

A few important figures are:—

Population, &c.—The population of Queensland steadily increases, and at the 31st December, 1935, it was 970,723. The birth rate for 1934 was the second highest, whilst the death rate was the lowest in Australia.

Livestock and Wool.—At 1st January, 1935, there were 6,052,641 cattle, 21,574,182 sheep, and 269,873 pigs in the State, each of these figures being an increase on the previous year. The wool production for 1934-35 amounted to 174,088,413 lb. (greasy), and was valued at £7,587,353, an increase in the production but a decrease in the value, owing to lower wool prices.

Agriculture and Dairying.—The total value of agricultural produce for 1934 was £11,905,806, a decrease from 1933. The production of cotton and maize was increased, but wheat and sugar showed decreases. The 1934 output of factory and farmers' butter was greater than that of 1933 by approximately 20,000,000 lb.

Mining.—The values of gold and tin obtained in 1934 were considerably higher than those of 1933. The total value of production was £2,281,000, a small increase on 1933.

Trade.—Combining Queensland overseas trade with the interstate figures, imports in 1934-35 were £25,396,000 and exports £31,290,000. Imports increased by £3,500,000 on 1933-34, while exports showed a decline of £1,500,000.

Unemployment.—The percentage of Queensland men wage and salary earners unemployed during 1935 averaged 11.0, compared with 15.1 in 1934 and 22.8 in 1931. The 1929 percentage was 10.1. The figures take account of the full-time equivalent of relief work.

This publication, of convenient size, should be of use and interest to all those desiring the latest information concerning the State. The price is only 2s. (post free), and it may be had upon application to the Government Statistician's Office, Treasury Buildings, Brisbane, or at any of the leading booksellers.

Protection of Native Plants on Friday Island, Torres Strait.

An Order in Council has been issued in pursuance of the provisions of "*The Native Plants Protection Act of* 1930," declaring Friday Island, Torres Strait, to be a district for the purposes of the Act. A further Order in Council declares certain native plants which shall be protected throughout Friday Island.

Darling Downs Fruit Districts.

Proclamations have been issued under the Diseases in Plants Acts adding to the list of fruit districts already declared under such Acts a description of the Warwick fruit district, and altering that of the Darling Downs fruit district. Further, it is notified that certain weeds and grasses growing within a distance of 1 yard from the trunk of each fruit tree in orchards in the Stanthorpe and Warwick fruit districts shall be pests within the meaning of the Acts, and directing that such pests shall, from October in each year to January following, be eradicated. Owners or occupiers of orchards in these districts are directed to take the necessary action to remove such weeds and grasses.

Regulation No. 30, made on the 16th November, 1933, relative to the spraying of deciduous fruit trees in the Stanthorpe fruit district, has been amended so as to apply to the Stanthorpe and Warwick fruit districts.

Northern Plywood and Veneer Board.

An Order in Council has been issued in pursuance of the provisions of the Primary Producers' Organisation and Marketing Acts extending the operations of the Northern Plywood and Veneer Board until the 2nd May, 1939.

Removal of Sugar-cane Plants in Mulgrave District Prohibited.

Executive approval has been given to the issue of a Proclamation under the Diseases in Plants Acts which rescinds a Proclamation issued on the 4th April, 1935, and declares a quarantine area under the Acts to include portions of the parish of Sophia, Mulgrave district. The nature of the quarantine to be imposed in this area shall be the prohibition of the removal from and the planting or replanting in the area mentioned of certain varieties of sugar-cane, except for the purpose of milling at the Mulgrave Sugar Mill, unless a permit shall have first been granted by an Inspector. The quarantine area is slightly larger than that declared last year.

Banana Planting Policy 1936-37.

It was announced at the Department of Agriculture and Stock recently in further amplification of the planting policy of the Banana Industry Protection Board for the coming season, that growers wishing to plant new areas or extend their present plantations must apply to the secretary of the Board for permission to do so.

In general it could be taken that a permit would not be granted to the owner of a neglected plantation, nor for planting in close proximity to a plantation badly affected with Bunchy Top. In the quarantine area, generally referred to as the buffer area, comprising the parish of Mooloolah and portions of the parishes of Bribie and Maroochy, special conditions applied. Unless the Board specially approved, no permit would be issued for any new plantings in the quarantine area, which would bring the total acreage under bananas for any one owner in excess of 8 acres.

The Flying Fox Pest.

The Minister for Agriculture (Hon. F. W. Bulcock, M.L.A.), commenting on a report from the Director of Fruit Culture (Mr. H. Barnes) on the serious damage by flying foxes to citrus orchards in the Rockhampton, Burrum, and Gayndah districts, stated:—The pest is undoubtedly a difficult one to cope with. Its chief food is the blossom of native gum and other wild bush trees, and it is very fortunate for orchardists that it is only in occasional seasons of shortage of wild blossoms that the foxes seriously attack commercial fruit trees. Practically all classes of fruit are attacked at times, and it is a fact that more damage is occasioned by the amount of fruit knocked off the trees and the breaking of the smaller branches than in the quantity of fruit actually consumed.

Some fruits, particularly mangoes, are very subject to damage each season, and this is no doubt due to the strong scent given off by such fruits when ripening.

Many millions of foxes exist throughout Queensland and New South Wales, and so far no economic means of extermination has been found. There are several different species, but probably the worst is the grey-headed fox.

In 1929 and 1930 the Queensland and New South Wales Governments contributed funds towards an investigation of the flying fox problem in co-operation with the Council for Scientific and Industrial Research, and Mr. F. N. Ratcliffe, B.A., was engaged to make a survey of the position. Mr. Ratcliffe, in his report issued in 1931, mentioned that various methods of destroying the foxes had been tried out. In the first place he stated that the numbers of flying foxes in Australia are so vast and their range extends so far outside the limits of close settlement that a system of general control based on the direct destruction of the animals must be ruled out as a physical and economic impossibility. The only hope of general control lies in the possibility of indirect destruction by biological means. Attempts have been made by one or two scientists to introduce epidemic diseases, but unsuccessfully.

The question at the moment then appears to boil down to protection so far as possible of his own orchard by the individual grower. In this regard only one method appears on experience to be in any way effective, and that is by the use of poison baits. It is recommended reluctantly because there is a risk where children and animals are allowed to roam the orchard. Where the orchard is attacked by foxes it will be observed that many ripe fruits are only partially eaten, and it is a fact that when such fruit is available the foxes will return to it again. If these fruits are dusted with powdered strychnine and wired on to the branches near the top of the trees some of the foxes will be poisoned. It has been noticed that in an orchad where a number have been poisoned in the course of a few nights the animals in future cunningly avoid that particular orchard. The use of scare-crows, lights, &c., is of no value, as the foxes quickly become used to their presence, and seem to sense no danger from them.

The use of poison gas, also, has been tried out as a means of mass destruction, but the results were ineffective.

Rural Topics

Udder Complaints in Dairy Cows.

Thus "Himi" in the "New Zealand Farmer":—

Perhaps the most fruitful topic of conversation amongst dairy farmers is the various forms of udder complaints. The present trend in milk and butter-fat prices makes it imperative to eliminate every possible source of waste or inefficiency in production, and as teat and udder troubles occur chiefly among cows in milk—the heavy-yielding animals being most susceptible—losses from these diseases may be very serious, especially as they may be permanent. The proper attitude to adopt in all udder troubles is to regard all of them as contagious, and to deal with them as a possible channel of infection for a general mastitis, or inflammation of the udder, for even simple teat injuries caused by accidents may be the starting point of pus infection and may develop into milk sinuses. Teat injuries must be dealt with in accordance with their nature, but under all circumstances strict cleanliness and antiseptic measures should be employed. If syphons are used they should be thoroughly sterilised; failure to do this is one of the commonest causes of udder trouble following on teat injury. It should be remembered that teats which have weak sphincter muscles, and which allow the milk to leak out of the teat when the udder is full—which means frequently that there is a drop of milk hanging to the end of a teat—are very liable to teat and udder inflammation. All sore or swollen teats should be washed carefully before milking or stripping with some warm, non-irritant disinfectant, such as a 3 per cent. solution of carbolic acid or a 2 per cent. solution of lysol, and after milking they should be dried and rubbed over with boracic acid ointment. A separate milker should handle all cases of sore teats and udders.

New Zealand's Dairy Herds.

Australian dairymen will do well to note the steps taken by milk cattle interests in New Zealand in developing the industry to the remarkable proportion that it has attained during the last decade. A dozen years ago the average butter-fat yield of cows pastured in the Dominion was 154.25 lb. The figure to-day is 250 lb. to 275 lb. a cow, with the heaviest yielders giving 375 lb. or over. Eighty per cent. of the production which nets the Dominion £11,649,000 in a year for butter export and £4,766,000, in addition, for cheese export, is from the North Island, and over the 5,000,000 acres of specially nurtured pasture devoted to dairying the 75,000 herds average twenty-four cows in herd strength. The New Zealand dairy farm is not extensive, the average holding being round about 120 acres. The most recent classification of the dairy breeds in the Dominion shows Jerseys to constitute 63.3 per cent. of the 287,000 cows under test, Milking Shorthorn 22.1 per cent., Friesian 12 per cent., and Ayrshire 2.6 per cent. More recently the number of Jersey or grade Jersey cows has very substantially increased, and it is now estimated that the Jersey strain predominates to the extent of 80 per cent. of all dairy cattle maintained. The declared reason for the breed's popularity is that as the Jersey is comparatively a small-build type, the herd owner is able to carry a larger number of cows in milk an acre, added to which he is assured, on satisfactorily responding land, of individual and collective high butter-fat production, while at the same time he is stocking his limited acreage range with an early maturing class of milking animal. An especially significant point is that practically invariably the New Zealand herd is headed by a specially chosen high-class bull in keeping with the commonly shared deliberate policy of maintaining the highest possible production standard. Unutilised patches of ground are hard to come across, and, on the contrary, density of herbage is the chief dairy holding characteristic. In districts subject, during the winter months, to frost and rigorous conditions, a pasture mixture of perennial rye-grass and white clover is depended on. Where the climate is less severe, paspalum finds its place with these pasture ingredients, and in other pasture mixtures, cocksfoot, crested dog's tail, and red clover find their place. Topdressing is almost exclusively in the form of superphosphate, heavy dressings averaging 3 cwt. to the acre, with more lavish distributions up to 6 cwt. or even 7 cwt. to the acre being applied both in spring and autumn.—"The Australasian."

Immigration.

It is not by economic criteria that national policy is or should be determined, and the promotion of immigration is one of those policies in which the question of cost is subordinate. Nevertheless it is proper that the economic limitations should be stated. Queensland has had an experience of over seventy-five years with this policy, and its limitations have been repeated many times. There is no field of Government "interference" where the economic conditions are so plain and the limitations so immediate in their effects. This, no doubt, is because action which moves population affects the economic life of the people more directly than action which regulates trade, or production, or industrial conditions. The aspirations of national or imperial policy, the merits, the desirability, and even the urgency of securing more people are none of them in question.

Pre-Depression Principles.—It is not necessary to go far back to discover the conditions for successful immigration. During the pre-depression years Australian immigration policy was governed by the slogan "Men, Money, and Markets." In those years there was no anticipation of any limited market in Great Britain. The price protection given to our products was disappointing, but more was hoped for. The men and the money were to be provided under an agreement between the British and Australian Governments. This agreement also proved to be disappointing, but it recognised in principle the connection between the two things. Periods of active immigration have always been periods of active investment from oversea, as a rule in Government loans. In effect the agreement provided for a small British subsidy in aid of interest. The subsidy was much less than the savings to be made by British relief authorities, and was based on a capital sum of only £75 per immigrant actually settled. The agreement had no effect on events.

Experience.—The boom period was the eight years 1922 to 1929, and it lasted as long as oversea borrowings continued. Australian population and oversea debt were alike swollen. Some parts of each—probably the greater parts—were additions within our normal capacities. The balances would have been net liabilities even if the world depression had not supervened, for such had been prior experience.

In 1929 the spending of oversea loans was exhausted and net immigration fell to 11,892. In the next three years there was a net *emigration* of 21,441. During the last three years net immigration has totalled about 5,000.

An immigrant, like a debt, may or may not create an equivalent asset. Both create liabilities. Human necessities go on as insistently as a contract for interest.

"Men and Money."—The following table gives (for Australia) the immigration of persons and of capital on Government loan account in the boom years, and also on the increase in oversea debt per head of population. The last column shows the rising debt per immigrant, but not the amount spent on immigrants. There was private investment also from oversea. On the other hand, some of the oversea capital went to increase the incomes of the native-born.

IMMIGRATION AND OVERSEA DEBT.

Period.	Net Immigration.	Increase in Oversea Debt.		
		Total.	Per Head of Population.	Per Immigrant.
		£ millions.	£ s. d.	£
Four Years—				
1922-3-4-5	165,968	92	9 19 10	554
1926-7-8-9	138,512	108	11 8 2	780
Eight Years	304,480	200	21 8 0	657
Average per Year	38,060	25	2 13 6	657

In the same period internal debt increased by £75 millions, total Government interest increased by 47 per cent., and taxation increased by 30 per cent.

It would be a reasonable deduction from the evidence that immigration during the period depended on oversea loans to the extent of about £500 per immigrant, rising from £400 to £600.

Limitations.—There are no limitations imposed on British immigrants, but only on the scope of subsidised passages, and new public oversea loans are suspended. Both limits are chiefly political and may be removed, but the economic limits are:—

(*a*) The relief employment still prevailing;

(*b*) The self-defeating effects on development of increases in taxation;

(*c*) The fact that a lowering of the standard of living would be self-defeating also, as detracting the desired immigrants; and

(*d*) Markets, both home and oversea.

One of the main problems before the Australian community is to absorb into current production the population formerly and still dependent upon "development." It was the large proportion so dependent that made the depression so severe, and which accounts for the large numbers still sustained by public works.—J.B.B., in "Economic News" (Brisbane).

Middle-aged—What?

Sir Philip Gibbs writes some consoling thoughts for people who have left youth well astern in a recent magazine article. This is what he says, *inter alia*:—

Middle age is more active than adolescence, when there is time for dreams. It is keener to do things, to find things out, to help things forward, because time is getting short, maybe, and there are so many things to do, to see, if possible to know, before the "chucker-out" knocks on the counter and says, "Time, gentlemen, please!"

It is the middle-aged men and women who are setting the pace these days. It is they, and not the younger crowd, who are busy shaping out the future—not without anxiety—trying to prevent another massacre of innocents, doing something to make life more pleasant for those who are coming along, adding a little to the store of knowledge, writing books that are most worth reading (at least more worth reading than those produced by undeveloped minds), controlling, organising, handing on a torch which youth seems reluctant to hold lest it should burn its fingers, or lest it should go out, as perhaps it may, when the wind blows.

It is middle age which has most mental energy, most interest in the affairs of life, most staying power, and most enthusiasm for a game or a job. Youth says, "Why worry?" but middle age says, "Let's get a move on." Youth says, "There's lots of time ahead," but middle age says, "Do it now, or time may catch us bending."

Youth is leisurely. Middle age is in a hurry—to play one more set of tennis, to enjoy one more game of chess, to make the most of another spring, to walk towards another sunset, to set out on another adventure, to find a good job, or to patch up a bad one, because time does not stand still on the other side of fifty. It rushes ahead.

The mind does not become middle-aged nowadays. It remains strangely and incurably young, in spite of the mask that conceals it—those grey hairs, those crows' feet. It is the same mind that looked out upon the world at twenty-five with just a little more experience (but not much), a little more tolerance for other people's habits, a little more pity, and a secret sense of humour in seeing how other people are as foolish as themselves.

Intellectually, spiritually, there is no such thing as middle age nowadays. We refuse to admit it. I am beginning to doubt whether there is any such thing as old age. At fifty one is just beginning another adventure, not saying, "Good-bye to all that." Middle-aged? Nonsense!

Remarkable Team Driving.

In a letter to "The Australasian," Mr. J. D. Cramond, of Wangaratta, quotes from Ion L. Idriess's book, "The Cattle King," where, on pages 324-5, reference is made to the late Sir Sidney Kidman having said "he remembered the Kennedy brothers driving a team of four blood horses from Wennaminta Station to Wilcannia, 110 miles, in ten hours."

"This," says Mr. Cramond, "works out at an average of 11 miles an hour, so that if the actual travelling time from the start of the journey to the finish was ten hours, as one would infer from the statement, it was a most remarkable performance. Possibly some of your old-time readers may know of a better record. However, in my experience, it is outstanding."

Shearing and Shearers.

In an article in "The Australasian" recently, E. S. Sorensen, the noted Australian writer, gave some very interesting particulars of remarkable shearing achievements with the blades, and later with machines, and from which the following extract is taken:—

In the days of the blades and big flocks, when sheds such as Milo, Queensland, shore up to 500,000 in a year, contests between noted shearers were not uncommon, though they were not very widely heard of unless there was something of special interest attached to them. Matches were usually made at a wayside hotel, perhaps for a £5 or £10 wager, and the contest took place on the last day or two of the shearing. Often it was the outcome of arguments between others as to the merits of two local champions. Bets were made, and a stake was provided for the two to settle the matter with a hundred-sheep race or in a whole day's shearing. It seldom happened, however, that two of the much-talked-of "big guns" of the day met in a shed, and there were only the tallies and times by which to decide who was the champion.

Tallies were not always reliable. The "cut," weight, and density of the fleece, varied a lot in different flocks. Some were clean, others dirty or sanded. Again, some sheep were more wrinkly than others. Bigger tallies were made in ewes than in wethers, though many old ewes were tough enough to be cobblers in a mixed pen. The quantity of yolk also had some bearing on cutting quality. Shearers with a reputation could pick their sheds. They knew the quality of the sheep on the various runs they passed through, and mostly got stands in the big sheds, disregarding the small places.

As far back as 1876 a match took place at Parratoo, South Australia, for £50 a side, between Angus McInnes and Jack Gunn. These men were two well-known "fliers" of their day, and the contest for the championship was probably the first for a substantial stake. It was to have been decided on the tallies for a day's shearing. McInnes shore 180 sandback wethers, when the pens ran out.

Among shearers it was an honour to ring the board—that is, to shear the highest tally for the shed, whereas the drummer, who figured at the bottom of the tally list, was the object of much good-natured chaff. The important inducement to speed with all shearers was the cheque. Each wanted to get as much out of the shed as he could. But the honour of being the ringer was a considerable spur to the topnotchers. There were always several men on a board cutting against one another, whether there was a wager or a prize at stake or not. Record tallies were mostly made as a result of such contests.

At Barenya, Queensland, on 19th September, 1895, eight men averaged 236 each; on 20th September, twenty-six men averaged 175 each; and next day Jimmy Power, the champion machine shearer of his time, made his record of 315 mixed sheep in less than eight hours.

Previous to this, in 1892, Jack Howe made the great record of 321 sheep with the blades at Alice Downs. For this achievement he received a ten-guinea gold medal from Coleman and Sons, of Cootamundra, N.S.W. A little later the same year, at Barcaldine Downs, he first worked with the machines, and in this initial effort turned out 276 in eight hours. He received a medal for this tally also.

Howe figured in one remarkable contest. A New Zealand champion named Harlin set out to lower his colours at Evera Station—and he had backers. The sheep carried heavy sandy fleeces, a condition that always meant a big drop in tallies. On the day shearing started Howe's tally was 111, Harlin's 92. Every succeeding day Howe turned out exactly the same number, while the New Zealander steadily got nearer to it. His backers were sure that with a little extra spurt he would ring the board. They expected to see Howe break up when hard-pressed. Wagering increased, and special inducements were offered to Harlin on Saturday. He shore 84 for the half-day, but was knocked out, like his backers, when Howe unfleeced the usual 111, and walked nonchalantly off the board with time to spare.

Harry Livingstone, the recognised Queensland champion of later times, shore in successive days 233, 235, 237, 237, and 221—a very profitable five days at 24s. a hundred. Higher tallies than these were put up in a race between several cracks at Cambridge Downs in 1910, but Livingstone was a very clean shearer, who treated his sheep without ever requiring the services of the tarboy. At the shed mentioned 117,000 sheep were put through in four weeks by a board of thirty-eight shearers. In one day, working on ewes and lambs, the whole team cut an average of 198½ sheep a man. The top scorer was Harrison, with 265; then came W. Garvey, with 259; S. Hookway, 250; J. Boyland, 246; Jack Seary, 244; and many others over the 200 mark.

At Wantalaynie, near Winton, five shearers in one day averaged 269 sheep a man in a go for shed honours. A clean left-hander, known as "Nugget" Daniels, shore 125 lambs in two hours ten minutes with cutters at Lenham Station, Queensland, and on the following day shore 280 full-woolled wethers. The best sprints were made in earlier years. "Long" Maloney, in 1874, shore eleven big wethers in eleven minutes at Fowler's Gap, near Broken Hill; and at Belalie, on the Warrego River, Sid Ross shore nine lambs in nine minutes.

In 1911 a purse of £500 was offered at Toowoomba, with a £100 side wager, to settle the question of the Australian shearing championship. But none of the noted shed champions of the time, such as Harry Livingstone and Dan Cooper, took part in it. The contest was between Fred Zimmerle, a Toowoomba native, and Charlie Maurer, of Glen Innes, both of whom had high local reputations. Points were awarded for quality and style, and the men consequently paid more attention to quality and style than they would have done in an ordinary shed. The conditions called for only two and a-half hours' shearing, about the equivalent of a "run" in a shed. The sprint was won by Zimmerle, who shore thirty-two sheep to Maurer's twenty-eight.

Against this, Dan Cooper's time in a shed, shearing all day, was under two minutes for a sheep. His record for a single sheep was 1 minute 38½ seconds. He shore 315 with the machines at Bundoran, Lower Flinders, in a working day in 1910. In the 1909 season he aggregated 37,502, but his sheds ranged over New South Wales, Queensland, and New Zealand. Cooper began as a rouseabout, and practised shearing by doing a cobbler at smoke-o times. When he was promoted to a stand he shore a hundred sheep on his second day.

In a shearing contest in Sydney in 1911 for the "championship of the world," Dan Cooper won from Syd Day, the South Australian champion, but the number of sheep shorn was below shed records, quality and style being again in the reckoning of points.

Day tallies made by some shearers in the same shed were not always reliable. A veteran of western sheds, who belonged to the good-humoured "unparticular sort," enlightened me on that matter.

"The bloke who rings the board isn't always the fastest shearer in the shed," he said. "I'll tell you a trick—and it's pretty common, too. Snip Sinker had the name of being a fast shearer, when he liked to extend himself; but he was mostly too lazy, or had a cronk wrist, or a kink in his back, when there were big guns on the board. He'd put up some big tallies here and there, but only his mate knew how. I was his mate when he made his record. 'I'm after it to-day,' he said in the morning, 'and you've got to help me. But keep a sharp eye on the overseer and the Wop Wops' (the pickers-up). Well, he'd helped me to surprise the mob at another shed, so I cuts in as if I'm racing him. He was a fair-to-middling shearer, but no scorcher. Every now and then I slipped a sheep down his chute, which made him faster than ordinary. I shore 150 that day, and Snip got through 170. But only 100 was counted out of my pen, and 220 out of Sinker's. It surprised the mob, I can tell you. Now when I see a bloke cutting for the shed record I keep an eye on his mate."

This trick was sometimes worked when there was wagering on the board, especially when a man had backed his mate against another shearer and there was nobody appointed to watch the contestants. Besides slipping a sheep now and again into his mate's chute, he left him all the easiest sheep in the catchpen, taking the hardest himself. The rouseabout whose job was to refill the pens as they were emptied was also induced to assist by putting all good sheep in the rogue's pen and all the bad sheep in his opponent's.

The big-gun shearers never stooped to any practices of that sort. When Jack Howe was catching sheep he did not waste time looking for soft ones, but grabbed the first he could get his hands on, which might be the hardest old ewe in the pen. In Queensland the sleeveless shirt worn by shearers is called a Jacky Howe. At one time there was a racehorse called 321, in compliment to Howe's record tally. The horse was raced on West Queensland courses, but was more of a drummer than a ringer.

There were other records in sheds as well as tallies. An unusual one was made by George Smith, of Dubbo district, New South Wales. He first shore at Bundemar in 1884, and from that time he never missed a season at that shed for fifty years, completing the half century in 1934. On that occasion E. L. Brody, of Bundemar, presented him with a cake decorated with a sheep and a pair of shears, also a cheque for £50—one pound for each year he had shorn there.

When "Gun" Shearers were Beaten.

Commenting on the foregoing article on Shearing in a subsequent number of "The Australasian" (Melbourne), an old blade shearer, Mr. A. J. Sullivan, writes very interestingly as follows:—

As an old blade shearer, now in the last half of my 81st year, I hope you will allow me a little space to air my views on shearing, shearers, and squatters.

As a preliminary, I think it will be as well to state my qualifications to pose as a judge of shearing. I first went into a shearing shed in 1872. In 1874 I commenced to shear. From 1874 till 1886 I sheared in Victoria, New South Wales, Tasmania, and New Zealand. During 1891-2-3 I sheared in Victoria and New South Wales.

I am not going to doubt the correctness of any of the tallies quoted by your correspondent, E. S. Sorenson, in your issue of 18/4/36 (Notes and Queries, "Shearing Contests"), but I am going to affirm that no man ever did, or ever will, shear that number of sheep properly*.

Let me give some illustrations to prove my contention. In 1878-9, 1880-1-2, I sheared at Brookong station, New South Wales. In 1878 and 1879 there were 82 shearers on the board. In 1880 there were 97. At this shed, owned by Mr. William Halliday, with Mr. Riddle, manager, 335,000 sheep were shorn in the general shearing that year.

Up to that date the number of sheep put through one shed had never been equalled and I don't believe that record has been beaten since. At Brookong in 1880 there were ringers from Victoria, New South Wales, Tasmania, and New Zealand, and strange as it may seem, the highest tally in 10 weeks' shearing was 135.

And, stranger still, the big-gun ringers were nowhere in the hunt. The reason of the small tallies was that the owner and manager insisted upon clean shearing.

Again, in 1877, the writer sheared for Mr. John Ware, at his station, Yalla-y-Poora, near Streatham, Victoria. For years there was a limit of 85 sheep a day imposed at this station. And in 1877 one man did 92, which was passed. For years on Longerenong Station and Mount Bute—now a soldiers' settlement—110 sheep was the limit allowed.

Many times during my long shearing career I have known big-gun shearers, where first-class clean shearing was insisted upon, to be easily beaten by ordinary men. In New Zealand during 1879 and '80 I sheared with many whites and maoris, who had done 200 sheep in a day there. If those men were at Brookong 100 sheep would have been their limit.

Here is another example to prove my contention. One day in 1884 I was one of eight men who sheared 1,144 sheep at Hawksview Station, near Albury, New South Wales. After finishinig at Hawksview I was one of four men out of the eight who went to Tasmania. Here are our highest tallies at Hawksview: 175, 163, 156, 154; Tasmania: 101, 101, 101, 86. At Hawksview I did 156; in Tasmania I was one of the three dead-heaters.

The sheep in Tasmania were a little rougher, but they had to be cleanly sheared. Mr. Sorenson, I notice, in his report of the £500 purse, with the £100 side wager, at Toowoomba, Queensland, in 1911, says:—"But none of the noted shed champions took part in it." I notice that in that match one man did 32 sheep, and another man 28 sheep in two and a-half hours. That is an average of 12 sheep an hour.

Now at the risk of being looked upon as an egotist I will quote some of my tallies, the price signed for, and the price received. It must be understood I was never a big-gun shearer. In 1884, at Yahko Station (N.S.W.), 111 sheep, price signed for 17s. 6d. per 100, price received 21s.; 1885, Coolamon (N.S.W.), price 18s., sheep 114, price received 20s.; Pevensey (N.S.W.), sheep 115, price agreed upon 18s., price paid 20s.; 1886, Heartwood (N.S.W.), 120 sheep, price signed for 18s. a 100, price received £1. In the 1884 Tasmanian shearing I did 101, and signed for 14s. a 100, and received 15s.

In my shearing days I met many men who could easily beat me. But none of them ever sheared 200 or 300 sheep in the sheds we met in.

Now in conclusion, during my shearing days it was generally by shearers who knew Australia that a shearer who could shear at Campbell's Duntroon Station (N.S.W.) could shear anywhere in Australia. But I never heard of any big tallies being compiled there.

* Mr. Sorenson in his article quoted figures of 321 and 315 with numbers of instances of days' quantities of over 250.

Tree-planting Time—Preparation of the Land.

Because their wholesale removal has been necessary in the process of land settlement trees have come to be regarded by many farmers almost as an excrescence. There are, however, those who appreciate that trees are of considerable importance in agricultural and pastoral economy as sources of shade and shelter, fuel, fodder, and timber, and that on the score of beauty, too, they have a claim to their place on the farm. Such farmers may be reminded that planting time is now, and that the best results will be obtained if the land has been well prepared.

Where a number of trees are being planted together, such as windbreaks, avenues, or tree lots, the land should be first ploughed. New land should be broken up before winter and allowed to lie until planting time. A plan which has its advantages is to make the first ploughing only deep enough to cover the grass and herbage. Shortly before planting the ground should be cross-ploughed deeply, and then harrowed. Ground previously under crops will probably contain many weed seeds, and to enable the young trees to become established before the weed growth becomes unduly aggressive such land should be ploughed and harrowed and planted immediately afterwards with the trees. Where hillside planting is being carried out the ploughing should follow the contour of the hills as far as possible.

Ordinary hole planting is attended with some risks, especially where the subsoil is impervious. In such cases the hole tends to become merely a pool of stagnant water and a grave for tree life. Where trees must be planted in holes, such as in the case of isolated shade, shelter, and ornamental trees, the holes should be made as large as possible. A hole 3 feet by 3 feet and 2 feet deep is the smallest size allowable, and where possible larger holes should be made.

Where deep digging carries the hole into an impervious subsoil it is better to make the hole wide and shallow, the depth not exceeding that of the soil. On wet, poorly drained soil, ridges or mounds may be formed as sites for planting. Ploughing two adjoining furrows so as to throw the sods together achieves this end in a minor way. Irrespective of what method is adopted the preparation of the land should be completed before stock for planting is obtained.

The best time for planting is when the plant is at its resting period, and when cool, moist conditions prevail. Generally speaking, May to August are the best months. The effects of frosts must be studied, and spring planting is often necessary in some localities, except for deciduous species. Where the rainfall is heavy and conditions generally are cool the planting period may be considerably extended. A cool, cloudy day and a fairly moist soil provide ideal conditions.—"A. and P. Notes," New South Wales Department of Agriculture.

Can Cows Hold Up Their Milk?

Can cows voluntarily hold up their milk? It was stated in the January issue of the "Farmer" that a cow could instantaneously exert this power. In the February issue "Observer" denied that a cow has the power to hold up her milk at will, and affirmed that when this habit occurred it was almost invariably the effect of the treatment to which the cow was or had been subjected. An experienced dairy farmer (Mr. A. Montgomerie, Kauwhata) desires to join in the debate. He says he has had quite a number of cows that required to be taught to let down their milk. There are, he says, many sulky cows—one expression of the sulks being milk-holding. The trouble, however, was largely the result of having been badly broken in as heifers. Twenty-three years ago he had a heifer that he valued very highly, and to his intense disappointment she developed this bad habit. After reflection he introduced the calf to her, and after the first few muzzlings the milk promptly arrived almost to bursting point. While allowing the calf some latitude about the udder and at the teats he milked the heifer out. This business was repeated for some days until the animal became accustomed to being milked right out, and after that she was quite all right. Since that time he has had several similar instances, but by breaking them in the same way they have all been made tractable, the "cure" taking, on an average, three or four days. Another point to which Mr. Montgomerie has taken exception is that the use of the dog is a cause of the milk-holding trouble.

(It should be stated here that "Observer" expressly said the "hard dog." Doubtless Mr. Montgomerie's claim is that a good dog would not cause trouble. Mr. Montgomerie proceeded to express the desirability of breaking heifers into the shed (with the use of the dog if one prefers it), the bail and the leg rope before they have calved. Afterwards they would only need to be broken in to the process of milking, and little or no difficulty about milk-holding would be experienced. If an occasional sulky one did hold the milk back, the useful aid of the calf provides a ready remedy.—"Himi," in "The New Zealand Farmer."

Jersey Breeding.

One of the aims of the Jersey breeder should be to breed only from well authenticated dairy ancestors, disregarding entirely the question of the value of the carcass of the animal when finished with. There is a difference of opinion regarding the live weight of Jerseys. Some breeders think that there should be no limit to the size of the Jersey cow, contending that the larger animals are stronger in constitution and yield more milk of equally rich quality. Others believe that with largeness of frame an increase of milk, though of poorer quality, is obtained, and that the smaller animals are the best for butter. The average of seven years' weighings at the London Dairy Show was 850 lb. live weight, which is considered by the majority of English breeders to be about the correct weight.

The history of the Jersey cow points a moral that cannot be overlooked; beauty and utility should be combined. Although always noted for dairy properties, it was not until show ring points (which are indicative of good dairy cattle) were drawn up, and some uniformity of aim was arrived at among breeders, that the increased demand arose for Jerseys from other countries, with a consequent increase in their value. To sacrifice appearance to dairy qualities, or the reverse, must in either case be wrong.

The only question in the selection of a bull by the most astute breeders on the island is whether the breed is a good one? Meaning, had its progenitors been renowned for their milk and butter-fat production. Breeders agree that the sires used in the herd should have good dairy ancestors for several generations, and with this individual appearance should be considered. On the island of Jersey a masculine-looking bull is preferred, while some English breeders favour a bull of feminine appearance. In Jersey, where in consequence of the warmer climate and the difference in the system of rearing the cattle are naturally finer and, consequently, smaller than in England, it is thought best to use bulls of strong constitutional appearance; while in England, where the cattle are apt to grow coarse, the use of smaller and more feminine-looking bulls is, by some breeders, considered advisable. At the London Dairy Show an attempt is made to secure both qualifications, viz., appearance and utility, by giving prizes by inspection to bulls descended from dams that have won butter test prizes. The secret of success in the management of cattle generally, whether Jerseys or not, is to study the individuality of each animal. To put it briefly, the temperament and constitution of an animal must govern its treatment, and this supplies the key to successful management.—F.W.L., in "The Australasian."

Trees on the Farm.

It is good to observe a growing "tree consciousness," especially in areas which, in the march of closer settlement, have been almost entirely denuded of native timber.

The usefulness of trees can be demonstrated in these ways:—

As windbreaks and shelter belts.

As isolated or scattered shade and shelter trees.

As a reserve supply of fodder for periods of drought.

As tree plantations to supply the timber and fuel requirements of the farm, in addition to providing a source of revenue by the sale of products.

As screens around dams and tanks to prevent silting up by dust and undue evaporation of the water contents.

As a means of preventing erosion on slopes and along the banks of creeks and rivers.

As a means of enriching worn-out or poor land.

As ornamental trees in improving the appearance of the homestead.

As bee trees.

Generally speaking, May to August are the best months for tree planting.

Where proper shelter is not provided for stock not only is their resistance to disease reduced but much food material is wasted in meeting the increased demands of an exposed body. This fact has an important application for dairy farmers. A cow's food is only devoted to production after the animal has satisfied its needs for nourishment and heat.

Conservation of the lastmentioned, especially in colder districts and situations, is considerably assisted by judicious tree planting. Shelter belts in the form of trees and hedges are a valuable aid to the well-being and productivity of the dairy cow, and now is the time of the year to plant.

Utilisation of Dairy Lands.

Not so many years ago, observed Mr. A. F. Emmott in a paper read recently before the Bodalla Branch of the Agricultural Bureau of New South Wales, it was the custom on all dairy farms to have a few paddocks only for the milking herd—perhaps one or two day paddocks and a night paddock. How such an inefficient system managed to survive so long was difficult to understand. Perhaps it was because the old-time farmer was very conservative, and followed closely the methods of his forefathers, viewing with great distrust any "new-fangled" ideas. In his opinion, said the speaker, the most important step towards pasture improvement was the subdivision of the farm, particularly the best and richest portions, into small paddocks.

The greater the number of small paddocks available, the greater will be the use made of the pasturage at its optimum stage of feeding growth. It has been demonstrated by analysis in England that grass cut at three-weekly intervals retains the non-lignified, highly digestible character, which it possesses at the end of a week's or a fortnight's growth, and that this characteristic of high digestibility obtained by cutting at three-weekly intervals is maintained throughout the entire season.

By having a large number of small paddocks which can be rotationally and heavily grazed for about two days by the milking cows, and from two to three days by the followers, and then permitted a three to four weeks' spell before being grazed again, it is possible always to have available pasturage that retains its high digestibility and nutritive value, which makes its eminently suited to supply the food requirements of most farm animals. Moreover, in large paddocks considerable food wastage occurs on account of excessive tramping and fouling of the pastures by the stock.

The size of the paddocks will mainly depend on the number of milking cows to be grazed and on the fertility of the land. The figure generally adopted in our coastal districts for good paspalum-white clover areas is twelve cows per acre. A farmer milking on an average of sixty cows on this class of country would, therefore, require to subdivide into 5-acre paddocks in order to obtain proper control of growth and efficient utilisation of the pasturage.

To reduce the cost of subdividing paddocks, fences consisting of three barbed wires, or the top wire plain and the two lower ones barbed, with posts 15 to 16 feet apart, can be used instead of erecting costly permanent lines of fencing, as it may be necessary at a later date to alter the general lay-out of the farm. Each paddock should open into a laneway, race, or long, comparatively narrow paddock that leads to the water supply. It is important that this area should be fairly wide, at least 50 feet, in order that the cows will not be herded together at any time in a narrow strip; this will reduce danger of injury through horning, &c., and also prevent the area becoming a bog in wet weather.

When commencing this system of grassland management, a start should be made with the most productive grass areas, gradually bringing other paddocks into the scheme. It is inadvisable to grass-farm intensively all the pasture paddocks on the holding until adequate fodder reserves of crop and grass silage or hay are built up to tide over dry periods and winter months.

The provision of suitable shade trees in the paddocks is most important; sufficient attention is not given to this essential work even in the large paddocks which are to be found on most of our dairy farms at the present time.

Travelling Dogs.

An interesting story is revived by a correspondent to "Notes and Queries," in a recent "Australasian," and an interesting avenue of research into the journeys of dogs unaccompanied by their masters is opened up. He recalls that an Englishman, "Edward Cook, of Togston, in Northumberland, who died at Togston in 1786, visited America, taking with him a pointer dog which he lost while shooting in the woods near Baltimore.

"Some considerable time afterwards his brother, who was living at Togston, was alarmed in the night by the barking of a dog which, when admitted, was recognised as the dog which had been taken to America. On Edward Cook's return he and the dog recognised each other. All efforts to trace the vessel by which the animal had left America were unavailing, nor was the place where it had landed in England ever discovered."

Records of such long-distance travelling by dogs, here, in Australia, or overseas, would make interesting reading.

Clean Milking.

At a Southern cheese factory contaminated milk was traced recently to the handling of dirty leg ropes and bails. Regular washing of the hands in running or frequently changed water is a precaution well worth while when milking. It is a practice beneficial on three counts—it tends to prevent contamination of the milk, it lessens the risk of transmitting disease from cow to cow, and it invigorates the milker's tired hands and wrists. Before the cow is milked the udder should be wiped with a clean, damp cloth; this is preferable to brushing, which only causes the dirt to float in the atmosphere and subsequently to drop into the milk bucket. A separate cloth should be used by each milker and should be kept thoroughly clean and sweet—a smelling cloth is a source of contamination. Where gravitation water is not available a good plan is to have, say, two oil drums, into each of which is fixed a small tap. These drums should be fixed to the posts or walls.

Dry versus wet milking is often a debated point, but the practice of drawing a little milk into the bucket and dipping the fingers therein is undoubtedly most insanitary. A good plan is to touch each teat with a little vaseline, which prevents friction, and also prevents cracks on the teats.

Vitamins.

Thus the Medical Correspondent of the "Sydney Morning Herald":—

Vitamins are complex organic substances that occur in almost all natural foods. The percentage of these present is very small indeed, but a certain proportion in the diet is absolutely essential to health and even life.

Although the discovery of vitamins is recent, it had long been known that ill-health and death resulted from the absence of certain foods from the diet. For example, sailors in the days of long voyages were found to suffer from scurvy, but it was known that the disease could be averted by a supply of fruit and fresh vegetables, and even by a daily ration of lime juice. Formerly rickets was a common disease of infancy, especially under slum conditions. It was known long before vitamins were discovered that rickets could be prevented by sunlight and animal fats, especially cod-liver oil.

There are a number of distinct vitamins, and the absence of any one of these from the diet causes characteristic symptoms. One of the triumphs of modern medicine was the abolition of beri-beri from the Japanese Navy. This is a disease of the nervous system causing paralysis and dropsy of the legs, and is a vitamin deficiency disease. The rice supplied to the navy was polished, and the substitution of unpolished rice abolished the disease at once. The diet of armies, explorers, &c., is now carefully calculated to prevent the possibility of any vitamin deficiency, and the late war was fought without any outbreak of scurvy or other deficiency disease.

If the supply of vitamins falls below a certain amount health is definitely affected, but it is not true that amounts in excess of the minimum are in any way beneficial. It can be taken for granted that there is no inhabitant of Australia, other than babies artificially fed and a few inhabitants of the outback, who do not take every day every vitamin in a dose far in excess of requirements. The public has become vitamin conscious, and many people are taking artificial vitamins which are quite useless and unnecessary, or are mistakenly regulating their diet from a vitamin instead of a nourishment and palatability point of view.

The exceptions to this are artificially-fed babies. Cow's milk is deficient in the vitamin requirements of the young human. The necessary vitamins can be easily supplied by daily doses of halibut or cod-liver oil and the juice of orange, grape, or tomato, whichever may be in season.

Some remote country dwellers live very close to the safety margin, or even below it. These are those whose diet consists for the most part of mutton, damper, and tea. Barcoo rot is a vitamin deficiency condition. These bush dwellers get plenty of the valuable vitamins contained in animal fats, but need fresh fruit, salads, and vegetables for safety.

Rain to the Minute.

Speaking at a dinner in his honour at Nanango, Sir Leslie Wilson strongly advocated irrigation in the development of Queensland. "Then," said he, "you will not have to rely on Mr. Inigo Jones. I'm a great believer in Mr. Jones. He is more often right than wrong. He was right to-day almost to the minute."—"Nanango News."

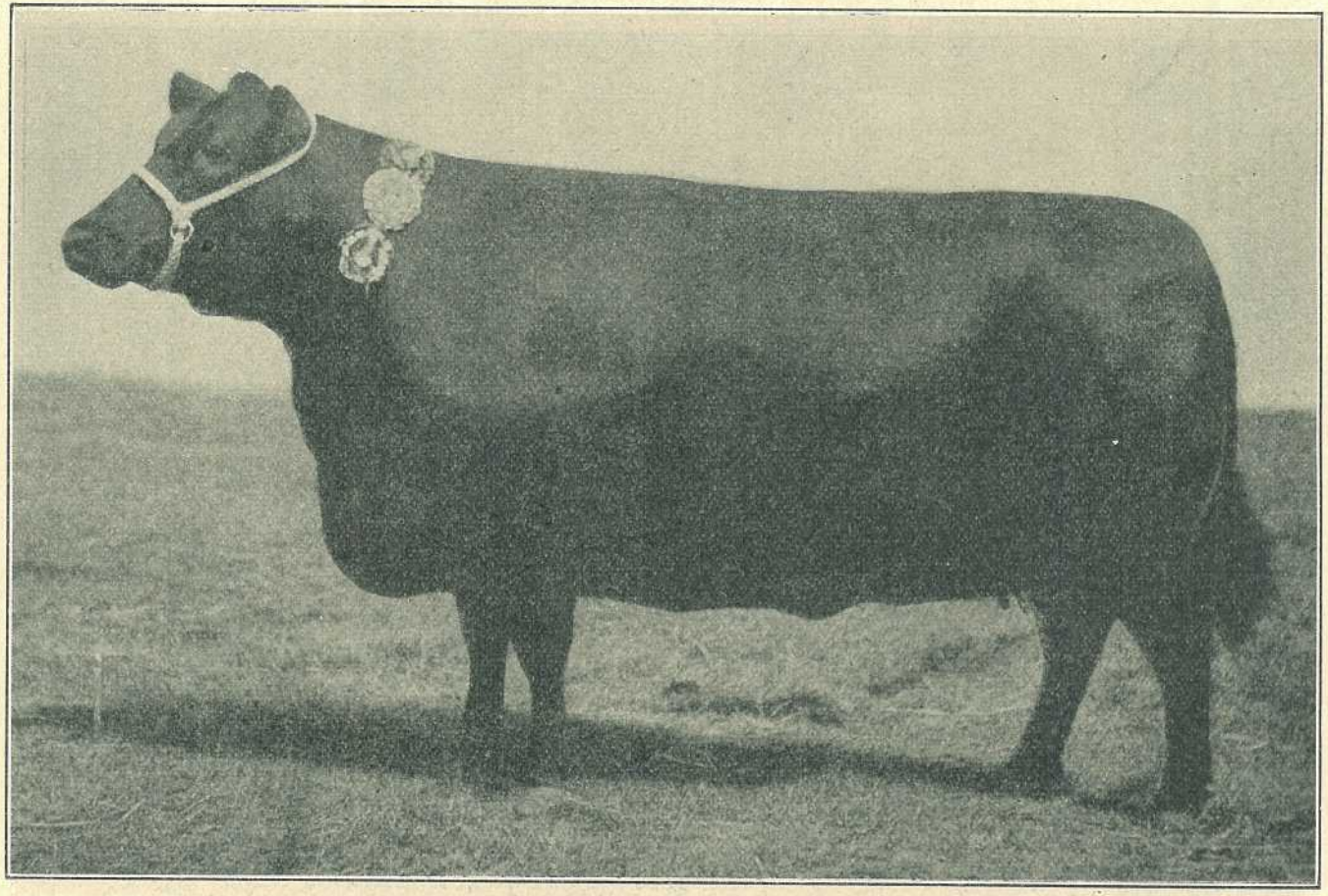

Plate 129.—The type of Aberdeen Angus Cow favoured by Scottish Breeders.

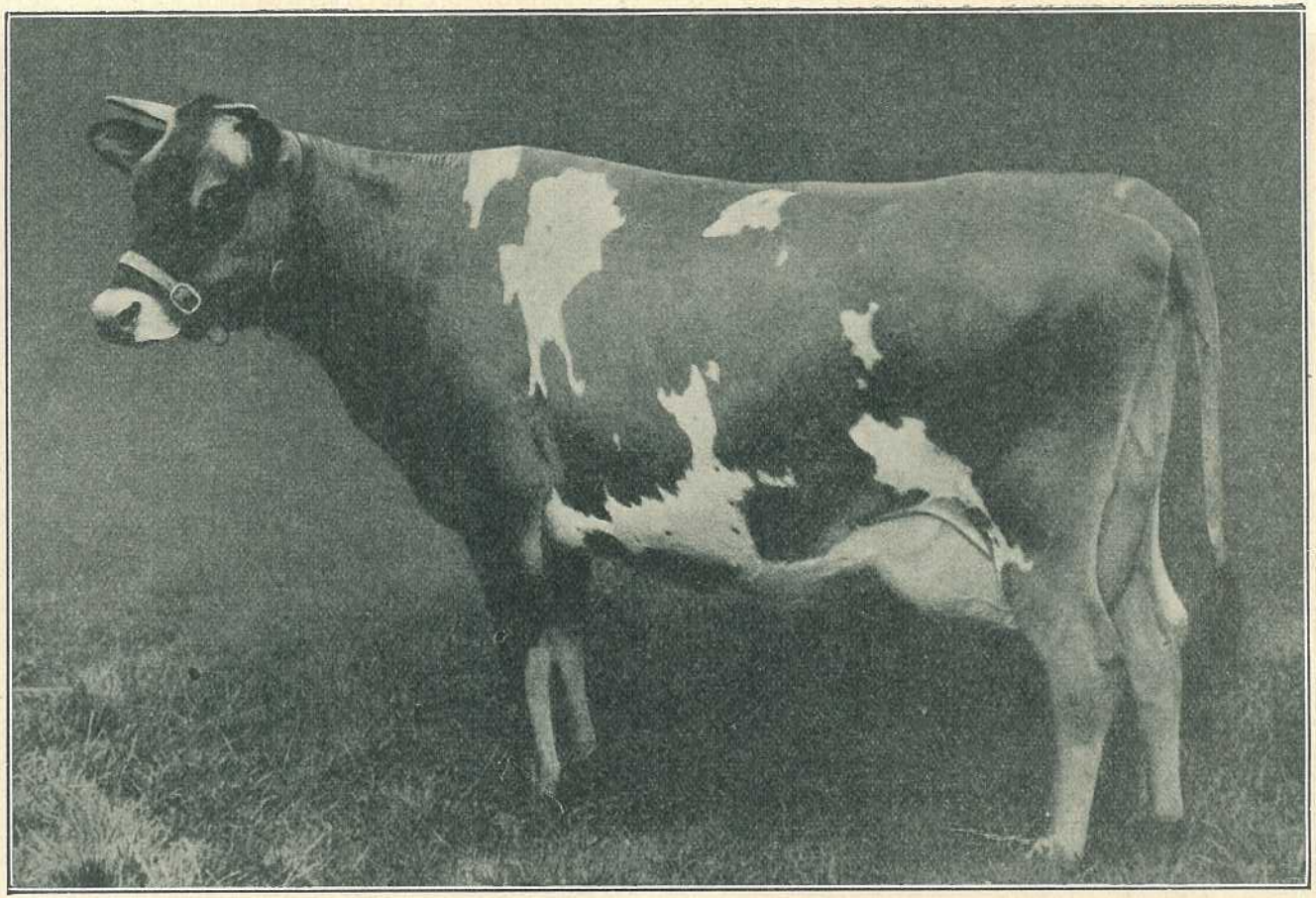

Plate 130.— A type favoured by Jersey Breeders in Britain.

Orchard Notes

SEPTEMBER.

THE COASTAL DISTRICTS.

In the North Coast and Gayndah districts the bulk of the citrus crops have been harvested with, perhaps, the exception of Valencia Lates. Orchard activities should be directed towards pruning, cultivation, fertilizing, and spraying. As a result of seasonal conditions and in some instances heavy crops, there are numerous instances of trees showing signs of impaired vigour, and these will require a severe pruning both in thinning and shortening back, removing superfluous growths, and diseased and weakly woods. Healthy and vigorous orange trees will require little attention beyond the removal of crowded lateral growths.

Mandarins will need special treatment, particularly Glen Retreats and Scarlets. These varieties usually produce a profusion of branches, and as the trees mature the growths harden and the fruit-bearing shoots make short, weakly growths which generally results in an over-production of small fruits and a weakening of the trees. This is particularly noticeable in the case of the former variety. Here the annual pruning should consist of a heavy thinning and shortening back. Mature mandarin trees require attention towards assisting them to produce new and vigorous fruit-bearing growths.

Unprofitable trees should receive attention and be prepared for top-working. They may be headed back to three or four main arms radiating from the stem and white-washed to prevent bark scald. Such trees may be grafted or later budded when suitable growths have matured.

Prior to working up the soil fertilizing should receive attention. The spring application should carry a high percentage of nitrogen.

In the warmer districts which are free from frosts plantings of young trees may be made. Serious consideration should be given to the selection of commercial varieties only, and having due regard for local conditions, selections may be made from the following varieties:—Washington Navel, Joppa, Siletta, Valencia Late, Beauty of Glen Retreat, Emperor, Scarlet, Solid Scarlet, Marsh Seedless or Thompson Grapefruit, and Villa Franca, Lisbon, and Genoa lemons.

Where Melanose and Black Spot are present in orchards preparations for control measures should be made, and Bordeaux sprays applied at the correct times.

The majority of citrus trees would be considerably benefited by the application of a strong lime-sulphur wash, 1-18.

THE GRANITE BELT, SOUTHERN AND CENTRAL TABLELANDS.

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.

Farm Notes

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, when the warmer temperatures allow of the obtaining of better germination and promote a healthier growth of the resultant seedlings. 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:—Peanuts, sweet potatoes, arrowroot, cow cane, and in those districts suited to their production yams and ginger. Plant out coffee.

OUR BABIES.

Under this heading a series of short articles by the Medical and Nursing Staffs of the Queensland Baby Clinics, dealing with the care and general welfare of babies, has been planned in the hope of maintaining their health, increasing their happiness, and decreasing the number of avoidable deaths.

JAWS AND TEETH WERE MADE FOR USE.

WELL formed jaws and sound, beautiful teeth cannot be formed without regular strenuous exercise, and this should be commenced by the sucking of the newborn infant, kept going by biting in the teething age, and encouraged by hard, crisp foods throughout childhood.

For Beauty and Health.

This exercise is not only necessary for the growth of a well-formed, beautiful face; it also invigorates the whole body.

The mouth is indeed a great primal "driving station," whence the nerve fibres carry impulses to the nerve centres, which quicken the life and activity of every tissue of the body. When the jaws are doing natural, honest, hard work the whole of the rest of the organism is impelled to activity—the heart pumps quicker and more forcibly, and the pressure of blood in the arteries rises and its stream flows more rapidly, even in the very finger-tips; at the same time the digestive juices are poured out freely, not only into the mouth but also into the stomach and bowels, as the result of messages transmitted from the mouth when busily engaged in mastication.

"Feeding exercise" is the most primitive, fundamental, and essential of all forms of exercise. A horse fed mainly on hard, dry food (and reasonably treated in other respects) becomes the ideal of strength and "fitness." Feed the same horse with soft mashes made from similar food materials, and he will become soft and "out of condition," simply because his whole organism will then lack the primary stimulation of daily, normal, active exercise which formerly he had to devote to

crunching the oats, &c—activities which are not called forth when dealing with food provided ready ground and softened food on which the work has been already done by millstones and mashing outside the animal body.

The same applies to ourselves—particularly to the young, who are always nearest to Nature. We need the exercise of active mastication, and the only effective means of ensuring this is to start training at the dawn of life. Never let a healthy infant take a meal in which he is not compelled to do active work in the form of sucking or chewing. We must begin with the baby and foster his natural tendency to masticate instead of doing everything in our power to make the function die out by disuse.

The Curse of Pap Feeding.

The mother should banish from her mind the idea of "pap feeding" being the natural course to pursue with a child who has teeth. Milk is best used as a drink, not as a fluid in which to soak food which would otherwise need chewing and insalivating. Parents who once grasp the fact that the more exercise a child can be given for mouth, jaws, and teeth the more he will tend to thrive will not be at a loss to find means by which the carrying out of what is needed can be ensured. Thus the small allowance of meat that a child may have is best given in the form of a bone, from which he can gnaw and tear off with his teeth what is eatable. The more extensive the bone surface to which the meat is attached the better, but even a small mutton chop bone chewed in this way will afford a considerable amount of very healthy, stimulating, and enjoyable recreation. Fortunately, the hands and lips are not unwashable.

Hard rusks, or what is better, fingers or slices of cerevite or wholemeal bread baked hard and crisp are excellent for the jaws. Hard oatcake is an acceptable change. Raw apples are superior in all ways to soft stewed fruit. Even raw carrots and turnips are good for older children, not to mention almonds and other nuts. Best of all would be a small piece of fresh sugar-cane; worst of all are sweetmeats made out of sugar.

IN THE FARM KITCHEN.

FOOD VALUE OF BEEF.*

Beef is an important source of animal protein. Furthermore, it yields energy in degrees varying with the amount of fat present, supplies mineral salts, especially iron and phosphorus with some copper, and in the case of glandular organs appreciable amounts of vitamins. Beef also contains small amounts of extractives which have little food value but are extremely important because they give flavour and act as stimulants to the flow of digestive juices.

All cuts of beef have much the same food value and contribute essentially the same food factors to the diet. However, fat meat has a higher calorie value than lean meat.

As knowledge of the protein values is increased there is greater stress given to the animal proteins such as meat, eggs, milk, and cheese because of their higher biologic value. In experimental work by Minot and Murphy the value of the iron and possibly the copper, particularly in liver, has been demonstrated. Although beef is known to be a good source of iron and phosphorus, it is low in calcium.

Ordinary beef muscle is not a rich nor an economical source of vitamin A; however, the adipose tissue contains significant amounts. Liver is a richer but quite variable source. Liver also shows a higher concentration of vitamin G than do other tissues, but its concentration of this vitamin compared with that in

* From a paper by RUTH TUCKER, Department of Food Economics and Nutrition, Kansas State College, U.S.A., in "Beef Cattle in Kansas" (Kansas State Board of Agriculture).

muscle is not as great as the vitamin A content. Day reports that there is vitamin G in the fresh tissues of beef and veal, but that beef heart is three times and liver ten times as potent. There is too little vitamin C in muscle beef to be measured by present methods even though observations on human scurvy have shown it possible to eat sufficient fresh, raw or "rare" meat, to prevent this disease. It is probably not safe to depend upon cooked meat for vitamin C since this vitamin is readily destroyed by heat. Meat may also contain some vitamin B, but it is usually considered better in vitamin G than B.

Care of Beef before Cooking.

Beef should be removed from wrapping paper as soon as possible, placed in a covered container and kept in a cool, clean place until ready for use. When preparing it for cooking, it should be wiped clean with a damp cloth, wrung from cold water. It should not be washed in water, as this removes some of the soluble extractives.

How to Use Different Cuts of Beef.

As constant repetition of an article of food prepared in the same way tends to dull the appetite it is desirable to introduce variety into the diet. When markets offer a limited choice, variety in preparation of a few food materials is one of the best ways to solve the problem.

Tender cuts of meat are in greater demand, chiefly because they can be cooked quickly. Consequently they sell at higher prices. Skilful cooks can economise by buying less tender cuts and cooking them in a way which makes them palatable. Long, slow cooking, pounding, chopping, grinding, and addition of acids such as tomatoes, sour cream, or lemon juice are methods which improve less tender cuts.

The principal cuts of beef and some of their uses are as follows:—

Cuts	Uses
Forequarter—	
Rib	Oven roast, rolled or standing
Chuck	Steak, Swiss or fry (sauté)
	Pot roast
	Stew
	Oven roast
Plate, brisket, and short ribs	Corn
	Braise
	Stew
Foreshank	Stew
	Soup
	Ground meat
Neck	Soup
	Stew
Hindquarter—	
Round	Steak, Swiss or fry (sauté)
	Pot roast
	Oven roast
	Ground meat
Rump	Steak, fry (sauté)
	Pot roast
	Oven roast
Hindshank	Soup
	Ground meat
Loin	Steak, broil
Sirloin	Oven roast
Porterhouse	
Short	
Flank	Flank steak en casserole
	Braise
	Stew
	Ground meat

Methods of Cooking Beef.

In general, the methods of cooking beef are roasting, broiling, frying, and cooking in water. Roasting, or baking, is cooking by means of dry heat in a hot oven. Broiling is cooking directly over coals, or over or under a direct flame, while pan-broiling is cooking in a heated pan without addition of fat or water. Boiling is cooking in boiling water. When the temperature is below the boiling point it is called simmering. The simmering method is preferable since it gives a more tender product. Braising or stewing is browning the meat then cooking in its own juices, often with the addition of vegetables.

It is generally agreed that a low or moderate temperature is better than a high one. With a low temperature cooking losses are less and meat retains more of its juices although a longer time is required for the cooking process. For thin chops or steaks and thin roasts a high temperature will dry out the meat too much and the interior becomes dry before the surface is browned.

Searing increases cooking losses and should be used only to develop an aroma and flavour on the outside of a roast. Searing may improve appearance of the roast, but it does not affect its inside flavour no matter whether the cut is browned at the beginning or the end of the cooking period. With high temperatures cooking time is materially shortened, but there is a decrease in the important factors of palatability, tenderness, juiciness, and flavour. Meat may not lose a great deal of nutritive value in shrinkage, but where the number of servings is important it should be mentioned there will not be as many if meat is seared. Muscle meat conducts heat slowly, while most metals conduct heat rapidly. Roasting speed is increased 30 to 45 per cent. by inserting nickel-plated copper skewers into the roast, and there also seems to be a decrease in total shrinkage of the meat as well.

Roasts cooked in water are low in palatability, lowest of all in tenderness and flavour, and very low in juiciness.

Weight and shape of a cut of beef affect the length of time for cooking, but are not altogether satisfactory factors by which to determine cooking time. A thin, wide roast will cook more quickly than a thick, compact cut, but a heavy roast the same shape as a lighter piece will require a shorter time per pound for cooking if oven temperatures remain the same, since the weight increases much more rapidly than does the distance heat must penetrate.

Degree of Cooking.

Personal taste plays a large part in the degree of doneness obtained in cooking. When considered medium done by many it may be considered rare by others. Rare meat has a much more distinctive flavour and is tenderer and juicier than meat which has been thoroughly cooked through, yet to many the colour of rare meat is so unattractive that it is unpalatable to them. Rare meat has a brownish coloured layer on the outside, a pinkish layer inside, and a bright reddish portion in the centre. However, this red colour is not the deep red colour of raw meat.

At the medium-done stage beef has a pink colour in the centre, but has turned a brownish-grey at least half way through the meat and the juice that forms when it is cut has a slight pinkish colour. Most people seem to desire meat cooked to this degree. It is very tender and juicy, and the colour is more attractive than in a cut cooked rare.

Well-done meat appears greyish-brown throughout. At this stage it is not so tender and juicy, as the fibres have shrunken and some of the juices have been forced out.

In cooking meat it passes gradually from one stage to another with no definite stage between rare and medium well-done, and between medium well-done and well-done. Heat penetrates slowly into the centre of a piece of meat and unless it is much over-cooked this area never attains the surface temperature. The length of time required to bring a pound of meat to the three different stages seems to be a fairly accurate guide. Periods suggested for standing rib roasts cooked in a slow oven are as follows:—For rare roast, 14 to 15 minutes per pound; for medium-done roast, 17 to 18 minutes per pound; for well-done roast, 23 minutes per pound; but there are variations in requirements. Factors which influence the time are—Cooking temperature, weight or surface area, stage to which meat is cooked, and composition of the meat. The higher the cooking temperature the sooner meat reaches a definite temperature, for heat penetrates to the interior more rapidly.

Usually when a roast is removed from the oven it is placed on a platter or hot pan and allowed to stand while gravy is being made and the rest of the dinner taken up. Unless meat is cut the temperature will continue to rise for about thirty minutes. Amount of this rise depends upon degree of doneness and the temperature to which meat has been cooked. Experimental work shows that the temperature of roasts cooked to the rare stage will rise more than those cooked to a medium or a well-done stage. If meat is cut immediately after removing from the oven then about three minutes longer per pound for each stage should be allowed in the roasting process.

Cooking Losses.

Losses in cooking meat are of two kinds—the evaporation of moisture and volatile materials, and secondly, drippings which when made into gravy are not actual losses. The amount of drippings is quite large when meat is well mottled with fat, but such meat is juicier than very lean meat and a liberal amount of fat

is desirable. Temperature of the oven makes a difference in quality of the drippings. A higher degree makes dark brown drippings which give a good colour and flavour to gravy made from them, while with a lower temperature lighter coloured drippings are obtained.

In meat that is cooked in water there is 10 to 40 per cent. greater loss in boiling water than in that cooked at 185 deg. F. or lower. Often the loss is twice as great in boiling water.

Meat should be cooked in such a way as to increase tenderness of a tough cut and keep tender a tender cut, also in ways which prevent to as great an extent as possible the destruction of food constituents. The method as well as the length of time of cooking may, and often does, spoil a good piece of meat, yet when properly chosen and executed the method may improve a poor piece. Cooking losses of moisture are accompanied by increased dryness and firmness of muscle fibres. The water loss varies with fat content of the fibres and the salt content of meat, as well as with temperature to which meat is heated and length of the heating period.

Time Required for Cooking.

Roast. It is hard to give any definite time for cooking roasts, for this varies with different kinds of meat and other essential factors. In recent experiments a temperature of 257 deg. F. throughout produced the smallest losses and gave the most desirable product if advantages of searing are ignored.

Steak. It takes from seven to nine minutes to cook a 1-inch steak, and from thirty to forty minutes or longer to cook a 2-inch steak. Steak is usually cooked by broiling, pan broiling, or frying.

Broiling is cooking by direct heat.

Pan broiling is cooking in an uncovered frying pan, pouring off the fat as it accumulates. If the fat is not poured off frequently while cooking, the meat will fry and not broil. The time for pan broiling is the same as for broiling.

Frying is cooking in a small quantity of fat and is specially suitable for cuts deficient in fat. Meat for frying is usually cut thin, browned quickly on both sides, then the heat is reduced and cooking continued at a lower temperature.

Boiled Meat. The term "boiled" is used to refer to meat cooked in water. However, meat should not be boiled, it should be simmered.

Stew. Stew means to cook by simmering heat. The meat is cut into small pieces to increase the surface area, then browned for flavour. After adding water or other liquids it is simmered either on top of the stove or in the oven.

Braise. To braise meat is to brown it in a small amount of added fat, then cook slowly in juices from the meat or with added liquid. Typical dishes which are prepared by braising are casserole meat, Swiss steak, and pot roast.

Casserole meat may be cut into small pieces or left in larger ones. Round or flank steaks are often cooked in a casserole. The meat may be cooked on a bed of vegetables such as carrots, turnips, and celery. Tomatoes may be added for a part of the liquid.

Swiss Steak. After flour has been pounded into the meat it is seared on both sides to brown it. Then water or liquid of some sort is added and the cooking continued in covered utensil by simmering on top of the stove or in the oven.

Tomatoes, sour cream, or other acid substances are often added to Swiss and smothered steaks as well as to some pot roasts. The effect of the acid depends on the amount used and its reaction with the meat proteins. It may cause the meat to swell and retain more water and become tender.

Pot Roast. A pot roast is usually a thicker Swiss steak. Flour is not pounded into the meat. The cut is seared and then cooked as Swiss steak in a heavy, covered pan on top of the stove or in the oven. A thermometer may be inserted to determine when the desired interior temperature is rached.

Soup. The meat is cut into pieces or ground, allowed to stand in salted water and then simmered to extract as much flavour as possible into the liquid.

(To be continued.)

WAYS OF USING UP CORNED BEEF.

Corned Beef Toast.

Take some cold corned beef, ¾ oz. butter, 2 eggs, 1 tablespoonful milk, 1 tablespoonful gravy, pepper, squares of hot toast. Mince beef, put butter into a saucepan, add meat, milk, gravy, season with pepper. Beat 2 eggs and stir in until the mixture thickens; then pour on squares of toast.

Toad in the Hole.

Take slices cold corned beef, ½ lb. flour, 2 eggs, 1 pint milk, salt, pepper. Mix flour in a basin with salt. Beat eggs in milk and stir into flour gradually, beating well all the time. Cut meat into neat pieces and place in a well-greased baking tin, pour over the butter, and bake in a hot oven for one hour.

Corned Beef Surprise

Take ¾ lb. corned beef, 1 oz. butter, 1 oz. flour, 1 cup milk, 3 eggs, salt, pepper, small onion. Put beef and onion through mincing machine, make a thick sauce with the butter, flour, and milk, add beef, salt, and pepper, and mix well. Then add beaten egg-yolks and cook for five minutes. Allow to cool, then fold in stiffly-beaten egg-whites and bake in a deep buttered piedish for three quarters of an hour. Serve at once.

Corned Beef Rissoles.

Take cold corned beef, 1 small onion, breadcrumbs, herbs, pepper, salt, 1 tablespoonful chutney, egg, a little gravy. Put beef and onion through mincing machine, mix with breadcrumbs, salt to taste, pepper, chutney. Moisten with half of egg and gravy, and shape into rolls or balls. Dip in egg (using the half left over), then breadcrumbs. Fry in hot fat.

KING GEORGE V. AS A FARMER.

It was not till 1863 that Sandringham became part of the Royal estates, for in that year the late King Edward VII., as Prince of Wales, bought the original property, which included the parish of Sandringham, the parishes of West Newton, Wolferton, Babingley, and portions of Dersingham and Appleton. This estate passed to King George V. through Queen Alexandra. The problems of changing to early maturity stock and finding by experiment the best commercial beast for British farmers had no greater enthusiast than His Majesty.

At Windsor His Majesty's historic estate comprises about 550 acres. The Windsor stud comprises about 175 head of beef and dairy stock, 300 breeding ewes, and a small select herd of pigs. Actually there are five herds of cattle—two of Shorthorn and one each of Hereford, Devons, and Jerseys. The non-pedigree Shorthorns are of dairy type, and, together with the Jerseys, they provide the milk, butter, and cream for the Royal household. When the King and Queen were in residence at Buckingham Palace the dairy produce and eggs were sent up from Windsor every day by car. The beef stock are a magnificent lot, and are representative of all the best British strains, with their proven first crosses. Many are already famous by their prize-winning at the English beef stock shows, and several were sold at high figures to Argentine, Brazil, and Rhodesia.

Sandringham is a magnificent estate. King George V. was the second Royal farmer at Sandringham, and it was because he was the personal owner of the beautiful Norfolk Estate, bought and developed by his father, because he practised the oldest industry in the land there so well and progressively, sharing with his fellow-farmers the changes of fortune and the struggles and successes that they brought, and because at Sandringham he was the Royal Squire and a model to all who possessed and farmed large estates, that his Norfolk home had a peculiar interest and appeal to agriculturists throughout the Empire. In all that was done within the estate on his own and his tenants' farms he took the closest interest. Like Windsor, it was known best for its pedigree livestock. There the famous Red Poll stud established by King Edward VII. in 1886 was maintained. In smaller stock his late Majesty's flock of Southdown sheep, dating back to 1870, preserved royally the proud name of their breed. The rams were in much demand overseas, and Australia had been fortunate in recent years in acquiring several high-class sheep from this stud.

Our late Sovereign and farmer King's interest in farming was not confined to events that met the public eye. It was more personal—more intimate. He had an ingrained love for a good beast, be it Shorthorn, Hereford, Devon, or Angus. He had a love for a good horse and a good job of farming. He took a lively interest in the Royal farms of Windsor, Sandringham, and Balmoral, and when away from them was always anxious to receive periodical reports from his land stewards. On his return he was soon inspecting the farms and discussing plans for the future. King George's sons, on their ambassadorial tours of the Empire, kept him in constant touch with the stock and land developments in each Dominion. It was in these personal considerations and in his intimate knowledge of the progress of his subjects and concern for their welfare that the King shone as Squire, as Lord of the Manor.

RAINFALL IN THE AGRICULTURAL DISTRICTS.

TABLE SHOWING THE AVERAGE RAINFALL FOR THE MONTH OF JUNE IN THE AGRICULTURAL DISTRICTS, TOGETHER WITH TOTAL RAINFALL DURING 1936 AND 1935, FOR COMPARISON.

Divisions and Stations.	Average Rainfall.		Total Rainfall.		Divisions and Stations.	Average Rainfall.		Total Rainfall.	
	June.	No. of Years' Records.	June, 1936.	June, 1935.		June.	No. of Years' Records.	June, 1936.	June, 1935.
North Coast.	In.		In.	In.	*Central Highlands.*	In.		In.	In.
Atherton	1·63	35	3·96	0·57	Clermont	1·67	65	2·51	1·27
Cairns	2·80	54	8·12	1·89	Gindie	1·44	37	..	0·78
Cardwell	2·03	64	2·82	2·41	Springsure	1·77	67	1·91	1·16
Cooktown	1·98	60	4·29	1·38					
Herberton	1·14	50	2·68	0·86					
Ingham	2·36	44	4·50	2·49					
Innisfail	7·16	55	13·64	7·11					
Mossman Mill ..	2·22	23	9·56	5·40	*Darling Downs.*				
Townsville	1·32	65	4·90	0·40					
					Dalby	1·67	66	1·56	0·13
Central Coast.					Emu Vale	1·50	40	1·27	0·07
					Hermitage	1·74	30	..	0·03
Ayr	1·42	49	5·37	..	Jimbour	1·66	48	0·79	0·07
Bowen	1·59	65	5·66	0·07	Miles	1·78	51	1·29	0·13
Charters Towers ..	1·25	54	5·23	1·15	Stanthorpe	1·92	63	1·27	0·44
Mackay	2·62	65	10·31	0·68	Toowoomba ..	2·39	64	1·64	0·18
Proserpine	3·17	33	11·44	0·83	Warwick	1·74	71	1·68	0·20
St. Lawrence ..	2·45	65	6·39	0·46					
South Coast.									
					Maranoa.				
Biggenden	2·16	37	5·48	..					
Bundaberg	2·84	53	5·23	0·52	Roma	1·57	62	1·29	0·38
Brisbane	2·71	85	1·90	0·06					
Caboolture	2·69	49	2·17	..					
Childers	2·46	41	3·90	0·12					
Crohamhurst	4·57	43	4·57	0·46					
Esk	2·22	49	2·02	0·05					
Gayndah	1·81	65	3·07	..					
Gympie	2·66	66	3·65	0·11	*State Farms, &c.*				
Kilkivan	2·10	57	3·47	0·05					
Maryborough ..	2·99	65	4·61	0·02	Bungeworgorai ..	1·30	22	1·26	0·07
Nambour	3·72	40	4·86	0·03	Gatton College ..	1·82	37	1·96	0·08
Nanango	1·98	54	2·13	..	Kairi	1·46	22	..	..
Rockhampton ..	2·55	65	4·67	0·40	Mackay Sugar Experiment Station	2·31	39	9·90	0·80
Woodford	2·90	49	2·57	0·04					

A. S. RICHARDS, Divisional Meteorologist.

CLIMATOLOGICAL TABLE—JUNE, 1936.

COMPILED FROM TELEGRAPHIC REPORTS.

Districts and Stations.	Mean Atmospheric Pressure 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	29·96	77	67	84	2	52	30	429	11
Herberton	..	68	53	78	1	30	29	268	16
Rockhampton	30·12	72	56	82	6	40	25	467	9
Brisbane	30·16	68	51	79	5	42	28	190	8
Darling Downs.									
Dalby	30·18	65	41	79	5	30	16, 30	156	7
Stanthorpe	60	60	34	72	5	23	16	127	7
Toowoomba	..	63	43	75	5	31	15	164	5
Mid-Interior.									
Georgetown	30·01	79	59	88	4, 5	36	28	156	6
Longreach	30·15	71	46	81	11	31	24, 25	69	3
Mitchell	30·20	65	38	80	4	28	16, 17	143	6
Western									
Burketown	30·04	79	57	88	10	45	24	26	2
Boulia	30·16	70	46	85	10	39	17, 25, 26	4	1
Thargomindah	30·21	63	40	76	10, 11	31	16	103	1

ASTRONOMICAL DATA FOR QUEENSLAND.

TIMES COMPUTED BY D. EGLINTON AND A. C. EGLINTON.

TIMES OF SUNRISE, SUNSET, AND MOONRISE.

AT WARWICK.

	August, 1936.		September 1936.		MOONRISE. Aug., 1936.	Sept. 1936.
	Rises.	Sets.	Rises.	Sets.	Rises.	Rises.
					p.m.	p.m.
1	6·35	5·21	6·7	5·37	3·26	5·23
2	6·34	5·22	6·6	5·37	4·29	6·28
3	6·33	5·23	6·5	5·38	5·33	7·34
4	6·33	5·23	6·3	5·38	6·38	8·42
5	6·32	5·24	6·2	5·39	7·41	9·49
6	6·31	5·25	6·1	5·39	8·44	10·56
7	6·31	5·25	5·59	5·40	9·47	..
						a.m.
8	6·30	5·26	5·58	5·40	10·56	12·1
9	6·29	5·26	5·57	5·41	..	1·1
					a.m.	
10	6·28	5·26	5·56	5·41	12·4	1·56
11	6·28	5·27	5·55	5·42	1·5	2·43
12	6·27	5·27	5·53	5·42	2·8	3·24
13	6·26	5·28	5·52	5·43	3·5	3·53
14	6·25	5·28	5·51	5·43	3·59	4·34
15	6·24	5·28	5·50	5·44	4·44	5·7
16	6·23	5·29	5·49	5·44	5·25	5·38
17	6·22	5·29	5·48	5·45	6·1	6·8
18	6·21	5·30	5·47	5·45	6·33	6·39
19	6·20	5·30	5·45	5·45	7·5	7·14
20	6·19	5·31	5·44	5·46	7·36	7·52
21	6·18	5·31	5·43	5·46	8·9	8·30
22	6·17	5·32	5·42	5·47	8·41	9·15
23	6·16	5·32	5·41	5·47	9·15	10·4
24	6·15	5·33	5·40	5·47	9·52	10·38
25	6·14	5·33	5·39	5·48	10·33	11·55
						p.m.
26	6·13	5·34	5·38	5·48	11·21	12.55
					p.m.	
27	6·12	5·34	5·37	5·49	12·13	1·59
28	6·11	5·35	5·36	5·49	1·10	3·2
29	6·10	5·35		5·50	2·9	4·7
30	6·9	5·36	5·35	5·50	3·13	5·13
31	6·8	5·36	5·34		4·17	

Phases of the Moon, Occultations, &c.

3 Aug.,	○	Full Moon	1 47 p.m.
10 „	☽	Last Quarter	6 59 a.m.
17 „	●	New Moon	1 21 p.m.
25 „	☾	First Quarter	3 49 p.m.

Perigee, 7th August, at 1.48 a.m.

Apogee, 22nd August, at 7.12 p.m.

On the 15th Uranus will become stationary amongst the stars of Aries.

On the same date at midnight an attractive picture will be formed by the nearness of Mars to the Moon in a narrow sickle-shape.

On the 17th the planets Mercury and Neptune will be apparently within a degree of one another, but the orbit of Neptune being 2,791,750,000 miles from the Sun and that of Mercury only 35,958,000 their real distance apart will be more like 2,755,792,000 miles.

On the 23rd Venus and Neptune will apparently be within half a degree of one another, but the enormous distance of Neptune's orbit from the Sun, as quoted above, and that of Venus being 67,190,000, they will in reality be 2,791,750,000 miles apart.

On the 26th when Scorpio, head inclined, is going westward Jupiter and the Moon will be seen near Alpha Scorpii (Antares) the brightest star in the constellation. At 6 p.m. Jupiter will be 2 degrees northward of the Moon.

Mercury rises at 7·10 a.m., 35 minutes after the Sun and sets at 5·58 p.m., 37 minutes after it on the 1st; on the 15th it rises at 7·27 a.m., 1 hour 3 minutes after the Sun and sets at 6·59 p.m., 1 hour 31 minutes after it.

Venus rises at 7·11 a.m., 36 minutes after the Sun and sets at 6·1 p.m., 40 minutes after it on the 1st; on the 15th it rises at 7·10 a.m., 46 minutes after the Sun and sets at 6·26 p.m., 58 minutes after it.

Mars rises at 5·54 a.m., 51 minutes before the Sun and sets at 4·12 p.m., 1 hour 9 minutes before it; on the 15th it rises at 5·22 a.m., 1 hour 2 minutes before the Sun and sets at 4·0 p.m., 1 hour 28 minutes before it.

Jupiter rises at 1·15 p.m. and sets at 3·1 a.m. on the 1st; on the 15th it rises at 1·23 p.m. and sets at 1·1 a.m.

Saturn rises at 8·32 a.m. and sets at 9·4 p.m. on the 1st; on the 15th it rises at 7·34 a.m. and sets at 8·6 p.m.

During this month the Southern Cross will be on its downward path towards the west during the evening hours. It will reach its extreme western point about 10 p.m. on the 1st and about 8 p.m. on the 31st, and being horizontal it will be at a hight above the horizon equal to the latitude of the place where the observer is situated.

1 Sept.	○	Full Moon	10 37 p.m.
8 „	☽	Last Quarter	1 13 p.m.
16 „	●	New Moon	3 41 a.m.
24 „	☾	First Quarter	8 12 a.m.

Perigee, 3rd September, at 8.48 p.m.

Apogee, 19th September, at 10.42 a.m.

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.