TYPE-OF-FARMING AREAS IN VICTORIA, AUSTRALIA

A Thesis presented for the Degree of Doctor of Philosophy in the Australian National University, Canberra.

Robert Kent Wilson, Melbourne, 1959.
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SUMMARY

The thesis is divided into four parts, of which Part 3 is the main section. Part I consists of one chapter only, which is an introductory treatment of the literature relating to the subject of agricultural geography and to studies of type-of-farming areas in different countries.

Agricultural geography is surveyed first, mainly through the literature in American periodicals dating from about 1920. Then the work of agricultural economists studying type-of-farming areas in parts of the United States is surveyed. This lead up to the study of the whole country which was based on the Census of Agriculture of 1930, and published in 1933 as Types of Farming in the United States by F.F. Elliott, of the U.S. Department of Agriculture. Modifications and revisions up to the present time were then examined, as well as research by other agricultural economists. Special attention was given to the use of a measure of labour expended on farms, which was found to contrast with Elliott's use of gross income from different enterprises on farms. Subsequent and related studies in Canada, Scotland and elsewhere were referred to.

Attention was then given to a classification of farms carried out recently in New South Wales. From the whole survey certain requirements were listed as likely to
be useful for a similar study in Australia.

Later work in agricultural geography was then reviewed, with special attention to "Major Agricultural Regions of the Earth", an article in the Annals of the Association of American Geographers of 1936, by Derwent Whittlesey. There follows a brief survey of notation schemes for land utilization study in both American and British periodicals. Finally some recent articles surveying agriculture in Australia are listed, and attention was also given to some recent articles by J.C. Weaver on crop combination regions of Middle West U.S.A. It is concluded from this latter examination, that one is liable to lose sight of the purpose of farm classifications or agricultural mapping, if one concentrates mainly on the detail of repeatable calculations.

In conclusion, C.W. Olmstead, an American geographer writing of "American Orchard and Vineyard Regions" (Economic Geography, 32, No.3,1956, p.190 ) is quoted with approval when he points out that "There is no equable quantitative measure of ....any large number of diverse agricultural products".

Part 2 briefly outlines the setting of Victorian agriculture: firstly the natural environment, of topography, climate and soils, and then some of the cultural changes effected in pastures and water resources.
In Chapter IV a very brief account is given of the historical setting, and a fuller account of the economy of present-day farming. For this part some estimates are made of the numbers of farms of different types and employment in each type of farming.

Part 3 deals with the main subject of the thesis that is, types of farming in Victoria, where they are, and their relation to one another.

Chapter V begins with a brief survey of the literature on farming in Victoria, and then proceeds to the topic of the equivalence of livestock compared with different kinds of crops. A table of relative values is laid out, giving the importance of a livestock unit or units, in terms of acres of different crops. Two different measures had to be used: firstly for livestock a measure of eight sheep equal to one cow was adopted from a previous study of livestock in Victoria. Then for crops a certain amount of equivalence was obtained by taking average values of production for the three years preceding the base year of the study, that is 1951.

Money values and relationships were changing rapidly in 1951, and for this reason it was not possible to establish any clear economic equivalence between livestock and crops. Previous studies of agriculture in Victoria, made by the Central Planning Authority, Premier's Department, for the Resources Surveys of the Planning Regions
were drawn upon for a list of types of farming. This list is given at the end of Chapter V.

In the succeeding chapters—Chapters VI to XI—the main types of farming are surveyed in the order of their relative importance, beginning with Sheep farming, and continuing through Wheat/Sheep farming, Dairying, Beef Cattle farming, Field crop/Livestock farming, Poultry farming, Viticulture, Fruit farming and Market Gardening. The method of treatment was somewhat similar for each type. For each main animal or crop, a map of its distribution—usually in detail—was prepared. In each case the general conditions of the type of farming were examined, and the distribution was usually analysed in some detail to bring out the main factors which had influenced it. Consideration was then given to the relation between the crop or animal and associated or competing enterprises. Where the type of farming appeared to be dominant within a number of parishes, a type-of-farming area was placed on a small-sized map.

For the lesser crops and for poultry, the area occupied by each type was found to be so small, that the latter method was hardly appropriate. It was useful in these cases merely to indicate localities in which these types were important. Then the position of the lesser crops vis-a-vis each other was summarised at the beginning of the final summary chapter. Map II
was included as a locality map.

In addition to the material on detailed distributions, there was included a series of maps based on county statistic and covering subjects subsidiary to the main types of farming. For instance, in sheep farming, statistics dealing with breeds were analysed in some detail because of the importance of the topic to the variations in the nature of sheep farming from place to place. On the other hand, parish statistics were used to analyse the relationship between wheat and sheep. In dairying, the question of breeds and of the relationship with other livestock was not very important, but the varying end uses of milk, and the numbers of cattle in broad regions of Victoria were dealt with.

Beef Cattle grazing was shown to be hardly an independent type of farming, while Field crop/Livestock farming was found to be largely an association of potatoes and onions, with dairying and fodder crops. Nevertheless the different enterprises in this mixed type were found to be interdependent.

Because of the disputes over egg marketing, it is difficult to measure and locate poultry farming, but it was shown to be located on the urban frigge of Melbourne and other cities. Viticulture was found to be largely conducted to produce dried grapes, the farms being small and almost entirely irrigated. Fruit farming of other fruits was found to be more widely dispersed and on
larger holdings, but much of it also supported by supplementary irrigation. Vegetables other than onions and potatoes were taken to be the main crops of market gardeners, but it was found that there were at least two different types of market gardeners, those within 20 miles of the metropolis, who grow a variety of vegetables in quick succession on small holdings, while away from Melbourne the growers were found to be largely specialists, who produced some crop or crops, especially suitable to the particular conditions of their own locality.

Other crops and livestock were found to be relatively insignificant and hardly important enough to give rise to a distinctive type of farming, except perhaps in the case of tobacco which was found to be not dissimilar to market gardening in its intensity, though more specialised in methods of farming.

Part 4, is a summary and conclusion. Victoria is divided into ten distinctive type-of-farming areas with readily recognisable farming types within them. A further region is a mixed one located along the Murray, its diversity being due to irrigation. This irrigation region is shown in greater detail on the final map. It has four main types of farming, viticulture in the west, other fruit farming at the eastern end, and dairying and sheep farming between the two types.

In conclusion it is pointed out that the point of
view adopted in the thesis is a restricted one, which has kept firmly in sight the concept of the type of farming, and its geographical expression in the type-of-farming area. Nor is there any formula to be found to explain the importance and location of every area. But where feasible this has been essayed in the body of the thesis by considering the available geographical and economic information.
PART I

INTRODUCTION

CHAPTER I AGRICULTURAL GEOGRAPHY AND TYPE-OF-FARMING RESEARCH
CHAPTER I

AGRICULTURAL GEOGRAPHY & TYPE-OF-FARMING RESEARCH

This study of types of farming in Victoria was accompanied by an investigation of other work which might yield ideas and methods. Two main lines of work were investigated: that on agriculture done by geographers and that undertaken by agriculturalists, mainly agricultural economists. Especial attention was given to classifications and the materials and ideas used in arriving at them. It is neither possible nor necessary to attempt to survey the whole field of relevant work. What is here attempted is to select those works which provide new ideas or new techniques. However, it was felt necessary to survey all the contributions to agricultural geography in Australia, which deal with areas larger than small localities.

Early Studies in Agricultural Geography

In an early work, Jones and Sauer suggested four classifications of agricultural land use: (1) Crops, (2) Livestock, (3) Crops & livestock, (4) Dairying, poultry, gardening or fruit. In the next decade Jones worked on the problem of outlining a world-wide system of agricultural regions, and in a paper which discussed uses of ratios and isopleths in

1 For a bibliography and account of development of agricultural geography in the U.S.A., see Ch., 10, American Geography, Inventory & Prospect, P.E. James & C.F. Jones (Syracuse, 1954).

the determination of boundaries to agricultural areas, he gave an indication of some of the types he proposed for a world classification of agriculture.\(^3\) They were: (1) Livestock Ranching, (2) Commercial Grain Farming, (3) Dairying and Livestock Farming (sometimes called "mixed farming"). Jones gave ratios for four counties, said to be typical of each system in the United States. The ratios were used to relate such items as density per square mile of farm population, percentage of total land area in all crops, total livestock units per square mile, total livestock units per 100 acres in crops, and the predominance of different livestock as measured by livestock units. Jones then worked with Derwent Whittlesey to produce a world classification.

**Baker's Agricultural Regions of North America**

Meantime O.E. Baker published a number of studies which made him the leading agricultural geographer of the period. In his "Agriculture of the Great Plains Region", Baker names the farming 'systems' with terms in ordinary use, and this is quite satisfactory. But in the placing of boundaries his method is unsatisfactory.\(^4\)

The boundary of an agricultural region should be drawn on the basis of its agriculture, but as the settlement of most of the Great Plains is recent


and the agriculture is immature, it seems best at present to determine the eastern boundary on the basis of the colour of the soil and depth to the layer of lime accumulation, as well as upon farm practices and systems of farming, which tend to vary with the climatic and soil conditions.5

This appears to be a muddle of principles - it is clear that Baker was really concerned with potentialities but did not see this clearly himself.

Beginning in 1926, there was published in Economic Geography a series of studies of agricultural regions of the world.6 A study by Baker of the agricultural regions of North America began the series. In the main he distinguished one region from another by crops; samples of his titles are Humid Subtropical Crops Belt, Hay and Dairying Region, Corn Belt, Hard Winter Wheat Belt, Columbia Plateau Wheat Region. Again there is mixture here, sometimes climate and types of crops are mixed, as in Humid Subtropical Crops Belt, or a specific locality is picked out such as the Columbia Plateau. To decide margins to the selected regions, Baker adopted a variety of measures, most of them specific to the region, and sometimes including potentialities also. For the Corn Belt, for example, "in general the boundaries have been drawn where the production of corn falls below 3,000 bushels.

5 Ibid, p. 112.
per square mile, but along the western margin where agricultural development is incomplete, possibilities of production have been taken into account and the boundary has been drawn where the production of corn at present is much less."7 Baker was explicit about his determinations: "... the physical conditions are the principal factors influencing agricultural development. For this reason they have been given primary consideration in this classification of North America into agricultural regions. ... it is desirable that in dividing a continent into agricultural regions the basis of the classification consist of conditions that are as permanent and unalterable as anything can be in this changing world." 8 The physical conditions may be unalterable, but contemporary agricultural regions cannot be drawn by guessing at the potential location of crops in terms of their estimated physical limits and optima.

A few years later, Hartshorne and Dicken published a study of agricultural regions in Europe and North America9 as a preliminary to a larger study. They used as limiting criteria isopleths, chiefly of crop acreage, as suggested by W.D. Jones.10 Isopleth maps of many different sorts were

7 Idem, Econ. Geog., 3 (1927), p. 449
8 Idem, Econ. Geog., 2 (1926), p. 460
10 Loc. Cit., (1930), pp. 177-195
drawn, and where the authors felt that a definite change from one type to another occurred, they selected the appropriate isopleth as a general limit. This is a widely-used method, that is to take known conditions and measure them or find their value, then extend the known to other areas of the work where conditions are not so well known. It represents a concentration on limits. These early workers thought out a sort of notional regional framework, based on the qualities of the types of farming or production which were readily distinguishable, before the work of clearly delimiting regions was begun. Hartshorne and Dicken decided on the following list:

- Truck Farming and Commercial Orchards;
- Commercial Grain Farming;
- Hay-Pasture;
- Small Grains and Livestock;
- Corn Wheat and Livestock;
- Mediterranean.

Clearly the types were decided upon mainly with crops in mind. They are cropping types, though "Mediterranean" is not as definitely so as the rest. To take a specific case, they pointed out that their "... system reveals essential cultural similarities between regions not commonly associated, e.g. the Po Plain of Italy and the American
However, while there are similarities in their crops, in the methods, organisation and economic conditions of farming these regions are dissimilar. To be fair to the later Hartshorne, it must be added that he makes this point in a mature consideration, not only of his own work, but of other attempts to devise world classifications of agriculture.

The work of 1935 marked a real step forward beyond the series of articles on world agricultural regions, because it did stick to agricultural features as the main criteria and subject, whereas the series in Economic Geography were all notable for a confusion between agricultural regions and "natural regions". There was thus no comparability between different parts of the world, nor even within many of the continents. "The Agricultural Regions of North America" was therefore an advance.

At the same time work was proceeding in agricultural economics in North America, on the regionalisation of agricultural areas.

Type-of-Farming studies in U.S.A., before 1930

Before 1930, some of the mid-western states of the U.S.A. were studied with the object of outlining type-of-

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11 Hartshorne and Dicken, loc. cit., p. 118
farming areas. Most of these early studies were the outcome of cooperation between F.F. Elliott, of the Federal Department of Agriculture, and local agriculturalists. They defined the concept they used, as follows:

The term type-of-farming as used herein, relates to the kind, quantity and proportions of the crops and livestock found on an individual farm. A "type-of-farming area" on the other hand, is an area in which there is a fairly high degree of uniformity in the types of farming prevailing. This uniformity consists not only in the general prevalence of a particular type, but in similar soil and climatic conditions, similar trends and similar methods and practices.\(^{13}\)

This includes the idea that Baker had about his regions, that is that they should have some significant environmental uniformity. Presumably, if some important environmental feature, such as soil type, were to change considerably but the farming carried on remained the same, these workers would distinguish a different type-of-farming area. In practice only major differences in conditions were allowed to alter classification. The procedure is worth a long quotation:

> It is apparent that no division of the state could be made if a strict adherence was held to segregation on all of these bases. Conditions are not uniform enough for this so in actual practice areas are differentiated if they are similar in

the major portion of their characteristics. Conditions vary to such an extent that more than one type of farming may be practiced within the same area. There is, however, a tendency for farmers to adopt a similar type of farming in areas where the basic conditions are essentially the same. The object in selecting these areas is to group those sections together which are nearest alike, considering all conditions upon which information is available. The data are available only by counties and so the division within counties may lack definiteness. Whole counties may lie between type-of-farming areas, making them unusually difficult to classify. On the whole, however, the greater number of farms in a particular area show considerable similarity or definite trends toward similar types. 14

Most of the studies of this period followed the same order of work and presentation. First they showed the centres of production of the more important crops and livestock; then examined the environment, yields, trends in farm size, mechanisation and crops and livestock commonly found. County totals of crops and livestock were compared and similar counties were grouped together. For example, in Kansas the 100 counties were grouped into 12 type-of-farming areas. Another point: the segregation was done with no reference to conditions of farming outside the state, but was based on comparisons of diverse areas within one state only. The names of the areas were:

14 J.A. Hodges, et.al., op.cit,p.6.
general farming, corn belt, wheat-farming, and grazing. There was no concern with classification on a broad basis to suit a larger area than Kansas.

A further part of the work was to outline "farm organisations" which were found to be typical in particular type-of-farming areas. By farm organisation the authors meant the association of different enterprises, and sizes of farms.15 The most common organisations found were termed typical farming systems. They were obtained by sampling individual farm records, for example:

Area 6. Approximately 575 records were taken from representative townships in Area 6 and used as a basis for the typical farming systems shown in Table XII. The 160, 220, 240 and the 320 acre farms were the most important sizes of farm in this area. Others comprise only approximately 5 per cent of all farms. The 160 acre farm was the most common size, comprising about 30 per cent of all farms. In this area, since wheat is the dominant crop, the farms were arrayed on the basis of the acreage in this crop. Wider variations in the acreage of this crop were found both on farms of the same and of different sizes, than of any other crop. Thus on the 160 acre farms there were five distinct organisations having respectively none, 40, 60, 80, 100 and 120 acres of wheat. On these same farms the corn acreage varied from 10 to 60 acres. As the wheat acreage increased the corn and pasture acreages decreased and vice versa. The nature of the other crops and livestock in the different organizations may be seen by referring to Table XII.16

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15 The term enterprise is used throughout this study, not in its ordinary sense of an individual productive unit, but rather a particular branch of production activity within the farm unit.

16 Ibid, p. 79
What of the purpose of such tedious work? "By segregating farms into typical groups in this way an accurate basis for determining the needs of such groups and of appraising the effect of changing economic conditions upon them is secured."

This consideration of the individual farm, in addition to consideration of larger areas, is an improvement over the studies made before this time.

Type-of-Farming Studies after 1930

After 1930, research by agriculturalists took a somewhat different direction. Elliott initiated a study of the whole of the U.S.A., based on the Census of Agriculture, 1930. To deal with such a large and diverse area required methods not needed in the studies of states, where there was more homogeneity. Especially important was the problem of deciding on a common denominator, allowing comparison of the great diversity of crops, animals, and intensities of utilization of land. Before the Census was taken it was decided to use value of production as the main common denominator, and the schedules of the Census carried a series of items inquiring about the gross income of farmers from each of their crops, kinds of livestock, and other agricultural enterprises. These enterprises were grouped in what seemed to be related collections of products. These collections were apparently decided on beforehand, not worked
out as a result of assessing the material once collected. Except that the need for simplicity is emphasised, there is no comment in the text on this group of decisions.

The following is the classification:

For each type, farm sales of one specified product or group of products had to be at least 40% of the total value of all sales, before the farm was classified under a particular type.

Cash Grain: Corn, wheat, oats, barley, flax, rye, emmer and spelt, buckwheat, rice, grain sorghum. (That is, if cash sales of any one, or a number of these products, made up more than 40% of farm sales the farm would be classified as a cash grain farm.)

Cotton: Cotton, (lint) and cottonseed.

Crop-specialty: Sweet sorghum for syrup, sugar-cane, sugar-beets, maple-syrup, soybeans, cowpeas, velvet beans, ripe field peas and beans, tobacco, hay peanuts, potatoes (Irish or white), sweet-potato, mushrooms, hops, broomcorn, and other field crops.

Fruit: Small fruits, tree fruits, nuts, grapes.

Truck: All vegetables sold.

Dairy: Milk, cream, butterfat, butter and dairy cows and calves.

Poultry: Chickens, ducks, geese, turkeys and eggs.

Animal-Specialty and Stock-Ranch: All classes of meat animals, beef cattle, sheep and hogs; also wool, mohair, and slaughtered animals - the chief distinction between "stock ranches" and "animal-specialty" farms lies in the ratio of the pasture land to the crop land. A stock ranch is a type of organisation in which chief emphasis is placed upon the production of livestock by grazing, while an animal-specialty farm has more emphasis on production of crops and feeding of livestock. For both, sales must be greater than 40%.

General: Farms with a value of products from any one source not greater than 40% of total value of production from the farm. If the value of products from each of two sources was 40% or more of total value, the farm was classified as "general" except for specialized combination types, such as cotton-tobacco, fruit-truck, dairy-poultry, and other similar combinations, when it was classified as one or the other of these types, depending upon which was dominant in the locality.

Self-sufficing: Where the value of the farm products used by the family was 50% or more of the total value of all products of the farm, it was classified as self-sufficing.

Abnormal: Farms of unusual types - Institution or Country estate, Part-time, Boarding and Lodging, Forest Product, Horse Farm, Feed Lot, Livestock Dealer, Unclassified.

Each farm was classified on its schedule as belonging to one or other of these types - a very small minority was unclassified. It amounted to placing every individual in a population of 5 to 6 million farms in one of a few groups. The approach is radically different from all the earlier studies, in that it proceeds from the individual unit in the population, - from detail to generalisation - rather than the reverse, as in most other studies.

If the basis of classification is examined further, one can ask whether the main divisions are based on products, or on types of farming or on economic types. All of these are of some importance, but the product is clearly the main one. The first eight could be described as specialized farms in that they must have 40% or more of their income from one type of product. The general farms are
unspecialized, in that their production and income is more broadly spread. But the self-sufficing class are different from the earlier groups, not so much in production, as in their economic status - they sell less than 50% of what they produce. It would be possible both to group all farms into either commercial or non-commercial, and classify them by type of production also.

Then again, in the case of animal-specialty compared with stock-ranch, the chief distinction is not based on products sold, but on the methods of farming - whether mainly grazing, or mainly production of fodder crops and animals raised and fattened on them.

In summary, there are four distinctions: products (the most important): specialisation in production or the lack of it: methods of farming (not used much), and the amount of commercialisation.

Some important questions arise when consideration is given to the use of income as the basis for measuring farms. It has both advantages and drawbacks. It is the best common denominator, but it does vary with time more than area or production figures would vary. But production figures do not provide a common measure which will allow one crop to be equated with, or compared with, a different one. Because of the variation of income over time, it would be
best (if it were possible) to get averaged figures extending over more than one year, but this is asking too much of a nation-wide census. Another disadvantage of using income is that it must be gross income, rather than net income, otherwise the calculation becomes too involved for farmers or collectors. Where gross income is used farms that buy and sell a great deal, such as animal specialty farms, are overvalued. Also, when income is used the comparability of farm classification from one census to another is made less valuable than it might be, if the figures are taken in a period of inflation or deflation, or of rapidly changing relative values of farm products.

Type-of-Farming Areas

To move from the classification of farms to the delimitation of type-of-farming areas was a further step, and it involved more than just a simple aggregation of farms. This was the first step, certainly - that is, to find the predominant farm type in any area by a simple count. But it was balanced against an estimate of the total income from different farm products in the area. This second measure was necessary because farms vary in size, and, especially in this context, in size of farm business. These two measures were considered together, but of the two the second was considered more important, that is if there was still doubt about the classification of an area, the
predominant income took precedence over the count of farms.

A further problem could be raised in attempting to apply the concept of a General farm - an unspecialised farm - to that of an unspecialised area. The latter might exist, (a) where most farms were unspecialised, but it was also possible to find (b) an area with a number of groups of specialised farms, but no one group dominant enough to give the area character.

The map accompanying the bulletin accordingly distinguished:
(a) unspecialised areas - called general farming, and
(b) areas with minor groups of specialised farms, no group dominant - called mixed farming.

A further question is that of the size of the type-of-farming areas distinguished. The measures or tests dealt with so far give proportions, but these could yield type-of-farming areas which were of negligible or trifling importance. So other factors were also taken into account - those which have been noted already as being basic material in most agricultural studies: proportion of land area in farms; farm area in pasture, or in different crops; number of livestock per square mile; production of the important crops of the district; yields; tenure; expenditure for fertiliser; soil; topography; climate, and in some localities the character of the vegetation.
This information was put together and charted for the United States by counties, but where it was clear that county information would be insufficient it was assembled at the township (minor local government area) level.

Map of Type-of-Farming Areas

In the construction of the map the material listed above was considered, although first weight was given to the major income source in a district, and the main type of farms. A type was not considered dominant unless 35-40% of income or 35-40% of farms belonged to or derived from that type. If two sources between them made up over 50% of farms or income that area was given a combination code.

The map had nearly 800 type-of-farming areas and sub-areas. It is mainly a reference map. The individual areas are best considered along with tables in the text, which add to the understanding of farming systems in each area. Economic groupings also have their place on the map. Part-time and self-sufficing areas are cross-hatched. Non-agricultural areas were also distinguished; a necessary part of any such study.

Use of the Map and Study

The study became the organisational basis for the work of the Department of Agriculture, work which in the thirties was mainly concerned with agricultural adjustment - how to
handle overproduction, and the problems of reduced farm incomes and backward areas. A much simplified version of the map appears, for example, in an outline of a programme for the Agricultural Adjustment Administration, 1936.  

It is interesting to speculate to what extent the description of regions and their organisational use by governments, tend as it were to bring the regions to life, and perhaps prolong their life – where they may be undergoing change – beyond what might otherwise be the case. This comment has been made about regions and regionalism in other discussions.

Revision of the Map, 1949

In the tabulations of the Census of 1945 some figures relating to types and economic classes of farms were set out. In 1949 the map was revised, much simplified, and published along with a directory of counties by farming types, and some account of the physical environment of American farming. The revision reduced the number of type-of-farming areas drastically to 165. They are used, amongst other things as the framework for calculations of farm costs and acreages in

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18 Regional Adjustments in Agriculture, Agricultural Adjustment Administration (Washington, 1936).

the price support programme of the Dept. of Agriculture, and in its programme of crop insurance.

Census of Agriculture, 1950

In the 1950 Census of Agriculture, more detailed information than before was collected on the subjects of economic classes and types of farms. All farms were classified by their economic stature as well as their type of farming. Farming had apparently become more specialised since 1930; it was found desirable to raise the percentage limit from 40% to 50% in deciding on the type of each farm. This had not been possible in 1930, because it would have thrown too many farms into the general group. The information from the Census on the topics of this study was published in a joint production of the Census and the Bureau of Agricultural Economics. It is a most interesting and revealing document, with many maps and a thorough discussion of the distributions they depict. It does not attempt original synthesis. In fact, it is not expected that the framework of agricultural regions presented in the 1949 revision of Types of Farming, will be altered for a long time.

Bureau of Census and Bureau of Agricultural Economics, Economic Class & Type of Farm, 1950 Census of Agriculture, Vol. 5, Pt. 9 (Wash., Dec., 1952).
References to "Types of Farming, 1933" in the Geographical Literature

The 1933 study has been referred to often in geographical literature. American writers on agricultural geography, especially, have given it attention. Whittlesey, in an article dealing with world agricultural regions summarily criticised one aspect of it thus:

the elements involved are the associated crops and livestock within each region. These are the items most readily subjected to statistical control; they are not the whole of agriculture. 21

It seems implied that the items which he includes in his own article as suggested means of classification, are neglected in the Types of Farming in the U.S. Certainly such items as tenure, farm structures, etc., are not included in Elliott's basis of classification, but many of the others, for example, density of farm population, output per farm and per acre, are either considered, or they correlate highly with one or another of the types. The reason for this correlation in the case of the U.S.A. was that Elliott was working within one economic system, but this would not be the case on a world scale. The correlations within the U.S.A. make agricultural classification very much easier.

Other Type-of-Farming Studies after 1933

Fortunately for the advancement of knowledge, the 1933 study did not curb other work on types of farming. In fact, it seems to have stimulated smaller surveys. Nor did they all follow the methods used by Elliott. A variety of methods is in evidence in the surveys of the next two decades.

A bulletin on Kansas was referred to above as exemplifying Elliott's early methods. These methods were followed by other workers of that period. Examples are surveys of Indiana and Minnesota. Later works showed a wider range of ideas and of methods of approach. One dealing with California did not attempt to follow Elliott, but gave individual crop distributions in detail and explained them. Californian agriculture, it said, is too diverse to be treated in other ways. Another on Wisconsin suggested its somewhat deterministic bias in its title: Forces Affecting Wisconsin Agriculture with Resulting Types of Farming. None of

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22 E.C. Young, F.F. Elliott, Types of Farming in Indiana, Purdue University, Agr. Expt. Sta. Bul. 342 (June, 1930)
For some indication of the changing emphases of these studies see also:


25 P.E. McNall, W.J. Roth, Univ. of Wis., Bul. 131 (Madison, 1935)
these introduced any great innovation, but there was some work in this decade which was radically different.

I.G. Davis, at Connecticut, developed a method which involved considering labour as the measure of farm enterprises. Farms were still classified by the proportions of component enterprises making up the farm business. The amount of labour expended on each acre of crop or animal was estimated; then individual farm figures were multiplied by the hours of labour required for their production. Each farm enterprise could then be measured and the farm classified. Some farms kept records of labour expenditures over a number of years, and from these the labour factors were estimated. Inherent in this is an assumption that the amount of work a farmer will put into an enterprise is as good a measure as any other of its importance to him. Davis claimed that it was a better measure:

This measure in (of) type may be considered as simply a refinement of the measures described above which have been used in the Corn Belt (i.e. Value and Area). It takes the additional step of multiplying acres, number of livestock, days of outside labour, cords of wood cut, etc., by a series of conversion factors which represent average labour-inputs per acre, per head of livestock, etc. In testing the validity of this classification, an attempt was made to establish the relationship between these representative labour inputs and the extent of the gross receipts from each source. If conditions are normal, that is if they represent long-time conditions for the average farmer, labour-inputs would theoretically be representative of net income provided the conditions of labour and technology among the several enterprises are fairly similar.
A high correlation between labour inputs in a particular enterprise and gross income from that enterprise on a number of farms may be expected to appear and does appear, the deviations from the line of regression being accounted for by the differences in efficiency in the operations and management of the several farmers. 

Such a system can be applied only within limited areas with uniform labour conditions and only with an assumption of similar technology from farm to farm. It cannot really equate labour units for production, with net income from different products, because a consideration of labour only fails to allocate a correct share of gross income to capital invested in the farm. The deduction of this part of gross income is one of the failures of all the early systems, not just that of Davis, but Elliott's use of gross income also. More serious, though is the criticism that Davis's productive-man-work unit would include an element due to individual efficiency, if efficiency of labour was such that there was higher production per acre or labour was released for other occupations. Elliott criticised the method on these grounds. Davis claimed efficiency was eliminated and that this was one of the advantages. 

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26 I.G. Davis, in Social Science Research Council, Research in Farm Management, Bul. No. 13 (1932) p. 41.
27 In Social Science Research Council, Bul. 13.
that the common denominator of labour-inputs seems to give results which correspond to the farmer's money return from the enterprises measured.

There were special conditions in Connecticut which led to particular aims in Davis's studies. He wished to sort out sidelines, and the New England area is one in which sidelines have become numerous, as has part-time farming. Also Davis had shown earlier that the Censuses of the twenties were rather more inaccurate in New England than elsewhere. In addition, it was not possible to locate individual farms in the manner that Elliott had done in the midwest because the township and range system of local government had not been used in New England. This meant that standard reference points in use through the rest of the country did not exist there.

In line with these special objects, Davis also had a detailed classification with more types related to his special interests. Consider this list of farm-types:

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29 Types of Farming in Kansas, p. 52
Estimated Nos. of Farms in types and sub-types in Connecticut

<table>
<thead>
<tr>
<th>Type</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>All farms</td>
<td>25,302</td>
</tr>
<tr>
<td>Residence, part-time</td>
<td>8,399</td>
</tr>
<tr>
<td>Semi-commercial, part-time</td>
<td>5,496</td>
</tr>
<tr>
<td>Commercial</td>
<td>10,907</td>
</tr>
<tr>
<td>Dairy</td>
<td>5,533</td>
</tr>
<tr>
<td>Fruit</td>
<td>477</td>
</tr>
<tr>
<td>Vegetable</td>
<td>827</td>
</tr>
<tr>
<td>Potato</td>
<td>130</td>
</tr>
<tr>
<td>Poultry</td>
<td>881</td>
</tr>
<tr>
<td>Tobacco</td>
<td>1,335</td>
</tr>
<tr>
<td>Outside Labour</td>
<td>1,452</td>
</tr>
<tr>
<td>All other</td>
<td>272</td>
</tr>
</tbody>
</table>

The groups are narrower in their range than those used in Types of Farming in the United States, and more detailed in both commercial and non-commercial categories. The economic standing of the farm was a special concern.

Briefly, the productive-man-work unit method seems well suited to small areas with uniform conditions. In larger areas each change in labour conditions or the level of mechanisation would mean a need for a reassessment of the calculated p.m.w.u. The United States Department of Agriculture, did assess labour requirements in this manner for different regions in a wartime publication, and the same sort of material was also published during the war.

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30 Davis, Social Science Research Council, Bul. No. 13, Di 23.
Summary of Three Approaches

A comparison of the three approaches examined so far, seems appropriate at this point.

In the early state studies the approach was from the general to the specific — using firstly statistics for counties, and secondly individual returns to give typical farming systems. In the income and labour approaches, it was from the specific farms to a general picture of farming built up from the classified individuals. None of these three is right or wrong in itself, though the latter are advances in measurement. Both income and labour have a general validity, as well as clear handicaps. Incomes and values fluctuate, but the areas constructed using them almost certainly have a greater stability than the money values used in making them. The labour approach has the drawback that it needs to be recalculated wherever technologies change. Both the income and labour approaches are to be commended because they start with the farm. This is good practice: the enterprise structure of the farm should be studied if it is at all possible, because on the farm are taken so many of the decisions concerning the output of any one product relative to another.

Later Applications of Labour Units

There is a good illustration of the last point - the need to keep the enterprise structure of the farm in mind - in some of the later applications of the p.m.w.u. concept. In studies in New York and Pennsylvania, Beck and Wrigley used p.m.w.u. factors calculated from farm records. They multiplied these factors with township totals of acres of crops and numbers of livestock. They then identified groups of townships or counties in which the gross figures showed a similar proportion of the various type of enterprises, and called these groups of townships, type-of-farming areas. It is still not demonstrated in this case, whether the enterprises are associated on individual farms or whether there are groups of different farms in the type-of-farming area. But both authors did appreciate that they needed to make allowance for varying yields, and so changed the factors in localities with yields different from state averages.

Type-of-Farming Areas of Canada

A study of Canada used all the ideas examined so far.

It was based on a Census classification of farms into types and economic classes, the classification itself based on gross income figures, as with Elliott's study. After farms had been classified, and at the stage of deciding the type to be given to areas, a calculation was made of productive-man-work-units for each farm enterprise important in a locality. This calculation was considered equally along with the count of farms by type, in the designation of the type of each farming area. On the final map, both the concepts of economic class and that of type of farming were presented for each area. Economic class was symbolised by black hatching over the colours used for type of farming.

Types of Farming in Scotland

There has long been an amicable mutual interest in the agricultural research done in New England and Scotland, so that it is not surprising to find that Scottish agriculturalists produced a survey of types-of-farming which incorporated some of the New England ideas. All returns sent in were scrutinised and classified, first into economic classes (full-time, part-time, spare-time), on the basis of the hours of labour which it was estimated would be provided on a farm by the crops and stock shown in the returns. Then all were

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P.M. Scola & A.M. Mackenzie, Types of Farming in Scotland, Dept. of Ag. for Scotland, H.M.S.O., 1952. The map of Types of Farming, Scotland & England & Wales, at 10 miles to 1 inch, by the Ordnance Survey was prepared earlier than this and attempts to show more detail.
typed by the nature of production, as revealed by the crops and stock on the farms. The limits between types were determined by a variety of measures - livestock units, estimated income from crops and estimates of labour needs.

A list of the types gives an idea of the scope of the survey:

**Types of Farming in Scotland**

<table>
<thead>
<tr>
<th>Economic Classes</th>
<th>Production Classes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-time</td>
<td>Hill sheep farms</td>
</tr>
<tr>
<td>Part-time</td>
<td>Stock rearing</td>
</tr>
<tr>
<td>Spare-time</td>
<td>Rearing &amp; Feeding</td>
</tr>
<tr>
<td></td>
<td>Cropping</td>
</tr>
<tr>
<td></td>
<td>Dairy</td>
</tr>
<tr>
<td></td>
<td>Dairy with hill sheep</td>
</tr>
<tr>
<td></td>
<td>Horticultural</td>
</tr>
<tr>
<td></td>
<td>Intensive Livestock</td>
</tr>
<tr>
<td></td>
<td>Unclassified</td>
</tr>
</tbody>
</table>

**Type-of-Farm Classification of New South Wales**

Finally, coming closer to the scene of the present study, as a sequel to the author's discussions with Government statisticians, the Acting Commonwealth Statistician for New South Wales, undertook a classification of rural holdings in New South Wales.

The basis of classification was the estimated gross farm income derived from the various farming activities. Farms were to be classified into "commercial" and "non-commercial", but only the commercial were to be classified by their type of farming. A commercial farm was to be one
with estimated gross farm income of not less than £400.

Generally commercial farms were classed as of one type only when the main activity gave rise to 50% or more of gross farm income.

Another type of holding, a multiple type, was recognized if a subsidiary activity amounted to 50% or more of the estimated value of the main product, and also in the cases where no one product accounted for 50% of the estimated value of output of the holding.

Combination types were specifically recognized and given a group name individually, in the case of the Sheep/Wheat and Sheep/Beef combinations because of their frequent occurrence.

In fact the Sheep/Wheat combination received special treatment, because it is an ubiquitous element in so much of Australian farming. For a holding to be described as belonging to this combination the two enterprises Sheep and Wheat, together must account for 75% or more of gross farm income, and one enterprise must give rise to at least one-fourth of the value of the other, and not more than four times that of the other. The ordinary rules proved too restrictive for Sheep/Wheat. For example when the ordinary rules were applied to the statistical returns for the S.W. Slope Division of N.S.W. they excluded four-fifths of holdings
with both sheep and wheat from a Sheep/Wheat classification.

The range of types is shown on page 32 (below)

The basis for the classification was data supplied by farmers in the annual Agricultural and Pastoral Return. The returns have great limitations. They do not indicate gross farm income derived from the various farming activities. Although the material that is supplied can be used to infer something like gross income for some products, even this is difficult.

The basis was to be a table of values, which was itself based on the average annual gross value of production (at place of production) from each principal farming activity in a recent period of years. In preparing the table of values, account was taken of such factors as varying crop yields per acre in various parts of the state, regional differences in returns from dairying, fruit and vegetable production and of the constitution of flocks and herds by breed, age and kind.

In classifying sheep farms — including Sheep/Wheat — into sub-types of sheep farming it was necessary first to note from details on the return the breed of sheep, type of ram used, and the incidence of breeding ewes and wethers and lambs in the flocks. Flocks were described in sheep units, to allow comparability between different sheep types and to
give a unit on which average gross income could be calculated (e.g. £2. 8. 7d per sheep unit, compared with £10 per pig unit).

Wheat was valued as total farm production and by average value per acre (wheat unit), with different values for regions with higher and lower yields. Oats and barley were valued at half the value of wheat, and rye one-quarter.

For dairying the state was divided into 7 regions with different values per cow, in milk and dry.

Beef Cattle presented a special difficulty, in that there is no information on the outturn of animals. It was assumed that herds at 31st March represented about twice the outturn. Pigs presented a similar problem: again a ratio to the number of animals shown on the return was adopted. Poultry units were given as the sum of pullets, hens and other birds.

Fruit farming was valued by annual averages per tree, and vegetables by estimated value of production over three or four years.

Of course these methods are arbitrary, but necessarily so in view of (a) lack of other information, and (b) the need for consistency and a system that could be worked by ordinary office labour. However, if recognizable types of farms

Table of Values, presented as Appendix No. 1
exist, it should be possible to test their classification under this system, by varying the equivalence values. If this makes little difference to the results of classification, then the basis for classification would appear to be doing the job of isolating real differences between farms. In an early test of the system, the equivalence values were altered by a considerable proportion, but only a low proportion of farms was found to be reclassified. The group Sheep/Wheat was the exception, with a large variation in numbers. The result supports the decision to give Sheep/Wheat special treatment.

Early in the work a small sample of returns was tested and the following table presents some of the results.

Types of Farms, N.S.W.: Test of Sample

<table>
<thead>
<tr>
<th>Type</th>
<th>No. Holdings in Sample</th>
<th>% of Total</th>
<th>Combinations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep sub-types</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Wool, non-breeding</td>
<td>542</td>
<td>25</td>
<td>21</td>
</tr>
<tr>
<td>(Breeding, Dual,</td>
<td>283</td>
<td>13</td>
<td>..</td>
</tr>
<tr>
<td>(Fat Lambs)</td>
<td>77</td>
<td>4</td>
<td>..</td>
</tr>
<tr>
<td>4. Wheat</td>
<td>38</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>5. Beef</td>
<td>86</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>6. Dairy</td>
<td>404</td>
<td>18.5</td>
<td>103</td>
</tr>
<tr>
<td>7. Fruit</td>
<td>106</td>
<td>4.5</td>
<td>17</td>
</tr>
<tr>
<td>8. Vegetables</td>
<td>56</td>
<td>2.5</td>
<td>15</td>
</tr>
<tr>
<td>9. Poultry</td>
<td>85</td>
<td>4</td>
<td>8</td>
</tr>
<tr>
<td>10. Miscellaneous</td>
<td>71</td>
<td>3.5</td>
<td>..</td>
</tr>
<tr>
<td>11. Other</td>
<td>49</td>
<td>2.5</td>
<td>..</td>
</tr>
<tr>
<td>Total Commercial</td>
<td>1,797</td>
<td>83.5%</td>
<td>173</td>
</tr>
<tr>
<td>12. Sub-Commercial</td>
<td>266</td>
<td>12.5</td>
<td>..</td>
</tr>
<tr>
<td>13. Unused</td>
<td>83</td>
<td>4</td>
<td>..</td>
</tr>
<tr>
<td>Total in Sample</td>
<td>2,146</td>
<td>100%</td>
<td>173</td>
</tr>
</tbody>
</table>

38 This information and that on the preceding pages is from an unpublished article supplied by the Acting Commonwealth Statistician for N.S.W.
This is a very interesting preview of how a full-scale classification might appear. There are some interesting points - for example, there were not enough Dairy/Beef combinations to make it worth including as a type.

The combinations (not given in the above table) were 14 Dairy/Beef out of 404 Dairy; 4 Beef/Dairy out of a total of 86 beef. Of course, Sheep/Wheat and Sheep/Beef are combinations as they stand in the classification. The N.S.W. work is still under way and further results can be expected.

Ideal Requirements for a Study in Australia

It is possible to sum up, using ideas from the studies of the agriculturalists overseas, listing what it would be desirable to do and to have in the way of material, to produce in Australia a study comparable with those discussed above. The Canadian and Scottish studies probably show the best possible combinations of materials and ideas and methods. This is not to belittle or undervalue other work, but is due to their coming in at a later date, and thus being able to use methods and ideas already evolved.

In a summary of this sort three categories need to be considered.

1. the aspects of other approaches which seem desirable as tools in a new study.

2. figures or material which it would be ideal to have.

3. methods to be used to get or test the material.
First in terms of principles it would be ideal to adhere to:

1. an emphasis on enterprise structure of the farm before crop-livestock association;

2. approach through the individual farm, rather than through areas, or at least areas alone;

3. the use of a common denominator, so that different enterprises can be valued comparatively, and dominance established in mixed areas;

4. if possible, the use of both gross income as a common denominator and estimated work units;

5. some presentation of typical farming systems.

To include all these approaches would involve a great deal of effort.

In terms of methods or procedure it would seem to be best to start with farm returns and then to type or classify all farms on both economic and type-of-farming bases. Sampling might cut the work. Individual farms would be classified on estimates of their gross incomes as derived from the enterprises which make up the farm business. The numbers of farms of different types and the estimated total gross income from separate enterprises added up for whole localities should form the basis for classifying type-of-farming areas themselves. This should be checked against estimated work units for enterprises in the whole locality. A scale of work units would need to be calculated.

From the few geographical studies referred to so far,
at least one point of importance emerges, that is to use ratio, or isopleth maps where possible and necessary, although of course, to use ratio maps exclusively is to run the risk of losing sight of reality behind relativeness.

The totality of the above ideal principles and procedures is a counsel of perfection. Consideration of the possibility of applying all or some to Victoria is deferred to Chapter 5.

Later Work in Agricultural Geography

Developments in agricultural geography have been followed above only to 1930. None of the subsequent work can equal the type-of-farming studies in accomplishment, usually because the latter were supported by the resources of Government in providing the machines so necessary for massive statistical analysis.

Perhaps the next relevant development in professional geography was the publication in 1936, by Derwent Whittlesey, of the scheme for a world system of agricultural regions, which he and W.D. Jones, had forshadowed some years before.

"Major Agricultural Regions of the Earth"

Entitled "Major Agricultural Regions of the Earth" it appeared in the Annals of the Association of American Geographers 39

Whittlesey argued that in the classification he presented, "regions are recognized and grouped into types on the exclusive basis of the inherent properties of the agriculture practiced," as distinct from other classifications which had "forced agricultural regions into the alien pattern of climatic distribution."\(^4\)

About method he wrote "An ideal geographic classification (of agriculture) might well begin with arranging the facts into a regional pattern. Within each region, its structure is built up of observable items in the landscape," that is, "all those which are susceptible of being observed directly and also through some device such as an instrument or a calculation based on enumeration. Not all the landscape forms are used. Only those are selected which disclose the collaboration of man and environment in agriculture."\(^4\)

The yardstick for measuring each area of agricultural occupancy was a list of "five functioning forms":

1. Crop and livestock association
2. Methods used to grow the crops and produce stock
3. Intensity of application to the land of labour, capital and organisation, and the outturn of product which results
4. Disposal of the products for consumption (whether used for subsistence, or sold off for cash or goods)
5. The ensemble of structure used to house and facilitate the farming operations.

\(^4\) Ibid, p. 200
\(^4\) Ibid, p. 208
Each can be measured and therefore might ultimately be used in a quantitative classification.

The advantages of the Whittlesey-Jones framework are clear enough, especially the merit of separating regions which produce the same commodity but under vastly different conditions of technology and human pressure on land resources. The use of methods and of ratios of land-labour-capital to differentiate agriculture has coincided with the growing tendency to view the world in terms of its economic levels as well as its political ties. 42

Although Whittlesey stressed the need for and advantages of quantitative measurements, and stressed that this was a great merit of his proposals, when it came to subdividing the earth into agricultural regions he admitted that his attempt was still largely empirical and qualitative. This could not be avoided considering the lack of world-wide information on some of the "functioning forms." But the study was not intended to be the final work, it was an essay, "a target for criticism."

"Major Agricultural Regions" in Geographical Literature

Considering the boldness of attempting a world outline, and the invitation to criticism, it is remarkable that little

42"Underdeveloped", highly-developed economies, etc.
criticism has been forthcoming. Possibly it could have been expected that there would be

1. criticism of the basis of the classification;
2. changes in the map by writers using it;
3. testing of the validity and utility of the major groupings in any one country or region;
4. subdivision of the major regions for local study.

The main development amongst these four, has been in respect of 2, that is changes in the map by writers using it. Usually they have made the changes but have not discussed the reasons for them, nor taken the opportunity to engage in 1. criticism or discussion of the system or its basis.

Under 3. — testing the utility and validity of the major groupings in any one country — there is an Australasian example. "The Agricultural Regions of New Zealand", is a study based on a long period of field observation followed by a consideration "of all statistical data available, pertaining to the 'functioning forms' criteria." Twelve specific

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43 Books in which the system has been used, with or without changes, include: Finch & Trewartha, "Elements of Geography," 2nd, 3rd, & 4th editions; Jones & Darkenwald, "Economic Geography" — very much altered but clearly a basis; Preston James, "Outline of Geography" (an Appendix); N.J. Pounds, Economic Geography; Goode's School Atlas (Chicago) in which Whittlesey has been responsible for successive changes in a map of World Agricultural Regions.

agricultural regions were recognized and "statistical data also suggested the grouping of specific regions into types (generic regions), three of which fit admirably into Whittlesey's system of 'major (world) agricultural regions'."^45 The connection with Whittlesey's classification is otherwise somewhat remote. The main criteria were ratios of different types of livestock to each other, and of total livestock (expressed as livestock units) to crops, while the intensity of production was considered mainly in terms of average size of holdings.

An article re-examining the bases of world classifications appeared recently in the Professional Geographer.46 The first part is a discussion of Whittlesey's contribution to this problem. Praise of his elimination of non-agricultural elements from the classification is tempered by the opinion that the 'five functioning forms' are not subject to quantitative differentiation. As originally stated (and the author summarises the originals to their disadvantage) some of the functioning forms were capable of being measured by readily-available information, and even those which are not, are nevertheless very useful differentiating features.

45 Ibid, p.44.
ThenHelburnsuggestssomemeasures:

1. crop-livestockratio;
2. land/labourratio;
3. proportionofproductionsold;
4. sizeoffarm;
5. landvalue;
6. totalvolumeorvalueofproduction.

Forcinghimselftochoose, the authordecidesonthreetheses - crop-livestock ratio; labour-land ratio; degree
ofcommercialization. Degreeof "specialization" (which is
notexplainedoramplified) issuggested, along with
sedentary-migratory, assecondarybaseswhichwillbeeasily
added.

There is a great emphasis in Americanattitudes
toworkinthesocialsciences, on attemptingtoimitate
the physical sciences in beginning with measurablephenomena.
Whether the product of "measurementgeography" illuminates
the physical and human world around us is not the primary
concern of workers who take this position. They criticise
past work which has not been based on repeatable measurement,
but thequantification which they present is not shown to be
aclearerpictureoftheworld, and issometimesseen to be
notworththeeffort. Measurementby itselfcannot be
equated withscience.
Although Helburn leaves his suggestions to be tested and offers no version of a map of world agricultural regions based on his criteria, he does show that he appreciates that the real test is whether the regions illuminate the properties of world agriculture and lead to an understanding of its relationships.

The most useful point made is that some of Whittlesey's criteria are too hard to measure, and that if all were capable of measurement the theoretical number of subdivisions of world agriculture would be very large. Of course the classification is not the less valuable for that.

Another point made by Helburn, although no more than incidental to his main themes, is to examine the map of world agricultural regions put forward by Van Royen in his Agricultural Resources of the World, and to compare it with the Whittlesey version on which it is based. He points out that Van Royen has included the terms "tropical", "subtropical", and "temperate", in the names of agricultural types, and so departed from the more rigorous logic of the original.

Notation Schemes of Land Utilization Study

There has been a large amount of work based on the use of fractional systems of noting land utilization in the field. The use of such notations began with the Michigan Land Economic Survey, developed with its wide use by the Land Utilisation Survey of Great Britain, and was improved and adapted further by the T.V.A. The technique and its products make up a large part of the output of professional geographers in many parts of the world, and modifications for local conditions will continue as long as the need for inventories of land resources.

There is one basic reason why the technique is not given much consideration here. It is that the scale of work engaged in is not appropriate to the study of an Australian state, or even of any considerable part of one. Just as the scheme for world classifications of agricultural regions cast their net too wide to be given the main weight in this discussion, so the technique of field study of land utilisation by fractional notation is too minute in its application, to suit a study of Victoria.

Land Utilisation in Australia

But it is appropriate that the term "land utilisation" should be introduced, because this theme - if not its study in the detail used in the mother country - has been an important one in the subject matter of Australian geography. The term "land utilisation" has had two interpretations. In the general stream of geographical work, the exact meaning usually given it is that of comprising all uses of the surface of the land, in direct terms, indicating what occupies fields, paddocks or other stretches of the land surface - including forest, bare rock, waste, pasture, crops (in detail if necessary), urban uses, etc.

Australian Examples

In this sense the term is used in Land Utilization Regions of Tasmania. This is evident from the categories mapped (pasture, crop, etc.), as compared with the greater detail of the version produced by the State Economic Planning Authority, where the categories are: Intensive Cultivation, rotational cropping and improved pastures, native pasture grazing lands, Lake country summer grazing.

The latter form is in the Australian tradition of using the term "land utilisation" to cover something closer to types or forms of farming, rather than to apply it to an account of what type of plant or other material occupies the

A.G. Lowndes & W.H. Maze, University of Sydney Publications in Geography, No. 4 (Sydney, 1937)
land surface. Of course, this latter strict use of the term is a convention with only a doubtful semantic base. In a sense a type of farming is using the land surface, as much as the pasture which is the base for farming.

The distinction is felt to be real and worth stressing by some workers in the field, particularly those who have transplanted English ideas overseas.

For example, J.W. Fox, in a paper presented to the Eighth New Zealand Science Congress defined land use as "the present use of the land in terms of its inherent characteristics," emphasised that form and not function constituted the basic criterion of classification, and that land use was not, in his opinion, synonymous with agriculture or land classification. Fox felt that there was "serious confusion now existing in the meaning of land use."

It is a well-developed Australian tradition that the term "land utilisation" can have a much wider meaning, one which is best exemplified by the Australian classic on the rural industries, Land Utilization in Australia, by S.M. Wadham

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52 The same point of view is undoubtedly expressed in J.W. Fox, Land Use Survey, Auckland Univ. Coll. Bul., 49, Geography Series, 1 (1956), not sighted.


& G.L. Wood. On the interpretation of the term provided by the authors' treatment of their chosen subject, it means to them the rural industries using the land, including forestry, and is a broad study of the use of land or soil resources, not including mineral resources.

It is not useful to make too much of semantic differences, nor to enlarge the differences that exist already. The important point is to try to ensure that terms are understood, and that two different meanings giving rise to confusion are not used alongside one another. The fact is that, in the main, the Australian literature tends to understand by "land utilisation" the broad use of land resources by various farming industries, rather than the narrower concept, as the term was used by Lowndes and Maze in Tasmania.

The reason for this local tendency is clear enough. It is the problem of scale, which has impressed itself so much on Australian endeavour and thinking. As the authors of Land Utilization put it; "Australia is as large in area as the United States of America, and this very size acts as a constant depressant of scientific investigation."

Further to this the consequent extensive use of land makes

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54 In the Preface to the First Edition (1939) p. vii.
for the dominance of livestock farming, and for an apparent uniformity of field-by-field land use. Even in Australia, a great deal can be learned from intensive studies of "land utilisation", in the English sense, but it means a more subtle appreciation of the features to be noted, and a readiness to generalize in a different way, and at a different scale, from that appropriate to the agricultural economies in which the plough is more common, and scale is not such a problem.

Even the study of Tasmania which uses "land utilisation" in something like the sense of the English geographers is based only on a reconnaissance survey, and does not pretend to cover this smallest of the Australian states in anything like detail.

This could have been a good reason for retaining in this study the term "land utilisation" for the study of agricultural distributions. Actually there is a more powerful reason, which will be dealt with below, for using instead the term type-of-farming.

55 A visiting American geographer remarked to the writer recently, about a trip to the Maffra Irrigation Area in East Gippsland, "I went there to map land use and all I could find was grass, in one field after the other."

56 Maze & Lowndes, op. cit.
A review will now be attempted of what might be called, accurately if cumbrously, work relating to the distribution of agricultural features in Australia. Using as broad a term as this will ensure that most of the useful work can be included.

Review of Studies of distribution of agriculture in Australia

An appropriate starting point is Griffith Taylor's contribution on Australia to the series on world agricultural regions, appearing in Economic Geography. His article is a general treatment of the subject, based on "land utilisation" categories, and consequently distinguishing such groups as: areas mainly in crop, pasture or forest with some reference to the type of livestock using the pasture. For example:

- Crop/Pasture - The Great Wheat Belt
- Pasture/Crop - Great Sheep Region - Wheat subordinate, etc.

These main types are then divided into specific numbered regions and described in more detail. The divisions are sensible, though simple. The use of Forest/crop/pasture divisions is appropriate at that scale. There was not another study embracing the whole of Australia until towards the end of the period surveyed: other contributions are accordingly dealt with on a State basis.

Western Australia

Dr. Gentilli has published a most informative Atlas of Western Australian Agriculture, \textsuperscript{58} which concludes with a map of Land Utilization (p. 44, Map 21). Its categories are farming types, except for Forest and an assumed category of "unused"; that is one is left to assume that parts of the map left blank are not used for farming or Forests. It is a clear presentation of an interesting pattern. Some years later, the W.A. Dept. of Agriculture published a set of "Notes" entitled Agricultural Regions of W.A. \textsuperscript{59} It is worth quoting the definition of region given on p. 1:

A region is used in this discussion as an area of land in which the soil pattern is generally similar and in which the climatic conditions also have a restricted range. \textsuperscript{60}

The map is divided into localities numbering 34 in all, and the pattern shown on Gentilli's map can be seen in the division. The map has no other descriptive function, description comes in the text. The classes used in the text are almost entirely commodities; Wheat for grain, Export Lambs, fruit, poultry, etc.

\textsuperscript{58} University of W.A., Text Books Bd. (Perth, 1941)
\textsuperscript{59} Notes prepared by the Dept. of Ag., Aug., 1947
\textsuperscript{60} There is some similarity between the ideas used here and the principles employed by Trumble in establishing "Edapho-climatic zones of South Australia", Trans. & Proc. Roy. Soc. S. Aust., Vol. LXI, (1937), Map III, pp. 62-63. See below.
South Australia

South Australian agriculturalists have done a great deal to advance studies of the Australian environment. In the course of this work, they have made numerous presentations of agricultural distributions and it is invidious to select any one study. As informative as any is probably that of Trumble,\(^\text{61}\) which presents a distribution map of wheat and seeded pasture, in relation to natural vegetation and period of "influential rain" and also a map of "Edapho-climatic Zones" which are related to the earlier map and to agricultural types described in the text.

Other general maps which show the distribution of farming types throughout the State are given in Hambridge\(^\text{62}\) (a mixture of farming types and physical land types) and in "South Australia", by the Government Immigration, Publicity and Tourist Bureau.\(^\text{63}\) Neither of these maps is good, in that the distinctions they make are not clear, and the information is too generalised. An agricultural map of South Australia is needed treating the closely settled parts in detail.

Victoria will be left for more detailed treatment in Ch. 5 as it is the area most closely considered in this thesis.

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\(^{61}\) Ibid.


\(^{63}\) Govt. Printer (Adelaide, 1947).
New South Wales

New South Wales has been treated as a whole in what is probably the best attempt to delimit type-of-farming areas in Australia to date. This is the Distribution of Farming in New South Wales, short in text but accompanied by an excellent map. The text discusses types of farming by Statistical Divisions, but the map is labelled "Location of the Main Types of Rural Production" and it adheres to this system. Products are shown by coloured and cross-hatched symbols, and types of farming can be arrived at by interpreting the product back to its farming type, or by an overlapping of the symbols. Some products and types are not located specifically - beef cattle, for example, are given only general limits within which they may be found. Some of the minor types of production are located and measured most specifically by a symbol showing the area cultivated for that crop. A modified version of the map is presented in a later publication but it lacks the sub-classification of sheep-farming, which is a most significant part of the early version.

65 Getting started in Farming, N.S.W. Dept. of Agriculture, (Sydney, 1953)
66 See Ch. 5 for a discussion of sheep-farming classifications.
For some of the planning regions set up in New South Wales, regional committees have made preliminary assessments of the land utilisation of their regions. The systems used are somewhat the same but there are variations from region to region, to suit local conditions. These maps are a useful addition to the literature.

An article dealing with the farming and irrigation of part of the Riverina, also uses a classification of farming types: Sheep grazing for wool; ... for mutton; Dairying; Crop cultivation, mainly cereals; Intensive irrigation - Orcharding or Rice growing; Extensive irrigation (a category out of keeping with the others). A critic complains of this article that "The map differentiates areas on the basis of function almost to the exclusion of form, and like so many 'land-use' maps it tends to be merely a portrayal of agricultural practices." This complaint is identical with that of Fox and is probably inspired by Fox's writing on this subject. Shaw's treatment of land use is suggestive, nevertheless, owing to its useful arrangement of numbers and letters to allow secondary uses to be

added to the primary ones, but this is carried to the almost astounding extreme of having one area marked with four "secondary" uses after being marked as "Extensive Irrigation" in its primary use. It has the appearance of system, but one wonders whether it may not be creating (or even covering) confusion.

Queensland

Contributions to agricultural mapping from Queensland are concerned almost entirely with agricultural potentialities. A good example is a map of the whole state, "Indicating present land use and areas where further development and more settlement may take place." The categories are fairly informal and potential is mixed with the present use - mainly use by different types of farming. Examples are; "Grazing, cattle; Grazing Cattle, Capacity can be increased by Cropping;" etc., ending with - "State Forest Timber Reserves". Shaw's map also includes forest, so that to this extent both are adhering to one of the forms expected of a land use map.

Tasmania

The pioneer land use map from Tasmania has already been referred to. It was followed by another version (referred

69 Bureau of Investigation, Queensland
70 Lowndes & Maze, op. cit.
to above), more detailed in its geographical location of
different types of land use, but no more so in the categories
it presents. Here one sees the disadvantages of land use
categories. "Intensive cultivation" covers all fruit farming
(reasonable enough), "Rotational cropping and Improved pastures",
includes dairying areas and those growing potatoes, and
other crops, plus land carrying sheep of the meat varieties.
The type-of-farming classification would give more information,
and whether it is to be called land use or type-of-farming
does not really seem to matter. The most recent work is
from Scott\textsuperscript{71}, but since it is closely related to work by
Weaver, which must also be examined, it seems appropriate
to defer consideration of Scott to give an account of four
recent papers of Weaver.\textsuperscript{72}

Crop-Combination Regions in the Middle West; Weaver

The four articles examine very detailed, but limited,
material relating to the percentages of total cropland taken
by individual crops, and the crops are ranked. Combination
regions are constructed using what is called a "theoretical

\textsuperscript{71} P. Scott, "The Agricultural Regions of Tasmania;
A Statistical Definition", Econ. Geog., Vol. 33, No. 2,
1957, pp. 109-121.

\textsuperscript{72} J.C. Weaver, "Changing Patterns of Cropland Use in
the Middle West", Econ. Geog., Vol. 44, 1954, pp. 1-47;
idem, "Crop-Combination Regions in the Middle West",

\textsuperscript{idem} "Crop-Combination Regions for 1919 & 1929 in
\textsuperscript{idem} with L.P. Hoag & E.L. Fenton, "Livestock Units
and Combination Regions in the Middle West," Econ. Geog.,
curve", actually not a curve, but a percentage system to eliminate small percentages. Livestock are ranked and combined also, but the cattle figures are dubious, types being derived from total cattle by the use of doubtful assumptions. All crop figures are based on total land area cropped, which introduces a very large qualification, as the area cropped varies from less than 10% to over 70%. Attacks are made on unidentified works on midwest agricultural regions, but none are identified or examined. There is no solution here to the problem of defining agricultural regions, except that once again it is emphasised that ratios or isopleths need to be used with caution and judgement, but with these they can be quite revealing.

**Agricultural Regions of Tasmania; Scott**

Scott follows Weaver in beginning his study with a ranking of crops. However, he improves on the latter in giving some interpretation of, and tentative explanation for, the distributions shown. But the crop ranking and crop-combination regions are not of much significance except in one or two places. The maps are based on the percentage of land cropped, and in most parts this percentage is minute. Also, there is no map of the percentage of land under crop.

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73 *idem*, *Econ. Geog.*, Vol. 32, No. 3, 1956, p. 239

against which the other maps can be checked. There is then
a composite of crop, animal and land use maps to make what
is in effect an agricultural regions map. This is perhaps
more expectable in its shape and features than the somewhat
roundabout way of getting there, by using ranked percentages,
consolidated groups superimposed on others and a medley of
devices.

The most dubious item in Scott's study is the expressed
future objective, "that the application of Weaver's
statistical procedure to a definition of agricultural regions
opens up the possibility of elaborating regional hierarchies." This seems to imply that a Linnaean-type classification of
agriculture will be possible, but surely human activities have
not evolved in any such set fashion. A qualification on
method is added. "...though the more elaborate the
hierarchy, the larger loom three important subjective elements:
the unit boundaries, the statistics themselves, and the
selected definition of the crop, livestock and land-use
categories."

A Comparison of three points of view on classification

This seems an appropriate point to consider three
contrasting views on classification. Helburn wanted to
abandon the world agricultural regions of Whittlesey

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75 Scott, ibid, p.121, and see earlier ref., p.119.
76 Ibid, p.121.
77 Helburn, op.cit., p.4.
because the classification was informal, not "quantitative".

Weaver claimed his work as a step forward because it was "objective, constant and precisely repeatable," while Scott, with a larger laboratory than Tasmania, would endeavour to manipulate rankings and combinations to discover a hierarchy of agricultural regions.

The mistake in all of these is to allow classifying to become a part of science, when it is merely an expedient to bring some order into the chaos of individuals. Helburn and many others want all phenomena forced into a hierarchy of ranks and classes. Weaver enumerates at great length, without either attempting correlation or establishing that his enumerations have significance in agricultural landscapes, practices or incomes. He confuses objectivity with what might be called repeatable "figuring".

The search for a hierarchy of regions has become a geographical Holy Grail since American Geography: Inventory & Prospect, appeared.

Whittlesey himself, had hopes of this sort in connection with his agricultural regions. In a letter,

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79 Letter to the present writer, March 19th, 1953.
he said;

It is certainly true that these types have to be subdivided for detailed study. It is my hope that as such studies are made, the subtypes that appear will be similar enough throughout the world to warrant carrying the classification to lower levels of the hierarchy.

It is not surprising that Whittlesey should say this, since he was mainly responsible for the chapter, "The Regional Concept and the Regional Method" in American Geography (above); a chapter which laid down a new outline of nomenclature and method for regional study and subdivision. But it is surprising that he should have failed to recognise, that to attempt to carry his regions beyond their present scale, would be to lose the advantage his types possess, of a quite remarkable clarity which is due to the success of generalising about the world, at that scale.

There can perhaps be no rules to show when generalisation at a certain scale is valuable and equally, none to show when it is folly, either to subdivide further, or to generalise too much, but the point surely becomes clear in practice.

Those who concentrate their attention in works involving classification on method and overlook purpose, miss the whole point. Marlin Cline was quoted by Helburnop. cit., p. 4 on method of classification. His introductory remarks on purpose, deserve
equal - or more - attention:

The purpose of classification is so to organise knowledge that the properties of objects may be remembered and their relationships may be understood most easily for a specific object. As the things important for one object are seldom important for another, a single system will rarely serve two objectives equally well.

It is also worth quoting, at this point from a study which appeared alongside the fourth of Weaver's articles and which neatly and modestly poses the problem of measurement, then says simply, 'there is no standard way out, use your judgement!':

In mapping agricultural activity, choice of the unit of measure poses the initial problem. Shall one measure the area used, the input of effort, or the output of product? For a full understanding of the geography of agriculture, all three kinds of measurement, each with its many components and variations, are necessary. Standardization of measurement among studies of different types of agriculture in different areas is desirable. But the objectives of a given study, the nature of the particular uses of land in the specific areas being studied, and the kinds of pertinent data available may make it necessary or desirable to emphasize one of these kinds of measures, or of its variants.

Olmstead goes on to drive his point home by more specific considerations:

There is no equable, quantitative measure of the output of orchards and vineyards, or of any large number of diverse agricultural products. How equate bushels or pounds of cherries with bushels or pounds of pecans, or either with bushels or pounds of corn? Shall the pecans or corn be shelled or the cherries pitted? How shall the corn fodder be measured? One might reduce all to calories. But calories serve to measure one phase of diet, not agricultural use of land. In terms of the use of land, the production of a million calories from apples is not equivalent to the production of a million calories from oranges, coffee or potatoes.
PART 2

FACTORS AFFECTING AGRICULTURE IN VICTORIA

CHAPTER II THE ENVIRONMENT

A. TOPOGRAPHY AND GEOLOGY
B. CLIMATE
C. SOILS
CHAPTER II

A. TOPOGRAPHY AND GEOLOGY

The greater part of Victoria is of low average elevation and lacks pronounced relief. Nearly 60% of the total area is estimated to lie below 600 feet, while only about 5% is above 3,000 feet. In addition, most of the surface below 600 feet is a smooth lowland landscape, while some of the surface lying even at an average of 2,000 feet is only undulating. The main contours are shown on Map 1. In the east there is a considerable area consisting entirely of pronounced relief, and elsewhere there are some steep and rugged localities of more than local importance. The greatest contrast is to be found between the mountains in the east and the generally moderate relief features of the rest of the state.

The most obvious topographical division is formed by an east-west line of ranges and hills, which divides Victoria into two main parts. The Great Dividing Range is the name usually given to this feature, but in some parts of its course the title is a misnomer.

Map of Physiographic Divisions

Actually the division is four-fold; in addition to
the Highlands and the plains north and south of them, the Otways and Strzeleckis in the salients west and east of Port Phillip Bay form another element; while recently a convention has grown up of distinguishing the central part of the Highlands from the rest. Map 2 is based on the divisions used by Hills, with some minor omissions and the picking out of the Central Highlands as a separate unit.

**Eastern Highlands**

The main highlands unit is the Eastern Highlands, an assemblage of ranges east of 145 degrees. The part most nearly approximating to a continuous range, begins due east of Melbourne and continues north of east to the upper reaches of the Murray and over the border to the Snowy Mountains. There are a few small plateau surfaces, locally called High Plains, but for the most part the crests of the ranges are narrow. Also "variation in direction and altitude is very marked along the main watershed, and many isolated peaks on subsidiary spurs have superior altitudes to the main range. The mean altitude of the Eastern Highlands is over 3,000 feet ...: considerable areas are over 4,500 feet with many peaks over 5,500 feet, reaching to above 6,000 feet, in several cases." There are several gaps which

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1 E. Sherborn Hills, "Physiography & Geology", in Introducing Victoria (Ed. G.W. Leeper, for ANZAAS; Melbourne, 1955); and cf. his Geomorphology of Victoria (Whitcombe & Tombs, Melbourne, 1948), passim.
2 Text accompanying Map No. 1, "Topography", in Report of State Regional Boundaries Cttee., 1944, (Govt. Printer, Melb.).
allow crossing of the Highlands by south-north routes. Most prominent are the Omeo Gap, a high saddle in East Gippsland, and the Kilmore Gap, which marks the western edge of the Eastern Highlands.

Central and Western Highlands

From the Kilmore Gap westwards, lie the Central Highlands, with a lower average elevation of approximately 2,000 feet. Large parts of the surface are merely undulating, and although some parts are hilly, with a few high and steep peaks, there are few places where the topography is as rugged as in the Eastern Highlands. The name Western Highlands should probably be reserved for the Grampians and Dundas Highlands. The former are prominent massifs, the latter low but with some marked relief and extending close to the western boundary with South Australia.

Northern Plains

These are the lowlands of the Murray Basin, for the most part featureless plains sloping gently towards the river and some of its tributaries. Most of the lowland is below 300 feet, but the southern portion adjacent to the Highlands is between 600 feet and 300 feet. Although the lowlands lack pronounced variations of relief to a remarkable degree, they have some features which have no great height but some local significance; such as remnants of lakes and the east-west sand dunes of the Mallee.
Southern Lowlands

In the Western District there is a continuous stretch of plains at an average elevation of 400 feet from Port Phillip Bay west to the border. There are also low plains at less than 400 feet around Port Phillip and Westernport, and again in the Latrobe Valley and East Gippsland. South of these lowlands is a further succession of highlands, which Hills calls the Southern Uplands.

Southern Uplands

These include the Otway Ranges in the Western District with peaks over 2,000 feet, the low hills of the Mornington Peninsula, and the South Gippsland Hills. The latter can be divided into the lower[and less steep]Strzeleckis in the west and east of them, the South-East Gippsland Hills with tops over 2,000 feet and steeper slopes. Wilson's Promontory is a rugged extremity projecting into Bass Strait.

Geology

When the maps of relief and geology (Map 3, Geology) are compared the major correlation is seen to be between the old rocks of the main highlands and the young rocks and unconsolidated sediments of the lowlands and plains.

The Eastern Highlands and most of the Central and Western Highlands are of Palaeozoic rocks, mainly sedimentary or metamorphic, but with some ancient lavas. In parts of
the Central Highlands the older landscape has been mantled by Recent lava flows and tuffs, and practically the whole of the Western District Plains has a surface of basalt. The other lowlands in parts of Gippsland and in the north are of Recent or at least Quaternary sediments, even if underlaid by Tertiary sedimentary basins. The Otways and the South Gippsland Hills are of Jurassic age, and the Jurassic occurs again in the low hills west of Hamilton. Wilson's Promontory is a range of granite domes as are many of the more prominent mountains of the Central and Eastern Highlands. This topographical pattern must be kept in mind when the subjects of climate, water resources and markets are considered.

B. CLIMATE

Victoria has a mid-latitudinal position, with a long east-west trending coastline and land boundaries reaching only a short distance into the enormous continental landmass of Australia. Its latitude places it roughly in the stream of westerly air that girdles the Southern Hemisphere between latitudes 35 and 45 degrees, and its connections with the continent expose it to extremes of heat and dryness. The climate is one of warm to hot summers with cool winters, rainfall moderate to low over most of the area and tending to occur at all seasons, but not normally to a very useful
extent in summer because of its irregularity and the high evaporation.

The air masses that affect Australia have not been identified and classified as have their counterparts in North America and Europe for in the Northern Hemisphere there seems to be fairly general agreement on nomenclature for the Northern Hemisphere air masses, both in the literature and amongst meteorologists. Because there are few studies of the air masses around Australia, it is difficult to avoid mixing the types of descriptions one adopts; the approach must veer from air masses to high and low pressure distributions and again to prevailing winds, because the material available on any one of these subjects is not sufficient by itself, to explain even the main features.

Gentilli named five air masses that influence the continent, but he seems to have derived them from a consideration of northern hemisphere parallels to some extent and the analysis is therefore not as useful as it might be.¹

The five are:

Antarctic - over the Pole;
Polar maritime - Pm, from 65°S to 40° - 35°S;
Tropical maritime - Tm, from 35°S to 40° - 20°S;
Tropical continental - Tc, over central Australia;
Equatorial - around northern Australia in monsoon.

Of these five the two most easily recognized and most constant masses are that over the Pole (Gentilli's Antarctic mass), and that over inland Australia — tropical air made dry by its stay over the continent. There is no dispute about the recognition and classification of these masses, though the first might better be called Polar than Antarctic. But in the case of that one which Gentilli names Polar maritime, the name seems to stress too much its ultimate origin near the Pole and to underemphasise its modification over the southern oceans. Two meteorologists, Ashton and Maher, use what seems a more appropriate name — they call it southern maritime. They describe it as moist and sufficiently unstable to form cloud and rain in winter when it is lifted by the coasts and coastal ranges of Victoria.

Considering the air masses in middle latitudes, it would seem that Tropical maritime is quite acceptable as a name for the tropical air that surrounds the continent and has the characteristics of the low-latitude to mid-latitude oceans; it is mild in temperature and humid. In Victoria these humid conditions with mild temperatures are sometimes experienced in spring, or less commonly in

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winter and autumn as one phase (the warmer phase) of the blustering westerlies. Infrequently the Tm air moves across Victoria from the Tasman, from which direction it mostly affects East Gippsland. At other times Tm air moves in on the state from the north, having crossed the New South Wales coast probably to the accompaniment of heavy rain.

Occasionally in summer the Equatorial air which brings the definite rainy season of tropical Australia, extends down to Victoria bringing widespread rains and very warm and humid conditions. But the main influence on Victorian weather in summer is the Tc air of the continent. It is dry air which has been modified by subsidence and divergence during a slow passage across the southern part of the continent, that is modified from moderately humid Tm air, to dry warm Tc air. Commonly its passage shows on the synoptic chart as that of the northern half of a large anticyclone which takes up to a week to pass.

Between the anticyclones there are usually low pressure conditions originating from depressions well to the south and causing first a flow of hot and drying Tc air from the interior, followed by a weak cool change with a flow of southern maritime (Sm) air and some coastal showers ahead of the next anticyclone.

The greatest heat can thus be expected from northerly
winds blowing from the Tc air mass, which contrasts with the fact that the greatest cold in winter comes from the south. Ashton and Maher state;\(^3\)

In Melbourne, the coldest southerly stream coming from the southern ocean has a temperature of approximately 45°F around mid-day in mid-winter, and this represents the coldest stream reaching the Australian mainland.

It follows from the differences in these two air masses (Tc and Sm) that the clashes between them may give rise to the heaviest rain and most violent mixing of air. The Tc mass is dry and often quite high in temperature, the Sm is moist and somewhat unstable. It will already have become apparent that describing the air masses by their usual locations or origins fails to bring out their mobility. For example, it was pointed out above that the Tc air mass is usually Tm air from the Indian Ocean to the west of Western Australia, modified in its passage across the continent.

On the other hand not all Tm air that affects the continent has most recently sojourned over it. Tm air can move in from the Tasman (as suggested above) and some moves across from Western Australia, but far enough to the

\(^3\) Ibid, p. 54.
south of the continent so that it does not lose its moisture nor does it warm up greatly. Such masses become part of the stream known as the roaring forties. Here they may be mixing with the northern edge of Sm air masses. The main vigour is in the latter however, and Sm air masses undercut and mix with Tm air along their zone of contact.

Warm fronts are rare in the south, but occlusions are quite common, an indication of the long period of development which lies behind many of the frontal formations. In winter periodical cold fronts associated with a chain of depressions passing to the south of the continent bring a considerable amount of rain to southern Victoria. They strike the coast, and further inland are lifted by various ranges lying at an angle across their path. Quite a share of cool-season rain comes from this orographic effect, and some more from frontal mixture. Northwest and southwest winds accompany the cold front passage. By the time the southwest winds have crossed the Divide, they have lost most of their moisture and only a further frontal interaction or a convergence effect is likely to lead them to shed further precipitation on the land on the northern side. It is therefore not surprising that rainfall totals fall away markedly on the northern side of the Divide.

There is more of a chance with northwest winds, than there is with southwest ones, that they have shed most of
their moisture over Western Australia or over parts of South Australia before reaching Victoria. But some share of total rainfall must be due to northwest winds all the same. This is shown by the fact that some localities which are sheltered from the northwest but open in the main to the southwest, have a rain-shadow effect in the lee of the northwest slope. The Grampian Mts. show this on the larger rainfall maps, and it occurs again to the south of the Divide near Bacchus Marsh, though in the latter place it is possibly due in some measure to a low line of hills (Brisbane Ranges), running S-N. The other rain-shadows of southern Victoria are shielded from both southern and western winds; they are the lowland running from the Otways to Geelong, and a neighbouring feature, the basin around Lancefield north of Melbourne; also the Maffra-Sale lowland in East Gippsland.

The map (Map 4) of mean annual rainfall shows that the southern two-thirds of Victoria receives over 20 inches annually, while in the far northwest the total drops to 10 inches. There are three necessary qualifications to annual averages of rainfall; they are seasonal occurrence, effectiveness, and reliability or its converse variability. Of course effectiveness is to some extent linked with seasonal distribution, while a consideration of effectiveness in different months of the year allows an estimate to be
made of the length of growing season. Therefore it is essential to discuss seasonality and effectiveness along with growing season.

**Seasonal Rains**

Over most of the state the rainfall regime is a modified Mediterranean one with a fairly general winter or spring maximum. The amount of rainfall received is not markedly different in different seasons, but the effectiveness of rainfall in the warmer part of the year is so low, due to the higher temperatures and higher evaporation, that the impression of cool-season maxima is very strong. Spring and autumn rains have an especial importance when considered beside the fairly dry conditions of summer and autumn months. Spring rains are important in the north as promoting growth in cereals, and in the south to bring on the flush of spring pasture and provide feed and hay.

Autumn rains are also important in providing some feed for stock through the winter and in moistening the ground before cereals are sown. On the other hand the summer drought makes it impossible to grow summer crops except under irrigation, or in cool moist localities on the southern coast.

**Effective Rainfall**

Effective rainfall is best taken as the amount that will keep the surface soil above wilting point, and so
sustain plant life. To find what amount is effective the amount of rain should be compared with the potential evaporation of the locality. Trumble calculated a formula which set out this effective amount in terms of a ratio between evaporation and rainfall. The basis for the evaporation calculations was originally a set of readings from evaporimeters, but later, saturation deficit readings were used to calculate evaporation. Trumble found the amount of rainfall needed to keep plants above wilting point to be equal to or greater than, a third of the evaporation. As long as rainfall was more than one-third of the evaporation the soil moisture should sustain plants.

Growing Season

Map 5 showing zones of effective rainfall seasons, of different lengths, is the geographical expression of Trumble's formula, and is enlarged from his map, with lines added for 10, 11 and 12 month seasons. It shows the length of time that the ground is moist enough to support growth, according to the formula. Superimposed on the rainfall information is a zonation of growing season according to temperatures in the winter months. The mean monthly winter-growing conditions are: no: growth, 45°F or

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below; moderate growth 50°F; active growth, 55°F. At some stations, but only a few, plant growth is limited both by having a month or months with too little rainfall in summer, and also in winter by having average temperatures too low for plants to grow.

The dotted symbol shows zones with a warm winter, above 50°F, which allows moderate growth in these three months. The warm winter zones are either along the coast, where they coincide with effective rainfall of 10 months or more, or in Northwest Victoria, where they coincide with an effective season of only five months (in winter and spring) which are moist enough for growth. Here, summer and autumn are too dry altogether for growth, and north of the five-month line even seasonal cropping is precarious. The remainder of the state, except for parts of the highlands where winter temperatures are too low for growth, has a period of retarded growth in three winter months with average temperatures between 45°F and 50°F. The growing period thus ranges from approximately six months in the northwest to almost twelve in the south, and there are highland localities between with periods of both drought and cold.

Leeper comments, "a growing season of twelve months, which is shown in the southeastern part of the state, is an estimate that errs on the generous side; this is a
shortcoming from the use of a very simple formula. 5

The Central Highlands at Ballarat and Kyneton, and the Eastern Highlands from Warburton to the Upper Murray on the eastern border, are localities where winter temperatures are below $45^\circ F$, on the average, and so prevent winter growth. But the Eastern Highlands are moist enough for growth right through the summer because of their elevation which gives them higher summer rainfall and lower temperatures and evaporation. The Ballarat district is not quite so favoured, having one or two summer months with droughty conditions, as well as three winter months of no growth.

**Variability of Rainfall**

These figures are averages on which a stable agriculture could be based only if the conditions described could be relied upon to occur with consistency. How reliable are the climatic averages, especially those of rainfall? There has been some misunderstanding of this important matter. The early work was done by Griffith Taylor 6 and Barkly. Griffith Taylor used the mean deviation per cent of mean, and his method was improved upon by Leeper 7, using a longer period of records.

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5 G.W. Leeper, Ch. 2, "Climate", in *Introducing Victoria*, (op. cit., p. 1), p. 23


7 See Fig. 19, *op. cit.* (3rd Ed.), 1957
Barkly used the standard deviation as a percentage of the mean and used it also for districts, not places. But his work has been misinterpreted and his map has been reproduced labelled "average deviation". A comparison of the Taylor map and the Barkly map show them to be so divergent that there must be some error. It is, of course in the mistaken attribution to Barkly of a calculation based on "average deviation" when he actually used standard deviation; standard deviation gives a very poor picture of variability.

For Victoria, Barkly's results give Melbourne a variability of over 20%, while Taylor's map shows it as under 15%. Leeper's map (using a longer period) gives a figure a little higher than 15%. The general effect of using standard deviation has been to understate the variability of the tropical areas and to exaggerate that of the southern part of the continent. Thus on the map reproduced in the Atlas of Australian Resources, Wave Hill, N.T., with 20 in. of rainfall is shown as having 20% variability, while Bendigo, also with 20 in. is shown with a higher variability of 25%. The variability of southern Australia is below the world average, as has been pointed out by Leeper, so that 20 in. of rainfall in southern Australia would certainly be more reliable than 20 in. in the

9 Fig. 18, Australian Environment (Ed. C.S.I.R.O.), 1950.
Northern Territory.

Leeper's calculations show all of Victoria as below the world average variability, for the amount of rainfall. Map 6 shows the variability of rainfall in Victoria and it can be seen to be highest in northwestern Victoria: at Mildura with a rainfall a little above 10 in., variability is above 25%; this just exceeds the expected world standard (24%) for 10 in. quoted by Leeper. Except in the most easterly part of the state the position is the same elsewhere; that is, by and large Victoria is not subject to greater variability than the average annual amount of rainfall would lead one to expect.

This does not mean that some parts of the state do not have quite variable conditions. In the northwest and to some extent in East Gippsland, the unreliability of the rainfall is an agricultural handicap. Localities on the northern edge of the highlands, with rainfalls from 15 in. to over 20 in., have been greatly handicapped in pasture improvement by having periods in which the annual rainfalls have been well below the average, so destroying the work of previous years. The most important fact here is probably this - that the driest places have the greatest variability.

Appendix 2 is a summary of climatic statistics for Mildura and other places.
Because of the low rainfall these localities are in any case the most difficult to farm, but they are also the most risky.

**Agricultural Limits**

Some of the limits outlined by Trumble and elaborated in the map here reproduced (by Leeper, after Trumble) were noted by him as having a specific agricultural significance. For instance, the line of 7.5 months growing season was indicated as the probable inland limit for Mt. Barker subterranean clover (Trifolium subterraneum). Experience has shown this estimate to be approximately correct. In the west the line is a little south of the actual limit of the Mt. Barker variety, and in the east it is a little too far to the north. Other varieties of subterranean clover have become established north of this general line, especially the drought-resistant West Australian varieties, such as Dwallganup.

The nine-month line marks the general limit of perennial pasture species fairly well: again it is somewhat too far north in the Northeast, but the actual pattern becomes very complicated here because of the penetration of narrow valleys into the Highlands.

The Highlands themselves make a good climatic divide, with a growing season of nine months or more to the south.
The two rain-shadow areas — around Port Phillip Bay and around Sale in East Gippsland — also appear on the growing season map as having longer summer droughts than the surrounding high rainfall localities. Around Werribee the growing season is only 10 months, while although it appears on the map as 11 months, the season at Sale is probably shorter, in general.

A passing reference has been made already to the importance of seasonal rains; a further aspect of this subject is the question, in which periods of the year is rain most reliable and how does this affect farming? Winter rains and those of early spring are reliable and they also fall in showers of low intensity, so that the water has the greatest chance of being absorbed. Summer rains, on the other hand, are erratic and fall in heavy showers, so being most likely to run off.

Perhaps the most important seasonal occurrence is the "autumn break" — the arrival of rain heavy enough to germinate annual grasses and revive perennials. Sometimes this rain is so delayed that soil temperatures have fallen too low for grass growth to be revived. Or alternatively a too-early break with no "follow-up" rains will initiate growth which withers with the following lack of moisture.
Cropping is very much affected by the autumn and winter rains. Cereals are usually sown after the autumn break, in March or April, and if it fails to arrive the sowing will be postponed. If the break is followed by recurrent rains which keep the ground wet, or by unusually heavy winter rains, the land surface will be too moist for farmers to sow seed. Spring rains are relied on to fill heads of grain, but they are a little less dependable than those of winter.

Excessive winter rains not only prevent the sowing of crops, notably cereals, potatoes and onions, but are also likely to damage fruit trees on soil types with poor drainage. The setback to wheat-growing from a wet winter is not likely to extend beyond one season, but fruit trees take years to replace and in this century damaging winter rains have twice destroyed considerable areas of trees in the Goulburn Valley on the heavier soils.

**Bush Fires**

In hot summers, bush fires are another farming hazard. With warm to hot air masses, and strong northerly or northwesterly winds, the risk of fire is great. Conditions like these rarely last more than three days, usually less, but the damage that can be done in a short period is enormous. In January, 1939, there were fierce fires in both the Mountain Ash (Eucalyptus Regnans) forests west of Melbourne and in
the Western District forests, and again in 1944 there were ferocious grass fires in the Western District.

Other Temperature Limitations

The limitations placed on farming by drought are great, and must be the main theme of any assessment of climate as it affects agriculture in Victoria, but temperature by itself sets some limits also. There are effects of both latitude, altitude and seasons. Oranges are found only north of the highlands, and this is mainly because of the cooler summers of the south with their lower total amount of sunshine. Lemons, on the other hand, do best under the cool summer conditions south of the Divide. Crops such as temperate berry fruits and some ornamental shrubs which suffer from fungi and other diseases in high summer temperatures are grown only in the hills south of the Divide, where summer temperatures never rise high enough to endanger them. Only in East Gippsland is the summer climate both moist enough and warm enough for maize to grow well.

Some of the stone fruits which need high ripening temperatures grow best north of the Divide. On the other hand the temperate pome fruits are found almost entirely in the Central Highlands or in the hills close to Melbourne. Many of the European, especially British, fodder crops are not cultivated because of summer drought. Some other distrib-
utions are related to optimum conditions rather than to the theoretically possible. Viticulture, for example has had periods of success in the south, but is now confined to the northern half of the state; even so, the growing of grapes for dried fruit production which is carried on in the northwest is plagued by the losses which follow occasional summer invasions by humid tropical air masses. These induce disease in the ripening grapes and upset the drying process.

Occasional frosts need to be guarded against in all the lowland fruit-growing areas, even in Mildura, and plants too sensitive to cold are not grown commercially in the south. Early crops may be grown in norther irrigation areas (tomatoes for example), but a large volume of out-of-season production is imported from other states. Potatoes are not grown at all in the northern half of the state and more than half total production actually comes from the cooler Highlands; all of the early potatoes are produced in low-lying localities in the south, because only in the southern half of the state do night temperatures fall consistently low enough (55°F) in spring for the potato plant.

Much more striking than all of these other effects of climate is the fact that temperatures are so benign that stock are nowhere housed, and the enormous labour of indoor hand-feeding common in Europe and much of North America is not necessary. Handfeeding of dairy cattle is common in the south,
nevertheless, both in winter and in early autumn before grass growth starts, but this is mainly done by spreading hay in the paddocks. However, more attention is being paid to fodder conservation as stock numbers increase. In the northern parts it is not possible to make hay, and drought precautions mainly consist in storing grain for emergency feeding. Feeding of this type is not a usual part of the farming methods, in that the methods aim rather at carrying as few animals as possible in the dryest part of the year.

The cool climate of the Central Highlands and the western fringe of the Eastern Highlands, would probably have been exploited more fully by growing more of the temperate types of crops, had not Tasmania been better placed to supply most of Australia's needs of these items. However, with the exception of potatoes, most of them do not take up a large area but are more notable for a high value of crop per acre.

C. SOILS

There are few features which are common to all Victorian soils, because in the main their characteristics vary with the different climates of the state. However, one feature which they all share is the low level of available phosphorus in the natural state. Sandier soils are worse than the clayey ones in this characteristic. It is true that there are one
or two localities which had plentiful natural supplies of phosphorus, such as alluvial soils and patches of volcanic tuff, but this is because both types were formed recently and therefore have not been heavily leached.

Other features of the mineral status of the soils are related to the main climates. In the cooler south with heavier rainfall and only a short summer drought the soils are low in chemical wealth, with a low pH. On the other hand, in the dry Mallee with its rainfall not much above 10 in. and with a wet season of only 5 or 6 months, the pH approaches 9 even in surface soils and certainly does so in subsoils.

The acidic soils, extend well north of the divide, including most of the hilly country with twenty inches or more of annual rainfall. On the other hand, less acidic soils with a calcareous subsoil occur in the south in the drier areas to the west of Melbourne and near Sale in Gippsland.

Again, potassium reserves are higher in the north with its lower rainfall and higher alkalinity, but the southern soils are low in potassium, although it is usually only after they have been farmed for some time that the deficiency is particularly noticeable. Also the sandier soils are likely to be the more deficient, and the drier localities of the south, such as west of Melbourne and around Sale, do not show

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1 G.W. Leeper, ch. 4 in Introducing Victoria, ANZAAS (Melbourne, 1955), p. 41. I am indebted to Assoc. Prof. Leeper not only for permission to use this and other quotations, but also through his writings (quoted below) for the main part of my information.
such low potassium levels. But there are some two million acres of pasture land in southern Victoria where pasture production could be raised considerably by the use of potassium fertilizer with superphosphate.

Humus levels are lower in the north but on the other hand the available nitrogen is higher in the drier climates. Before farming began, the supply of nitrogen was fairly low everywhere, but by introducing pastures that include exotic clovers, a great improvement has been effected in some of the higher rainfall districts. Trace elements have received particular attention in Australia, especially in states other than Victoria but deficiencies of some minor elements have been shown to be important in certain localities within Victoria. Molybdenum, zinc, copper and manganese, are all used in one place or another, the practical severity of the deficiency sometimes varying with the type of farming that has been carried on.

Salt has been brought to the land surface from the sea, but only on drier soils has it accumulated. Localities with less than 17 inches of rainfall may accumulate dangerous amounts of salt and irrigation water may then bring it from the subsoil to near the surface so that plant growth becomes impossible. An understanding of the mistakes of past irrigation practice is now helping to minimise the danger and
the damage already done.

**Skeletal and Swamp Soils**

Considerable areas of the land surface are so steep and rugged that the soils are immature and skeletal: on such steep slopes they cannot remain stable, and so the soils are thin and profiles undeveloped. Other large areas have surfaces of rock with only patches of soil here and there, or there is a large amount of stony material present in all horizons. This is especially the case on soils formed from basalt, and on these there is also often very poor natural drainage, with water lying on or near the surface through the winter. There seems to have been only a limited area covered with natural swamp, and few localities have peaty soils.

**Soil Map**

The broad-scale map (Map 7) presented here is based very largely on that of Leeper, with some additions and alterations suggested by an unpublished map of the Soil Conservation Authority of Victoria.

**Podzolic Soils**

Podzolic soils cover the southern two-thirds of Victoria, except the mountain regions: they are what Leeper describes

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Fig. 7, *Introduction to Soil Science* (M.U.P., 1952)
as the "Australian podzol".

The commonest kind of soil in sloping land in the country with between 20 and 30 inches of rainfall, especially in the eastern part of the state, is one with a permeable surface of grey sandy loam or silty loam, and a subsoil of yellowish-grey clay. The transition from the light loam to the clay is sudden, and occurs usually at a depth between one and two feet. The sub-surface is pale above the clay, and usually a layer of ironstone gravel occurs at this junction. These soils occur both on granite, tertiary sediments, and palaeozoic sedimentary rocks. During the wet periods in winter and spring, these soils become saturated down to the level of the almost impermeable clay. Below the immediate surface, where living and decomposing roots help to consolidate it, the sub-surface becomes semi-fluid...

In spite of their unpromising appearance either under their native eucalypt cover or under native grasses after clearing the trees, these soils grow first-class pastures after the usual treatment of superphosphate and subterranean clover. In some places molybdenum also is needed before the clover will grow well. The worst defect is poor drainage, which caused some early failures with crops grown on these soils. It is only where orchards have been planted in southern Victoria that tile drainage has been used on these soils.³

Leeper uses the term "Australian podzol" to emphasise the distinction between these soils and those called podzolic in other parts of the world. The former are soils of inherently poor structure and deprived of much chemical wealth by leaching, but they are capable of considerable improvement with known techniques. They are acid throughout the profile, with no free lime, but these properties are also those of other soils in the higher rainfall zone.

³ op. cit., Leeper, *Introducing Victoria*, pp. 49-50
Within the broad group of podzolic soils sub-groups can be distinguished based mainly on the nature of the parent material or on elevation and aspect.

**Podzolic Soils on Deep Sands**

Podzolic soils developed on deep sands are one such sub-group; they do not have the same sharp contrast in texture between the surface soil and the subsoil as others in the podzolic group, and often lack the clay subsoil altogether. A further disadvantage is their tendency to dry out quickly - an inability to hold water. They are mainly located along the coast, particularly at either end of the coastline, in East Gippsland and in the far Western District. There are other patches from Wilson's Promontory to Wonthaggi and around the head of Westernport Bay. It was not known until recently, that the crippling deficiency of these soils was their lack of the trace element copper, in addition to the usual low level of available phosphate and nitrogen. Large proportions of the area under podzolic sands have been left uncleared because of the difficulties they have presented to pasture establishment and in some areas (such as the "grass-tree podzols" of East Gippsland) suitable techniques have not yet been evolved. Some of the patches of podzolic sands along the coast have calcareous subsoils.
Podzolic Soils of the Uplands and Woodlands

More commonly the podzolic soils are not deep sands but are developed on Tertiary and Recent materials of a sedimentary type, or on the Recent basalt of the south. J.K.M. Skene makes a distinction between the podzolic soils of the "woodlands" and those of the "uplands" in northern Victoria, the main difference in their potential probably being a higher natural fertility in the lowland soils, perhaps because they are deeper. In the south he makes somewhat the same distinction between the "lowland" and "upland" soils, the main difference here being that upland soils are shallow and developed on steep slopes which are usually unsuitable for clearing. The podzolic soils of the uplands are divided from those of the woodlands mainly along the line of break of slope in the Northeast. From Seymour west, the podzolic soils are all located on the uplands, and the line of break of slope is therefore the main division between them and other groups such as red-brown earths and chernozem-like soils. Skene's division is an arbitrary one and has not been reproduced here, but it is worth bearing in mind in the setting of the two localities mentioned, the Northeast and East Gippsland.


Podzolic Soils on Jurassic Rocks

Podzolic soils which have developed on Jurassic sandstones and mudstones are different again from the other podzols of the south. Podzolic characteristics are not well developed in this case and their fertility is higher than that of their neighbours. Leeper attributes this to the fact that they have skeletal properties, with decomposing rock often close to the surface. "This rock is simultaneously fresh enough and highly enough decomposed to contribute to the chemical wealth, so that the soils are above the average for podzols." 6

They are friable, yellowish, or brownish grey loams and clay loams which become heavier in the yellow subsoil, but without the strong contrast in texture found in other podzolic soils. They retain good structure in the subsoil. They are found in the South Gippsland Hills and in the Otways and in a small area near Geelong (not marked on the map). The Jurassic of Coleraine and the surrounding hills has given rise to podzolic soils with lateritic properties and to black earths intermixed with the ordinary podzols. These three localities of Jurassic country have been partly cleared, and in general the Jurassic hills are capable of being developed into good pasture, where slopes are not too steep.

It is the intensity of relief which governs the nature and degree of utilization of these soils, rather than the properties of the soil itself.

**Podzolic Soils with Alkaline Subsoils**

Elsewhere in the podzolic soils there are some recognisably different podzols with alkaline subsoils rather than the usual acidity throughout. These are found in drier climates; for example on the northwestern edge of the "woodland" podzolic soils in the lowlands of the Northeast, or in the rain-shadow of the Latrobe Valley in East Gippsland. They are intermediate between podzol and pedocal, with an acid surface and an alkaline subsoil containing small lime concretions. These soils support excellent permanent pastures and have proved suitable for cereal and sugar beet crops, but where they have been poorly drained, they will not support more than partly improved native pastures, and are not suitable for irrigation.

**Krasnozems or Red Loams**

The term, Red Loam, as used locally does not mean just loams that are red, but is applied to a group of soils which are acid throughout; red or brown in the upper ten inches and lighter in the subsoil; texture heavier in the subsoil; highly friable and permeable, although with little sand, and deep - perhaps up to 6 feet to decomposing rock. Leeper recommends the use of the name krasnozem for this description.
of soil. The krasnozem is not necessarily volcanic in origin and is found on other rocks. Much of it is elevated, but there are some occurrences which are at low levels or even at sea level. Leeper opines that the great reputation of these soils is not entirely deserved. The virtue of the krasnozem is that it is friable, deep and permeable, and although it occurs in localities with considerable rainfall it is well-drained, which the podzolic soils common in higher rainfalls are not. But the krasnozems are not necessarily well endowed with chemical wealth, and some have quickly become exhausted by cropping.

Krasnozems occur in many parts of southern Victoria, but the best-known and most important localities are perhaps three in number. The largest is a discontinuous extent of krasnozem from Ballarat to beyond Woodend to the east. Here it is found on Ordovician slates in some cases, but mainly on the Newer Basalt and one or two small patches of Older Basalt. Another important occurrence is around Warragul in Gippsland, and related smaller localities are to be found at Thorpdale, Mirboo South, and Leongatha. A third well-known locality is that on the Dandenong Ranges and nearby at Gembrook. Other localities are on the coast from Warrnambool to Port Fairy, on Mornington Peninsula and Phillip Island, and in small patches elsewhere in the Western District, Bellarine Peninsula, Portland, and odd localities in the hills of the Northeast.
Miscellaneous Soils

These are marked on the map in the mountainous part of Eastern Victoria. Little investigation has been carried out here, and although podzolic soils undoubtedly cover considerable areas many other types and groups are known, or can be inferred. Many are undoubtedly thin, stony, or skeletal, and not suitable for much development, if any.

Skeletal Soils

The soils of the Grampians in the Western Highlands are poorly developed because of the prevalent steep slopes of the ranges. They are marked as skeletal.

Red-brown Earths

The red-brown earths occupy what might be called the mid-northern plains, the greater part being in the Northern District. The soils are derived from unconsolidated riverine material of Pleistocene to Recent age, except where they are residual on granite and Ordovician slates around St. Arnaud and Charlton. They are neutral to slightly acid sandy loams and loams, overlying alkaline, heavy clay subsoils. The heavy clay layer is their main disadvantage as it presents something of an obstacle to the penetration of water. The soils have undergone moderate leaching only, so that some calcium carbonate is still present in the deeper subsoils, although gypsum and soluble salts are usually low. Grey-brown
and grey soils of clay loam surface texture occur as well as brown and red-brown types, but the grey phase is of smaller extent and is found in the lower-lying situations of the landscape. Fertility is good and the soils are suitable for cropping and irrigation. On the western edge they become more mixed with the grey self-mulching clays of the Wimmera, and on the northern edge of the Wimmera the two groups are inextricably mingled. In the mid-northern plains the grey clayey phase of the red-brown earths has been degraded in structure by cropping; the silty surface is hard to cultivate and presents difficulties to the establishment of better pastures. In the south, the same soil group is found on basalt in the rain-shadow west of Melbourne and extending as far as Geelong.

**Chernozem-like Soils**

The greatest extent of these soils is in the Wimmera where they are grey calcareous clays, locally called "black", with a physical structure which makes them dry out to form small loose crumbs ("self-mulching"); they swell greatly on wetting and crack deeply on drying. They are much similar in the subsoil, though the colour gradually lightens from dark grey to light grey and the lime increases in amount. These physical properties make them excellent for cropping, but in a wet season cultivation is difficult because the clay becomes sticky and unworkable when wet. Wimmera roads are
dangerous in the winter if unsurfaced.

Around "stony rises" of basalt there is a black friable calcareous clay, which is darker in colour than the Wimmera clay, but resembles it in other properties. The main occurrences of this clay associated with stony rises are marked on the map: they are three, firstly north of Melbourne, secondly around Lake Corangamite, and thirdly in the southwest of the Western District.

Other Pedocals

These are groups of soils which are especially notable for their heavy clay texture and calcareous subsoils. They are not greatly different from the Wimmera clays except that the physical state is much less favourable to cultivation, and the salts present make irrigation hazardous if not undertaken carefully. In the north the surface soil is both grey and brown, but in the south, in the Western District occurrences, there is no brown. Like the red-brown earths these soils need care when irrigated, and considerable areas have become salted near Kerang due to faulty methods of watering. They are capable of carrying improved pastures, but these are found only with irrigation in the north, or in the higher rainfall localities in the Western District. They are also found intermixed with the black earths and stony rises in the Colac locality and north of Melbourne.
Mallee or Brown Calcareous Solonized Soils

The basic material for the soils of the Mallee, was river and lake sediments and these have been re-sorted by wind action. For the most part, Mallee soils are sandy loams, alkaline throughout with an increase in clay with depth and appreciable calcium carbonate in the subsoil. The surface is ridged with alternating east-west rises and dunes and the tops of the ridges are of lighter soil, either sand or of sandy loam texture with less lime. The lime often forms a rubble zone about two feet from the surface. The profile is often saline to a considerable degree, and Mallee soils are often described as solonized because of the importance of salt in their formation.

Because they have an attractive physical condition and salinity is not too high in the surface to interfere with plant growth, the Mallee soils are suitable for cropping. But they are just as deficient in phosphorus as other soils. The deficiency was early noticed and remedied because of the rapid depletion of phosphorus with the wheat-fallow rotation which was universal fifty years ago. Irrigation is hazardous without careful attention to the amount of water applied and to drainage. Soil texture is important in relation to irrigation, only the sandy types being suitable for citrus, while a wider variety of types
is capable of carrying vines. Stretches of wind-blown sand occur amongst the developed soils; the largest areas of these are referred to below.

Sand Without Profile

On the western border of the state there are large areas which have a covering of white featureless sand with no profile, and have been mapped as "Sand without profile".

Alluvial Soils

Geographers often describe as "alluvial" any soil formed from river-sorted material, whatever the age and properties of the soil. There, the term alluvial is reserved for soils formed from river-sorted material, so recently deposited that it lacks profile or any vertical differentiation due to normal soil-forming processes. This restricts the use of the term alluvial to surface areas of small size, and not really large enough to show very well on the map. The type has such exceptional properties, however, that it has been indicated diagramatically on the map to emphasise its locations. Textures are generally silty or those of fine sand, but may vary greatly. Generally the soils are acid, but not inevitably so. Usually they are high in mineral wealth because they represent a concentration of the finer parts of other soils washed into rivers and deposited by them along their course or near their mouths.
Commonly they are located along the valleys of some of the rivers in the Northeast, and along parts of the Murray, but most frequently near the mouths of the rivers draining the southern half of the state. These soils usually have high fertility and are most intensively used, supporting cropping and/or first-quality pastures, very often with no additions of artificial fertilizers.

Soils on Volcanic Tuff

Patches of soil developed over volcanic tuff occur through parts of the south, particularly in the Western District and the Central Highlands. They accumulated on ejecta from a number of volcanic cones, and being very recently formed have not lost their chemical wealth by leaching. They are highly fertile and have a very considerable reputation for intensive cropping and pastures of first quality. Some of the favoured localities are Tower Hill (Koroit), Mt. Leura (Camperdown), the Warrians (Colac), Mt Noorat (Terang), Buninyong and Warrenheip (near Ballarat). Onions are largely confined to this soil type.

Farming and Soil Characteristics

A century of human use of Victorian soils must have had great effects on the soils, not only in using and alternately replenishing mineral nutrients, or in the lowering of the humus content, but also in the effects of implements
and hooves on soil structure.

The present agricultural use of much of the land is already limited or influenced by what has happened up until now, and for some soils there are urgent problems to be solved in new or changed farming methods. In the north there are the problems of lessening cultivation or its harmful effects on soil structure, and raising humus levels again where there has been consistent cropping. Nitrogen levels also need raising in both northern and southern soils, but more so in the former. Potassium is becoming short in heavily-grazed southern soils. It would be better for soil conditions if there were less cropping in the north and more in the south. The latter would make best use of the nitrogen and humus which is building up under the "sub and super" regime.
CHAPTER III  PASTURES AND IRRIGATION

A. PASTURES

B. WATER SUPPLIES AND IRRIGATION

C. AGRICULTURALLY UNUSED LAND
A. Pastures

This section is mainly concerned with the pastures of Victoria, but because in the pre-European period grassland made up only a small part of its natural vegetation and surface area, it seems essential to survey the natural vegetation zones of the state in a brief and summary fashion. The broad outlines of natural vegetation are important features which had considerable influence in conditioning the type and the timing of agricultural and pastoral settlement.

Natural Vegetation Zones

The main zones of natural vegetation are shown on Map 8, which is adapted from the map of "Vegetation Regions" in the series of the Atlas of Australian Resources. Eight main types are represented here, some of them constituting mixtures of two types.

Savannah Grassland

The vegetation type most readily available for grazing was the savannah grassland of the south, a combination of native grasses of the tussock varieties and of trees dotted across the grassland to give it the appearance of a parkland.

1 Dept. of National Development, Canberra, A.C.T.
The land around Melbourne carried this type of vegetation and it extended to the far west of the Western District, where it was succeeded by thicker trees. The savannah is partly related to the lower rainfall of parts of the south; around Melbourne and Geelong and in the east of Gippsland its distribution corresponds to the rainshadows of these districts.

**Sclerophyll Forest and Temperate Rain Forest**

The Central Highlands and the Southern Uplands were mainly covered with the dry sclerophyll forest which coincides to some extent with the greater rainfall of the Highlands. However, the wettest and highest parts of the Southern Uplands carried a true rainforest of the temperate variety with tall trees and tree ferns and dense, almost jungly growth in the gullies. Intermediate between the rainforest and the dry sclerophyll forest was a wet variety of sclerophyllous forest, covering most of the Eastern Highlands, except for the highest spots. These high spots had alpine complexes of different sorts varying from tussock in some places, to shrubberies and even stunted woodlands.

**Temperate Savannah & Woodland**

North of the Central Highlands and the Eastern Highlands further savannah occurred but no so open in this case, and without the tussock grass of the south. Along the rivers –
the Murray and its tributaries - there were thick forests of trees in the wet land around the water.

Mallee Scrub & Heath and Shrub

Most of the northwest was covered by Mallee scrub, a low branching eucalypt which has a group of thin branches rising from a common root. On the poorest soils of the north and west, the scrub was not the Mallee, but rather communities of heath and shrubs. In this very generalised setting of natural vegetation zones the pastures existing today have been developed, both from the native material and from importations.

Pre-European Grasslands

The grasslands of Victoria were small in extent and composed of relatively few species before European activities began to alter them. The native grasses were perennials, many of them tolerant of a wide variety of conditions and found throughout Victoria - indeed in many parts of the continent. It seems likely, therefore, that the pre-European native pastures were not markedly differentiated from one part of Victoria to another. These characteristics also imply that the natives were not capable of making best use of the more favourable southern environment.

The most important species of the indigenous grasses were Kangaroo grass (Themeda triandra), Wallaby grasses
(Danthonia spp.), and Spear grasses (Stipa spp.). The last two were found throughout the state, but Kangaroo grass was absent from the driest parts. Other important grasses (there were no indigenous clovers) were Tussock grass (Poa caespitosa) and Windmill grass (Chloris truncata). These grasses have a tussock form with bare patches or herbs between neighbouring tussocks. On the pre-European landscape there were probably few areas where the tussock grassland was not dotted with trees in savannah fashion. Even so, grassland without trees together with savannah grassland, probably covered only about one-fifth of Victoria.

Elsewhere there was much less grass and instead trees grew much closer together in the various types of sclerophyllous forest and rain forest. In the northwest, Mallee scrub covered the ground closely and there was very little grassland and very little accessible grass between the Mallee trees.

**Changes brought about by Europeans**

The processes of clearing, grazing, burning, the introduction of exotic pasture plants, as well as cultivation and the use of artificial fertilisers, have all had a marked

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effect on the type and spread of pastures. The most considerable change was in the enlargement of the area on which pastures could be grown. Large areas of rain forest and sclerophyll forest have been cleared in the southern and central parts and most of the mallee scrub has been cleared to make way for cropping and grazing.

Of great importance also, has been the introduction of exotic grasses and clovers, either accidentally, or for improvement of pasture types. The introduced species were mainly indigenous to the British Isles or the Mediterranean Basin, the English species being suited to the higher rainfall of southern Victoria, and the Mediterranean plants suited both to the south and to localities with summer drought.

Qualities of indigenous and exotic plants

In many ways the indigenous and exotic plants are strongly contrasted. The native grasses tolerate low soil fertility but the most useful of the exotic species demand high levels of fertility. The native pastures lacked clovers or trefoils and produced tough, fibrous growth of low feeding value. The best of the introduced plants can supply green feed of high quality for a good part of the year, and the exotic clovers help to raise soil fertility. The most common soil deficiency is of phosphorus, and this is usually corrected by top-dressing with superphosphate. If exotic clovers, or clover and grasses, are sown at the same time,
the clover builds up the humus and nitrogen content of the soil and makes possible a more vigorous growth of other grasses. The resultant improved pasture then offers more variety, improved quality, and a much greater bulk of feed than could be had from the native pasture.

General types of Pasture grasses and clovers

Pastures of the highest quality consist of perennial grasses and clovers indigenous to northern Europe, especially perennial ryegrass (lolium perenne) and white clover (Trifolium repens). Soil fertility needs to be moderately high and a rainfall not below 30 in. per annum is necessary to maintain the best perennial pastures. Cocksfoot (Dactylis glomerata) is usually an important constituent of these good pastures, though it competes with perennial ryegrass and tends to be displaced by it where conditions are especially favourable for both. Strawberry clover (Trifolium fragiferum) and red clover (Trifolium pratense) may also be seen in addition to white clover.

With approximately 30 in. or more of rainfall the best perennial pastures provide some grazing through the whole of the year, but they are checked by drought in January and February and growth practically stops in most localities from May to July, due to low temperatures. On the other hand spring growth is prolific, much more than can be used at the time. Sound farming includes the conservation of surplus spring
growth by hay and silage-making for feeding out in the late summer and the winter. During the summer some of the spring surplus will remain on the paddocks as dry fodder but it has a low value. Even for the best pastures the period of growth is short compared with other dairying countries such as Britain and New Zealand.

In some of the high-rainfall areas where white clover has not been established, other leguminous plants have appeared, and have been important for so long that some are known as "native clovers". Birdsfoot trefoil (Lotus major) is a common perennial legume which has volunteered in high rainfall areas. Others are annuals, more common with lower rainfall. On perennial pastures where fertility is not maintained, ryegrass will be replaced by perennial exotics of poor quality, such as Yorkshire fog grass (Holcus lanatus), sweet vernal (Anthoxanthum odoratum) and crested dogstail (Cynosurus cristatus).

In East Gippsland and the valleys of the Northeast, paspalum (P. dilatatum) is common. It provides a large bulk of feed in the summer but some pastures become dominated by it and then give no feed in the winter. Paspalum and other species, Silt grass (P. distichum) are common with irrigation.

Lucerne (Medicago sativa), a hardy legume, was a pioneer grazing crop through the early irrigation areas, but
while it has been declining in these localities, its value is being proved in others. It is now becoming popular in places with water at depth but with a drying summer drought. It has a deep-rooting habit which allows it to reach stored winter moisture during dry summer months. It is coming into favour in some localities with less than 20 in. of rainfall but with deep sands or deep soils. In higher rainfall localities and in irrigation districts it needs to be leniently grazed and is often cut for hay through the spring and not grazed at all.

Subterranean Clover

Elsewhere, subterranean clover is the basis for permanent exotic pastures of good quality. This versatile clover flourishes with lower soil fertility than white clover will tolerate and with rainfall as low as 22 in. Its general northern limit is the 18 in. rainfall line, though it survives in places with averages down to as low as 14 in. or 15 in. When sown into pastures of native perennials (Danthonia spp. mainly), it tends to raise soil fertility to the point where superior exotic grasses may volunteer, but it needs to be introduced with top-dressing of superphosphate. "Sub and super" is the successful combination that is revolutionising the pasture history of much of southern Australia.

Perennial ryegrass grows with subterranean clover in rainfalls down to 22 in. and ryegrass (Lolium rigidum) or
Phalaris tuberosa, both of them grasses that tolerate dryer conditions than perennial ryegrass, may be sown with "sub". The buried seeds of subterranean clover will shoot in the spring and some will germinate also in autumn with quite small autumn rains, thus supplying a considerable amount of feed through the winter. Maximum growth occurs in spring but there are different strains suited to varying spring rainfall and temperatures. Varieties are; early-flowering, mid-seasonal and late. Dwalganup and Yarloop are especially early and Bacchus Marsh is another early type. Mt. Barker is the main type sold and is mid-seasonal in its flowering. Tallarook is a late-maturing type for cool localities with medium rainfall, but it loses the general advantage which subterranean clover has, that is its early spring growth. The early strains tend to produce less leafy fodder than the others, and so are useful only where rainfall is low and near the drier limits for pasture improvement.

Grasses Grown with Subterranean Clover

In localities with rainfall below 25 in. and where perennial ryegrass may not grow strongly, Phalaris (P. tuberosa) is often an excellent complement to subterranean clover. It is a hardy, drought-resistant perennial grass, best suited to rainfalls of 25 in. down to 20 in. because in composite pastures under higher rainfalls the other perennials will smother it. Although hard to establish, it provides a large
bulk of feed, of a coarse type. Pastures of moderate carrying capacity and having annual species as their basis are usually founded on subterranean clover. It is often complemented by the annual Wimmera ryegrass (Lolium rigidum) which flourishes with rainfalls lower than 20 in. and seems to have spread even into areas with as little as 12 in. annual average. Although they are annuals, these species are self-regenerating. Subterranean clover buries its seeds or places them on the surface. These provide high-protein feed for fossicking sheep or dry cows through the summer, long after the plant has died in the summer drought. The combination of subterranean clover and Wimmera ryegrass is most commonly found on the southern edge of the wheat belt where there is occasional cultivation, or where there has been cultivation in the past. This is because Wimmera ryegrass is stimulated by cultivation and this also makes it objectionable in land about to be cropped, because it revives with fallowing and uses up the moisture which fallowing is intended to conserve. Many wheat farmers regard it as a weed.

Other Winter Annuals

In localities with environmental conditions somewhat similar to those just described, other annual clovers have often been long-established without deliberate introduction, and are frequently described as "native clovers". Such legumes as cluster clover (Trifolium glomeratum), suckling
clover or "Trefoil" (T. dubium), gin gin clover (T. cernuum), woolly clover (T. tomentosum), striated clover (T. striatum) and hop clover (T. procumbens).

These have spread into habitats with medium rainfall, and have been growing for as long as 40 or 50 years in some localities in the southern part of the wheat belt. The main sown medick is Barrel Medick (M. tribuloides) first recorded in Victoria 50 years ago, but not really noticed much until it spread naturally into parts of the Mallee and Wimmera in the 1920s, probably from South Australia.

Pastures Map

An attempt to show the geographical spread of pastures is made on Map 9. To some extent it is derived from Pasture Map of Australia, 1935. But this map is in part, one of natural vegetation. Map 9 owes something also, to the map Pastures of Australia, by C.S. Christian and C.M. Donald, but their map is rather one of zones of pasture associations, whereas the map presented here attempts to show the pastures actually likely to be present on the ground. In this feature, the map has more in common with a map, "Land Utilization" in the Regional Boundaries Atlas, but

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3 Division of Plant Industry, C.S.I.R., 1934 (Canberra, 1935)
4 Division of Plant Industry, C.S.I.R.O., in The Australian Environment, (Ed., C.S.I.R.O.), 1950, Fig. 26
5 Fig. 26, Govt. Printer (Melbourne 1945)
the categories used there (Cropland, Forest Reserve, degree of intensity of grazing and pasture improvement) are rather different in type.

The intention of Map 9 is to get as close as possible to showing what the actual pastures are like in any part of Victoria. There is some limited information in the agricultural statistics which is useful to this end. The area under pastures is returned annually and in the return is classified as "native" or "sown". These terms are capable of widely different interpretations. One of the most obvious difficulties is that the judgement of the pasture, its classification, is left to the individual farmer and the interpretation is likely to vary greatly from farm to farm. Another problem is that many exotic grasses and some trefoils and clovers are regarded as "natural" in the sense that they have been prevalent for some decades and were not originally sown; but this does not really make them "native".

On the other hand "native" pastures are usually considered to be those in which the native perennials (esp. Danthonia) are dominant. It seems likely that in the more favourable climates and environments, pastures which are not well improved or consist of poor exotic species may be returned as "native" rather than "sown"; whereas in localities where pasture improvement is more difficult it seems likely
that Danthonia pastures may be returned as "sown", where they have been top-dressed and subterranean clover has been broadcast or has appeared strongly.

### Sown Pasture Distribution

Map 121 shows the distribution of the area returned as sown pasture in 1950-51. Altogether 7,142,000 acres were returned as under sown grasses, clover or lucerne, and almost three times as great an area - 20,591,000 acres - as "other cleared ground - pasture". Elsewhere in the Year Book statistics this category is described as native pasture.

There is a concentration of sown pasture on the southern edge of the Western District extending in an arc from Colac through Hamilton to Edenhope. There is another concentration east and west of Ballarat in the Central Highlands. There is a smaller area in Gippsland, more evenly spread than in the Western District, but with a concentration in the Strzeleckis, at Warragul, and little sown pasture in East Gippsland. The other main locations of sown pasture are in the valleys of the North-East and in the northern irrigation districts.

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6 Victorian Year Book, 1950-51, p. 69
A useful supplement to the map of sown pastures, is that of pasture topdressed. This is shown on Map 122. Almost all of the topdressing used is superphosphate. The total area of pastures topdressed in 1950-51 was 7,185,000 acres, almost the same as that of sown pastures. At first this suggests that they are the same item. To a considerable extent this must be the case. Phosphorus deficiency is so nearly universal that most of the area of reasonable pastures should be topdressed annually.

However, a comparison of the maps shows that the topdressed area is not as concentrated and localised as that of sown pastures and especially that there is more topdressing in the Northeast and it is more evenly spread there than sown pastures. Again, in the Western District, the topdressed area is not as large nor as concentrated in particular localities, as are sown pastures. Clearly in the Northeast and in the southern Wimmera there is a considerable acreage returned as native pastures but receiving topdressing. Equally there are sown pastures in the south which are not topdressed annually. In fact many are known to be untreated for two years out of three. Moreover one of the commonest methods of pasture improvement is to spread superphosphate on native pastures to encourage whatever clovers are already present.
An important question emerging from this is - what proportion of sown pastures is topdressed in any one year? In N.S.W. this figure is available and in 1955/56 and 1956/57 the proportion was about one-third. It has been suggested that this indicates an average interval of three years between fertiliser applications to sown pasture. The proportion is probably higher in Victoria, because paspalum pastures are dominant in parts of N.S.W., and their treatment is different from that given to clover-ryegrass pastures in Victoria.

Altogether, these points suggest that the maps need to be used with a very definite conception of the limitations of the information on which they are based, but they can be useful in verifying the distribution of pasture types, shown on Map 9.

Areas of Permanent Exotic Pastures; Perennial Species

The permanent exotic pastures of perennial grasses and clovers are to be found in Gippsland, the southern part of the Western District, parts of the Central Highlands, the river valleys of the Northeast and the Northern Irrigation Districts. At their best, as around Yarram or Warragul or Warrnambool, they are completely sown-down in white clover and perennial ryegrass, regularly top-dressed and with a high carrying capacity of, say, 2 cows to 3 acres.

Cocksfoot is often present with white clover and ryegrass and is also spread over much of the wider area that is not first-class perennial pasture but is permanent and productive. These latter areas contain cocksfoot, some ryegrass perhaps red clover, subterranean clover or birdsfoot trefoil, with couch grass, Yorkshire fog and other grasses of lower fertility. In the milder climates of East Gippsland and the NorthEast, paspalum (P. dilatatum) is common and in northern irrigation districts there is some P. distichum also. Even into rainfalls as low as 25 in. there are pastures of mainly ryegrass and subterranean clover, which can be considered good perennial pastures.

**Exotic Perennial Pastures, interspersed with Danthonia grassland**

There are larger parts of southern Victoria where perennial pastures have been developed only on patches of better soils or by the more progressive farmers in a district; this irregular development leaves portions unimproved between the improved patches. For instance, around Apsley in the far western part of the Western District, with a rainfall of 23 in. and a podzolised soil of low natural fertility, pasture improvement with "sub and super" began more than 20 years ago. Today there are pastures of either subterranean clover and perennial ryegrass with some H.1. ryegrass (perennial for a few years), or of "sub" and Phalaris. North and east of Apsley there are still many farms unimproved, with
pastures of Danthonia and other indigenous perennial species.

Similarly, patchy improvement is found along the whole extent of the Western District from Apsley to Lake Corangamite. Soldier settlement subdivisions are mainly improved and are often located between larger holdings which are not improved.

**Danthonia Grassland**

There are some districts which lack any pasture improvement so that the native species, mainly of Danthonia, make up a tussock grassland. This native association is undoubtedly greatly modified from its indigenous condition, and often lacks the tussock form. Pasture improvement may have been held up by poor soils, or the country may be too rugged or have too severe a climate. In the Omeo Valley in East Gippsland, both climate and topography militate against improvement, while in Southeast Gippsland it is the poverty of the coastal sandy podzols which prevent it. The rugged country between the main parts of the Central and Western Highlands is another and this type of grassland also extends right out on to the northern plains along the valley of the Loddon. Here the soils have poor physical structure and have deteriorated further in this respect under cropping. The rainfall is also too low for real improvement. The rain-shadow of the Werribee Plains west of Melbourne is another locality with rainfall too low for real improvement.
Permanent Exotic pastures, annual self-regenerating species; interspersed with Danthonia grassland.

These pastures have subterranean clover as their main constituent, associated with a wide range of annual grasses. Much of it is "sub" with Danthonia, where pasture improvement has not proceeded far.

Permanent pastures of annual self-regenerating species are found where physical conditions are too harsh for the perennial grasses and clovers to flourish. Low soil fertility, but, even more, extended summer drought, and low total rainfall, are the adverse conditions that characterize these localities. Because pasture improvement is patchy and because of broken terrain, these improved areas are interspersed with Danthonia grassland. Some parts of the northern irrigation districts are an exception to this, but in other localities, even irrigated land is partly covered with native perennials, mixed with exotic, winter annuals.

The largest areas of permanent pastures of annuals are on the northern slopes of the Highlands and the southern edge of the plains of the Wimmera and the NorthEast. In these localities, more than others, the present state of the pastures must be regarded as part of a transition not only because a large proportion of the area is still unimproved, but also because only with time will it be clear whether improved pastures will last; and also whether the farming
system will maintain them as permanent pastures, or will plough them under periodically to raise crops.

The main constituent of the permanent exotic pastures of annuals is subterranean clover, associated with a wide range of possible grasses. The grasses are annuals usually, but they are annuals with a self-regenerating habit which ensures their continuance. Wimmera ryegrass is the most important sown species of this sort. Others sometimes sown are Italian ryegrass (Lolium Multiflorum), or H. l. ryegrass which will persist for a time where perennial ryegrass will not survive.

More common are the volunteer annuals, especially barley grass (Hordeum murinum), but also hairgrass (Vulpis herdonensis), brome grasses (Bromus spp.) and Poa (P. annua). In the absence of subterranean clover, either because of low rainfall or insufficient encouragement many of the annual clovers or trefoils, especially burr clover (M. denticulata) and cluster clover (Trifolium glomeratum), snail clover (M. scutellata), and perhaps black medick (Medicago Lupulina) will be present. They are encouraged by topdressing.

Temporary rotation Pastures with cereal or other cash crops

Temporary pastures deliberately sown in rotation with crops do not cover large areas. They are located only where
there is a considerable acreage of annual crops, in environments favourable to easily-established and productive pasture. The pasture is then part of an established crop rotation. Map 123 shows the distribution of the area under all types of crops. The winter cereals are very prominent in the north and areas elsewhere are small.

There are only three or four localities where pastures are sown after crops as a major part of the district farming practice. East and west of Ballarat a considerable acreage is occupied by potatoes which may be preceded and followed by temporary pastures. The pasture species are mainly high-quality perennials providing grazing and hay, and they are grown in varying rotations which may include cereals for hay (mainly oaten) or grazing, or grain (oats especially), or flax and green fodder crops, with some period under fallow.

The rotation is thus one in which the cash crop, potatoes, alternates with crops or pasture grown as animal fodder. Apart from potatoes, practically all farming effort is directed towards feeding animals and good-quality pastures meet much of this need. They are supplemented in winter by hay, and in spring and summer by grazing fodder crops. Where natural soil fertility is high, the rotation tends to be short, so that the pastures have a short life. On the other hand both oaten hay and chaff production are now declining, so that pastures are coming to occupy more of the rotation period.
Perennial ryegrass seed is an important crop.

At Rutherglen in the Northeast the annual rainfall is 22 in. on the average, and the growing season is eight months with some winter check. Here a distinctive system of pasture-crop rotation has been developed. It is a long rotation of perhaps eight years with up to five years under a sown pasture of annual grasses and clovers - mainly subterranean clover and Wimmera ryegrass. This is followed by perhaps three years under cereals with no preceding winter fallow. This system is very localised because there are practically no other environments with the combination of a good rainfall (22 in.) and a long, dry, ripening period.

At Wickliffe (21 in.), in the Western District, conditions are approximately the same but with a cooler summer and a shorter summer drought period. Here a limited amount of ley-farming is undertaken, with perhaps 2 years of cereals, followed by sowing down of subterranean clover and perhaps Phalaris.

The climate of the south-western Wimmera is much like that of Rutherglen but cropping seems to be undertaken mainly as part of the process of pasture improvement, and the farming system has not yet become stabilised and recognisable as a ley-farming one. Many farms have only recently been created by sub-division of larger stations. Elsewhere, between
Horsham and Edenhope, although the climate might have been expected to encourage ley-farming, both soils and topography are obstacles to improvement beyond the stage of extensive grazing.

Modified forms of pasture-cereal rotations are appearing in the wheat belt, especially on its southern edge where there is higher rainfall. The western Wimmera, from Dimboola to the South Australian border is one such area, but it is quite possible that the long-term effect of pasture improvement here will be a decline in cropping and that the subterranean clover pastures once sown, will not be taken up, unless they need renovation. These improved practices are not yet so widespread in any other district, that it could be described as mainly engaged in ley-farming.

Exotic Winter Annuals as volunteers on cropland, interspersed with induced indigenous pasture with exotic annuals

The pastures of most of the Wimmera, Mallee and northern plains have come into being following three main developments. The clearing of Mallee scrub from much of the country has made way for crops and pastures. Then the farming methods have evolved slowly, especially in establishing the length of rotation, and finally, introduced grasses and weeds have spread through the countryside. However, not all the clear land, or cleared land, is cultivable.
The non-arable land carries indigenous tussock grassland, either established before European arrival or induced since by clearing and grazing. The grasses are those found further south but not including poa tussock. Kangaroo grass (Themeda australia), Wallaby grasses (Danthonia spp.), Windmill grasses (Chloris spp.) and Spear grasses (Stipa spp.), all perennial, were the most prominent grasses in the indigenous tussock. The Kangaroo and Windmill grasses have tended to become eaten out, probably because they remain green well into the summer. A number of exotic winter annuals, more common on cropped land, also appear now amongst the tussocks.

The other type of pasture is mainly composed of these annuals. After the grain harvest, Mallee paddocks are left with the stubble standing and sheep are turned in to nibble it and to pick up dropped grain. In the following Autumn a variety of Mediterranean annuals germinates: Barley grass (Hordeum leporinum), brome (Bromus spp.) brome fescue (Vulpia spp.), long storksbill (Erodium botrys), Arabian grass (Schismus barbatus) and especially the hardy Wimmera ryegrass (Lolium rigidum). In the southern parts some of the annual medicks reappear on idle cropping land. Burr medick (Medicago denticulata) and black medick (M. lupulina) usually called native trefoils, are found even well into the Mallee and Wimmera ryegrass volunteers after cropping, even as far north as Ouyen.
It is questionable whether these volunteers should be described as pasture. Supplies of phosphorus which remain after cropping encourage more vigorous growth, but such growth usually dries off early in summer, supplying very little fodder through the summer drought. Even then some paddocks may look a little green, but close inspection shows that this is due to ephemeral weeds which grow after the summer rain showers.

Sheep are often turned onto fallows because their trampling and hunger will help to keep down weeds. Pasture then, for the Mallee at least, signifies a haphazard, poor-quality element compared with the sown pastures further south.

Alpine shrub and grassland

This grassland type provides as little grazing as that of the Mallee. It occupies only a small area of mountain landscape in the Eastern Highlands of Victoria; the so-called High Plains - undulating plateaux surfaces at about 5,000 feet. There are three main localities - the Dargo High Plains, at the head of the Mitchell River - the Bogong High Plains, at the head of the Kiewa and Ovens Rivers, and the Upper Murray-Kosciusko High Plains. The shrubs provide little grazing, the main pasture plant being tussock grass (Poa caespitosa) with some wheat grasses (Agropyrum spp.) and
Bent grass (Agrostis venusta). The tussocks provide green shoots in spring and some summer grazing, but with the severe weather in autumn, stock are taken to lower ground.

The Importance of Pasture in farming

Taking a comprehensive view of land under pasture one finds that half the area of Victoria - 27.7 million acres of a total land area of 56.2 million acres - is in pasture. From Map 9 it would seem that much more than half the area should be in pasture. This makes no allowance for 6 million acres cultivated, nor for the land attached to holdings but unproductive; the latter is almost 4 million acres (3.8m.)\(^8\). Some of this possibly provides some grazing, as when cattle are turned into the bush in summer. At one time many of the beef cattle in eastern and southern localities were bred and reared in leased bush runs, and burning was periodically practiced to clear the runs. It seems probable that little of this scanty grazing is returned as pasture.

A quarter of the pasture area - 7 million acres - is sown pasture; three-quarters is native. A quarter of the pasture area, which is approximately one eighth of the total area, is topdressed in any one year, and this category is increasing much more rapidly than "sown pasture". At a glance one would be entitled to assume that pastures and livestock are

\(^8\) See Table 6, Ch. 4.
the most important items in farming. Not only is this so, but an understanding of the causes of the regional variation of pastures implies a simultaneous grasp of the basic geography of the Victorian environment.

B. WATER SUPPLIES & IRRIGATION

With an environment as dry as that described, it will be clear that the size and location of water resources will have been important influences on the type of farming in any locality. The main features of the location and size of surface water resources can be inferred from the climate and topography of the state. The major source of water is the high rainfall area of the Eastern Highlands, while it is only here and in the Southern Uplands, that the ratio of run-off to rainfall is at all high. The main river system is that of the Murray, and its tributaries are next after it in size. The estimated flow of the larger rivers is set out in Table I.\(^1\)

**Flow of the Murray**

By comparison with the famous rivers of the world, even the Murray is not outstanding. Its average annual flow is only 12 million acre feet, compared with say, 168 million for the Indus – and the Indus is less than half the size of the Ganges. Losses due to irrigation, ponding and diversions reduce the

\(^1\) Appendix 3, Table I.
Murray to a flow of only 8 million acre feet on the average, where it passes into South Australia.

One other notable feature of the Murray, is that once it debouches on to the inland plains at Albury, its fall is very gradual. From there to the South Australian border it falls only 400 ft. in more than 500 miles of flow. For this reason it forms anabranches quite readily and swamps and backwaters are common. From the South Australian border it travels another 600 miles to the sea but falls only a further 100 ft. Flooding along the Murray is thus slow but sure, below its highland section. The floods can be predicted and prepared for even if not prevented.

Southern and Western Rivers

All the rivers draining to the south are small except the Snowy, which rises in New South Wales and flows for only a short distance through Victoria in East Gippsland. It averages more than 1½ million acre feet per annum, while the next largest on the southern side of the Divide, the Latrobe and Yarra, are less than 750,000 acre feet. These south-flowing rivers reach their maximum in winter or spring, whereas the Murray, supplied more from snow, has a spring maximum. The area of snowfields in the Murray headwaters can be very large, but the depth of the snow is not great compared with the snowfields of higher mountains, such as the European Alps,
Western Rivers

The western half of the state has few rivers, and they are mostly small. The Barwon, flowing from the Otways and the Glenelg draining the western side of the Western Highlands are the largest of them. The Glenelg averages only about 100,000 acre feet in its headwaters where the Rocklands Dam is located, but increases to nearly 600,000 acre feet by the time it reaches the sea. The northwestern part of Victoria is also poorly supplied with rivers for although the Wimmera River flows north from the Grampians, it empties into salt lakes and in dry years hardly reaches them.

The Avon and Avoca, further east do not reach the Murray either, but empty into ephemeral lakes in the middle of the Mallee. The Loddon and Campaspe are capable of reaching the main river, but their water resources, like those of all the northern rivers are closely controlled and in any cases they are small. Their significance lies more in their being adjacent to some of the main goldfields and having been developed early.

Goulburn River

The Goulburn is the biggest of the Murray's tributaries, at 21 million acre feet, is partly snow-fed and reaches its peak in spring. The Ovens, King, Kiewa, and Mitta Mitta Rivers,
all make considerable contributions to the Murray, though none is as large as the Goulburn. A spring peak is common in these rivers also.

Variability of Flow

As with rainfall, so with water flow, there is a fairly considerable annual variation. In the western part of the state the margin between precipitation and evaporation is low, and there is little water to run off. In the Eastern Highlands the run-off is much larger but subject to very great variations. The yearly flow of the Murray has been as large as 23½ million acre feet, that is double its average—while its minimum has been as little as 1.5 million acre feet. The Goulburn, its biggest tributary in Victoria, has been as large as 6.2 million acre feet, but fell to 500,000 acre feet in the drought of 1914.

With such large variations in flow as these and with so much dry country, it is clear that the long-term aim of water conservation projects must be to store the flows of good years for use in the dryer ones. This means very large storage structures; there are few sites suitable for great storages. The stage of developing perennial carry-overs had been reached in 1951, and the large dams to do this were being planned or built.

It follows from the unfavourable features of the water
resources, that they have been more expensive to store and distribute than those of many other countries. Only the fact that water is the long-term limiting factor in Australian development has led to so much effort being expended on such a poor and unreliable resource. Even so, Victoria has given more attention to its water resources than dryer and hotter states. Other states either lack water, as in South Australia or Western Australia, or face even higher costs in storage and distribution. Victoria is the most irrigated state.

Water Storages and Capacity

The basic information about storages is set out in Table 2 in Appendix 3 giving the capacities as they were in 1951. The largest storage is the Hume Reservoir, on the Murray, but only half of this is to be used by Victoria. Victoria and New South Wales share the waters of the upper part of the Murray, but a set amount must be allowed to flow over into South Australia, not so much for irrigation use there, as to keep the waters near the mouth of the river, from becoming saline. In case of drought, the three states confer through the medium of the River Murray Commission, an inter-state body, with a Commonwealth chairman. The main purpose of the weirs lower down the Murray is not storage, but diversion; there are a dozen or so of them from Yarrawonga to the border. The capacity of water storages on the Goulburn amounts to almost as much as Victoria's half-share of the Murray storages.
The Wimmera-Mallee system is quite large, but the individual storages are quite small. It is the multiplicity of storages, set up on all the small streams, that emphasises how urgent it has been to conserve the small water surplus of the Grampians. Glenmaggie in East Gippsland is in a locality where water is fairly plentiful and irrigation not as vital as in the other irrigated areas. The remainder are either the small southern ones which are mainly for town supply, or those of the Central Highlands tapping the rivers which flow north from Ballarat and inland from Bendigo. Some of these are town systems also.

Large works which were to alter the whole picture of water conservation, were being planned in 1951. (Some are listed at the lower part of Table 2.) Rocklands Reservoir in the Wimmera-Mallee system, is interesting in that it is the first actual case of a coastal river being turned inland to make up for the water deficiencies of the interior. It was also to be of such a size that it would take a number of years to fill, but be able to supply water to the north through droughts. Its planned capacity of 272,000 acre feet is two and a half times the annual flow of the Glenelg at that point.

**Water Delivered & Area Irrigated**

Table 3 shows the water delivered in and around irrigation districts and the area irrigated. It shows the general character and importance of different districts. The Goulburn
and Murray systems are the two large ones. Although these water deliveries include domestic and stock water this inclusion does not alter the emphasis of the figures. Domestic and stock consumption is very small, the largest for the systems shown being nearly 8,000 acre feet in the Rodney-Deakin portion of the Goulburn system. The important supplies from the Wimmera-Mallee system for stock and domestic supply are not shown here. But in 1950-51 the amount released from headworks to flow through the Wimmera-Mallee system amounted to only 65,000 acre feet, while even of this, 90% would be lost by seepage and evaporation before it arrived on the farm or in town storages.

Intensity of Use of Water in Districts

The figures of Table 3 also hide a good deal of local variation, which may be hinted at by one or two of the differences shown. In the third column showing the ratio of water delivered to areas irrigated, there is some indication of the possible intensity of use of water. For example in the Dingee-Loddon irrigation localities the water is clearly spread rather thinly over the area irrigated, and one would expect to find that horticulture was not important. The Mildura-Robinvale settlements appear quite differently in that they use almost 3 acre feet to every acre irrigated. The intensity of use is high, and tree crops would be expected.
Area Irrigated for Different Products

Table 4 shows the areas irrigated for different products, and some attempt is also made to indicate the water requirements of different products under the conditions in the main irrigation areas. There can never be agreement on such a subject as this, because the requirement will vary with climate and soil type, and these will vary with location. Also the theoretical need may be exceeded in practice, or some crops may be given only what can be spared. This is particularly likely to be the case with cereals and fallow, which are often irrigated only in a transitional phase in the development of a farm or in the change from dry-farming to irrigation.

Water Requirement Compared with Practice

A comparison of Tables 3 and 4 raises one or two questions. For instance, the Mildura area is shown as using approximately 3 acre feet per acre irrigated. The theoretical requirement of vines is given as $2 - 2\frac{1}{2}$ ac. ft. per acre, while for orchards it is only 2 ac. ft. per acre. It is true that citrus require more than this, but most of the citrus grown in Victoria is located outside S.R. & W.S. Commission localities. Rather, the explanation for the high use of water seems to be in the methods used; most irrigation experts agree, that farmers generally over-irrigate and in the porous Mallee soils this is even more the case than elsewhere.
From Table 4 the main "crop" in the irrigation areas as a whole, is seen to be annual pastures. Almost a third of the total of 700,000 acres irrigated is in annual pasture; the other pasture types amount to 27% for perennial pasture, and 14% for native pastures. Over 70% of the irrigated lands of the state are under pasture, and if they are combined with other fodders, such as sorghum and lucerne the total comes to nearly 80%.

Livestock Farming Main Farming Type

Irrigation farming is not unlike the farming picture as a whole, in that its main emphasis is on pasture and livestock. This may be something of a surprise since the general impression is that irrigation is mainly used for fruit and vineyard production. Of course it is a little misleading to lay so much emphasis on pasture, because the intensity of use of water on native and annual pastures is low compared with that on fruits.

Value of Products in Irrigation Areas

Another way to approach the question is to compare the values of different types of production; this is done in Table E. Values for 1949-50 have been used to avoid the temporarily high prices for wool of 1950-51. Livestock products amounted to £12.5 million of a total value of production of £22.5 million - that is more than 50% of the total value came from livestock. Fruits account for a little less than 30%
and vegetables and miscellaneous products for another 10% each. Further, the trend is in the direction of increasing the importance of livestock, in the production from irrigated land.

**Map of Irrigation Districts**

Map No. 11 of Country Water Schemes, shows that a considerable total area lies within their boundaries; only a small part of this area actually receives irrigation water. The maps may well give a wrong impression in that many portions of the land surface within are not able to receive water, that is, they are not commanded. Some lie above all possible channels and some would be too expensive to serve, while others are so inferior in quality of soil and surface that irrigation would not be justified. Other parts again, have been included in an irrigation district even though there was not at first, enough water to serve the whole area. In the long run there might be, and so administrative arrangements have sometimes been made for this later expansion.

**Intensity of Water Use in Districts**

Map 13 attempts to show three different intensities of use of water within the irrigation districts. The heavy dots show areas in which a large amount of water is applied to small areas; the second intensity shows areas in which a moderate amount of water is applied to the land; the third category is left blank - where there is "dry" land within an
irrigation district. There is some correspondence between the intensity with which water is applied and types of farming. Orchards, vineyards, vegetables and dairying are mainly found where water is applied intensively; where supplies are only moderate, and annual pastures are therefore the main pasture, there may be some dairying, but generally sheep rearing with lamb fattening and fattening of other sheep or beef animals, will be the common type of farming.

Water Rights and Types of Farming

It is a general practice in the irrigation districts to describe the locality in terms of the water right. Thus one area will be called "one in one" another "one in four". This is not an exact guide to the amount of irrigation there is likely to be as there may be a large area not commandable, and so instead of every acre receiving 1 acre foot of water only a few favoured acres may get water. On the other hand in some places with say, 1 in 2 water rights there may be extra water available should the irrigator want it or if the year has been wet, on what is called a sales quota. So an area described as 1 in 2 might in practice have above 1 in 1. 1 in 1 is an intensive application though it will not be enough to water perennial pastures adequately on more than half the farm.

Location of Irrigation Areas

The map, No. 11 shows the general layout of the
Irrigation Districts and Domestic and Stock Supply areas. There are also some localities near them which are supplied with irrigation water by private groups and organisations, but the area involved and the water used, is not great.

A notable feature is the lack of irrigation development in the eastern part of the Murray Valley between Yarrawonga and the Hume Dam. This part of the country has a medium to high rainfall in any case, and so needs irrigation less than other parts, but also not a great deal of it is commandable from the river or even from the Hume Dam itself. The level of water in the Hume was 606' before its enlargement and will rise to 626' only, when the new structure is finished. Some land but not a great deal, lies far enough below this height to be watered.

To the west of Yarrawonga the nearest town in the irrigated land is Cobram, an irrigation settlement which was administered in the first stage of its development by an Irrigation Trust, one of the local bodies which controlled irrigation water before the beginnings of the S.R. & W.S.C. At first water was pumped from the Murray and used intensively on orchards and vegetable crops. This high intensity is still maintained around Cobram but the subsequent expansion of the District by using water from Yarrawonga has been on a less intensive basis. However, the holdings around Cobram have carried over their very high water rights from the Trust
days; they are still greater than 1 in 1. The surrounding land is receiving water on the basis of approximately 1 in 5. In the centre of this larger District (the name of the new district is the Murray Valley Irrigation Area) a block of land has been used for War Service Land Settlement. In this case original landholders were dispossessed and offered one of the smaller blocks of a new subdivision. In the surrounding country (most of it 1 in 4 or 1 in 5) they were not dispossessed. The W.S.L.S. area is on a 1 in 1 basis with a sales quota; on 450 of the new farms the type of farming is dairying and another 100 are fruit farms. A detailed soil survey was carried out before the settlement was made.

The M.V.I.A. was described in rather more detail than will be given for the other districts, to show how the interaction of historical factors and Government policies can influence the amount and distribution of water and the type of farming.

Goulburn Irrigation System

From Eildon Reservoir, water runs down the Goulburn River to the Weir at Nagambie whence it is either sent to the northeast along the Shepparton-Katandra Channel, or north to the Waranga Reservoir. Most of the water from the eastern branch is used intensively in raising fruit or vegetables around Shepparton or in growing perennial pastures for dairying further north. On the western side the land around Tatura,
Stanhope, Rochester and Lockington receives a great deal of water, but the rest of the area south of Echuca receives small supplies.

Development of Tongala-Stanhope District

This locality was one of the first to be developed by the S.R. & W.S. Commission after it had been set up in 1906 and had worked out a closer settlement policy. Estates were purchased and subdivided beginning with 1909, then allotted to small farmers some of whom were British migrants. Most of the irrigated area was planted with lucerne, the remainder of the farm being left in native grasses or sometimes cultivated to produce summer-growing fodder crops. Failures, especially amongst the migrants were common and the Commission was forced to re-organise the subdivisions, raising the average size of farm from the 50 to 60 acres which was the usual size at first to 100 to 120 acres which is a common size today. Drainage became increasingly necessary as water tables rose, and now it is commonly said that it costs as much to get surplus water off the area, as it costs to put water on. These extra expenses were unforeseen and have raised the overall cost of irrigation. Improved pastures species appeared in thinning stands of lucerne, in the 'thirties'. Farmers began topdressing with superphosphate and later sowing

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2 L. Molnar, "Dairy Farming under Irrigation", Quarterly Review of Agricultural Economics, July, 1950, p. 119
these improved species. Productivity per cow increased from
den on, the area of lucerne declined and instead of growing
summer fodder crops, the farmers conserved grass hay. They
had made lucerne hay in earlier times and sometimes added to
income by selling it, and had also given agistment to animals
from the Riverina during drought years. Rather than supply
agistment the usual modern practice is to sell grass hay,
the amount made having gone up sharply in the last ten years,
following the introduction of the pick-up baler. The history
of Tongala-Stanhope illustrates some of the problems of early
irrigation development, even where it was promoted and
planned by a large public authority. Further west there are
examples of other types of development, due at first mainly
to individual action and presenting more problems.

Loddon Plains and Torumbarry System

From Waranga a large channel goes on to Dingee across
a considerable space of dry land, and then to the plains
around the course of the Loddon. Some goes further west
again as far as Birchip, 230 miles from the Waranga Reservoir,
to supplement the Grampians water in the Wimmera-Mallee
domestic and stock water supply. Water is not supplied in
large volume to the great stretches of plains around
Pyramid Hill, though in the early days of irrigation develop­
ment a great deal of water was diverted from the Loddon in
favourable years, and spread with no care over very large
stretches of flat country. The result was a raising of
water tables with salting at the surface, and deterioration of large acreages of good grazing land. Some of this land is still in the same poor state 50 years later. The locality is a good example of the misdirected efforts of some of the early groups of irrigators, who handled water with no knowledge and skill as if it were a bonus which would return extra growth and production by merely turning it onto the land.

The area around Pyramid Hill is very lightly supplied with water today, but north of the Macorna Channel from Torumbarry Weir, water is used intensively again. Channels run from here as far as Swan Hill. Just south of Swan Hill is a narrow island in the river surrounded by the Murray and its distributary, the Little Murray, and controlled by a group of private irrigators. Other lands nearby are also commanded by private systems.

Beyond Swan Hill along the Murray, the settlements all get their water by pumping from ponds held back behind weirs. Because of the cost of pumping, the water is more expensive to reticulate, than it is with ordinary diversion, and the crops need to be of high value per acre to help offset higher costs of water.

Southern Victoria; Irrigation Areas

South of the Divide there are less than 50,000 acres
under irrigation and the main part of this is supplied by the Glenmaggie Reservoir in Gippsland, in a dairying locality around Maffra and Heyfield. This irrigation area is in a mild rain-shadow formed by the Southern Uplands of south Gippsland and the Eastern Highlands to the north. There is one other similar rain-shadow in southern Victoria, that is the area of low rainfall to the west of Melbourne, where there is another small irrigation system watering small areas at Bacchus Marsh and Werribee. There is also a good deal of irrigation in the southern and eastern suburbs of Melbourne, where despite the high cost of water from the metropolitan system, it is used on market gardens and nurseries.

The Costs and Benefits of Irrigation

It would be difficult to assess the costs and benefits of irrigation. Since 1937 the state has decided to bear practically the whole cost of rural water-supply and irrigation works, and it then transferred the amounts owing "from the water users to the general taxpayers of the state". Irrigation is viewed like other non-profit making activities of the state, as a service which benefits the community at large. This should not mean that no attempt is made to establish whether any one project is really worth proceeding with, but it does mean that ordinary accounting is not used.

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3 L.R. East, Chairman of S.R.W.S. Commission, Ch. 9, Introducing Victoria, p. 116
Value of Produce from Irrigation Districts

Of the total value of agricultural and pastoral production, a little more than a tenth is produced from land supplied with irrigation. The total value of farm products in 1949-50 (chosen to avoid the high wool prices of 1950-51) was £178,738,000, and the S.R. & W.S.C. estimate for the value of production from irrigated land, was £22,500,000, or 12.5%. Of course only a portion of this is due to the extra value of water, but undoubtedly much of it would not have been produced without water having been available.

Underground Water Resources

Ground water has not been used a great deal in Victoria, partly because there are so many places where it does not exist, or is of poor quality and unreliable. The early habit was to catch rain water for domestic use, and to use creeks and pools for stock. Ponding water by digging dams, came later, mainly for stock supply. Large parts of the Mallee were left unoccupied last century because of a lack of surface water supplies and in most of this country there are no supplies of ground water and either no artesian water or it is of poor quality.

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4 Caution is needed with these figures (as with so many) because it is very difficult to disentangle dry land production from that of irrigated land: Appendix 3, Table 5
5 Victorian Year Book, 1949-50, pp. 505-506
Nevertheless in other parts ground water and artesian water have been undeservedly neglected, and this is only just being realized. In the Mallee, from Underbool west to the border is an area supplied by bores, and further south from Nhill west to Bordertown, there are bores with water in sufficient quantity and quality for small areas of irrigated pastures on many farms. The charting of underground supplies has really only begun. It will bring to light new supplies, not so much in the dry lands of the north, as in the south and west.

Irrigated Pastures and Soils

Irrigation creates its own climate. In the dry parts of the country which are usually hot also, it makes growth possible where it would otherwise not take place. For this reason, and because of the importance of livestock production with irrigation, there are some special aspects of irrigation and animal fodder, which need to be outlined.

For instance, some grasses and clovers which would not be found under high rainfall in perennial pastures, are found in irrigated perennial pastures. The best examples are probably the summer-growing grasses, which often would not be found in perennial pastures outside the irrigation districts because they flourish with hot summers which do not occur where perennial pastures are grown. Rhodes grass
(Chloris gayana) is an example, or Kikuyu (Pennisetum Clandestinum) and the fact that paspalum (P. dilatatum) is important here more than in other localities, is due to the combination of water and high summer temperatures.

Again, the summer forage crops cannot be grown in many other parts of the state, but with irrigation they become possible; Maize, Japanese millet and sorghums are usual. Even the "native" pasture is different when irrigated, because the summer grasses become so much more prominent; for example, Windmill grass (Chloris truncata). Lucerne even though its position is changing so much, is still more common in irrigation districts than under "dry" conditions. It has even received a longer lease of life in irrigation practice, because the W.S.L.S. farms have been planted with a certain area of lucerne each, before being handed over to the farmer.

Much more important though, than the differences between the pastures of irrigated and dry land, is the other problem of changes in irrigated land itself, due to the regular addition of water. Some authorities lean towards the view that irrigation is such a drastic alteration in natural events that it must be expected to have some unfortunate results in the long run. Others view the process as being a continuing and dynamic one, in which the land is slowly changing, and yet may not deteriorate drastically
if the irrigation is only moderate and is carefully controlled.

"Salting" which has been referred to above, is the most serious deterioration that has occurred with irrigation in Victoria. It can happen in any locality, and not necessarily under irrigation, but it is not common in the wetter parts of the state. This latter feature is related to the accumulation of salt in the subsoil over centuries in the dryer localities. "The climate is wet enough to wash most of the salt down to three or four feet, but not wet enough to wash it right out of the profile." 6

16 in. or 17 in. of rainfall is probably the critical amount in northern Victoria, to judge from the fact that "salting" has occurred in the western part of the Goulburn system but not in the central and eastern parts.

Following irrigation the water table is raised, and the ground water may have a high enough percentage of salt in it, to kill plants such as dillon bush or samphire to grow. Much land has been lost to ordinary production in this way, and although it can be reclaimed in all probability, it is not certain that the effort is always likely to be worth it.

G.W. Leeper, Introduction, p. 172
Other ways in which irrigation affects its environment are, in the tendency of some soils to become less capable of absorbing water. This is possibly a progressive, and probably an irreversible, process. It may be that clay particles are washed to a lower layer in some soils. A great deal of hydrological investigation under some irrigation areas – especially 1 in 1 areas – is in progress, and it is tending to show how much water affects not only the immediate area of application, but also the surroundings.

Another problem of irrigated areas is that of disease where animals are carried at an unusual intensity. For example, the limit of carrying capacity of sheep and lambs on good pastures of perennial type, in the northern irrigation areas is well below the feeding capacity of the pasture. Experiments carried out at Werribee seem to show that even when care is taken to keep sheep and lambs healthy they do not gain weight as they should, considering the food available. In fact lambs cannot be fattened as well on irrigated pasture as they can on dry land with less fodder. The maximum stocking rate is probably below 8 sheep to the acre in the irrigation areas, but it is quite possible to carry the equivalent of this in cattle – 1 cow to the acre – without disease problems.
It seems likely that the irrigation areas are in climates which favour disease amongst heavily stocked sheep. It is probable that it is therefore uneconomic to use the best irrigated pasture for sheep, just as it seems to be uneconomic to use the best perennial pastures, without irrigation, for sheep. 7

C. AGRICULTURALLY UNUSED LAND

A considerable part of Victoria is not used for farming and it is important to establish which parts these are, the type of use if any, and the reasons for the non-agricultural character of such localities. It is, of course, difficult to draw a line between the used and the unused.

An attempt to draw this line is shown on Map 10 where the black areas are intended to delimit those parts of the state which are mainly non-agricultural. The boundaries of unused land should in many cases be regarded as temporary, since the boundary between used and unused is a reflection of a dynamic process, and consequently swings to and from a good deal, at least in local detail. Of course the cores of at least the main blocks are stable. The simplest way to meet the points raised in the opening sentence of this section is to discuss the blank areas singly.

7 Most of these points were made by experts attending the School on Irrigated Pastures and Fodder Crops, Victoria, November, 1954, and are difficult to document.
Along the western border of the Mallee and Wimmera, are five or six main blank spaces on the map from south to north. The three largest of these - those to the north - correspond to the soil type described as Sand without Profile. It is an almost worthless white sand which carries a very poor cover of Mallee and other hardy scrub. It is not capable of supporting crops, like the Mallee soil nearby, and in the north rainfall is really too low, even if soil conditions made cropping possible. The most northerly portion, on the banks of the Murray, does not appear to have this edaphic handicap, but it is only very sparsely used as yet, that is for grazing, because it has not proved economic to clear the land, fence it, and supply water.

Similarly the cost of development probably deters the use of the scrub-covered country in the great bend of the Murray, between Swan Hill and Mildura. Here again the cost of clearing is matched with low rainfall and low prospective grazing capacity. This is not the case further to the south. In the neighbourhood of the western Wimmera the rainfall is 15 in. or more in what is known as the "Big Desert", and 17-18 in. in what is called the "Little Desert". Not only is rainfall sufficient for some types of improved pastures, but it is also more reliable than equal amounts falling in other parts of Victoria. Similar
types of land occurring just over the border in South Australia have been brought into production in recent years.

Why is it that the Victorian counterpart has not been similarly improved? It is possible that the ultimate reason is an historical one, in the sense that the development of land resources in South Australia has proceeded under pressure of a somewhat higher ratio of population to resources. Whether for this reason or not, the main discoveries of the role of trace element deficiencies were made in the so-called Ninety Mile Desert of South Australia, a tract of heath, covering sand. The treatment needed by such land to bring it to production was still expensive, in spite of the remedial discovery, and only individuals or organisations with considerable capital could be expected to undertake it.

The South Australian portion is, in any case more attractive than the Victorian part, because it is closer to the coast and therefore has higher and more reliable rainfall. However, the largest body undertaking development, the Australian Mutual Provident Society, leased 500,000 acres in South Australia and followed this with a later lease of

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1 By 1870 the limits of sound agricultural expansion had been reached in South Australia with known techniques of cropping, whereas expansion continued in Victoria for another 30 years. Much of the Victorian development was carried through by emigrants from South Australia and, since that time the ties with South Australia have tended to be stronger than might otherwise have been the case.
240,000 acres in Victoria. Since 1949 it has cleared and improved more than 100,000 acres of scrub land near Keith and Bordertown in South Australia. In a report on its activities the Society stated in 1957 that it undertook the project to,

"create an outlet for investable funds ..." "at a time when satisfactory investments were relatively difficult to secure." But, "The urgent need for the Society to establish outlets for its investable funds has passed with the change in economic conditions during the past six years."²

This could be interpreted as saying that the more usual investments for an insurance company were likely to return more, and that the Society was reverting to these forms of investment.

Other private persons have done something to clear and farm this country also, since the trace element deficiency has been discovered, but so far the "Big Desert" and the "Little Desert" on the Victorian side have been left untouched. When the profitability of the South Australian areas is clearly established, and when investors are attracted by the profits of land development, a change may occur on the Victorian side also. Alternatively the State Government may take a hand with a deliberate policy of fostering development in this part of Victoria, but there are no signs of this at present. The handicaps of the Victorian parts are that rain-

fall is not as favourable as in the neighbouring portions of South Australia, and that in all of this type of country, even with correction of its various mineral deficiencies, the settler is still farming a poor sand with its obvious handicaps of low levels of mineral wealth and poor water-holding characteristics.

**Swamps in the Southwest**

The uncleared localities further south along the border of the two states have been affected by the same sorts of general considerations. Here there are large stretches of podzolised sands, some of them constantly wet in the subsoil, others actually closer to the form of swamps, and some although receiving quite good rainfalls, liable to dry out quickly. The problems of the undeveloped southern portions, then are those of balancing the rewards from clearing country with good rainfall, against the costs of clearing and farming poor sandy soils with either too much water or too little. It is not possible to verify this point without more detailed soil information than is available.

The soil map simply shows these uncleared areas as having "podzolised soils" and the geological map shows areas of "marine sedimentary rocks and continental deposits". Actually more detail would distinguish along the border, alluvium, sands, gravels, clays and dune-limestones of Recent and Pleistocene age. This does not really help with the
problems concerning the locality, because there is both cleared and uncleared land on each type of surface.

There is a reference to the locality under discussion in a study of sheep farming; it is described as "low land sloping gently to the west and south-west. It is generally poorly drained and has many swamps". Vegetation associations of different types "alternate with heathy moors and swamps". "The soils generally are of a podzolic type, a typical profile showing 3 in. of grey sandy loam overlying 15 in. of light grey loamy sand with some buckshot accumulation in the last 2 in. Below this again is a yellowish grey heavy clay". A large portion of this western area was "excluded from the survey since sheep are not important there". Poor drainage, swampy conditions, the expense of clearing substantial vegetative cover to bring poor land into production; these three can be advanced as the reasons for the lack of development on the western border.

As to the vegetation, the authors of the Sheep Survey, describe it as "extensive woodlands of messmate, Baxter's stringybark (E. baxteri), manna gum, and occasional stands of red gum, usually associated with "yacca" (Xanthorrhoea spp.) These alternate with heathy moors and swamps". This is one locality where the present outlines are changing, even if slowly, and more land may be cleared over the next decade or two.

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P.S. Lang, N.M. Tulloh, B.V. Fennessy, Survey of the Sheep Industry in the Western District of Victoria, School of Agriculture, University of Melbourne (Melbourne, 1952), p. 9.
Western Highlands

The Western Highlands as a whole are unused only in their steeper and higher parts. The Grampians are mainly unused, but the Dundas Highlands have been largely cleared, except around Mt. Dundas (1,600 feet) itself. The Grampians are exceptionally steep and would not support more than small numbers of stock on poor native grasses. Accelerated erosion would be bound to follow attempts to clear some of the slopes. They need to be preserved under their original cover because of this high erosion risk, and because they are the source of much of the water used in the Wimmera-Mallee stock supply scheme. North of the Grampians there are some swamps and timbered stretches along the Wimmera River.

Central Highlands

In the Central Highlands there are very many patches of uncleared land. On the northern edge of the highlands they mark the trend of high ground in a northeasterly direction at about the 700-800 feet contour. This line of timbered patches is also a geological divide, between the Recent unconsolidated material of the plains and the Ordovician slates or the granites of the highlands. Except in the granite country around Charlton it is also the divide between the red-brown earths and the podzolised soils of the uplands. In the Central Highlands there is a number of prominences of between 2,000 and 3,000 feet, and the more rugged of these have usually been left uncleared. A close inspection shows that
the uncleared areas are more often Ordovician slates or granite than basalt. The Ordovician has a special reputation for soil poverty (and the Siulurian is thought of in the same way), though of course this is a very broad generalisation, while the granite makes up more than its share of peaks.

Not all the undeveloped portions are rugged, nor elevated, but they are poor in soil characteristics. Indeed, so is much of the cleared land. Undoubtedly much land cleared and grazed today is as poor as other parts left undeveloped. Because the Central Highlands were also the main goldfields of the state, once gold began to decline the land received greater attention than it might otherwise have done and much poor country was brought into use which might have been ignored still, had it been located elsewhere.

Of the land still uncleared some is now forest reserve, and there are even some small areas of exotic softwoods. A description of the Ordovician hills in the Survey of the Western District Sheep Industry, confirms some of these statements. "The main geological formations are of Ordovician, sedimentary and metamorphic material ... The hilly portions are separated by plains or undulating country derived from alluvial deposits ... The hills are still largely timbered but extensive clearing has occurred on the alluvial plains." 4

4 Ibid, p. 10
Again in a discussion of pasture improvement in different parts of the Western District, the Survey authors make this comment on the Ordovician hills ... "In this zone the general standard of improved pastures was poor, and subterranean clover was only rarely observed to make growth comparable with that in other zones."

Silurian outcrops are much the same as the Ordovician and also often remain uncleared. There is a low range of hills south of Waranga Reservoir which is like this.

**Jurassic Hills or Southern Uplands**

The Otway Ranges, still largely forested are the most southerly part of the Western District. They should be compared with the other Jurassic hills in the Southern Uplands. These are the Strzeleckis in the western part of Gippsland, and the Southeast Gippsland Hills to the east of them. The Strzeleckis are almost entirely cleared and used, the other two are mainly unused. Attempts have been made to farm parts of both the Otways and Southeast Gippsland Hills. Even the diagrammatic representation on the map shows that narrow clearings have been driven through both. A comparison of this map and the map of Topography shows that some of the clearings are on the ridges rather than the lower parts of the hills. A further point is that the Strzeleckis are lower than the others, and (perhaps partly in consequence) it seems true to say that their slopes are normally gentler.

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5 Ibid, p. 57
In the Otways the main ridge is partly cleared and it is the steep slopes, dropping down from over 2,000 feet in some places, that are uncleared. The Strzeleckis attain their highest point in one scarp reaching 1,600 feet, overlooking the Gainsborough flats, but for most of their length they do not exceed 1,000 feet. The Southeast Gippsland Hills also reach 2,000 feet in peaks in the northern end of the ranges, and because both slopes and valley-heads are so steep, most of the roads are forced to follow the ridges. Again the slopes are much steeper than in the Strzeleckis and even those that have been cleared have tended to revert to bracken and second growth.

In other factors which might be expected to have some bearing on the extent of occupation each of these ranges is found to be similar. Natural vegetation, for example is given as a mixture of temperate rain forest and wet sclerophyll forest in each of the three. All have rainfalls above 40 in. over most of their area. Their geological history and types of rocks are strikingly similar.

The details of their historical geography differ somewhat, in that the Strzeleckis, lying close to Melbourne, were opened up before the others and also because of their easier relief were penetrated by railways before the Otways - at the end of last century instead of early in this one. The Southeast Gippsland Hills were never penetrated by
railways, although they were partly served by lines to the north and south. Again it was probably the more intense relief that kept railways out.

Unused Lowlands in the South

This discussion of the Jurassic hills should be separated from that of neighbouring localities which at first sight might be confused with them. It is worth noting that the hills are higher in fertility than is usual in the podzolised zone of southern Australia, but that they have alongside them some of the poorest country in Victoria. East and west of the Otways there are Tertiary sands, clays and limestones, and to the north, low-lying Recent Material of the same sort. On the west this land has been shown to have trace element deficiencies which have held it back. The soil is probably mainly responsible for the backwardness of the other areas. They are mainly on poor podzolised sands, whether to the west of the Otways in the Heytesbury Forest, northwest of the Strzeleckis in the neighbourhood of Nyora, southeast of the Strzeleckis around Wonthaggi and from there to the heath-covered country east of Inverloch.

The contrast between the poor sands and the occasional alluvial flats that occur on the rivers draining them is brought out by Leeper in this comment:
Thus, Tarwin River in South Gippsland and Carlisle River in the Western District drain the poorest of sandy podzolic country, yet their alluvial flats carry first-class dairy pastures.... Many similar contrasts of alternating podzolic country and alluvial soils occur in the far east of Gippsland and along the east coast of Australia.  

Almost everywhere the sandy podzolic soils are only just beginning to be brought into use, or are still neglected. This is the case on the east side of the Southeast Gippsland Hills also, where the sandy coastal strip is either uncleared or carries poor native pasture. South of Lake Wellington this poverty is exacerbated by swampy and saline conditions, and on the coast between Bairnsdale and Orbost, one of the most complex sets of mineral deficiencies which could be envisaged is being found in the soils of the "grass-tree" areas. Other soils from Orbost to the border are probably poor sandy types also, but it is not so much the soils themselves as the dense, although not valuable, forest cover which they support (mostly consisting of banksia and messmate) which impedes clearing. The Orbost flats are an island in the midst of uncleared forest, an island of high quality alluvial soil.

Eastern Highlands

The largest area of unused country is the Eastern High-lands. Because it is also the most elevated and most extensive highland it seems unremarkable that so much of it should be unused. However, there are some further points. Elevation

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G.W. Leeper, *Introduction to Soil Science*, p. 25
alone does not explain the fact that in the south the lower edge of the unused land begins at heights of not much more than 1,000 feet, and in some places even lower. By contrast, in the Central Highlands a large area of land above this height has been brought into production.

In the Eastern Highlands the lower country receives a higher rainfall on the average than its counterpart in the centre. Thus in the Central Highlands the isohyet of 25 in. outlines the 1,200 feet contour, whereas in the Eastern Highlands it is the 30 in. isohyet that lies along this contour, or even the 40 in. isohyet on the northern side.

Undoubtedly part of the reason for this greater rainfall is simply that the highlands of the east are much higher in any case, but important in the question of utilization and rainfall is the fact that the slopes rise steeply from 600 feet to 2,100 feet and even higher in places. Such slopes are too steep to use under the prevailing rainfall and with poor or thin soils. The valleys are also narrow, for the most part and difficult to enter. Many have no roads or tracks. There is a general difference here between the slopes and valleys of the northern side, and those of the south - the northern edge is in general easier.

There is a further area in East Gippsland, not too far away from the coast, which is also not used but is not as
elevated as the rest of the Eastern Highlands. Half of it is below 1,200 feet and there is some evidence from small settlements in odd places that parts are not too wet or too densely forested to prevent use. The crucial factor seems to be the poverty of the soil. Skene says of the soils of this area, occupying the lower mountain region on steep slopes.

The podzolic soils are shallow types, with rock close to the surface... for the most part, these soils are unsuitable for settlement... however, land has been taken up for grazing purposes in areas adjoining streams. Associated with these podzolic types are skeletal soils, pockets of alluvial soils along some of the streams, red loams derived principally from basalt, and terra rossas and rendzinas from limestone. Except the skeletal soils, these are of higher fertility than the podzolic soils and have been selected for occupation where accessible. The principal settlement is at Buchan where the soils are utilized for dairying and grazing stock.

For the Eastern Highlands as a whole, one must conclude that the main impediments are poor soils and thick forests on steep slopes, with much of the land surface so elevated as to be too cold for winter or even spring growth. Summer use is quite possible and it must be said that there is quite an amount of summer grazing in the Highlands. But its intensity is very low and it is probably decreasing in importance. The reasons for this probable decrease are many, but in general it is a case of a shift from an inefficient use of a low-grade resource to its preservation for other purposes. Better methods of farming are being substituted for the "bush

runs" which have been common in the valleys of the Northeast and in East Gippsland. Summer grazing on the Bogong High Plains is being reduced to help preserve them for hydro-electric water catchments. The periodic burning which is said to be needed in bush runs to clear them of undergrowth is usually forbidden nowadays in those times of the year when the bush would burn most easily.

In many ways then, the Eastern Highlands are becoming less used for farming, rather than more so, and it is probably in the interests of the community that this general trend should continue.

Other Unused Areas

Other areas not used for farming include lake surfaces varying from those of the Mallee and Wimmera to Lakes Corangamite and Colac in the Western District and the lakes of East Gippsland. Reservoirs, such as the Hume, Eildon and Waranga Reservoirs are another category, as are the built-up areas around Melbourne, Ballarat, Geelong and Bendigo. Reserves for forestry purposes or those for national parks are also included in the non-agricultural category; examples are Wilson's Promontory National Park, and the Wyperfield National Park in the western Mallee.
CHAPTER IV  HISTORY AND ECONOMY

A. HISTORICAL INFLUENCES

B. ECONOMY
CHAPTER IV  HISTORY AND ECONOMY

A. HISTORICAL INFLUENCES

Summary of Historical Influences on Farming

Only the briefest of historical outlines seems called for in a study of present-day type-of-farming areas. In fact, it is not possible to do more than summarise some of the influences which affected farming as it developed.

The earliest influences came from neighbouring states, mainly Tasmania and New South Wales. Graziers brought the first Merino flocks from these two states and carried over the fairly simple methods evolved there for looking after sheep. But the English background of many of these settlers was important, and England was also the source of most of the capital which flowed in for early development, as well as being the main wool market.

The discovery of gold in Victoria in the 'fifties led to a period of rapid growth with a very big expansion of trade and population, and when the value of gold production began to fall some of this increment was diverted to other farming and trading occupations.

South Australia was the source of most of the techniques used in growing cereals. Machines were invented there and later introduced into Victoria, and when the most
accessible wheat land in South Australia had been taken up, some of the next generation of farmers turned to similar land in Victoria, which had not yet been occupied. An era of railway building had begun in the 'fifties, and when these lines began to extend beyond the Central Highlands, a real expansion of wheat-growing in the Wimmera and later the Mallee, became possible. A wheat-fallow rotation with a long period of fallow to conserve moisture was almost universal in South Australia in the early years of wheat-growing and this was also the rule at first in Victoria. South Australians had also developed techniques for rolling and burning the Mallee scrub to develop wheat farms and these same methods were introduced into Victoria. The stripper and stump-jump plough were also great aids in settling Mallee land. In the long run it came to be recognised that there was an almost universal shortage of phosphorus in the soils of southern Australia, but until the practice of topdressing with superphosphate became widely adopted wheat yields tended downwards.

At first wheat farms were too small to carry many stock and sheep flocks on wheat farms were rare. But later when water supplies were improved and as farms were amalgamated to larger sizes, sheep became more and more common, and began to be integrated with wheat-growing.
At the end of the nineteenth century the introduction of refrigeration brought new markets for meat and dairy produce. Dairy farming expanded rapidly in the wetter parts of Victoria, and a good deal of the heavily forested part of the state was cleared at this time.

By this time too farming had become accustomed to the prospect of occasional bad droughts and bush fires, and some attempts were made to cope with the need for supplementary fodder in the autumn and winter. The main supplementary fodder was oaten hay, although most of this was used to support the large horse population. Dairy farmers commonly grew summer cereals as supplementary fodder for their cows, because the high quality pastures which have since supplanted crops were then a rarity.

The beginnings of irrigation owed a good deal to the example of California. The Chaffey Bros. brought ideas and techniques from there to Mildura and adjacent localities in South Australia. At first, the crops grown under irrigation were vines and citrus fruits and it was not until much later that irrigation was used for dairying and other livestock. Many mistakes were made in the early development of irrigation, both in the technique of applying the water and in the administrative arrangements for bringing water on to the land. A good deal of land was ruined in the process and most of the early irrigation authorities became badly indebted, until the state took them over. Thus a pattern of state activity
in irrigation was set up early in this century, and today private schemes are mostly very small in scale.

Government intervention in settlement dated from much earlier periods when various Acts of the Victorian Parliament set out the tenure and other conditions of land settlement. Just how influential Government actions were at any one time, it is difficult to estimate (and much beyond the scope of these brief notes) but intervention became more direct and decisive with the settlement of the dryer parts of the Mallee for wheat-growing and with Government irrigation and Closer Settlement schemes early in this century.

In the train of the First World War came a succession of similar settlements for returned soldiers. They were made in almost every line of rural production, from dried fruits production on irrigation farms at Mildura to dairying in parts of the Western District and the Northeast, wheat-growing on the dry northern edge of the Mallee and sheep-grazing in parts of the Western District. Many mistakes were made in the schemes: blocks were often too small, or the market prospects were overestimated, or environmental conditions were quite unsuitable for the type of production planned. Some settlers had later to be compensated and persuaded to leave. Some of the mistakes of this period led to the realisation that soil science was poorly developed, and the inter-war period saw a big improvement in this sphere. Allied to it was the
realisation that the pastures of southern Victoria needed topdressing with superphosphate if they were to attain their optimum growth. The importance of pasture management was then recognised, and the deliberate sowing of subterranean clover along with topdressing became the main technique of pasture improvement. Tractors were introduced in the wheat belt in the interwar period but this type of mechanisation was held up by the low prices of the depression of the 'thirties', and was not completed until after the Second World War. However a scheme for bulk-handling wheat in country silos was carried through in the earlier period. The inevitable decline of the horse which accompanied mechanisation on the farm, has freed a considerable acreage of land formerly used to produce horse fodder, or given over to the grazing of horses.

Britain was the main market for Victorian farm produce through most of its early development, but the increasing size of the home market should also be noted. The Australian population had always been remarkably concentrated in a few cities and towns, and Victoria was not an exception. A further aspect of this was the chronic labour shortage in the country and the continual adoption of labour-saving methods on farms. Another fact of importance was the tendency for the proportion of exports going to Britain to fall in the interwar period: although this tendency was halted by the Depression and by some of the measures which Australia took to cope with the
trade crisis of the 'thirties, it reappeared in the period following the Second World War. Another feature of rural development in the 'twenties, was the immigration of southern Europeans who settled mainly in the irrigated farming districts. Here by hard work and saving, they soon became established as independent landowners. There is a strong correlation between crops requiring intensive care and a heavy expenditure of labour, and the distribution of Macedonians, Albanians, Yugoslavs, Italians and Maltese in the country.

During the interwar period farmers became highly organised, both through associations centred on one or two products, and through specific political parties set up to sustain country interests. As a result of this organisation and of the economic chaos of the Depression years, marketing schemes came into being for many farm products. Most of them have come to involve some form of public support for commodity prices, either in the form of outright subsidy, or by high internal prices in Australia. To some extent the farmers are now protected from the world market, or feel its effects only after they have had some support from the taxpayer.

At the same time, Government-sponsored research is doing more than ever to eliminate problems of animal breeding and disease, and to determine the most favourable soil treatments and farm rotations. The mechanisation of hay-making
has led to a big switch from oaten hay to meadow hay, and to an increase in the total amount of fodder conserved, and this change is certain to go further as pasture improvement itself expands. At the same time, animal numbers have reached record heights and consequently a much bigger fodder reserve is needed now, than when stock numbers were lower.

Throughout the century of growth of Victorian farming there has been a bias in production towards the livestock side of the rural industries, due to the relative ease with which livestock can be supported in southern Australia compared with most other world farming regions. This has meant that under the general level of world prices of livestock products compared with crops, livestock have usually been more rewarding. Pasture improvement has reinforced this tendency and there are few countries in which pastures have received so much attention with so successful an outcome. The most recent phase of farm improvement has certainly seen big increases in the yield per acre of most crops, but the increase in productivity of pastures continues more steadily and certainly.

Victorian agriculture, in common with that of much of southern Australia has entered a phase of consolidation, or intensification as Wadham called it,\(^1\) and it is in this phase that the study takes up its geographical features for examination.

B. ECONOMY

The role of different branches in the general pattern of farming may be assessed in various ways; for instance by area used, or by numbers employed, but economically speaking, value of production is a more significant measure. Each of these measures will be treated in the following which is an analysis of the information available on the farming economy and landscape, but the starting point will be the number of farms in the state.

Problems of Assessing the Number of Farms

When the annual agricultural census is taken, a return is required from any holding of an acre or more which is used for agricultural or pastoral purposes: this latter is not the same thing as a farm. Because the lower limit to the area of a holding is as small as an acre, it is inevitable that it should include many small plots which have little productive value and are not much use for grazing. On the other hand if the area limit were raised this would exclude some intensive production from nurseries and commercial flower gardens. Another difficulty is that in the cases where one part of farm is geographically divided from the main part, both pieces will be entered as separate land-holdings for the purpose of the census, even though they may be operated together as one farm.
Another development of some importance in confusing the returns is connected with income tax. Nowadays, to lighten the tax imposed on the income accruing from a single farm, it is often legally split into two or more entities and because farmers associate one branch of government with another, the legal fiction created for tax purposes, is often continued for the Statist's returns. The incidence of income tax is not so heavy for a property thus nominally split, as it is for an undivided one.

Number of Holdings

The number of holdings counted in the returns in 1951 was 69,698, and of these a proportion could be expected to be either "split" holdings, or else pieces of land not used much for production.1 A count of farms employing one male or more (either owner-operator or wage-earner), was made in 1954, and those without any permanent labour (owner-occupier or employee) on them were considered "part-time" holdings, not contributing significantly to production.2 The count is shown in the following figures: the total number of holdings in 1954 was little different from 1951.

1 All the figures used in this section are from the Victorian Year Book, unless otherwise indicated.
2 From manuscript figures supplied to the author by R.M. Boeree, of the Bureau of Agricultural Economics, Canberra, A.C.T.
If the ratio of farms with permanent labour to total holdings was much the same in 1951 as in 1954, then the number of farms with permanent labour in 1951 would have been almost 59,000 (58,990). That is, there would have been approximately 10,000 holdings which did not produce much. Map 220 shows the numbers of such farms in the various counties and Map 204 shows the percentage that these "part-time" holdings make up/all holdings. The number is absolutely large only in the central part of the state, both around Melbourne, and in the hills to the north such as those in the counties of Talbot and Bendigo. In the cases of Melbourne and Bendigo it can be readily appreciated that the growth of a large city leads to subdivision in its periphery, so that a considerable area of land at any one time is in the half-way state between farm land and built-up land. Hence the considerable number of holdings without permanent workers in the four counties of the Central District. In the Central Highlands the explanation is probably related rather to the history of the goldfields. The subdivision of this land is likely to have proceeded further than that of other
districts, simply because it was near the gold mines, and as well, many former gold miners retired on small plots, which they obtained by taking out miners rights over them. The social corollary is that today the goldfields areas have a larger proportion of old people – and especially old men – in their populations than have other districts.  

The opposite feature, that is the low numbers in the plains of the north and of the Western District, is explained by the impracticability of part-time farming where holdings need to be large on account of poverty of soil, or lack of rainfall. Towns, which usually encourage residential, part-time farming, are also lacking in the Mallee, and to some extent in the other parts of the northern plains. It is true that there is a number of towns in the irrigation district of the north, but irrigation does not encourage part-time farming; nor does the S.R.W.S. Commission. Part-time labour to assist irrigation farming is of course common, but is a different matter from part-time farming.

Map 204: Percentage of Farms without Permanent Labour

The map shows the information dealt with above, but in percentage terms. Again the proportions are high around Melbourne, but also in the Central Highlands and in the far

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southwest. The proportion is low in some densely settled localities such as those with dairy farming in Gippsland, and is low also, in localities without concentrated farming, such as in the Western District grazing counties. The proportion is not low in the Wimmera and East Gippsland, but reference to Map 20 shows that the absolute number is not high in these counties, considering their area.

**Numbers of Farms of Different Types**

Information about the numbers of farms of different types is not available directly, but it is possible to make some estimates. The table below lists some indirect measures with the years to which the figures belong:

<table>
<thead>
<tr>
<th>Type</th>
<th>Year</th>
<th>Nos. of Holdings, Herds or Flocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dairy Herds</td>
<td>1951</td>
<td>22,139 herds &gt; 9 cows</td>
</tr>
<tr>
<td>Sheep Flocks</td>
<td>1948</td>
<td>23,930 flocks &gt; 100 sheep</td>
</tr>
<tr>
<td>Wheat Holdings</td>
<td>1951</td>
<td>11,203 wheat holdings &gt; 20 acres</td>
</tr>
</tbody>
</table>

In the case of poultry, in 1950-51 there were more than 6,500 people owning more than 150 fowls each, and so eligible to vote in elections to the Egg Board of Victoria. The following shows the number of holdings growing other crops in 1950-51.
Holdings Growing Minor Crops; 1950-51

<table>
<thead>
<tr>
<th>Crop</th>
<th>No. of Holdings</th>
<th>Crop</th>
<th>No. of Holdings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potatoes</td>
<td>5,174</td>
<td>Flax &amp; linseed</td>
<td>297</td>
</tr>
<tr>
<td>Onions</td>
<td>652</td>
<td>Maize for Grain</td>
<td>293</td>
</tr>
<tr>
<td>Other vegetables</td>
<td>3,430</td>
<td>Green Fodder</td>
<td>1,668</td>
</tr>
<tr>
<td>Orchards</td>
<td>5,541</td>
<td>Flower &amp; nursery crops</td>
<td>N.A.</td>
</tr>
<tr>
<td>Vineyards</td>
<td>2,467</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The number of beekeepers in 1950-51, was given as 1,562. Potatoes are grown on about a quarter of the numbers of holdings carrying livestock. The numbers of holdings with dairy cattle appear to be about 23,000 and about the same number have sheep. Holdings with wheat number about 11,000 and most of those also carry sheep. Most holdings with potatoes have dairy cattle as well.

Employment in Farming

There are two sources of information on the farm labour force. The periodical censuses of the Commonwealth, and the annual agricultural census at the state level. Of these the latter is more generally useful, since it gives a good idea of trends, but it does not give information on type-of-farming, which is the main preoccupation here. Some summaries of the figures of the two post-war population censuses are given below:
<table>
<thead>
<tr>
<th>Type of Farming</th>
<th>1947</th>
<th>1954</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agriculture, Mixed Farming</td>
<td>56,863</td>
<td>49,659</td>
</tr>
<tr>
<td>Other</td>
<td>4,151</td>
<td></td>
</tr>
<tr>
<td>Grazing</td>
<td>14,764</td>
<td>21,358</td>
</tr>
<tr>
<td>Dairying</td>
<td>30,511</td>
<td>31,932</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>106,289</strong></td>
<td><strong>102,949</strong></td>
</tr>
</tbody>
</table>

There is little that can be firmly deduced from these figures. The allocation of individuals to types is fairly arbitrary, often done by inspection, and not necessarily from any definite typing by the individual himself. It is most unlikely that the numbers working in sheep farming and beef cattle grazing would have risen so sharply in 7 years in a period when total rural employment was declining. Some of the difference is due to there being no category of "other" in the 1954 figures, which meant that all the work force had to be given a class.

The annual estimates of farm labour from state sources, consistently show a lower figure. This is understandable. Collecting from the farm end, means that all casual and seasonal workers are excluded. But in the general population there are many workers whose occupation is casual and seasonal work, the type of work they do, varying as they move about.

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The state figures miss these employees. Trends are not of great interest in this study, but the state figures are given over a few years to allow a comparison with the Commonwealth censuses.

**Males Permanently Engaged on Rural Holdings**

**Commonwealth Census: Total Farm Workers**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Farm Workers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1947</td>
<td>106,289</td>
</tr>
<tr>
<td>1954</td>
<td>102,943</td>
</tr>
</tbody>
</table>

**State Figures**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>92,533</td>
<td>92,178</td>
<td>88,728</td>
<td>86,943</td>
<td>87,917</td>
<td>88,663</td>
<td>91,376</td>
<td>92,388</td>
</tr>
</tbody>
</table>

Source: See Footnote 4, and Vic. Yr. Bks.

The labour force is shown as stationary in both sets of figures. Temporary employees total about 16,000 persons in March each year.

**Stated Industry of Persons Employed in Farming**

*Victoria, Census, 1947*

<table>
<thead>
<tr>
<th>Type of Farming</th>
<th>No. of Persons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farming</td>
<td>8,504</td>
</tr>
<tr>
<td>Mixed Farming</td>
<td>25,140</td>
</tr>
<tr>
<td>Wheat Growing</td>
<td>5,889</td>
</tr>
<tr>
<td>Fruit Growing</td>
<td>6,920</td>
</tr>
<tr>
<td>Grape Growing</td>
<td>719</td>
</tr>
<tr>
<td>Vegetable Growing</td>
<td>2,830</td>
</tr>
<tr>
<td>Market Gardening</td>
<td>3,695</td>
</tr>
<tr>
<td>Flower and Nursery</td>
<td>1,166</td>
</tr>
<tr>
<td>Horticulture</td>
<td>741</td>
</tr>
<tr>
<td>Grazing</td>
<td>14,764</td>
</tr>
<tr>
<td>Dairying</td>
<td>30,511</td>
</tr>
<tr>
<td>Pig Farming</td>
<td>207</td>
</tr>
<tr>
<td>Poultry Farming</td>
<td>2,978</td>
</tr>
<tr>
<td>Bee Keeping</td>
<td>419</td>
</tr>
<tr>
<td>Other</td>
<td>1,806</td>
</tr>
<tr>
<td>Total</td>
<td>106,289</td>
</tr>
</tbody>
</table>

---

5 Unpublished figures kindly supplied by the Commonwealth Bureau of Census & Statistics, Canberra.
Obviously many of these categories overlap each other and might be distributed amongst the others in some cases. The general categories of "farming", "mixed farming" and "other", might be distributed amongst the remainder. In general the totals for each type are below the probable numbers employed in that type of farming.

Some comparisons can be made between these figures and those (given above) for herds, for flocks, and for holdings growing different types of crops.

11,000 holdings grew wheat, but only 6,000 persons gave wheat-growing as their industry. Some of the difference would be accounted for by persons in "mixed farming" and "farming". There were 24,000 flocks of sheep but only 15,000 employed in "grazing". Again redistribution would be part of the explanation, plus the elimination of some of the small flocks, which would be run in with other enterprises. It may be safe to assume that the number of sheep farms lies between 10,000 and 20,000, allowing for wheat/sheep farms. The number of farms on which wheat is a major source of income, may be higher than 6,000 and close to 11,000. Perhaps these two main types might account for 25,000 out of the total of 59,000 to 60,000 full-time farms and in that case 35,000 remain to be accounted for.

Dairying is clearly most important and probably numbers more farms than the wheat/sheep type. There are 22,000 herds
of more than 9 cows, and although some of the smaller herds are not a full-time task, it would be safe to assume that perhaps 20,000 of them would be full-time enterprises, with a labour force of above 30,000, that is, almost a third of farming employment. There are 5,200 holdings growing potatoes and potatoes are probably an important source of income on perhaps 4,000 farms.

Onions are probably not important on more than 400 or so, and on most farms with onions and potatoes, dairying is almost certainly quite important in addition to the other enterprises. Farms which are mainly orchards or vineyards probably number 5,000 or more, but some orchards are to be found on farms which derive a good deal of income from livestock, especially poultry and dairy cows. Poultry farms may number from 2,000 to 4,000, and such intensive farms as market gardens and nurseries, may number as many as 4,000 or more.

The rural labour force, some casual, but mainly permanent, is about 100,000 - a little less than two workers per full-time farm.

**Value of Production of Farm Products**

Value of production, with employment, is a good measure of the economic importance of different branches of farming. It may be given in three forms:
a. Gross value of production; the wholesale price realised in the principal markets.6 Principal markets are the places where primary products are absorbed locally or where they become raw materials for a secondary industry.

b. Value at the place of production: is gross value minus marketing cost. Marketing costs include freight, carriage, brokerage, commission, insurance, and containers.

c. Net value of production is the figure most useful for comparisons between industries, but gross value of production may be more significant for broad comparisons. Some products cost a great deal more than others to produce and market but fetch the same in the market place. Unfortunately figures of net value of production for every rural product in detail, are not available. The following table shows the figures for larger groups (there are some small discrepancies due to rounding):

<table>
<thead>
<tr>
<th>Industry</th>
<th>Value at Place of Production</th>
<th>Cost of Production</th>
<th>Net Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>£million</td>
<td>£mill.</td>
<td>£mill.</td>
</tr>
<tr>
<td>Agriculture</td>
<td>64.5</td>
<td>9.6</td>
<td>53.4</td>
</tr>
<tr>
<td>Pastoral</td>
<td>78.0</td>
<td>2.8</td>
<td>75.2</td>
</tr>
<tr>
<td>Dairying</td>
<td>31.5</td>
<td>4.4</td>
<td>27.1</td>
</tr>
<tr>
<td>Poultry &amp; Bees</td>
<td>10.8</td>
<td>2.3</td>
<td>8.5</td>
</tr>
<tr>
<td>All Farming</td>
<td>184.8</td>
<td>19.1</td>
<td>164.2</td>
</tr>
</tbody>
</table>

Victorian Year Book, 1950-51, pp. 407-409
The tables illustrate the much greater 'cost of production' element in the cropping section. The absolute figures also show the great fluctuations in value of pastoral products which occurred in the two years in question. Pastoral products more than doubled in value from 1950 to 1951. Volume of output was actually very little different. Wool for example totalled 179 million pounds weight in 1949/50 and only 8 million pounds more in the next year - 187 m. lbs.

The cost of producing £160 m. worth of pastoral products was only some £3m. in 1950/51, whereas crops worth £64 m. cost £11m. to produce.

The following table gives net production values in more detail:
### Value of production at Place of production

<table>
<thead>
<tr>
<th></th>
<th>1949/50</th>
<th>1950/51</th>
<th>Average</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep (Wool, mutton &amp; lamb)</td>
<td>65,259</td>
<td>143,285</td>
<td>104,273</td>
</tr>
<tr>
<td>Dairying (incl. 1/3 val. cattle slaughtered)</td>
<td>33,598</td>
<td>38,351</td>
<td>35,974</td>
</tr>
<tr>
<td>Grain (wheat, oats, barley)</td>
<td>39,977</td>
<td>35,999</td>
<td>37,988</td>
</tr>
<tr>
<td>Poultry</td>
<td>10,549</td>
<td>12,674</td>
<td>11,611</td>
</tr>
<tr>
<td>Beef (2/3 val. cattle)</td>
<td>10,028</td>
<td>14,722</td>
<td>12,375</td>
</tr>
<tr>
<td>Hay &amp; straw</td>
<td>6,686</td>
<td>8,295</td>
<td>7,490</td>
</tr>
<tr>
<td>Vegetables (other than potatoes &amp; onions)</td>
<td>4,140</td>
<td>6,086</td>
<td>5,113</td>
</tr>
<tr>
<td>Vineyards</td>
<td>4,053</td>
<td>3,930</td>
<td>3,991</td>
</tr>
<tr>
<td>Orchards</td>
<td>3,592</td>
<td>4,420</td>
<td>4,001</td>
</tr>
<tr>
<td>Pigs</td>
<td>2,967</td>
<td>3,359</td>
<td>3,163</td>
</tr>
<tr>
<td>Potatoes</td>
<td>2,849</td>
<td>3,169</td>
<td>3,009</td>
</tr>
<tr>
<td>Onions</td>
<td>480</td>
<td>504</td>
<td>492</td>
</tr>
<tr>
<td>Honey &amp; beeswax</td>
<td>236</td>
<td>269</td>
<td>252</td>
</tr>
<tr>
<td>Other crops</td>
<td>1,754</td>
<td>2,194</td>
<td>1,974</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>186,168</strong></td>
<td><strong>277,257</strong></td>
<td><strong>231,706</strong></td>
</tr>
</tbody>
</table>

(Small discrepancies due to rounding)

**Source:** Victorian Year Books

The categories used here are approximately arranged in the order of type-of-farming groups. The table thus gives some idea of the economic importance of different types of farming to the state.

Sheep farming is of overwhelming importance: taking the average of two years it amounts to 40% of all rural production. In more normal years it would be somewhat less.

Cereals and dairying are hard to separate; averages...
of £37 million over these years place them second equal. Cereals might be put ahead because the dairying figures include a Commonwealth subsidy of £3.1 m. in 1949-50, and one of £5.2 m. in the following year. On the other hand, pigs are worth over £3m. on the average, and mainly originate with dairying. However, this does not cover the average size of the subsidy to dairying. The cereals group does not include maize or millet but only the products of extensive grain-growing in the winter and spring in the semi-arid areas of the state. In any case, there is no doubt that sheep, cereals and dairying are the three leaders economically.

Beef cattle are more important than poultry, on the average, but were not so in 1949-50. However, beef should be placed ahead of poultry, as the trend of these figures is also the long-term trend - a decline of poultry-farming relative to beef. Hay and straw are common elements in many types of farming, but most commonly-occurring in sheep farming and dairying. Not a large share of hay and straw now comes from the cereal types of farming, but in the main they are used on the farm and the return to the farmer occurs later in terms of the production of meat or milk sold off the farm. The decline in horses has reduced the outside market for these items.

Market-gardening would rank after beef cattle grazing
with an average value much lower — £5m. Vineyards and orchards both produced an average of about £4m. in these years. Onions and potatoes are produced by a field-crop type of farming, and rank well down the economic scale; £2m. and £3m. respectively.

The "other crops" are those which are small items in one of the types of farming already dealt with, except perhaps, the case of flower and nursery products, which could be included along with market gardening.

Aspects of Area and Farming

To the student of the landscape the most directly relevant feature of the land surface, in the differentiation of farming is probably the surface areas devoted to different land uses.

In giving a summary of this picture, it is safe enough to use the figures for one year because acreage fluctuates less than values in general and certainly did not fluctuate greatly at the time of the study.

The following table is a summary of statistics relating to farm crops and animals.
Victoria, 1950-51. Numbers of Livestock,
Area of Main Crops

<table>
<thead>
<tr>
<th>Livestock, Number</th>
<th>Cereals &amp; Hay, Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sheep (&amp; lambs)</td>
<td>20,011,000 Wheat 2,735,000</td>
</tr>
<tr>
<td>Dairy cattle</td>
<td>1,489,000 Oats 527,000</td>
</tr>
<tr>
<td>Beef cattle</td>
<td>726,000 Barley 217,000</td>
</tr>
<tr>
<td>Pigs</td>
<td>237,000 Meadow Hay 261,000</td>
</tr>
<tr>
<td>Horses</td>
<td>186,000 Oaten Hay 219,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fruit-Bearing, Acres</th>
<th>Other Crops, Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vines</td>
<td>42,000 Potatoes 52,000</td>
</tr>
<tr>
<td>Citrus</td>
<td>5,600 Onions 4,100</td>
</tr>
<tr>
<td>Other Fruits</td>
<td>50,300 Other Vegetables 36,000</td>
</tr>
</tbody>
</table>

Source: Victorian Year Book, 1950-51, Pt.11

Amongst the livestock it is plain that sheep are not only more numerous than any other animal, but on any basis would be more important. Consider the ratio of 8 sheep to 1 cow, which will be used later to relate these different types of animals. The 20,000,000 sheep would reduce to 2,500,000 cow equivalents, compared with 2,100,000 total cattle, if both beef and dairy cattle are added together.

Of course there are other aspects to be considered. For example, these figures do not give any idea of the production of animals, but are merely a census of numbers.
of animals as at March 31st. There is no information on the numbers of animals bred and sold, and while this point does not affect greatly the valuation placed on dairy production it does affect that of sheep farming and beef cattle and pigs.

**Animal Turnover**

Of the 20 million sheep in 1951, approximately 8½ million were breeding ewes, mated in 1950/51 to produce lambs. With a lambing percentage of 82% about 7 million lambs would have survived to the marking stage a few weeks later. Of this 7 million about 2/5ths would have been fattened and slaughtered, and about 3,900,000 lambs would have been kept to be recorded in the census in March.

Beef cattle are usually fattened and sold earlier in the season than lambs, but since they take two or more years to fatten, they are included in the census at least once more before they finally leave the farm. On the other hand, one cannot quite equate dairy cattle figures with those of beef cattle, since the purpose of keeping the animals is so different. Pigs are very difficult, because the two crops of pigs per annum are both disposed of, before any count of them can be taken. One can only make assumptions from the number of possible or probable parents retained.
Crops

Amongst the crops, wheat covers the largest area; normally from 2½ to 3 million acres. Oats takes only one-fifth of this area on the average, and barley only about one-twelfth of the area of wheat. (Both of these lesser crops have increased greatly in area since 1945.) Meadow hay is cut from a larger area than oaten hay, and the tonnage produced is also much greater. The trend also favours an increase in meadow hay and a decline in cereal hay.

Of the fruits, vines are the most important areally, filling 40% of the total area of fruit, and eight times the area of citrus. Fruits other than citrus and vines, cover 50,300 acres. The areas of individual types of pome and stone fruits are not available, but to judge by numbers of trees, apples, peaches and pears are of first importance. Citrus orchards cover 5,600 acres.

The actual area under fruits is small, but they are hard to compare with other crops on any basis other than one of value of production. After the winter cereals, the most important "other" field crops are hay, and potatoes and onions. Potatoes equal non-citrus fruits in acreage, at just over 50,000 acres, but the area planted to onions is small at 4,100 acres. Vegetables of other types than onions and potatoes, occupy a relatively large area at 36,000 acres. A few of the minor crops and animals have not yet been accounted for.
One of the main distinctions that can be made in differentiating the varied parts of agriculture, is that between crops and animals. If one is studying the subject from the point of view of the actual area of the land surface used by crops and animals respectively, then an outstanding feature of the position in Victoria is that the total area under cultivation, including both crops and fallow, amounts to only a small part of the land area used for farming. The following table shows the main features:

**Land area and Land Use: Victoria, 1950-51**

<table>
<thead>
<tr>
<th>Land category</th>
<th>% land area</th>
<th>Percentage of occupied land</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alienated or part-alienated</td>
<td>32,764,000</td>
<td>66%</td>
</tr>
<tr>
<td>Crown Lands</td>
<td>23,481,000</td>
<td>34%</td>
</tr>
<tr>
<td><strong>Total area</strong></td>
<td><strong>56,245,000</strong></td>
<td><strong>100%</strong></td>
</tr>
<tr>
<td>Land occupied by agricultural holdings</td>
<td>38,108,000</td>
<td>100%</td>
</tr>
<tr>
<td>Land occupied but unproductive</td>
<td>3,869,000</td>
<td>10%</td>
</tr>
<tr>
<td>Pasture (&quot;sown &amp; native&quot;)</td>
<td>27,734,000</td>
<td>73%</td>
</tr>
<tr>
<td>Cultivated land (including hay)</td>
<td>6,504,000</td>
<td>17%</td>
</tr>
<tr>
<td>of which ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fallow</td>
<td>2,153,000</td>
<td>6%</td>
</tr>
<tr>
<td>crops</td>
<td>4,351,000</td>
<td>11%</td>
</tr>
</tbody>
</table>

The most important item in Victorian farming is grass, and if this comment seems trite, it should be remembered that there are countries in which the idea that pasture could
form the basis of the farming system would seem ridiculous. The United States is a good example.

In Victoria grass covers 40% of the state's surface, and 73% of the land occupied for farming. Cultivated land on the other hand (and this includes hay and fallow) covers only one-ninth of the total area, and only 17% of the occupied land.

Fallow is quite considerable in area, that is 6% of occupied land, and this is related to the particular technique of cultivating winter cereals which has been developed in Australia. Of the cropped area the winter cereals take up the greater part, ¾ of the cropped land is planted with them, that is about 3½ million acres. When the area of hay - more than ½ million acres - is added, there is only 215,000 acres in crops other than winter cereals and hay. This remaining 200,000 acres includes other field crops and fruits and vegetables.

Particularly noteworthy is the lack of fodder crops, and of cereals grown for harvesting and feeding after storage. This lack is related not only to the predominance of livestock in any case, but also to the fact that they can feed outdoors for the whole of the year, and do not need to be housed and fed indoors in the winter. Hay is supplementary feed, and it is used to carry animals over the
critical periods of the year, that is in the case of Victoria, the late summer and the winter. But the special role of hay, serves only to emphasise the important place of grass in the whole rural economy. The improvement of pastures and the availability of better machines, both now combine to reinforce the predominance of grass in hay-making.

Pastures and animals are the basis of the Victorian rural economy, and the winter cereals provide a lesser underpinning. The few intensive crops are of minor importance compared with the basic animal and cereal production.
PART 3

TYPES OF FARMING AND THE DISTRIBUTION

OF TYPE-OF-FARMING AREAS

CHAPTER V TYPES OF FARMING IN VICTORIA

A. STUDIES OF VICTORIAN AGRICULTURE

B. THE BASIS FOR DISTINGUISHING TYPES OF FARMING IN VICTORIA
CHAPTER V

A. STUDIES OF VICTORIAN AGRICULTURE

The discussion of the literature relating to agriculture in Victoria was postponed to this chapter from Chapter I, since it is germane to the subject of distinguishing types of farming for the study of Victoria. Most of the work done on farming in the state, has come from the Government Department of Agriculture and from the School of Agriculture of the University of Melbourne, and especially from its Professor; S.M. Wadham. Naturally enough the greater part of the Department's publication is advisory, and it is from the work done under Professor Wadham, that the more substantial studies (that is for the purposes of the work undertaken here) come.

Four of them lay a very substantial basis for any study of the state: they are, Country Towns of Victoria, Sunraysia, Survey of the Sheep Industry in the Western District, and Wheat Farms of Victoria. The first of

2 A.J. McIntyre, Sunraysia - A Social Survey of a Dried Fruits Area (M.U.P., 1946)
3 P.S. Lang, M.M. Tulloh, B.V. Fennessy, (School of Agriculture, University of Melbourne, 1952)
4 A.J. Holt, A Sociological Survey (School of Agriculture, University of Melbourne, 1947).
these, while concerned it is true with the milieu of the country people, is not specifically informative on farming as such. What it does is to point out that country towns below a certain size, were very poorly served with basic amenities and provided a rather backward environment, at least during the years of the 2nd World War, when the study was carried out. Sunraysia was a study of the group of settlements centred on Mildura, and depending on irrigation and vines for economic support. Both this and Holt's Wheat Farms, were also sociological in their main content, and provided a contrast in the conditions they disclosed. Sunraysia showed a group of farmers, moderately well provided for by Australian standards, who had maintained these standards through the Depression by special marketing arrangements and appeared stable and not readily threatened economically. Holt drew a picture of a farming group which had been diminishing for decades due to mistakes in the early period of settlement, and due also to the lack of attraction which the low prices for wheat and the rigorous life, had for the younger people of the wheat-farming population.

The Survey of the Sheep Industry of the Western District was begun in the early post-war years when it was feared that wool would quickly lose its market due to the advance of synthetic fibres, and was designed to study alternative uses of the land, as well as ways of reducing costs and increasing efficiency. However, these conditions never
came about and the survey recorded instead the practices and problems of this very important sheep-farming District.

Wadham's own writings cover a longer period, and more varied subjects, including a number of Royal Commissions and other enquiries which were countrywide in their scope, and his Land Utilization in Australia referred to above. On the historical side there is his "A Century of Agricultural Progress in Victoria" and "History of Victoria's Wheat Industry". More immediately relevant to the type of study undertaken in this thesis were two publications of the middle of the Depression. The Productivity of Victoria, and Intensity of Rural Production in Victoria, both showing the amount and location of some of the main items of rural production, and with comments which have absolute relevance today. The latter was perhaps the first attempt to put parish information on maps, although this scale of presentation has been used increasingly since, and is the basis of much of the information presented in this thesis.

6 S.M. Wadham, Chamber of Agriculture of Victoria, Yearbook, 1951.
7 S.M. Wadham, reprinted from "The Age" (about 1937).
Other unpublished surveys have been carried out by the Agriculture School, or by workers attached to it. A survey of Whittlesea Shire carried out in 1946, is unpublished except for a summary - The Whittlesea District. Another survey with which the School was indirectly associated was that of M. Rothberg, Victorian Dairy Farming, A Social Survey. Studies with a bias to soil science but usually with an agricultural aspect as well were also carried out by the School. Such included "Soil Studies in the Mt. Gellibrand Area," "A Survey of Soils and Land Utilization in the parishes of Koo-wee-rup and Koo-wee-rup East", and "Soil and Land Utilization Survey of the Country Around Berwick". A somewhat similar study is, "A Survey of portions of Counties Tambo, Croajingalong, and Auckland, in S.E. Australia". These are the main contributions from the Melbourne University School of Agriculture, but by no means the only ones.

9 Whittlesea Agricultural Society (printed, V.A. Reid, 548 Little Bourke St., Melbourne) undated, but prepared by A.J. McIntyre.

10 Unpublished thesis, University of N. Carolina, 1948, which Mr. Rothberg has kindly allowed me to use for the purpose of this work: See also Victorian Dairy farms, abstract of thesis by M. Rothberg, Aust. Jour. of Dairy Technology, April-June, 1949.


Turning to the Victorian Department of Agriculture, it would be very difficult to summarise adequately the tremendous amount of relevant information that they have produced. The record is to be found largely in the Journal of the Department, but there are separate publications, not all of which are reprints from the Journal. References will be made to these publications and to other studies, in the appropriate places in the remainder of the work.

It would seem to be most necessary to concentrate attention at this stage on two aspects of the work. One would be to single out those studies which are sources of information specifically on the location of different types of farming in Victoria, and the other, to consider the way in which the problem of distinguishing and assessing the different types of farming to be found in Victoria, has been faced by other workers. The latter will be dealt with mainly in the next section; the former can be summarised here.

Since 1948, there has appeared a series of publications dealing with the resources of various "regions" of the state. These reports were the outcome of a wartime and postwar decision to define regional subdivisions for planning future development on a regional basis. The first to appear was that on the Goulburn Region and others have followed over
the succeeding years. The format is similar but not identical: all have a section on land use and primary industry, and a set of large maps, showing land use over the region. The classifications used are again similar but not identical, and although the authors of some sections are anonymous, they have usually been prepared by the nearest advisory officer of the Department of Agriculture.

The maps of land use are so detailed that they are capable of being used to check the results of the study in this thesis, only in a general way. They have been particularly helpful in outlining the areas of non-agricultural land, as dealt with in Chapter III, above. Of course, for the southern and western parts of the state, other maps had to be used. The accounts of agriculture in the text of the surveys, are if anything too generalised for this strictly geographical and "place" study, because they have to deal briefly with the diversity of farming in a whole region. Nevertheless they have been used, along with the accounts of climate and soils, at appropriate places in this text.

Questions about the classification of types of farming, are raised by the classification used in the Regional Surveys,
and in some of the literature referred to above, and will be better dealt with in a separate section.

B. THE BASIS FOR DISTINGUISHING TYPES OF FARMING IN VICTORIA

In Chapter I it was suggested that it would be ideal in a type-of-farming study in Australia to adhere to certain basic ideas\(^1\). These were listed as:

1. an emphasis on enterprise structure of the farm before crop-livestock association;
2. approach through the individual farm, rather than through areas, or at least areas alone;
3. the use of a common denominator, so that different enterprises can be valued comparatively, and dominance established in mixed areas;
4. if possible, the use of both gross income as a common denominator and estimated work units;
5. some presentation of typical farming systems.

This is a counsel of perfection. One of the problems faced immediately is that it is not possible for an individual to begin with the farm returns for a whole state, although one of the studies referred to above in Victoria\(^2\), did use the returns for two parishes, as its basic material. But

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1 Chapter 1, above; p.34.
2 A.G. Goudie, op.cit.
there are approximately 2,000 parishes in the state, and
the work of handling and classifying this material must be
left to Governments who alone have the access, manpower and
machinery necessary for a task of that size. This meant that
in considering the basic material for the study individual farm
figures could not be entertained as a basis. The next level
of detail was the parish figures. A complete cover of the
agricultural statistics of Victoria can be had from the Statist's
Office, in county figures - 37 counties - not all of them
published, but some kept in the manuscript Statistical Register,\footnote{Statistical Register of Victoria, formerly
published annually, but kept only in manuscript form
since 1917.} or the information can be had in the form of parish records
kept in manuscript and not totalled. Between these two
units, there is the unit of municipal government, - the shire
in this case - but although there are some scores of shires,
and they are a useful size for a study of this sort, they
are not normally used for agricultural compilation, except
for occasional special tabulations. The parish therefore
was the only possible unit for the basis of the study, in
spite of the fact that using such a detailed unit means
sacrificing a wider range of work for more detailed work.

How does this decision appear when viewed with the
objectives stated above (p. 195).
1. emphasis on enterprise structure of the farm, rather than crop-livestock association; this cannot be done with the use of the parish, though it might not be very important unless there are many types of farms in Victoria with mixed enterprises.

In connection with 2. approach through the individual farm, rather than through areas; it is not possible either though it might be borne in mind that in cases where a point of view needs to be found, that which considers the type of farm, should be the one used.

3. the use of a common denominator, so that different enterprises can be valued comparatively, and dominance established in mixed areas; this concept is clearly likely to be a most valuable one, and one to which it is possible to adhere, even when using parish figures. The question then arises - what types of parish figures? They are figures of acreage of farms and crops and numbers of animals on the farms at the time of the annual census. This relates to, the fourth proposition,

4. if possible, the use of both gross income as a common denominator and estimated work units; it is not possible to get income for individual farms, although it could be imputed in the way that has been done since in New South Wales. The decision as to how to proceed turns at this point on the nature of the material and the best way to handle it. One is confronted with statistics of acreages of crops and numbers of farms and animals for

See Chapter 1, above; p.28, et.seq.
2,000 geographical units. Some simple scale is needed against which the crops and animals of each parish can be readily measured and the character of the parish determined.

One solution would be to place an imputed value on each of the animals and compare them numerically to decide which type was most important in any one parish. This was in fact done, but it was difficult to place any confidence in the values of the period 1950/51 and the immediately succeeding years, when inflation was rampant. On the other hand, value or money terms seem the only possible way to relate crops and animals. One can agree readily enough with Olmstead (p. 59 above) "There is no equable, quantitative measure of the output of any large number of diverse agricultural products", but nevertheless need to assume in an arbitrary way that some means of equating them can be used.

With this in mind it is interesting to survey the ways round this problem used in prior studies in Victoria. In the Survey of the Sheep Industry of the Western District,\(^5\) the ratio of 8 sheep to 1 dairy cow, was used and this was based on feed requirements of animals estimated on a uniform

\(^5\) P.S. Lang, N.M. Tulloh, B.V. Fennessy, op. cit. Appendix 4, p. 264
basis. Davidson, in his study\(^6\) of East Gippsland adopted these same ratios, and both cases distinguish between dry cattle and dairy cattle in milk. In the study of Berwick, by Holmes and others\(^7\), a livestock unit was defined as 1 cow, heifer or horse, 2 calves, 10 sheep or 15 lambs. The basic ratio between cows and sheep is therefore 1:10, but in setting limits below which a holding was not to be considered "productive" the figure of 80 sheep was considered equivalent to 10 head of other stock.

It was decided to take the ratio of 1:8 from the Sheep Industry survey, and to apply it to all cattle, whether beef or dairy, or in milk or dry, this latter being done to simplify the calculation of livestock units. At the same time some value figure was needed to link animals to crops. The relative values of livestock production fluctuated so much at the time that the statistics were collected for the parishes (1950/51) that this really had to be done on a fairly arbitrary basis. To a considerable extent the high wool prices of 1950/51 were discounted and it was decided to estimate the gross income from one dairy animal at £20 per annum and by comparison the income for each sheep at £2.12.0. Certainly the values have advanced markedly since that time, but to some extent one is bound by the circumstances prevailing

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\(^7\) L.C. Holmes, G.W. Leeper, K.D. Nicolls, op. cit.
at the time of the collection of the statistics.

This provides an approximate gross income estimate which helps to satisfy the proposition advanced above under:

4. the use of gross income as a common denominator.

But it is not possible to estimate work units for Australia, without a great deal of special investigation.

In making the link from animals to crops, there are two different sorts of cases which need to be dealt with. In the first case, there is the intimate and very important interrelationship between sheep and wheat, and in the other, the problem of comparing field crops and fruit crops with livestock in very limited areas.

Wheat prices varied in 1950/51, depending on which market the wheat was sold to; home prices were much lower than some overseas prices, but the average was still only approximately 10/- per bushel. Then there is the fact of a larger proportionate cost of production for wheat to be taken into account. It was decided to equate nine bushels of wheat with one sheep. The way in which this relationship was varied for different yields is dealt with in Chapter VII (below). If one sheep is taken to equal nine bushels of wheat, then the larger animals would equal 8 x 9 bushels,

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8 See Chapter IV, above.
or 72 bushels - 1 cow, or 8 sheep. The state average yield has been 18 bushels per acre in the postwar years, at which rate it would take 4 acres to equal 8 sheep or 1 cow. To simplify the many calculations that had to be made with the parish figures, all grain acreage was counted as being of equal value, but this is not the case with oats and barley, which are lower-priced than wheat. Nevertheless their combined acreage is still only a quarter of that of wheat. To look at where this helps the study of type-of-farming areas, one can realize that the problem of the areas of the sheep/wheat type of farming will be capable of some statistical resolution with such a ratio as that given here. The predominantly livestock-farming areas will be capable of treatment by the livestock ratios, and the remaining types are those involving the crops of more intensive type-fruit, field crops, vegetables, etc.

These areas are mostly in concentrated pockets, where the specialty of one or other crop can be assumed or easily recognized, but in some cases there will inevitably be a local mixture or complex of crops and animals or complex of crops of different types. Consequently the various crops must be valued. Since the statistics to be used will be of acreages, rather than production, it seems necessary to value production per acre for various crops.
If the resulting value per acre is related to the value of £20 for a cow, then it is possible to maintain some part of the principle set up in Chapter I (p. 34) under:

3. the use of a common denominator, so that different enterprises can be valued comparatively, and dominance established in mixed areas.

The same problem of changing money values occurs with these crops, as it did with animal products over this period, but in general the changes were not so marked though steadily upward in trend. On the other hand the variations from season to season that one expects to be quite important especially with fruit were quite marked. Accordingly it was decided to take a three-year period prior to and including 1951 and to take the mean of values of production and acreages.

### Value, Acreage and Value of production per Acre, 1948/51

<table>
<thead>
<tr>
<th>Fruit or Crop</th>
<th>Avg. Value</th>
<th>Avg. Acreage</th>
<th>Avg. Value per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Field Crops</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potatoes</td>
<td>£3,293,800</td>
<td>49,639</td>
<td>£66</td>
</tr>
<tr>
<td>Onions</td>
<td>£554,500</td>
<td>4,598</td>
<td>£120</td>
</tr>
<tr>
<td><strong>Fruit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Citrus</td>
<td>£650,400</td>
<td>5,293</td>
<td>£122</td>
</tr>
<tr>
<td>Other orchards:</td>
<td>£3,756,700</td>
<td>51,435</td>
<td>£73</td>
</tr>
<tr>
<td>Vineyards:</td>
<td>£4,202,000</td>
<td>42,273</td>
<td>£99</td>
</tr>
<tr>
<td><strong>Nurseries, flowers</strong></td>
<td>£371,300</td>
<td>3,097</td>
<td>£120</td>
</tr>
<tr>
<td><strong>Other Vegetables</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tobacco</td>
<td>£208,900</td>
<td>978</td>
<td>£213</td>
</tr>
<tr>
<td>Linseed</td>
<td>£108,402</td>
<td>7,103</td>
<td>£15</td>
</tr>
</tbody>
</table>

To merge the two different ratios of acreages and values, a scale of values and a scale of acreages is assembled below:

1. Scale of Relative Values

<table>
<thead>
<tr>
<th>Description</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approx. 9 bushels grain</td>
<td>1 sheep</td>
</tr>
<tr>
<td>72 bushels grain (18 bus. ac.)</td>
<td>approx. £2.12.0.</td>
</tr>
<tr>
<td>State avg. 4 acs. grain,</td>
<td>8 sheep</td>
</tr>
<tr>
<td>1 livestock unit</td>
<td>£20 approx.</td>
</tr>
<tr>
<td>Potatoes @ £66 p.ac: 1/3 ac.</td>
<td>1 livestock unit</td>
</tr>
<tr>
<td>Orchards @ £73 p.ac: 1/4 ac.</td>
<td></td>
</tr>
<tr>
<td>Vineyards @ £100 p.ac: 1/5 ac.</td>
<td></td>
</tr>
<tr>
<td>Nursery @ £120 p.ac: 1/6 ac.</td>
<td></td>
</tr>
<tr>
<td>Onions @ £120 p.ac: 1/6 ac.</td>
<td></td>
</tr>
<tr>
<td>Citrus @ £122 p.ac: 1/6 ac.</td>
<td></td>
</tr>
<tr>
<td>Vegetables @ £136 p.ac: 1/7 ac.</td>
<td></td>
</tr>
</tbody>
</table>

2. Scale of Numbers and Acreages

<table>
<thead>
<tr>
<th>Description</th>
<th>Conversion Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>State avg. 4 acs. grain</td>
<td>8 sheep 1 dairy cow or livestock unit</td>
</tr>
<tr>
<td>Potatoes</td>
<td>1 ac. = 3 dairy cows</td>
</tr>
<tr>
<td>Non-citrus orchards</td>
<td>1 ac. = 4 dairy cows</td>
</tr>
<tr>
<td>Vineyards</td>
<td>1 ac. = 5 dairy cows</td>
</tr>
<tr>
<td>Nursery</td>
<td>1 ac. = 6 dairy cows</td>
</tr>
<tr>
<td>Onions</td>
<td>1 ac. = 6 dairy cows</td>
</tr>
<tr>
<td>Citrus orchard</td>
<td>1 ac. = 6 dairy cows</td>
</tr>
<tr>
<td>Vegetables</td>
<td>1 ac. = 7 dairy cows or 7 livestock unit</td>
</tr>
</tbody>
</table>
Finally, there remains a question raised in the early part of the chapter and not yet dealt with: how have other workers solved the problem of distinguishing and assessing the different types of farming to be found in Victoria, and what is to be the classification adopted here. Basically, what is needed is a realistic list of the sorts of farm occupations which are distinctive because of their methods. To a considerable extent the product and the environment in which it is produced determine that there will be basic differences in methods of farming, but it is necessary to avoid classifying by the end-product alone, as one might do were one thinking in terms of industries and their products.

Other workers have produced useful workable classifications already, especially in the Resources Surveys of the planning regions of Victoria. These are realistic groupings of distinctive types of farming, and the terms they use are well-known. It would be easy to make too much of this subject, but it is simply decided. A short list of main types follows:

Sheep grazing;
Dairy farming;
Sheep/wheat farming;
Beef Cattle grazing;
Field-crop/Livestock farming;
Fruit-growing (including viticulture);
Market-gardening;
Poultry farming;
Special crop raising;

The categories are practically self-evident, but will be defined more exactly in the relevant chapters.
CHAPTER VI SHEEP FARMING
CHAPTER VI

SHEEP FARMING

The Primary Position of Sheep Farming

The average gross value of production of sheep products — wool, and mutton and lamb — in 1949-51 was £104 million, rising from £65 million in 1949-50 to £143 million in 1950-51. This places sheep-farming first amongst the farming types in Victoria, as dairying and cereals — the next most important — were no more than £36 to £37 million each. An important question is, how many farms are there which could reasonably be described as sheep farms, rather than as wheat/sheep or other types?

In Chapter 4 it was pointed out that the rural labour force — some of it casual, but most of it permanent — was about 100,000 and that of these the 1947 and 1954 censuses listed respectively, 14,700 and 21,350 as employed in "grazing." The big increase in the total figures for 1954 is connected with the lack of an "other" category, in that year. "Grazing" would also include a small number of workers on beef grazing farms, but this would not reduce the total by much. In both years a category of "agriculture" (meaning cropping) and one of "mixed farming" (cropping and animals) was included, which would cover...
most of the work force in the wheat/sheep type of farming (as well as in some other types). It seems probable that both of these figures is an understatement for the type of farming being considered here: that is, it is estimated that employment in the sheep grazing type of farming would be greater than 21,000.

In 1943 there were 29,000 flocks of sheep, but 5,000 of these were of less than 100 sheep, and another 6,100 were between 100 and 250 sheep. There were thus 18,000 over 250 sheep, and most of those below this size would be on wheat/sheep farms or not large enough to be considered the support of a full-time farm. In 1955-56, the distribution of sizes was a little different - the total number of flocks increased from 29,000 to 32,000. The details are as in the following table:

<table>
<thead>
<tr>
<th>Size of Sheep Flock</th>
<th>Victoria, 1955-56.</th>
<th>Size Flock</th>
<th>Number of Holdings</th>
<th>Number of Sheep</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 499</td>
<td>17,718</td>
<td>3,840,184</td>
<td></td>
<td></td>
</tr>
<tr>
<td>500 &amp; over</td>
<td>15,235</td>
<td>19,448,519</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>32,953</td>
<td>23,288,703</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Somewhat less than half the holdings with sheep have 80% of the total number of sheep, and it seems

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reasonable to suggest that about 15,000 farms raise sheep as their main activity. The labour employed on these holdings is much more a matter of a guess; it may be a good deal more than a ratio of one man per sheep farm, but it is not likely to exceed 2 men per farm. A rough approximation might put it, say, 25,000, which means that it is not far behind dairying as an employer.

In summary then, the sheep type of farming has products of a much greater value than any other: its work force may be about a quarter of the rural labour force, and the number of farms of this type may be about 15,000.

Sheep Distribution, Map 101

Map 101 shows the distribution of sheep, and its main feature is undoubtedly the very wide dispersion of sheep over the state. So much so, that it is best to approach the analysis of distribution by looking first at the blanks on the map. These are in the eastern and northwestern parts with some small vacant localities along the southern coast.

Localities with few Sheep

The eastern localities which have no sheep are largely the roughest and most timber-covered parts of the Eastern Highlands. The large timber-covered region of East Gippsland, outside the Highlands, but nevertheless
uncleared, is also a major blank. The northwestern and western border has a number of blank spots; these are mainly stretches of sand with no soil structure. The southwest is different; here there are swammpy conditions, very poor sandy soils, and some lack of trace elements. Other large blanks are the Western Highlands and the Otway Ranges.

Through the Central Highlands, there are many small blank spots which are bush-covered localities for the most part.

Sheep in Dairying Districts and Metropolitan Districts

The sheep map appears to reflect the map of holdings (Map 104) and consequently it is easy to miss a major feature, which is the lack of sheep where dairying is most important. The conditions of productive soil, moderate to high rainfall and low elevation which favour dense dairying, exclude sheep-farming. Another feature is the lack of attraction for sheep exercised by the metropolis.

In Gippsland sheep become important only on the eastern side of the Southeast Gippsland Hills where there is a rain-shadow and one finds poor soils also. In the Western District, sheep do not occur south of a line from Colac to Terang and Port Fairy.
Influence of High Rainfall on Sheep Distribution

An important question is whether it is the high rainfall of the dairying districts which excludes sheep from them, rather than that dairying itself competes successfully for the land on economic grounds. Are there any instances of a considerable number of sheep in rainfall greater than, say, 30 ins.? It is hard to find such a locality. In the Central Highlands from Ballarat east, rainfall is over 30 in. but there are few sheep. In some parts there are also few cattle, but not everywhere. Some small portions have dairy cattle, and intensive farming of potatoes but few or no, sheep. Proof that sheep can flourish under rainfall greater than 30 ins. comes from the far west of the Western District, where north and west of Warrnambool there is a considerable number of sheep. There are a few in the wet part of West Gippsland, but it is commonly said that farmers find it difficult to breed sheep there. This tends to bear out the traditional explanation, that is that sheep do not flourish under wet conditions. It may not be the actual amount of rainfall, so much as the high temperatures in summer and autumn combined with dampness. These conditions are very likely to bring increased risk of footrot, and stomach worms and other diseases.

There is a small patch of farm land in the hills between Alexandra and Euroa, the Strathbogie Range (Map 1),
where sheep have taken over after the land had been used for dairying in the early stages of settlement. This little plateau has rainfall above 30 ins. but it also has lower temperatures, due to its height of a thousand or more feet above the plains. Similarly there are odd patches of wet country right along the northern fringe of the Eastern Highlands which support some sheep. The upper reaches of the Goulburn River show this situation again. It is probable that high rainfall of itself, does not forbid sheep farming, but that the combination of damp conditions and high temperatures makes conditions unhealthy for sheep. But lower temperatures resulting from increased elevation offset the risk of disease, while such rugged country as that of the Upper Goulburn, with its low temperatures for part of the year is not attractive for dairying.

Location of Zones of Greatest Sheep Density

The topic can also be considered from the reverse aspect. Where are the zones of greatest sheep density? The zone of greatest density is along the southern half of the western part of the state. It continues north of Melbourne, midway between northern and southern halves, then densities decline in the northeast. Within this southwestern and central belt of greatest density, there are localities of the size of a few parishes in which
densities are much greater than those general elsewhere. Most of these are in the Western District, with a few in North Central. The greatest densities occur in a central belt through the Western District: here rainfall totals are close to 25 ins. and pastures are either native pastures mainly of Danthonia, in an open grassland, or Danthonia alternating with patches of permanent exotic pastures of mainly perennial species. A considerable portion of the country has been topdressed, but there are stony rises, rugged patches and backward areas which have not been so treated.

Although the main part of this belt has soils that are actually not rich in mineral nutrients at all, nevertheless the greatest densities occur on some of these poor soils. At either end of the belt there are equally heavy densities on quite different soils and base rocks. Beyond Hamilton there is a heavy density on the Jurassic, which here supports a variety of soils; the associations are of fairly rich soils in the main, and most of them support pasture improvement. At the other end on the Barrabool Plains near Geelong, there is also a patch of Jurassic which has good soils, though they are more like those of the Otways than those of the Jurassic to the west. Nearby, the plains are underlain in places by basalt, and on the southern edge by Tertiary materials, so that there
is clearly no limitation of high sheep densities to one geological or soil type. What can be said is that the greatest densities are found in a belt of country with about 25 in. of rainfall, and which has soils of no great wealth but which are capable of improvement. The greatest densities are not confined to any one geological material, and although they are in localities near dairying districts, they have rainfall which is too low to allow dairying to be a practicable alternative to sheep farming.

Lower densities are to be found in the Central Highlands and from there northeast along the foothills of the Eastern Highlands. These lower densities are still irregular, and are greatest in such places as to the north of Ballarat, northeast of Castlemaine and along the Goulburn River.

Sheep Densities in the Northern Plains

Very regular densities occur in the northern plains right across the state, from Yarrawonga to the Wimmera. They increase slightly in the irrigation localities of the Goulburn and north of the Macorna Channel in the Torumbarry system. But the notable point is how little the regular density of the northern plains is affected by the presence of irrigation water. A negative aspect of the pattern found in irrigation localities, is that even
in parishes with very heavy densities of dairy cattle the sheep density is little different from that of the surrounding country. This indicates that no parish is entirely given over to dairying, and that the higher stocking of sheep which is possible with irrigation water is not truly revealed because only a certain proportion of available water is used for sheep and the remainder goes to support dairying.

Except just around the Hume Reservoir, there is only a light sprinkling of sheep in the far Northeast. In the central part of the Wimmera also, the density drops and it changes little even for considerable distances north into the Mallee. In the central part of the Mallee around Lake Tyrell (the large central lake) densities decline again with decreased rainfall and are only very light from there on to the northwest.

**Sheep Breeds**

One of the main factors differentiating sheep farming regions from each other is the various breeds of sheep, or the varying proportions of breeds, to be found in different districts. Differences in breeds are associated with the type of end-product, whether wool, or lamb and mutton, and also with the flow of animals from one locality to another. These movements of sheep are a response to demands for different types of animals, for
varying types of production.

The question of breeds, their interrelations and purposes for which they are kept; all this is a highly complex subject, in which generalisation is often dangerous, and exact causes hard to specify. Farming practice, rather than the reason given for it, is often the most convincing and coherent part of an analysis of local differences in breeds. Although it is a subject in which decisions may be highly idiosyncratic, nevertheless there is in the lore of most localities a sufficient common quantity to suggest that the choices made in breeds and breeding are close to the optimum, being based mainly on practical experience by elimination and specialisation. It is understandable therefore that the analysis that follows concentrates on practice rather than causation, unless the latter be in very general terms.

The Main Sheep Breeds used in Victoria: Characteristics

The main sheep breeds used in Victoria are:
the Merino, and crosses between the Merino and British breeds. The Merino produces a range of wools, all of them fine by any general standard, but within the Merino breed

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2. This section of the work is partly based on a publication of the Vic. Dept. of Agriculture, The Sheep Industry, but much of the material is also available in a number of handbooks about breeding.
the smallest animals usually have the finest wools. These fine wools are traditionally associated with the Western District, while the northern parts of the state generally identify their Merinos with the coarser-woolled, big-framed animals of the dryer parts of N.S.W. The even bigger sheep of South Australia, are sometimes found in the northwest of Victoria.

The British breeds can be grouped into Long-wool, Downs and Mountain breeds. The Mountain breeds are not important in Australia, and by local convention the Downs breeds are often lumped together as Short-wools. The Longwools include the following of importance in Victoria: Leicester and Border Leicester, Lincoln, Romney Marsh.

Downs breeds are: Southdown, Ryeland, Shropshire, Suffolk, and most of the latter have been improved by adding Southdown blood at some time. The Dorset Horn is not a Downs breed (all Downs sheep are hornless), but is a Shortwool. The Lincoln is not now so significant but it was most important in the past because of being used so much during the early crossing between Merino and British breeds.

Polwarth & Corriedale

These breeds are both fixed crosses with the Merino; the Corriedale was first bred in New Zealand,
the Polwarth in Victoria. The **Polwarth** is a Merino/Lincoln cross fixed at the point of $\frac{3}{4}$ Merino and $\frac{1}{4}$ Lincoln. It was evolved to meet the conditions of wool-growing localities which were too wet and cold for the Western District Merino, and the Lincoln blood is assumed to give hardiness as well as giving weight to the wool and the carcass. The Polwarth resembles a plain-bodied, extra-long stapled Merino, with better mutton.

The **Corriedale** is an inbred half-breed, between Lincoln and Merino. It is thought of more as a dual-purpose sheep than is the Polwarth and is used both as a wool sheep and for fat lamb production. Its wool is as fine as that of many Merinos and equal to the Polwarth, but it is also long, much longer than Merino-type wool and could almost be called long-woolled.

**Relative Importance of British Breeds**

Although the Romney Marsh is the most numerous of any one British breed in Victoria, the three breeds which have had the greatest influence on sheep farming in the state are the Lincoln, through its presence in so many early crosses, the Border Leicester because it is the commonest strain in imported crossbreds from New South Wales, and the Dorset Horn, through its being used so commonly as the sire of fat lambs produced in the warmer parts of the state.
The Longwool sheep have a great size of carcass, and are big animals altogether, growing quickly and easily fattened, but their carcasses are considered too fat and the mutton is second-rate, with poor flavour and colour and too coarse in the grain. Their wool is of long staple and dense, but it is not valuable. Longwool sheep are moderately hardy, some like the Border Leicester being able to stand dryer conditions, some like the Romney Marsh, wetter ones.

Some of the Downs breeds are smaller than the Longwool sheep, with an important extra quality, that of quicker maturity under dry conditions. For fat lamb production large size may be a handicap, if it means either, that the lamb may be too big for a small Merino mother, or that the lamb may be slower than the progeny of other breeds in reaching the acceptable size of something under 40 pounds weight. As an example, the Southdown is said to have the advantages of early maturity and small bones which give no waste, as well as having meat which is finer in quality than that of the Longwool breeds.

Crossbreds may be the products of a wide variety of breeding histories, but they are most often close to the half-bred, having one-half or more of Merino blood, and less than a half of British breeds. They are usually
large with much coarser wool than the Merino, but with a good bulk of wool because it grows on a large frame. The tendency to breed from crossbreds back towards the fine-woollen Merino is summed up in the name for this type of crossbred, that is Comeback. Comebacks are fine-woollen crossbreds, closely resembling the Merino.

The statistics for sheep breeds incorporate most of these terms, but the categories in the statistics have been changed from time to time. Breeds were enumerated in 1947 and again in 1950. A change was made in 1950 because it was felt that by requiring owners to describe their sheep in terms of "pure" breeds the statistics were neglecting the opportunity of finding the main types of sheep and were throwing too many into meaningless groups. In place of "pure" breeds owners were asked to declare their sheep in terms of their "recognized" breeds, and this led to a big increase in the numbers and proportions of Corriedale and Polwarth. There were fewer Crossbreds, and Comebacks (with the elimination of coarse Comebacks) were a little smaller.

It must be emphasised that the figures for numbers of sheep of different breeds, need to be interpreted in the light of sheep-farming practices. A fundamental question would take this form: in what proportions does the blood of different breeds flow in the veins of the
sheep population following lambing?

The reason for framing the question this way, is that crossbreds may be consistently of the one British breed which has been crossed with Merino: then for a particular purpose one or two breeds of rams may be used consistently with certain types of crossbreds, thus introducing a proportion of their blood into the sheep population which is much greater than the number of sheep listed as being of that breed.

The figures for British breeds therefore present some paradoxes in that breeds that are hardly represented may be very important in fat lamb farming, while some that are numerous, are of little practical importance.

This emphasises the point that breed statistics need interpretation in the light of practices.

<table>
<thead>
<tr>
<th>Sheep Breeds 1950 : Ram Breeds 1951</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Sheep Nos. 1950</strong></td>
</tr>
<tr>
<td>(’000)</td>
</tr>
<tr>
<td>Merino</td>
</tr>
<tr>
<td>Comebacks</td>
</tr>
<tr>
<td>Crossbreds</td>
</tr>
<tr>
<td>Corriedale</td>
</tr>
<tr>
<td>Polwarth</td>
</tr>
<tr>
<td><strong>Longwool</strong></td>
</tr>
<tr>
<td>Romney Marsh</td>
</tr>
<tr>
<td>Border Leicester</td>
</tr>
<tr>
<td>Leicester</td>
</tr>
<tr>
<td>Lincoln</td>
</tr>
<tr>
<td><strong>Shortwool</strong></td>
</tr>
<tr>
<td>Dorset Horn</td>
</tr>
</tbody>
</table>
Shortwool (cont'd.)

<table>
<thead>
<tr>
<th>Sheep Nos. 1950 ('000)</th>
<th>Rams 1951</th>
</tr>
</thead>
<tbody>
<tr>
<td>Southdown</td>
<td>65.1</td>
</tr>
<tr>
<td>Ryeland</td>
<td>10.7</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>19,080</td>
</tr>
</tbody>
</table>

Source: Victorian Year Books.

In the total picture, British breeds are numerically unimportant. It is in the uses of the rams of British type that one finds the clue to their position in the sheep economy. The rams can be considered firstly from the point of view of whether they are used to produce some of the millions of crossbreds which amount in total to more than a quarter of the sheep population. Then the crossbred ewes in turn, can be viewed in their role of mothers of prospective fat lambs. And finally, the British breed rams can be viewed again to see whether, and in what environments, they may be used as sires to produce fat lambs from Merino or crossbred ewes.

But to look for a moment at the wool sheep: it is right to consider that the finer Comebacks are intended, as is the Merino itself, for fine wool production. The Comebacks are closest to the Merino, but as they become coarse from cross-breeding, they tend to move toward the crossbred groups. At this stage the Comeback owner will bring in Merino rams and breed back to the Merino. The
Corriedales and Polwarths can breed true, and so need not be crossed with outside blood, but some are bred with British rams to produce fat lambs. Here the clue is in the use of the British breed ram; the use of Corriedale or Polwarth rams can be taken in general to mean keeping up the breed (which is mainly a wool one), on present Victorian practice. It is therefore safe to divide ewes mated, into two groups, those bred with Merino, Polwarth and Corriedale rams and whose progeny are intended mainly for wool production, and those bred to British rams and intended to produce fat lambs for meat.

There is one flaw in this assumption, and that is in the case of the Comeback owner who considers his flock too fine and is starting to breed back to crossbreds, by introducing British blood. But the numbers will be small and also, Corriedales or others may be used instead in order not to alter the wool quality too radically.

The Role of British Breeds as Fat Lamb Mothers

Considering the table of sheep and ram numbers, it would seem that amongst the British breeds, those which need consideration are the Romney Marsh, Border Leicester, Dorset Horn and Southdown. What is it that is required from a fat lamb mother? She needs to be big, with a good milk supply, and the Merino is poor on both these counts.
Using a Merino for a fat lamb mother will produce a lamb with indifferent meat, slow to mature, and not always able to be fattened properly. Only a small proportion of the sheep used as fat lamb mothers in Victoria would be Merino ewes. The longwool mothers appear to have advantages over others in wool quality and in early maturity. The Border Leicester particularly, has a lamb which matures early and does well under dry conditions. This is the most important breed of ewe in Victoria for fat lamb production. The Border Leicester also has quite good wool, which is an advantage from a ewe that will be shorn a number of times before being culled and fattened.

**Sires of Fat Lambs**

Wool quality is not important in choosing the sire of the fat lamb. But the sire needs to give early maturity to the qualities of the lamb, and for this reason both the Dorset Horn and the Border Leicester have become the important sires of fat lambs in Victoria. The Southdown would be best if conditions were not likely to be trying, but the Dorset gives a lamb that will do best on dry conditions, and the Dorset ram is able to breed in very dry and hot conditions. In fact, it is quite possible to turn off good lambs from unimproved pastures using Dorset Horn rams, but economically it is risky. Using Downs rams means that no risk should be taken that the lamb will not
be finished off and sold, because Shortwool fleeces are of low value.

The geographic effect of this combination of ability to stand up to hot conditions and the need for certainty in finishing in spring, is shown by the distribution of the breed, Map 255. It is spread through the northern counties but heavy in the irrigation ones in the Northern District - Moira, Rodney and Gunbower - while it also occurs heavily in the rain-shadow, west of Melbourne, a dry locality but one with reliable spring rains.

It is true that the Southdown has an advantage in that its lamb is the right weight for the export trade, that is about 33 lbs. when dressed. On the other hand the heavier Dorset lamb makes up for the loss of highest quality export prices - a loss due to its being overweight - by getting 6 or 8 lbs more meat, and so covering a lower return per pound. It is quite possible that if the export trade were large enough to dominate the thinking and practice of farmers, the Dorset Horn would lose ground, especially with the spread of improved pastures. However, the present position is that fat lamb production rests very heavily on the two breeds: the Border Leicester as sire and crossbred mother, and the Dorset Horn as sire.

It is nevertheless true, that the Romney is the
most numerous of the British breeds. What then is its role?

The Romney is kept to breed a Romney X Merino crossbred, which is used for wool production and as a fat lamb mother. It is little used as a fat lamb sire. This can be seen from the table of ram numbers, where Romney rams are included in "Other" rams of British breeds, along with a number of others. The total does not much exceed that for the number of Southdown rams and is half that of the Dorsets and Leicesters. The number of rams is the clue to the importance of a British breed in siring fat lambs, and in the case of the Romney the importance is clearly low.

To detail the Romney's role elsewhere, the best clue is given by Map 252 which shows that the breed has a littoral distribution in the wetter and cooler parts of Victoria. It is preferred in these wetter and cooler places with their lush pasture, because as a flock sheep and as a crossbred it has a high resistance to footrot and a tolerance of damp. Those farmers who produce fat lambs under these conditions will use a Romney crossbred as the mother, and some are used also in the irrigation districts, sometimes with a Romney sire but more usually with a Downs sire. Some of the ewes are imported from the Southern Tablelands of N.S.W. where this cross is popular.
Imports of Sheep into Victoria

The subject of sheep imports, raised at the end of the last section is of great importance, because a large part of the sheep farming of Victoria depends on imports of ewes from N.S.W. The static picture given by the breed statistics cannot hope to interpret the dynamics of breeding and production, especially when so much of the preparatory husbandry is undertaken in N.S.W. Indeed in the case of some of the crosses which are bought for Victoria, the chain of breeding and selling begins in southern Queensland. Here Merinos are crossed and the crossbred ewes may be sold to the Northern Tablelands of N.S.W. After one or two lambs they may be sold further south where conditions are not so trying for older sheep, and may finish their life in northern Victoria, producing one or two more lambs for export. Many sheepmen in the central parts of N.S.W. so arrange their breeding programme that they sell off crossbreds which have been raised specifically to meet the demand for fat lamb mothers in northern Victoria, though a surplus of this sort will only come regularly from districts which do not have the harshest conditions and are able to raise their own replacements as well.

The long trek of sheep from Queensland to Victoria, parallels the better-known movement of cattle in the same
direction. It is an important stream of animals, integrating environments of quite different types and meeting needs which are created by the different conditions of climate and pastures in over 1,000 miles of eastern Australia. To document and measure the movement would be a major undertaking, but it needs to be done.

**County Maps of Sheep Characteristics**

It is now possible to interpret the statistics of breeds further. These were placed on maps by the Bureau of Agricultural Economics using the collection of 1947. Two qualifications to the figures need to be borne in mind. One is that 1947 followed one of the worst droughts ever, in southern Australia; another is that the 1950 statistics brought in changes in the method of assessing breeds. In itself, this change is a good reason for using the 1947 figure. Even with these qualifications the maps still show the relative position quite well, and changes are not so drastic as to upset the general picture of distribution given by the maps. Map 233 shows the total of sheep within counties. The great concentration is that already noted, that is in a belt from the southwest to the north central parts. Map 235 shows sheep density per unit of farm land, and here it is the Western District which shows as very densely populated, with the North Central District next in density, and the northeastern plains
coming after them. Map 234 shows the distribution of Merinos; the great concentration being in the southwestern quarter. Map 236 shows the percentage of Merinos to all sheep and it is seen to be low for many of the counties of the Southwest. However, the proportion is over half in Ripon, Dundas and Grenville in the Western District, as well as in all the Wimmera counties, except Gladstone.

Map 239 shows the distribution of crossbreds. There is a strong bias in their relative location, towards the northern parts of the state, especially in the counties of Moira and Delatite, and from the percentage map (No. 240) it can be seen that the dominance of crossbreds in these two counties and in the neighbouring ones of Rodney and Bogong is strong. The percentage is high also, in the dairying counties of Evelyn, Mornington, Buln Buln and Heytesbury, but here, absolute numbers of sheep are small. Tatchera is in an intermediate position; it has moderate numbers, but 2/3 or so of the sheep are crossbreds.

According to Map 242, the heaviest fleeces come from the Wimmera, but in wool shorn per 1,000 acres occupied - a measure of the intensity of sheep farming production, shown on Map 243, more wool is shorn per acre in the Western District than elsewhere.

Map 241 differentiates the type of sheep farming carried on in terms of the proportion of wethers to all ewes
and wethers. Where the proportion of wethers is high, wool is the main aim of sheep farming, and where it approaches or exceeds 50% it is certain that conditions are difficult for breeding replacements. Only in Anglesey and the far western counties is this the case. On the other hand there are very few wethers in the counties along the northern boundary.

Map 244 gives almost the inverse of this information, and emphasises the low proportion of breeding ewes in Dundas and Follett in the far west, and in Anglesey. Maps 241 and 244 are not quite mirror images of each other, because there is always a number of ewes not being used for breeding for one reason or another and they do not show up in either map.

Map 245, showing the percentage of ewes mated with wool type rams, distinguishes the two main types of sheep farming, for wool or for meat. The counties with the heaviest concentration on wool are Ripon - from 80% to 90% of ewes mated with wool rams - and all its neighbours in the west - they are above 50% or close to it. The concentration on wool ends abruptly along a line which is roughly north-south, from about Geelong to Ballarat and Bendigo. To the east of this line the soils change from the podzolised types of coastal Australia to the red-brown earths of the
Werribee Plains near Melbourne and the krasnozems of the Central Highlands, while in the northern plains, irrigation begins along the line of change. There is practically no breeding with wool rams in the main part of the wheat belt, that is in counties Tatchera and Karkarooc, but in the far north in the Milleva it is half and half.

Map 246 shows the absolute number of ewes mated to rams of the wool breeds in 1951. The largest numbers are in the Western District. On the other hand Map 247, shows that ewes mated to British breeds (that is for fat lamb production) are largest in number in Moira in the Northern District, and in neighbouring counties.

To relate Maps 246 and 247 to the dot maps of sheep distribution (Map 101) brings out two features. The strip of country holding most of the sheep of the state, runs from southwest to northcentral, and it can now be seen that this can be subdivided into a southwestern part running wool sheep, and a northern section, of meat production. This latter type is associated with two separate features. One is the prevalence of irrigation in parts of the northern plains, and the other is the association of fat lamb farming and wheat farming in the wheat/sheep type of farming. The methods of the two types of farming are somewhat different, although they are linked by common problems and markets.
But the structure of farms and their enterprises is different and so the two should be treated separately.

**Flock Replacements and Non-Breeding Localities**

Thus far the distinction made has been mainly between the use of Merinos, Polwarths, and Corriedales for wool production and of crossbred ewes with British breed rams for meat production. But a further subdivision is possible if the subject of replacements for the flock is considered. In the case of the fat lamb flock it is assumed that most replacements are bought, mainly in the manner suggested above, from outside the state. But where wool quality and breeding history are so much more important, as in the case of the Merino ewe kept for wool production, it is not desirable to do this to any extent.

Nor is it possible; no large supply of Merino or Comeback flock sheep is available. There is no stream of purebred or fine Comback sheep from further north, making its way to markets in Victoria. The N.S.W. back country disposes of its surplus adult sheep by crossbreeding and selling the surplus young stock. The Merino areas of Victoria are like this back country in being mainly wool-growing areas, but they are neither noticeably in surplus with breeding of young stock, nor in deficit in replacements, as are the fat lamb areas. In the main these localities breed their own replacements. But it is true some localities are not suited
to this purpose, for lack of green or succulent feed at lambing time. Such country usually contains only dry sheep—some of them dry ewes, but mainly wethers. An indication of where this is the case, is to be found in a high ratio of wethers to other animals. The best indicator is the ratio of ewes mated compared with the number of wethers. If the proportion of wethers is greater than of ewes mated, then the country should be considered "non-breeding country."

Map 241 shows the percentage of wethers to total ewes and wethers for 1946-47, and on this map the percentage nowhere comes as high as 50%, although in Anglesey, Dundas and Follett it is between 40% and 50%. It is possible then, that parts of these counties may have localities which are "non-breeding" country. Also, there may be some such country in the neighbouring counties of the Western District, or in Lowan or Dalhousie.

Of course, not all wethers are sheep of wool breeds, and crossbred wethers are to be found in numbers in the poorer parts of some of the fat lamb country. Wethers are not segregated by breeds in any accessible statistics, so that the breed of wethers, have to be assumed from the breeds of sheep present.

Meat and Wool Localities in Detail

The distinction between the meat and wool areas
seems so basic that it needs to be made in detail. Map 130 gives this information by parishes. Parishes with very few sheep are left blank, but if there were some sheep the parish was classified, even if the main farming type of the parish was dairying or some other type of farming. In this feature, Map 130 differs from Maps 131 and 132. Parishes in which a majority of the ewes mated, were joined to British breeds of rams were cross-hatched, and parishes with a majority of wool-type rams were covered with the dotted symbol. The two types, wool and meat occupy about half each of the total surface area differentiated.

Types of Sheep Farming Correlated with Agricultural Features

What correlations are there with other agricultural phenomena?

(a) correlation of fat lambs with wheat in most of the northern part of the state. This is shown on Map 130 as a tan colour.

(b) a few wheat areas have wool-type sheep. They can be picked out on Map 130 by the combination of tan colour and the dotted symbol.

(c) fat lamb areas overlap with practically all the dairying areas. This can be seen by comparing Map 130 with Map 136; the parishes with a mixture of sheep and dairy cattle and those with dairying dominant (shown on Map 136 with blue dots), overlap with the cross-hatched symbol on Map 130.
(d) association of fat lamb farming and a moderate supply of irrigation water. This can be seen by comparing Map 130 and Map 13, showing the supply of irrigation water in different intensities.

When these correlations are accounted for there remain certain localities of the sheep farming for meat type, which are neither in nor associated with dairying areas, nor are they associated with wheat-farming, nor in the irrigation localities. They are picked out on the overlay to Map 132. The wool farming areas remain as well.

**Sheep Farming Areas**

Maps 131 and 132 distinguish the main types of areas. They have been outlined by dividing into two groups of types the features noted above and those from Map 130. There is one important difference between Map 130 and Maps 131 and 132; Map 130 was arrived at by classifying all sheep over the whole state, with insignificant exceptions, whereas Maps 131 and 132 are a classification only of those parishes in which there were enough sheep livestock units for sheep to be at least a third of the livestock units in the parish.

**Types of Sheep Farming Areas**

The types of sheep farming areas are:

- Mainly sheep farming for wool;
- Mainly sheep/wheat farming, with fat lambs;
- Mainly sheep/wheat farming, with wool production;
- Mainly sheep farming for fat lambs - not associated with wheat or dairying and with or without irrigation.
In addition there are a few parishes in which sheep are mixed with dairy cattle or with beef cattle, in the proportion of one-third to two-thirds.

The overlays to Maps 131 and 132 pick out specific areas of each of the types given in the list above, and give an estimate of the total number of sheep within each. Such an estimate can be only approximate because of the nature of the statistical material.

The areas in which sheep appear to be mixed with dairy cattle and beef cattle are shown on Map 132. It is not common to find farms on which sheep and cattle are mixed in somewhat similar proportions; in the survey of farm types carried out in N.S.W., out of 66,000 holdings classified, only 272 were listed on which sheep and dairy cattle were of near equal importance.\(^3\) It is true that there is much less land in N.S.W., than in Victoria, which suits both sheep and dairying. The irrigated sections of the Riverina are the main exception to this generalisation, but even granted the greater physical possibility of mixture in Victoria, it seems to occur little in practice. The exception is "mixed farming" - meaning animals and crops - and is dealt with in Chapter 9.

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Sheep and Beef Cattle Mixed

The other type of mixture is that of beef cattle and sheep. In the classification carried out in N.S.W. less than 2% of the state's holdings were considered to be sheep/beef mixtures. Even so, some of these 1,300 holdings were clearly dominated by one or other type of animal. In N.S.W., the Eastern Highlands are the state's beef area, and as the eastern slopes are too humid for sheep, it is only on the Tablelands and Western Slopes that one would expect this mixture. Victoria has more localities in which the mixture might occur, even though the state is smaller. The edges of the Highlands seem the most likely places, but on the southern edge of the Eastern Highlands there are very few sheep indeed until the rain-shadow of East Gippsland is reached; but neither are there many beef cattle. There are odd patches of mixture along the edges of the "plains" country of East Gippsland, from Traralgon to Bairnsdale, and again in the Omeo rain-shadow; notably not in the dryest and best parts which are the centres of the valleys, but rather around the edges of them. Then a small patch of mixture occurs in the Buchan strip, parallel to the Omeo valley.

The others are in the upper reaches of the Murray on the hills around and above the Hume Reservoir, and along the valleys of the Northeast, mainly in their upper
reaches, where fat lamb farming and sheep mixed with dairying occur alongside the beef-sheep parishes. Even here, there is a good deal of geographical separation of the two types of animals. Sheep are more likely to be found on bare hills, completely cleared of bush, but the partly-cleared country is grazed by cattle, and indeed they are often turned into tracts of uncleared bush. Sheep would be unable to make economical use of such grazing because once in the bush they lose some of their wool and also lose condition.

**Sheep Farming for Meat**

There is a small number of parishes, widely scattered, in which fat lamb farming is carried on, but the sheep are not associated with wheat or dairying. Disregarding the sheep/dairying parishes, eliminates most places not in the wheat belt, which make a speciality of fat lambs. For instance, in the main part of the Western District, such fat lamb farming as there may be, is very largely confined to the dairying parishes. Only in the far west are there one or two spots in which there is fat lamb farming as a major occupation, but not associated with dairying. In Gippsland, this is even more the case, while the Central Highlands, the irrigation regions and the Northeast have only a small number of parishes with fat lamb farming on its own. But when they are added together
these scattered places amount to a considerable total. They are therefore considered below, in so far as they can be separated out.

Sheep Farming areas, apart from the mixtures, are shown on Maps 131 and 132 and their boundaries are picked out on the overlays to these maps. Each main one has been given a name and an estimate has been made of the total number of sheep in each area.

Table

Estimated Numbers of Sheep in Sheep Farming Areas, 1951.

<table>
<thead>
<tr>
<th>Areas of Sheep Farming for Wool</th>
<th>Nos. of Sheep '000 (Sub-Totals for Type)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western District &amp; Loddon</td>
<td>7,500</td>
</tr>
<tr>
<td>Central and North East</td>
<td>1,620</td>
</tr>
<tr>
<td>South East Gippsland</td>
<td>630</td>
</tr>
<tr>
<td>Omeo &amp; East Gippsland</td>
<td>250</td>
</tr>
<tr>
<td>North West &amp; Millewa</td>
<td>50</td>
</tr>
<tr>
<td></td>
<td>10,050</td>
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</table>

<table>
<thead>
<tr>
<th>Areas of Sheep/Wheat Farming</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Mallee, Northern Wimmera</td>
<td>3,050</td>
</tr>
<tr>
<td>North Eastern Plains</td>
<td>1,580</td>
</tr>
<tr>
<td>Dunolly, Rochester</td>
<td>250</td>
</tr>
<tr>
<td>Werribee Plains</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>4,912</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sheep Farming for Meat-Fat Lambs—without wheat</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>North East Plains &amp; Foothills</td>
<td>780</td>
</tr>
<tr>
<td>Talbot</td>
<td>600</td>
</tr>
<tr>
<td>Bourke</td>
<td>584</td>
</tr>
<tr>
<td>Goulburn Valley, Anglesey</td>
<td>300</td>
</tr>
<tr>
<td>Gee long</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td>2,324</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sheep Farming for Meat-Fat Lambs—with irrigation</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Irrigation Districts</td>
<td>1,300</td>
</tr>
<tr>
<td>Total</td>
<td>18,586</td>
</tr>
<tr>
<td></td>
<td>===========</td>
</tr>
</tbody>
</table>
The following is a brief account of the characteristics of each main sheep farming area:

**Western District & Loddon Wool Area**

This is the largest of the sheep farming areas of the state, covering the main part of the Southwest and even stretching into the north (Map 131). It has the greatest sheep population and the regional name "Western District" which is in common use, probably summons up mental pictures of sheep farming in the public mind.

The heart of it is a group of six counties: Ripon and Dundas on the northern side and Normanby, Villiers, Hampden and Grenville on the southern side of a rectangular block. Ripon and Dundas have practically no portion of other type-of-farming areas within their boundaries, so that they are likely to be most nearly representative of this particular type of farming. Figures for Grenville, Hampden and Villiers will not be representative of sheep farming alone because of the strip of dairying which runs along the southern parts of these counties. In any case Ripon and Dundas and the four southern counties are dissimilar in some major environmental features.

The latter southern counties can be thought of as "plains" country, originally wide level expanses of grassland, and not so greatly altered by occupation. Ripon
and Dundas are largely though not entirely, undulating or positively hilly, and in part cleared from original savannah forest and grassland.

The southern boundary is mostly the edge of a dairying zone. In the southeast it is partly the Otways, where they meet the sheep country with no dairying between them.

South of Geelong the sheep country goes right to the sea, but around Geelong there is a narrow strip of more improved grazing land which is used for fat lamb farming. North from Geelong the boundary is mainly that between the red-brown earths of the Werribee Plains, with improved farming, and the poorer grazing of the podzolic soils. As Leeper notes, the boundary between these two soil associations is confused in this zone, and there is a corresponding medley of patches of wool grazing and better farming. On the map it has been simplified.

On the southern edge of the Central Highlands, the boundary is mainly that between the krasnozems and related patches of better soils around Ballarat, and the poorer podzolic types of soils, particularly poor on the patches of Ordovician to be found south of Ballarat. Much

of this land is uncleared, or reserved as State Forest, which means that it will not pass to farming in future, and it is here that there is a good deal of "wether country" with unimproved pastures, and environmental conditions too harsh for much successful breeding of replacements.

North from Ballarat to Maryborough, there is much the same sort of division, largely between the Ordovician with unimproved pastures on the one hand, and basalt patches with improved pastures associated with the use of British type rams on the other. Wool farming continues on north of Maryborough in a narrow zone into the northern plains on the eastern edge of the Wimmera. This strip lies approximately along the bed of the Loddon River. It is a zone of wool-farming with wheat/sheep farming and fat lamb breeding on either side. The Loddon has had some influence on the soils, which foreshadow the zone marked on Map 7 as Grey pedocals mixed with brown-soils of heavy texture. To the east there is fat lamb farming for the most part, associated either with irrigation or with wheat/sheep farming.

To the west the boundary of the wool-growing zone is very largely that between flat country which is part of the wheat belt proper and hilly country with little pasture
improvement, and raising wool sheep. It is not only
topographic but also a soil boundary, with the Wimmera
chernozem-like soils to the north and podzolic and
skeletal types to the south on the hills. There is also
a change in basal rocks, from the continental deposits of
the plains to the Ordovician and Devonian etc., of the hills.
Southwest of Horsham the change from wheat to wool takes
place on flat land, however. Here it corresponds still to
the transition from chernozems to podzolic types of soils,
and tends to bear out the general proposition that animal
production is more rewarding than is cropping on the podzolic soils of southern Australia. Wheat could be grown
on these soils, even with the higher rainfall and cooler summer, but pastures pay better.

From here to the border the boundary is a narrow strip of heathland called the Little Desert (Maps 8 & 2).

On the Southwest the boundary is one of topography and natural vegetation. Low but rugged hills, with uncleared sclerophyll forest generally mark the edge of the wool-growing country. The exception is the Jurassic sandstone patch, which has some dairying, and is highly improved in parts.

This large wool-farming area covers about one-sixth of the surface of Victoria and contains about one-
third (7.5 m.) of its sheep.

**Characteristics of the Wool Farming Area**

Throughout the area most of the land surface has been taken up for farming. Map 201 shows the proportion of the total land area occupied for farming to be over 70% in all the counties of this wool farming area, and in the plains county of Hampden it rises above 90%. Map 206 shows that the amount of unproductive farm land included in farm boundaries is low, and Map 203 shows that the same is true proportionately. The average size of holding in Ripon and Dundas, the two counties with fewest farms of other types, is about 1,000 acres (Map 205), and the relation of labour to land in the same counties (Map 232) is not intensive, there being less than 20 workers per 10,000 acres in farms. The carrying capacity of all livestock decreases from south to north or from the coast inland, in the wool farming area (Map 227) but the position is a little different when sheep only are considered, as on Map 235, because then it is seen that the farms of the six counties in the centre of the Western District are more heavily stocked with sheep than any other part of the state. Most of them have 800 and more sheep per 1,000 acres occupied.

Productivity is correspondingly high. Maps 242
and 243 show that the weight of wool from each sheep is fairly high to quite high, from 9 lbs. per sheep to over 11 lbs. and that the six central counties have the highest wool production per acre.

Cropping is unimportant except for hay, to judge from Maps 208, 210 and 211. For the most part from one-half to three-quarters of the land cultivated is in hay, and the percentage of the farm land cultivated is mostly less than 5% and not above 9% (Map 208).

**Breeds and Types of Sheep in the Western District.**

The Merino is the main breed in the wool farming area. At first glance the distribution maps do not seem to bear this out entirely. There is no doubt about the concentration of a large absolute number of Merinos in this part of Victoria; Map 234 shows this clearly. But Map 236 showing the percentage of Merinos to all sheep, reveals a big difference between the northern tier of counties and the southern ones; the northern ones have a preponderance of Merinos, the southern ones seem fairly low. The pattern of Map 238 needs to be taken along with 236. Maps 237 and 238 show the numbers and percentage of Merino Comebacks, and it is notable that the northern counties which were so dominated by Merinos have practically no Comebacks, whereas the southern ones have a moderate percentage of both, making a preponderance of...
Merino blood altogether. But again Ripon and Dundas are closest to the stereotype of the pure Merino wool-growing type-of-farming area.

Maps 245 and 246 which show the breeding pattern of these counties, confirm the heavy concentration of wool breeding in the six central Western District counties and in Lowan. This is particularly striking if one refers back to the maps of pasture distribution first examined in Chapter 3. According to the zonation drawn up on Map 9 the pastures of this zone are a mixture of permanent exotic pastures of the perennial clover and ryegrass types, and unimproved Danthonia grassland; Maps 121 and 122 confirm the prevalence of improved pastures and topdressing, and in fact this is the main zone in Victoria for both. It must be noted that the heaviest occurrences of both topdressing and pasture improvement are actually in the dairy farming zone south of this wool growing area, or in the Casterton-Coleraine locality. But very substantial acreages of improved pasture occur right through the wool zone, both in the centre and to the northwest. County Ripon is perhaps least improved of the wool counties, but it is certain that wool farming is being carried on increasingly using a higher quality pasture base.
There are some features of sheep types which may correspond to some of the pasture distributions and modify these generalisations to a minor extent. Map 252 shows the distribution of Merino strain (Comebacks and pure Merinos) as a background to the specific distribution of Merino Comebacks. Counties with more than half of their sheep of Comeback and Merino breed combined, are shaded. Except for Grenville, the southern tier of Western District counties has less than half of its sheep of these strains. But Maps 250 and 251 show the distribution of Polwarths and Corriedales to be quite heavily concentrated in these counties. Not so much with the Corriedale which seems fairly versatile but more particularly so with the Polwarth, which is mainly confined to the southern tier counties.

Of the 860,000 Polwarths in Victoria to 1950, 520,000 were in the southern counties, from Grenville to Normanby (but including County Polwarth itself, not included with these counties in the preceding discussion.) The Polwarth is essentially a substitute for the Merino in wetter conditions where fodder is in good supply, such as the southern counties with their cooler, wetter climate and greater amount of pasture improvement. But the Polwarth is still a wool animal.
Map 250 shows the distribution of Corriedales. They are more widely dispersed than the Polwarth; indeed instead of being confined to one quarter of the state, they are spread over more than a half of it, the Southwest and the centre and some of the Northeast. The Corriedale is an attempt to reach a compromise between the Merino and the English meat breeds, so that it is not surprising that it should appear versatile, and somewhat dispersed. This versatility is shown by its distribution inter-state also, as a map by the Bureau of Agricultural Economics demonstrates. Not only is it fairly widespread in Victoria, but it occurs also in considerable numbers in the eastern part of the Riverina, N.S.W. The Polwarth is not used outside Victoria and Tasmania.

Even taking account of the greater dispersal of the Corriedale the largest number is in the Western District (1.4 million of a total of 3.1 million) and more than a quarter of the Corriedales in Victoria are in the three southern counties of Hampden, Villiers and Normanby.

A survey of 1946 carried out in the Western Dis-

strict to investigate the sheep industry provides some valuable information on the reasons for choice of breeds. 6

Corriedales were regarded as dual-purpose sheep, commanding good prices as fat sheep, while cutting big fleeces of long staple. Corriedale rams were used on Merinos or Comebacks at times to breed back toward the coarser-wooled type. The Corriedale was a wool sheep primarily however, since it would not produce a good fat lamb at the right weight and time unless an English ram were used.

Merinos were universal on the poor pastures of the southwest and western edge of the area. Here probably no sheep did well, the authors felt, but Merinos fared better than others, even though their fleeces were light, and they probably suffered from malnutrition at times. Merino breeders were in the majority, and usually gave as their reason for running them, that they were fine-wool producers, or that Merinos "suited the country." At this time there was found to be a widespread prejudice against running Merinos on improved pastures. Farmers tended to the belief that

6. P.S. Lang, N.M. Tulloh, B.V. Fennessy, Survey of the Sheep Industry in the Western District of Victoria, School of Agriculture, University of Melbourne, 1952, Ch. 4, p. 74, et seq.
their wool became stronger by several counts, and that they were more prone to disease than on native pasture.

Research work has shown these beliefs to be largely wrong, but they are important because rightly or wrongly they influence farmers' decisions. Merinos were most numerous in the centre of the Western District plains where pasture improvement was least developed, on the Palaeozoic hills on the northern rim of the plains, and in the far west (called the 'redgum country' because of the ubiquitous E. Camululensis) where there was then little pasture improvement. Since that date it has made great progress in the west.

The Comeback was said to have the advantage of versatility in breeding, that is, it was possible by changing the ram to switch from wool towards meat, and if fleeces were becoming too coarse and the animals too heavy, to switch back again. Comebacks also appear to have the advantage of hybrid vigour. On the other hand Comeback flocks were often merely the result of unsystematic or careless breeding without any definite policy. Just north of Lake Corangamite and in the small spot of wheat/sheep country around Willaura, there was a moderate proportion of crossbred flocks, a part of which was usually intended for fat lamb production.
One of the problems of fat lamb breeding in the wool area is the lack of first-cross ewes suitable as mothers for fat lambs. Another is the lateness of lambing and weaning - lambing in June and weaning at the end of November - which means that prices are not as attractive as those of July and August. Map 134 shows the average date of lambing for different zones of the state, and while the main part of the wool area is not quite as late as its southern edge, nevertheless June is about the average month for the greater part of it. This point - of the lower prices for late fat lambs - partly explains why the proportion of wool sheep has remained roughly constant in the face of a rapid increase in pasture improvement. Another reason is the growing realisation that Merinos can be run on improved country without deteriorating. The Border Leicester was the most popular ram for fat lamb breeding. A further discouragement is that crossbred lambs have a higher mortality in the Western District than other breeds.

Shearing and Lambing

These two sheep activities are related, and the date of either one influences the other. Lambing needs conditions of weather not too cold, and with some green grass. Away from the coast, conditions are not as mild in mid-winter as they are closest to the sea, and so the
risk of cold snaps and exposure of lambs is greater.
Lambing should not therefore be delayed beyond June in
the south. Shearing should not be delayed into the
really hot summer weather because wool is a protection
from sun as well as cold. In the south and west shearing
is carried out as late as November, but is progressively
earlier to the north and east - September in the north.
So although conditions are suitable for lambing in the
spring, say September, with warmth and grass growth, the
lamb would then be in the way at shearing. This factor
pushes back the date of lambing to just prior to the
coldest snaps of the winter. Should the autumn happen to
be a dry one the gamble turns out badly, and it is an
unfortunate fact that spring rains are much more reliable
than autumn ones.

Of the Border Leicester, Dorset Horn and Romney
Marsh, whose distributions are shown on Maps 255, 254 and
253, only the Romney Marsh is more common in the wool
farming southwest than elsewhere in the state. Since fat
lamb farming is unimportant here compared with the north­
ern parts of the state, the role of the British breeds
is connected more with breeding Comebacks and crossbreds,
than with their use as fat lamb sires. But stud flocks
are important also in providing rams for associated fat

lamb flocks, and probably for selling rams out of the District to other farmers.

The Romney Marsh is known to be used much less than the other two British breeds (on the above maps), for special purposes, so that to explain the large numbers in the state altogether, and in the area in particular one needs to assume that they are ordinary flock sheep in a number of cases, or associated with Crossbred flocks. Romney wool is certainly more acceptable than that of the Dorsets because it is long, while the Downs breeds have short wool which is worth less.

Cropping

It has already been pointed out above that the proportion of farm land cultivated in the wool counties is very low. But there was a boom in wheat in the period 1910-1916. It took place mainly in County Ripon, but cultivation has declined steadily since then. Nowadays cropping is associated with pasture improvement or with providing fodder reserves, so the survey found. Sixty percent of properties had cropped areas, and oats was the main item, both for oaten hay and as a cover crop in pasture sowing. There are two factors which will operate against an increase in cropping in future. Since the
present cropping is often part of a pasture improvement programme, the completion of this programme would mean that good pastures, presumably well-established, would have to be ploughed up if it was found necessary to keep some land under crop. But the improved pasture will make cropping of the present sort redundant, because grass hay from the improved areas will replace oaten hay as a reserve fodder. This trend is well under way; oaten hay is fast being replaced by meadow hay or silage through all the southern part of the state. Of course the question is not quite as simple as this, because there would be some level of prices between wool, meat and grain, at which it could become worthwhile to switch to grain. At that point, a system of ley-farming, such as is already found in limited parts of southern Australia, would become worthwhile and would make great use of the stored reserves of nitrogen which are now accumulating from the clover of the improved sward. Cereal crops can be grown easily in much of the wool zone; the decisive factors will be relative prices. In terms of the physical environment - the cooler summer and unattractive characteristics of the podzolised soil types - these things favour pasture over crops, but in many localities the balance is close.
Central and Northeast Wool Farming Area

The area is shown on Map 131 and the boundaries on the overlay to that map. The number of sheep there, is about 1,620,000, which compares with 7½ million in the Western District. This Western District wool farming area ends on the northern edge of the Central Highlands and the Western Highlands, for the most part, and this smaller wool farming area is a continuation of the same type of farming on the same type of country but further east. But between the two there is a strip of better soils and of different types of farming, which physically cuts off one from the other.

Where the Highlands front the northern plains, the soils change from red brown earths to poor podzolised types, on the hills and the farming changes to wool production. Rainfall is higher, but most of the hill country is as yet unimproved. It has only recently been found that much of this hill-country is deficient in molybdenum and that applications of superphosphate and traces of molybdenum, will lead to good responses in pasture growth. 8 The hills are sedimentary rocks of the Lower

Palaeozoic or occasionally they are granite.

A considerable part of Counties Dalhousie and Anglesey is within this farming area, with some part of Delatite. The average size of holdings is about 500-700 acres (Map 205), and the livestock carrying capacity much the same as that of the northern counties in the Western District wool area, that is about 5 to 6 acres per animal unit, or a bit better than 1 sheep to the acre of productive farmland. Like them also, there is not the same considerable area carrying sown pastures as in the southern counties of the Western District, but the acreage topdressed is quite considerable (Maps 121 and 122).

There is a high proportion of wethers on some of this country: up to 50% in Dalhousie and from 30% to 40% in Anglesey (Map 241). Equally the percentage of breeding ewes is no higher than in most of the Western District (Map 244). The weight of wool shorn per 1,000 acres is lower than in the southern counties, and is probably related to some noticeable differences in the balance of breeds. They are similar to the northern tier of counties in having a preponderance of Merino blood as shown in Map 252, but nevertheless the percentage of crossbreds is higher in Anglesey (Map 240) than in the southern wool counties. The gap between these two is in
the absence of special cases such as the Polwarth, which is quite important in the southwest, and in fewer Corriedales, also important there.

Lambing time is a little later than in most of the Southwest, occurring in mid-winter - June and July - rather than in late autumn (Map 134). Although this farming area is almost entirely on the hills there is a small strip which runs north to the plains. The reason seems to be that there are a few large runs here which work in lowland holdings with hill wool farms, using the country below mainly as holding ground and "hospital country."

South East Gippsland Wool Farming Area

South East Gippsland is a rain-shadow with poor soils. At first glance it might appear that the low rainfall of only 25 ins. on average, might be the reason for this area engaging in sheep farming rather than dairying. But there are one or two other localities in the southern part of the state where dairying is carried on with rainfall as low as this, for example the Bellarine Peninsula and the Stony Rises west of Colac. The soils are decisive: they could not support pastures good enough for dairying. They are podzolic soil types, in the south mainly the particularly poor deep grey sands with some rather better soils on the plains around Sale and Bairnsdale.
The sheep numbers in the southeast are estimated to be 630,000 which is almost two-thirds of the total sheep of Tanjil and Buln Buln counties, but as can be seen from Map 101, the sheep of these counties are largely concentrated in Buln Buln. This is not a fine wool district, and the Merino strain is less important than in most other wool growing districts. Tanjil, the county with the smaller sheep population of the two, has a majority of its sheep Merino and Merino Comeback (Map 252) but Buln Buln has as many Crossbreds as others. In fact breeding is somewhat backward and the sheep more nearly nondescript than in other wool districts.

The coolness and dampness of the climate is sufficient in itself to account for the larger crossbred element in the sheep, but also this part of Gippsland has been much slower to approach full utilisation than other parts of the state. Its nearest parallel in this characteristic is the far west along the southern part of the South Australian border. Some of these points can be seen on earlier maps; for example, unproductive land included in farm boundaries is particularly high in Tanjil, as can be seen from Map 206, and the average size of holdings in Tanjil is also quite high at 700 - 1,100 acres.
This wool region has a big potential although some of the improvements will be costly. It would seem an ideal environment for the Polwarth and Corriedale and this may be the future course, since it is not "early" enough to become a good fat lamb farming area.

**Omeo and East Gippsland Wool Farming Area**

This is a small wool-farming area lying in the headwaters of the Tambo River, and along some of the streams that become the Mitta Mitta. The valleys constitute a small rain-shadow surrounded by the main ranges of the Eastern Highlands, the slopes of the valleys covered with tussock and improved to a limited extent in better pockets. The sheep population is only 250,000.

**Northwest and Millewa**

In the extreme northwest there is a number of parishes with a very small sheep population, in the driest part of the state. An attempt was made to start a wheat settlement along the railway to Morkalla, southwest of Mildura, but most of the land is now being changed back to sheep farming only. Of course, cropping will take some time to die out. Meantime the types of sheep are mixed, mainly wool-growing, but some fat lamb breeds. A good deal depends on the season, as to what the sheep farmer decides to do.
As indicated in Map 134, lambing is variable in time depending on the seasonal prospects, but usually fairly early. If the gamble is favourable, and there is some autumn feed available, a good drop of early lambs may occur. If the winter or spring is dry, the sheep will be turned in on the remnants of the wheat crop. The largest area of grazing land is held on lease and is true "station country" and the average size of holding is the largest in Victoria (Map 135) that is over 2,000 acres. The livestock carrying capacity is very low, much above 40 acres of farm land per livestock unit (Map 227) or more than 5 acres per sheep. Surplus sheep are sold at Yelta, near Mildura in September each year, but these sales act for the most part as an outlet, not for Millewa sheep, but for the great stretches of pastoral country along the N.S.W. border, to the north. The total number of sheep is only about 50,000 in the wool farming parts.

Sheep Farming mainly for fat lambs

As noted above, there is a break in the sweep of the wool farming areas from the southwest into the hills and foothills of the Northwest. In this break, which occurs in the middle portion of the Central Highlands, there is a swath of country with different environmental conditions, and certain possibly significant historical differences, compared with the wool farming areas. The climate is not
noticeably different from that of the neighbouring wool areas, for parts of them are equally elevated and wet. Geology and soils seem to differ.

A good part of the wool farming of the Central Highlands is located on the Palaeozoic sedimentary and metamorphic rocks (Map 3) which surround Ararat, Bendigo and Castlemaine, and are found south of Ballarat. In other places the Ordovician and Silurian is not cleared, so there is no farming.

But north and northeast of Ballarat there are stretches of the younger basalts, which carry better soils than the Palaeozoic rocks that surround them. This point is one involving correlation not causation. The same basalt on the plains of the Western District is generally covered by some of the poorer and more difficult soils of the state, but in the Central Highlands the soils and farming on this geological type are better than is found to the south.

On the soil map, Map 7, only the krasnozem patch from Ballarat to the northeast is distinguished. But there is no doubt that there is also an intricate pattern of other soils of quite good quality. They are podzolised types in the main, but appear to respond better to pasture improvement. The term 'Solodic' is coming into use for
some of these soils, as noted by Leeper. In addition, there are patches of krasnozems scattered through the solodic types and probably some black earths, or what are often called locally, "chocolate soils". There is a very complex soil pattern here, but it is not well enough mapped to help this explanation.

The point has been laboured, but it seems safe to say that improved farming with fat lamb farming as a major interest, is carried on on the basalt country and on some of the granite (where not too steep), while around them the Palaeozoic sedimentaries support only native pastures and wool farming. Map 256 shows that the Border Leicester is the main English breed. The total sheep population in the Talbot part of this type of farming area is 600,000.

**Bourke Fat Lamb Farming Area**

West and northwest of Melbourne, there is another strip of basalt, again with soils types somewhat different from the general podzolised soils of the higher rainfall zone. The southern part of it, which is basalt on the Werribee plains is flat, but further north it rises slowly,

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9. G.W. Leeper, in *Land Utilisation in Australia*, Ch. 3, p. 49.

10. Like most conventional soil names, it is a source of confusion.
and eventually ends in a basin in the hills of the Central Highlands. Another strip, contiguous with the first but further east, leads north towards the Kilmore Gap.

These plains are in a rain-shadow caused by the ranges to the northwest and have a particularly warm and dry summer and a tendency to early spring. In these ways and with the red-brown earths, the environment is suggestive of the northern plains of Victoria rather than the south. Certainly it has many of the features of the northern plains. For example Bourke has as many crossbred sheep as Rodney, that is over 70%, and British breeds of rams are used to an overwhelming degree (Map 247). They seem to be mainly Dorset Horn to judge from Map 254, and it is worth remarking that the Dorset is used where there is an early and reliable spring.

Some of the preponderance of meat types of sheep is due to nearness to Melbourne rather than to any other factor. Some farmers are dealers, merely holding sheep till prices give them a profit. Others are not so much dealers as fatteners, particularly buying sheep and fattening them in the period of spring growth. The general pattern of farming is quite like that of the northern plains along the Murray due north of Melbourne. The sheep population in the area outlined on the overlay to Map 132, is estimated at 584,000.
Geelong & Goulburn Valley

There are a few parishes with fat lamb farming around Geelong. The main centre is due west of the city where a patch of Jurassic rocks supports improved pastures, but there are also some strips of better farming than the wool type, on strips of red-brown earths running to the north. The total number of sheep is about 60,000.

In the Upper Goulburn Valley in County Anglesey there is a thin strip of land along the river, on which there is a small area of improved pastures with a little dairying. Around it on the lower slopes of the hills, pastures are somewhat improved and there is fat lamb production. The sheltered basin seems to be warm enough for lambing to be undertaken in June and July (Map 134) which is later than in the main wheat/sheep areas. The Mansfield Basin to the east is a smaller basin, similar to the Goulburn but a little higher; lambing takes place there in the spring. Altogether in this fat lamb farming area sheep number about 300,000.

Northeast Plains and Foothills

Of the fat lamb farming areas outside the wheat/sheep belt, the Northeast has the largest sheep population. It is located partly on the plains themselves and partly on the foothills. On the flat land of the plains, it occupies a strip of country which is between the wheat/sheep
belt of the Northeast and the hills. In this strip the acreage of wheat declines to very little or none at all, although the surface is flat enough for wheatgrowing. Some other factor limits wheat production in the fat lamb strip; the possibilities will be examined in the next chapter (Chapter 7). As one descends from the hills towards the plains the pastures improve and the amount and effect of topdressing increases: subterranean clover is the basis of the improved pastures, with Italian ryegrass (Lolium multiflorum) or Wimmera ryegrass. Delatite is typical of the area. Maps 239, 240 and 244 show the great concentration of Crossbreds in the area: Map 244 the high percentage (over 80%) of breeding ewes, as in all the northern counties.

As pointed out above, the crossbred ewes must be of a Longwool Merino cross, deriving in the first place from the surplus of the woolgrowing areas. The Border Leicester and Romney are both popular but in northern Victoria, the Border Leicester ewe is the basis of most fat lamb breeding because it is able to thrive under hot conditions and its lamb matures earlier than that of the Romney. Maps 253, 255 and 256 show the distribution of the British breeds, and these are either rams for fat lamb breeding, studs to keep up the supply of rams, or flocks to keep up a supply of crossbreds. Dorset Horns, Southdowns,
and other Shortwool sheep would not be kept as flock sheep, and even with the Longwool breeds flock sheep are not common. In Delatite, Romneys and Border Leicester are about equally common with the Dorsets much less so. It is practically certain that the Romney ram is not used much as a sire of fat lambs in northern Victoria. Its distribution is in general very much to the cooler, wetter parts of the state as Map 253 shows, and if it is used with crossbred ewes in the northern fat lamb country south of the wheat/sheep belt, it is probably to produce mothers for fat lambs, to be used on cooler wetter country or in the irrigation districts. The Dorset Horn and the Border Leicester ram are the ones used in the Northeast strip, as sires for fat lambs. The Dorset Horn is not as important as the Border Leicester, and in fact the basis of the fat lamb type of farming in the Northeast is the Border Leicester, both as the strain in the imported crossbred ewes and in the rams used. Delatite is one of the few counties in which the Southdown is also of some importance as a fat lamb ram. Elsewhere in Victoria it is important only in the counties around Melbourne, and is considered best for cooler and wetter conditions than suit the Border Leicester.

Lambing is carried out from May to June on the plains, but the foothills cannot hope to lamb as early as
this, because they cannot fatten a lamb in midwinter.
Pasture improvement is a help in this direction, but has benefited the plains country more. The upper limit on the fat lamb type of farming is set by ruggedness of relief (that is at the point where there has been no pasture improvement for this reason) and by the colder climate of the higher parts of the hills, which of itself restricts the sheep type to the wool breeds. Aerial topdressing can bring big changes here, but has only just begun.

The total sheep in this area are about 700,000.

Sheep Farming for Meat : with Irrigation

Those localities in the mid-Murray which have water rights lower than 1 in 2 or sometimes with as much water as up to 1 in 1, usually concentrate on using their water supplies for annual pastures, watered in spring and autumn. The autumn watering brings on the pastures which are then ready for ewes to feed on before and during lambing in May and June. In fact there is some grass growth right through the winter, and in spring a further watering brings on the main growth of the year, which is used to fatten both sheep and lambs for sale in August and September. If the ewes are retained through the summer they feed on the burrs of subterranean clover, which provide a very sustaining fodder and can even be used to fatten young sheep.
Irrigation encourages specialisation on fat lamb production. Of 30 farms classified as "specialist producers" in a survey of fat lamb producers in Australia, nine of the 30 were in the irrigation zone of the Southeast of the continent, that is the Murray-Murrumbidgee irrigation areas. These specialist farms had the highest production of lambs of any fat lamb farms.

The irrigation farms also had the highest lambing percentage, and 20% of the lambs sold from irrigated fat lamb farms were purchased lambs not bred on the farm itself. But most farms also buy ewes and do not breed their own replacements, in this feature being no different from the general run of northern fat lamb farms. Some farmers specialise in fattening broken-mouthed and old animals quickly and in maintaining a rapid turnover of animals, or in straight out dealing.

The total sheep population within the boundaries of the main irrigation districts is about 1,300,000 and no real attempt has been made on the overlay to Map 132 to distinguish those parishes which have mixtures of sheep and dairy cattle, from the others which lack dairy cattle.

County Rodney is the closest to being an example of a county largely influenced by irrigation, although Gunbower is perhaps about the same. But in each case the position is complicated by the presence of some very concentrated dairying. This can be seen by comparing Map 227 which shows that Rodney has a high carrying capacity of animals, with between 4 and 5 acres per livestock unit with Map 235 where it rates a good deal lower than all the Western District counties, in sheep per 1,000 acres of occupied land. The difference is in the greater importance of dairying in the irrigated parts of Rodney.

Very typical of irrigation is the almost complete absence of Merinos or even of Comebacks, as shown on Maps 234, 236 and 238, and the low proportion of wethers (below 20%) Map 241, with an equally low proportion of ewes mated to wool type rams (Map 245). Moira is similar in many respects, but there is the complication in the case of Moira of a good deal of wheat/sheep farming (Map 130).

In general one can say, that although fat lamb farming with irrigation is an intensive form of sheep farming, it is carried on on annual types of pasture which are only moderately productive compared with the perennial pastures in much of the irrigation area. Fat lamb farming is, as it were, located toward the margin of intensity in
Livestock in the Wheat/Sheep Farming Areas

Most of the northern part of Victoria is occupied by the wheat/sheep type of farming. The way in which this was distinguished from other types is dealt with in Chapter 7 (below), but it is necessary here to point out some of the general features of raising sheep on wheat/sheep farms. They are little different from the methods already described for fat lamb raising: in fact they are similar, but with an emphasis greater than in the other fat lamb districts, on the seasonal nature of production.

The way in which this type of farming fills the northern third of the state, can be seen from Maps 130 and 131. This is of course the dryest part of the state, with a growing season decreasing with distance north. The wheat plant is well adapted to a short growing season, and to fit livestock farming into such an environment it needs a similar adaptation to the seasons. Fat lamb farming achieves this adaptation provided a minimum number of livestock needs to be carried through the summer, and most of the production can be carried on in the winter and spring when maximum growth occurs.

The wheat/sheep farmer buys the ewes he needs as adults, from what is mainly wool-growing country to the
north. There is a big saving here in not having to use his own limited pasture to carry a flock from which must come replacements for his own farm. The movement of these potential fat lamb mothers is all from across the Murray to the northeast and north of the Victorian wheat belt, and there seems to be hardly any flow from the wool-growing districts of Victoria to the south, into the wheat belt.

The date of lambing is shown on Map 134: the wheat/sheep belt is the earliest of any major district in Victoria. The lambs are born in time for their mothers to feed on the new pasture growth induced by the "autumn break" and they grow through the winter and spring while corresponding pasture growth occurs. Then they are sold fat, in July or August, before the pastures begin to dry off and finishing lambs for market becomes a problem. The choice of different breeds for this purpose, has been discussed in the earlier parts of this chapter, and the main combination was seen to be a crossbred ewe of Border Leicester/Merino strain, mated with a Dorset Horn ram, to produce an early lamb.

It is true to say of the main part of the wheat/sheep belt that the drier localities seem to produce the best fat lambs, to produce them early also, and so to fetch the best prices. Early production is imperative for the drier localities for another reason apart from prices. If
the lambs are not out of the way before the seeding of Barley grass, the seeds lodge in their eyes and wool, and blind them and reduce them to poor health and low weights.

The advantages of including animals in the farming system of the wheat/sheep belt are dealt with in Chapter 7, but can be briefly restated here. They help to maintain soil fertility by returning mineral wealth to the soil through excreta, and relatively little is sold from the farm in animal products compared with that exported in cereal and hay crops. The income from sheep grazed on fallow and on land being rested from cropping under volunteer pasture, compensates for the loss of income from crops themselves, while at the same time the lengthening of the rotation is an improvement in methods in so far as it halves the running down of soil fertility.
CHAPTER VII WHEAT/SHEEP FARMING
CHAPTER VII

WHEAT/SHEEP FARMING

Of the major types of farming in Victoria, the wheat/sheep type is second in importance.

Value of Production and Employment

The value of production of winter cereals averaged £38 million in the two year period 1949/51, and sheep associated with wheat-growing probably totalled 4,500,000 (see Ch. 6 above) giving rise to one-fifth of the value of wool, mutton and lamb produced. This would approximate £21 million, but is perhaps a little high because of the lower quantity and quality of wool produced from wheat/sheep type farms.

Altogether then the total value of production at the place of production would have been somewhat less than £59 million, or not far below one quarter of the value of production of all farm produce. The number of farms on which wheat is a major source of income was estimated as being between 6,000 and 11,000, and there is some support for this estimate from that of A.J. Holt, at 8,250.† Holt also found an average of two adult males per

farm unit which means that the labour force might be close to 16,000, although it has probably been reduced since his survey by depopulation and amalgamation of units.

To summarise the main economic features of the type of farming: the total value of production approximates £50-60 million, between a third and a quarter of the value of all farm production: there are about 8,000 wheat/sheep farms, employing up to 16,000 owners and workers, that is about one-sixth of the farm labour force.

Environmental Conditions

The environmental conditions for this type of farming have already been outlined in general above. The main features are sufficient winter rainfall for a quick-growing crop to complete its life cycle before the long dry summer period and a light soil suitable for frequent cultivation. Sheep have become possible with two further developments, one of them being a change from the simple wheat-fallow rotation of the early days of settlement and the other, the provision of water supplies by farmers themselves or by the State Rivers and Water Supply Commission. The soils of the wheat/sheep farming areas are moderately well suited to cultivation, and within the general area occupied by this type of farming there are localities with unsuitable soils and where because of this, the type of farming is different. Very
little wheat is grown in Victoria in rainfalls above 18 ins.
and little below 12 ins. per annum. These are approximate
limits but of course the amount of rainfall is a rather
cruder measure than one which takes season and effective-
ness into account.

Cornish has shown for South Australia, that a
rainfall of 17 ins. in the period April - October, gives
maximum wheat yields. However practically all of the
South Australian crop is grown in areas with lower totals.
The use of the period April - October would not quite suit
Victoria because both March and April rains are often of
considerable value to the Victorian crop, while too much
rain in October may actually threaten it. The location of
wheat-growing is most easily described within the effect-
ive rainfall zones as shown on Map 5 (Months of Effective
Rainfall in Victoria).

With a few minor exceptions, the great part of
the acreage of wheat for grain, shown on Map 105 would
lie between the lines of 8 months growing season and 5
months. In the area to the north with less than 5 months,
the growing period is not only too short on the average for
successful cultivation of wheat, but even with moisture

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2. E.A. Cornish, "The influence of rainfall on the yield
conserved in the fallow there is insufficient for reasonable growth. Also, on the northern edge the rainfall itself has a variability above 25% so that the crop is very risky and the amount of rainfall received is so low that average yields are likely to be below a payable level (Map 144). Accordingly the country north of Ouyen is being reconstructed from wheat/sheep farming to pastoral farming. Wheat-growing here is now little more than a relic.

The northern limit can thus be fixed not far north of Ouyen and on an east-west line through the big bend in the Murray River. The southern boundary of the wheat/sheep belt is roughly between 18 ins. and 20 ins. of rainfall, but rainfall is not the critical factor on the southern side. It is rather the change of soil and topography as the plains are crossed towards the Highlands, that sets the southern boundary. It seems likely that even should the plains continue to the south, wheat would decline in importance not far south of the present boundary, but there is really no place where this generalisation can be tested, except perhaps in a narrow zone to the southwest of Horsham. It is interesting to note (Map 144) that in this zone yields per acre are on the average 18 to 21 bushels per acre which is below the yield of the wheat belt to the north.
Temperatures do not affect wheat distribution, because the range of temperatures during the growing season is not great and varieties can be found for the cooler and warmer localities. Occasionally late frosts in spring may spoil some flowering wheat but this is rare.

**Southern Boundary of the Wheat/Sheep Zone**

The southern edge of the zone will be examined in more detail from west to east, to determine the limits to wheat on the south. From Serviceton to Dimboola (Map 11) there is the long strip of scrub marked as Sand without Profile on Map 7. Some of the poor sand of the Little Desert or the Big Desert (the northern edge of the Dimboola strip) could possibly be brought into production, like the land around Keith in adjoining parts of South Australia. From what has happened in the A.M.P. development, it seems likely that the type of farming would be one based on the sale of fat lambs and some wool, and that the cropping which accompanied the first sowing of pastures in South Australia, would become less important with time and with pasture improvement.

Only from Natimuk to Horsham, do the northern plains continue to the south uninterrupted. It is interesting therefore that here also the type-of-farming should change to one in which grain is unimportant (Maps 133 & 131). East of Natimuk, the Grampians interpose themselves between
the wheat/sheep zone and other types of farming, and then the boundary follows the northern edge of the Highlands to the north of St. Arnaud and Wedderburn (Map 11). This is also the line of change from red-brown earths to podzolic soils, and from the black earths of the Wimmera to podzolic types on the higher land. At some points the importance of a change in soil type is emphasised, even on the lower country. For instance, along the line of the creek which flows from Glenorchy to Rupanyup (Map 11), one can see the effect of the silty soil around the creek on farming. There is a change from wheat/sheep farming on the red and black ground, to sheep for wool in larger holdings on the riverine material.

The Loddon River marks a break in the wheat/sheep zone. On the east of the Loddon are the grey and brown soils, not amenable to cultivation because of their heavy texture (Map 7). To the south there is still a strip of red-brown earths, and on these is a strip of wheat/sheep farming from Dunolly to Rochester. This zone finishes at the edge of the Goulburn Valley, where irrigation becomes important, and then wheat appears again on the plains of the Northeast, its southern boundary coinciding with the southern edge of the red-brown earths. 3

In general it can be said that the southern boundary of wheat coincides with a rainfall of about 18 to 20 ins. but that this is mainly because rainfall, soils and topography all change together as the Highlands are approached. Even so, with rainfall above 18 in., as in the southwest of the Wimmera, wheat falls off rapidly in importance, and it seems that a farming system based on pasture and the sale of meat and wool is more profitable than a wheat/sheep type of farming.

**Soils and Wheat/Sheep Farming**

Across northern Victoria in the general region of wheat-growing, five main soil groups are shown on Map 7. Not all of these are equally suitable for wheat. Two types are anathema to cultivation, the Sand without Profile, and the Grey and brown soils - those of heavy texture. Some of the major gaps on Map 133 are due to unfavourable soils; on the western border the two main blanks are areas of Sand without Profile, and a third such marks the southern boundary on the border. In a general way, also the unsuitability of heavy-textured soils for cultivation explains the large gap which lies in the middle portion of the course of the Murray. On the eastern side where the heavy-textured soils are replaced again by red-brown earths, it is irrigation development which has precluded wheat farming.
Natural Vegetation

The natural vegetation of a district was early taken as a descriptive type-of-country classification of the land. It was likely to be a useful one because often the vegetation has been fairly sensitive to differences in soil and climate and reflects them to an extent. 4

The grey and brown soils of heavy texture and the red-brown earths were more suitable to easy cropping at first because they were savannah country (Map 8) and relatively few trees needed to be removed. The Mallee was a different problem however, and it was partly for this reason that it was settled much later. Before the domestic and stock water supply schemes were constructed to the Mallee, it was very difficult to water horses and keep up domestic supplies, and sheep farming was not practicable. There are no surface streams in the Mallee and little chance of conserving rainfall because of the porous sandy nature of the soil. The number of sheep in the whole of the wheat/sheep belt is only moderate; in 1951 it was 4,750,000 approximately out of the state total of 20 million, or about a quarter of the whole.

Soil Types and Methods of Wheat-Farming

Of the three soil types suitable for wheat-growing

the black earths of the Wimmera were found most difficult to deal with at first. They became sticky when wet and could not be cultivated after rain. In the long run Wimmera farmers came to use a special plough and to delay sowing until late in the season, as recorded by Wadham. The Wimmera soils are now accepted as the best for wheat-growing and the red-brown earths, which were at first so easy to cultivate because of the crumbly nature of the soil, and the relative lack of trees have shown some deterioration over the last few decades.

Early farming methods made a drain on soil organic matter, because wheat was grown every second year and in the early days even the stubble was burned. In addition the early wheat-fallow rotation meant very frequent cultivation which tends to destroy the particles of the soil. Not only have the red-brown earths been cultivated longest of the wheat-growing soils, but they appear also to have suffered the greatest amount of damage of this sort. It is probable that the content of organic matter in all wheat soils is still declining, because there are so few localities where the rotations now used return organic matter.

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Dry Farming

Early in the history of Australian wheat-growing it was round that fallowing was essential before growing a crop. It was long thought that this was because the cultivation broke capillary tubes which would otherwise take moisture to the surface, but it was later shown that the virtue of fallowing was in the destruction of weeds which would otherwise have consumed some of the moisture it was intended to store. Later still it has been demonstrated that this suppression of weeds does more for the following crop by conserving soil nitrogen released prior to sowing, than it does by conserving moisture. Any other method, including weed spraying or eating down of weeds by sheep on rangistment, will accomplish the same result of improving the yield of the following crop. This discovery offers a chance of halting the progressive deterioration of soils which must continue to some extent, as long as there is frequent cultivation.

Farming Methods and Soil Deficiencies

Both phosphorus and nitrogen are at low levels in the soils of southern Australia. The Wimmera soils were the exception in this, that they had naturally high levels of nitrogen and herein lies part of the reason for their consistently high yields.
But it was realised before the beginning of this century that a deficiency of phosphorus was crippling the areas of repeated cropping. Superphosphate was then adopted until today there is no cropping carried on without prior topdressing. But the nitrogen deficiency was more difficult to deal with. Nitrogenous fertilisers are too expensive for a broad-scale crop like wheat, and known legumes would not grow in low rainfalls such as those of the wheat-belt, even if they could be shown to be commercially practicable. No clear way out of this dilemma has yet emerged. On the southern part of the wheat-sheep zone, subterranean clover has proved practicable in sown pastures grown between the cropping phase of the rotation, but this implies longer rotations than in the past. Certainly it means an abandonment of the wheat-fallow rotation of old. In many of the best parts of the south - around Horsham for example - farms are so small that there is a compulsion to continue the wheat-fallow rotation as long as yields are maintained. Surprisingly enough they are still being maintained. This is due to the breeding of new varieties, and a more exact timing of farm operations rather than to there being no fall in fertility.

The general point is this: Where subterranean clover will grow best - that is on the southern fringe of the wheat/sheep belt with higher rainfall - there are still farms
which cannot use it, because they are too small to have room for stock.

Length of Rotation and Methods of Wheat-growing

Elsewhere there has been a general trend to longer rotations which include wheat less frequently, and give the soil more rest and a better chance to preserve fertility, even if not positively to build it up.

Fallowing is almost universally used for wheat-growing. In 1950-51 the area fallowed was 2,153,000 acres and the area under wheat was 2,498,000. The fallow area was almost entirely in the three northern wheat-growing districts: Wimmera, Mallee and Northern. This suggests that fallow precedes about 85% of the wheat crop, though the figure should perhaps be lowered a little to allow for a little fallowing of other types.

In the long run, then, few farmers would plan to sow much wheat without fallowing. The fact that some is sown without fallow is partly due to sudden alterations of long-term plans. But it is very difficult to find an average of farming systems, that one can confidently apply to a locality. The remarks that follow are therefore very general and it is not surprising that they cannot be supported

7. See Col. 6, Appendix 4.
by local or regional statistics, because in practice very few farmers have the same rotation even on any one paddock.

**Long and Short Rotations**

From the wheat-fallow rotations of the early days, farming methods have slowly changed towards longer spells between crops. The longest rotations are on the northern edge of the wheat belt where it is common to find a four-year rotation, consisting of one year of cropping followed by grazing for two years, and fallow. Sometimes oats follows the wheat crop and the rotation is wheat, oats, volunteer pasture, fallow. The length of this rotation is reduced in the south and on the western and eastern edges of the wheat belt, by restricting the grazing to one year.

The longer the rotation the more space and attention is available for sheep. On the other hand in localities with low rainfall (those which tend to have the longest rotations) there is less grazing for livestock. Sheep cannot be carried where wheat-fallow rotations are still being followed, because there is so little fodder for them. Are there any discernible differences in the wheat/fallow relationship, which might have further effects on sheep carrying capacity?
Ratio of Fallow to Wheat Acreage: Wheat Counties, 1950/51

<table>
<thead>
<tr>
<th>Mallee</th>
<th>Wimmera</th>
<th>Northern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Millewa 36%</td>
<td>Lowan 88%</td>
<td>Bendigo 68%</td>
</tr>
<tr>
<td>Weeah 87%</td>
<td>Borung 83%</td>
<td>Moira 51%</td>
</tr>
<tr>
<td>Karkarooc 82%</td>
<td>Kara Kara 77%</td>
<td></td>
</tr>
<tr>
<td>Tatchera 74%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The largest proportion of fallow is in the Wimmera: Lowan 88%, Borung 83%, while the western and southern part of the Mallee is almost as high: Weeah 87%, Karkarooc 82%; the eastern Mallee is lower: Tatchera 74%, Bendigo 78%, while in the east in Moira county the proportion is as low as 50%. In the eastern parts of the wheat belt, more wheat is sown without a year's preparatory fallowing, than in the west.

Place of Oats in Rotations

Oats is very often sown following wheat, but it has varied purposes: It may be sown for grain, for hay, or for grazing. Often the growing crop is grazed in any case, and the final purpose may depend on the condition of the oats towards the end of the season. Oats follows wheat without fallowing rather than preceding it, since the price of oats is lower and the second successive cereal crop from the same paddock will be lower in yield than the preceding one. Oaten hay is declining in importance because of the work involved in cutting and stacking it, and instead of conserving hay against drought, wheat farmers are harvesting
the oats and storing the grain in small farm silos. Oats for grain is the main crop, but in 1951 half the grain area was cut for hay, and only a small area was entirely fed off.

The area of oats for grain is usually about 500,000 acres, and of oaten hay more than 200,000 acres, but in all the wheat-growing counties in the north, oaten hay is at least half of the hay acreage. In the Mallee it is as high as 90% in Karkarooc. The only alternative to oaten hay which is of any importance, is meadow hay and this is not practicable in the Mallee. In odd counties wheaten hay is important, notably in Borung, which is the central part of the Wimmera. This is probably due to the fact that there is not the same place in the rotation for oats, as there is elsewhere. Map 106 shows the distribution of oats which can be seen to be absent from the localities with a great concentration on wheat.

**Wheat Yields per Acre**

Map 144 shows the yields of wheat per acre in shires as a weighted average of the years 1948/9 to 1951/2.

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Shires in which the acreage of wheat was very small have not been shown. The range of yields is from 6 to above 28 bushels per acre, and the figures have been grouped in seven classes, of which the two lowest are not found outside the Mallee. 6 to 9 Bushels is found only in the Millewa and is part of the evidence that it is not an important or typical wheat locality. A large part of the northern edge of the Mallee proper, from Sealake to Ouyen and Murrayville had yields of only 9 to 12 bushels. The next category, from 12 bushels to 15 bushels is found only around Swan Hill - Northern Mallee - and a small locality not important for wheat, at the Echuca bend of the Murray.

The state average yield is about 15 to 18 bushels an acre and this is to be found in the middle of the Mallee and on the northern edge of the central Wimmera, as well as on the southern fringes of wheat-growing where wheat is again unimportant. The higher yield of from 18 to 21 is found in a small locality of the Wimmera proper, as well as in most of the eastern parts, from Echuca to Rutherglen. The very small locality in the Western District also has this fairly high yield. The southern edge of the eastern part has a very high figure, above 21 and up to 24 bushels and this is also the average in a large belt across the middle of the Wimmera.
The highest yields are around Horsham itself and both east and west of it, with a large area on the eastern edge of the Mallee also reaching yields from 24 to 28 bushels. This latter should be ruled out because not only is the acreage of wheat very very low, (see Map 105) though not low enough for these shires to be excluded, but as well, some of the acreage is almost certainly irrigated. The latter is not a practice of any importance but it raises the yield per acre. To relate the yields to environmental features: the red-brown earths and the grey soils of the Wimmera have the highest yields, the latter being the only soil type with the peak yields of up to 28 bushels per acre. But the red-brown earths of the eastern section are all above the state average in their yields. The Mallee has moderate to low yields of less than 18 bushels per acre, all of them below the state average and they drop fairly regularly to the north with the decline of the length of the growing season and of total rainfall.

Scale of Values between Sheep and Wheat

As explained in Chapter 5, some arbitrary value had to be struck between wheat and sheep. Nine bushels was taken as equivalent to one sheep, and this makes 72 bushels equal to one animal unit. The average yield of wheat per acre is 18 bushels, so one animal unit would equal 41 acres.
Practically all of the Mallee is at or below this figure in yield, and all of the Wimmera and the eastern wheat areas above it. Some allowance needed to be made for this latter fact, but how much it should be depended on the amount of a real subdivision which was considered practicable.

The most important part of the Mallee, the southern Mallee from Birchip to Sealake, just reaches the state average yield of 18 bushels, but yields are much lower to the north. It was decided to divide the wheat belt into two, using a figure of 5 acres of grain equal to 8 sheep in the Mallee, and a figure of 3 acres equal to 8 sheep in the Wimmera and the eastern wheat-growing districts. Although the other cereals are not as valuable as wheat, and their acreage should therefore not count as highly, it was not possible to take account of this difference and accordingly all cereals were counted as wheat.

**Wheat/sheep Balance of Parishes**

All parishes of the wheat/sheep belt were assessed as being of one of two categories. Either:

a. Wheat/sheep approximately equal,

b. Grain more than twice as important as sheep.
In a., 72 bushels are taken as equal to 1 animal unit or 8 sheep, and neither element was more than twice as important as the other. This ratio (the one used in a.) gave a fairly wide limit to the measurement of localities on both the wetter and drier sides of the wheat/sheep zone, where grain was not of great importance but sufficient to be a definite part of normal farming. The anomalous locality was the Millewa but it could not be expected that any system could measure it adequately.

The wheat/sheep farming areas are divided into these two types on Map 133: one type is that in which grain and sheep are of about similar proportions (or up to twice the value of the other), and the other type is that in which grain is more than twice as important as sheep. The geographical pattern shows consistent changes from the one central block outwards: in the centre wheat is of great importance and sheep are a lesser interest, but nearly all the peripheral zones have a lower ratio in which grain and sheep are of about equal value.

**Wheat/Sheep Type-of-Farming Areas**

Maps 131 and 133 supply two different types of characters on which the wheat/sheep farming areas can be described. One is the alternative types of sheep enterprise,
that is either wool production or fat lamb production, and of these two the fat lamb type is much the most important. The other is a division into:

a. grain and sheep of about equal importance,
b. grain more than twice as important as sheep.

To these can be added the average yield shown on Map 144. Holt\(^9\) divided the northern part of Victoria into 13 zones, on the basis of:

1. climatic and soil differences,
2. average yield,
3. type of farm organisation,
4. relative agricultural age.

The first and second criteria are very closely related and Map 144 should sum up the relative position. The third factor is that shown on Map 133, and the fourth which was very important for the purposes of his survey—a sociological one—is not so important here.

The divisions proposed to be used in this study are shown on the overlay to Map 133, and are the following:

- Mallee
  1. Millewa
  2. Mallee northern fringe

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Mallee (Cont'd.)

3. Murrayville Corridor
4. Northern Mallee
5. Southern Mallee

Wimmera

7. Central Wimmera
8. Western Wimmera
9. Eastern Wimmera

Northern District

10. Dunolly-Rochester

There is very little difference between Holt's divisions and those proposed to be used. The Millewa and the northern Mallee fringe are districts in which wheat is now of only small importance in the type of farming, and so they need not be considered further as wheat/sheep districts.

Murrayville Corridor

This district is a small one, occupying the western end of the long corridor from Ouyen to the South Australian border. It has a growing season of five months (Map 5), though this is possibly a little generous, and it also has the typical sandy Mallee soil. Stock and domestic water is supplied by bores. Yields are low - between 9 and 12 bushels per acre. Murrayville differs from the
Mallee to the east in the importance and type of sheep farming. Its sheep are predominantly kept for wool (Map 130), and the ratio between sheep and grain is about evenly balanced, whereas in the rest of the Mallee grain is much more important.

Why should this locality be different? Its physical conditions seem to be approximately similar to the rest of the Mallee at the same latitude. The Western Wimmera has these same features, and is correspondingly different from the neighbouring Central Wimmera. Both of these localities grow more barley than neighbouring localities further east (Map 107). Barley has been included along with wheat and oats in the total of "grain" for each parish, on which the grain/sheep map (133) is based, and so barley is not one of the explanations for the differences to be seen between the farming of these two places and those further east. But it may be indicative.

10. It is true that its climate may be a little less trying than that of places due east. Map 4 shows that the isohyets curve northwards between the centre of the Mallee and the western border, and the Murrayville climate is more reliable than that due east (Map 6), but all that this does to the argument is point out that similar conditions to those of Murrayville will be found closer to Sealake than to Ouyen. Another difference to be noted, and perhaps a significant one, is that the Murrayville soil is said to have a clay layer at depth, which is retentative of moisture, but it seems probable that it is not the only part of the Mallee which has this feature.
The Murrayville Corridor is also the only place where rye is important as a grain crop. It is easy to overemphasise this, as rye occupies only 13,000 acres in the whole of Victoria, but as Map 217 shows the crop is concentrated here. Rye is actually suited to cooler summers than those of the northern Mallee, but it is grown here, because it has been found to be the most successful binder of sand ridges against wind erosion.

Usually rye is planted and left, not being either grazed or harvested, because both practices reduce its binding qualities. Also, the tops of the ridges are not easy for machinery. But where the soil has been held by earlier treatment, the more enterprising farmers now take off a grain crop if the topography allows.

It is hard to say precisely, what influences and conditions have combined to make these localities different. The location along the State border may be indicative: they are both on the border, and it may be that they have been influenced by agricultural developments in South Australia. Barley is especially important as a main cereal crop in South Australia, and other innovations in the wheat/sheep type of farming have originated there. It has been much ahead of Victoria in popularising pasture plants
(clovers and others) for wheat belt environments, and this innovation is the sort that would be likely to make sheep more nearly equal to grain in importance.

There are two pasture plants in use round Murrayville, which are not yet common in the rest of the Mallee. These two are lucerne and Evening Primrose (Oenothera vars.): the former is found on clay flats between the sandhills, and its roots seem to reach down to 20 ft. or more to moist layers. Evening Primrose is not in general use elsewhere in the Mallee, though well known in the drier parts of South Australia. As a matter of fact, agricultural experts in Victoria caution farmers against using perennial pasture plants, especially lucerne, in wheat-growing country, pointing out that the result must be to cut down the amount of cropping land available — each crop means that a considerable cost must be incurred to replace the long-lived pasture. But whether it is the cause of the lower ratio of cropping to animals at Murrayville, or whether it is an effect of having land not suitable for cropping, is difficult to judge but the probability seems to rest with the latter.

Another influence is that of the South Australian territory just beyond the border — this is very poor land
which is either unused, or occupied for sparse sheep grazing for wool production.

**Northern Mallee**

The Northern Mallee has a growing season between 5 and 6 months (see Map 5) and the average yield of wheat is from 9 bushels to 15 bushels per acre. The average size of holding is from 700 to 1,100 acres (Map 205) but this is too low for it to be anywhere near the size of operating farms, which are probably as large as 2,000 acres. Cultivated land is between 6% and 7% of total farm land (Map 208) which is as high as anywhere in Victoria.

The carrying capacity is low, for the most part one animal to more than 40 acres (Map 227) and the ratio of labour to farm land (Map 232) is also low, at from 11-20 workers per 10,000 acres in farms.

The common rotation in the Northern Mallee is between three and five years: it varies from wheat-pasture-fallow, to wheat-oats-pasture-pasture-fallow. The oat crop is not an invariable part of the rotation but is very common, either for grain or for grazing off. The pasture is merely the voluntary growth following a grain crop. A large part of this volunteer growth is weeds and some of the weeds are a menace to sheep or to subsequent
These points serve to emphasise that the "pasture phase" is a difficult one in the Mallee, and that its growing importance does not yet mean a painless transition to ley-farming and mixed farming.

When a reliable grass-clover mixture is generally adopted the relative importance of sheep will rise sharply.

Southern Mallee

This is the sound heart of the Mallee. It has a growing season of six months, a very large total area under crop, a moderate but considerable sheep population, (up to one million sheep), and wheat yields of from 15 to 18 bushels per acre. Its western boundary is the worthless sand of the Big Desert, its eastern edge a line running roughly from north of Donald to Sealake (Map 11) but with a deviation to the west around Birchip. The same line can be seen in a generalised form on Map 8, with Mallee scrub on its western side and Temperate Savannah and savannah mixed with woodland, on its eastern side. On the east the typical sandy soil of the Mallee begins to give way more and more frequently to silty and/or, clayey patches: the latter are described as 'plains' to distinguish them from

11. Paddy melon (Cucumis myriocarpus) is poisonous to sheep, and obstructs cultivators: Rigid ryegrass (L. loliaceum) obstructs implements also, and other obstructive weeds are Turnip (Rapistrum rugosum), Saffron Thistle (Carthamus lanatus) and especially the almost ineradicable, Skeleton Weed (Chondrilla juncea).
Mallee sandhills. To the east these 'Windswept plains' become more and more frequent.

In the Mallee proper, rotations tend to be shorter than further north, but even so the main emphasis is on wheat rather than sheep, which still have only a minor place. Stock and domestic water is supplied by a channel system with its source in the Grampians and the Goulburn Valley. The authorities are encouraging farmers to sow Barrel clover on spelled land, and there seems good reason to believe that it will eventually be shown to be suitable over most of the Southern Mallee. The problem of a clover for this climate and soil type will then be solved, but the resulting pastures lack balance: as yet there is no satisfactory grass. Some innovators suggest that farmers must become reconciled to Wimmera rye grass, which most of them dislike because its growth is stimulated by cultivation and it then obstructs implements and competes with the wheat. After the first year a grass of some sort will come into the sward, but before it does the weeds may be a menace to the health of sheep, and the volunteer grass will probably be an unwanted plant such as Barley grass, which is a menace to lambs when the grass is seeding. Some farmers solve the problem of pasture balance by sowing oats with Barrel medic. What the eventual pasture system will be is not clear, but it will probably include Barrel medic.
Oats is as important in the Southern Mallee as anywhere in the wheat belt, but it is noticeable (Map 106), that there is a gap in the southeastern corner of the district: it seems likely that this is due to the heavier soil of the Birchip plains. It can be seen also as a gap in the wheat crop on Map 105.

Barley (Map 107) is largely concentrated in the Southern Mallee. It requires a sandy soil but with cool conditions, and this combination exists only on the southern edge of the Mallee (soils are too heavy to the south) and on the western side, which is more sandy than further east. Where barley is included in a wheat rotation, it follows wheat and is usually sown without a long fallow, but with only a quick preliminary "working up" of wheat stubble. This cheapens the cost of production and makes it a profitable crop in spite of prices lower than those for wheat. Other rotations, such as barley-barley-volunteer pasture-fallow, are common.

Southeast Mallee

This subdivision is notable for its high yields of 24 to 28 bushels per acre, and Holt named it Mallee fringe because he considered it an area of transition from mallee to northern plain country. "Alternate tracts of plain and ridge weave in and out of the whole zone."12

It has from six to seven months of growing season, and a rainfall of about 14 ins. Sheep are relatively as important as grain, and the reason for this must surely be the mixture of plain and ridge country, the sandy soil types being heavily cropped, and the plains country given over much more to grazing and infrequent cropping. If this is the case— that is that cropping is concentrated on the land best suited for it—this may also be the reason for the high yields of the subdivision, which are otherwise difficult to explain. Another possible explanation given for these high yields was that the Cannie Ridge, one of the broad sand ridges which are a feature of the Mallee, had the highest yields of the Mallee. But only the southern tip of the ridge lies in Kerang Shire, and it is Kerang which has the high yields shown on Map 144. It seems more likely that these are due to the irrigation of a proportion of the wheat acreage, in the irrigation district to the west of Kerang (Map 11).

Wimmera District

The Wimmera is probably the most remarkable wheat-growing district in the whole country, both because of its high yields—shire averages of up to 28 bushels per acre—and for the unique soil type on which they are grown. The soils are heavy-textured but friable, and have alternating grey (or "black") and brown (or "red") phases.
The brown phase has some similarities to the red-brown earths of the Northeast. On the northern edge of the main grey soil zone there is a strip of intimate intermixture of Mallee and grey soils (Map 7). The red soil phase in the Wimmera is sometimes clayey, sometimes sandy, the latter occurring especially on higher ground, and overall the red soil is not as good as the grey for wheat, so is cropped less often.

The southern fringe of the Wimmera has sufficient rainfall to grow subterranean clover, which flourishes on the red soil phase, but does not do so well on the grey phase. The grey soil is more suited to Barrel medic (M. tribuloides), which is best established by being sown under a cereal crop. On much of the grey soil the so-called 'native clovers' have long been present: species such as Cluster clover (T. glomeratum) and others detailed in Chapter 3, but Barrel medic is usually more productive than these species and lacks their objectional burrs. The northern limits of proved establishment of Barrel clover and Subterranean clover are marked on the overlay to Map 9, and again on the overlay to Map 133. Between these two lines Barrel clover is almost certainly practicable everywhere, and in a few localities the Dwalganup variety of Subterranean clover.

clover has been successfully established. North of the
dotted line Barrel clover is being grown, but not all
attempts have been successful.

For a balanced pasture a suitable grass is needed,
and it should be an annual grass in a cropping region of
this type. Wimmera ryegrass and some other of the exotic
annuals will volunteer on stubble, but Wimmera ryegrass is
disliked because of its vigorous growth after cultivation,
and the other grasses have worse disadvantages.

Some advise reliance on self-sown cereals, which
spring up from dropped grain, and will take the place of
a grass for one year. In the following year it is suggest­
ed that a light seeding of oats will exclude Barley grass
and other undesirable species. 14

The Wimmera appears not to be as heavily cultiv­
ated as the Mallee, to judge from Map 208, except in the
central portion where up to 7% of farm land is cultivated:
as high as any part of the state. Although grass hay is
of some importance here, whereas in the Mallee it is un­
important (Map 214), oaten hay still makes up more than
half of the hay conserved (Map 215). But the position is
changing rapidly towards predominance of grass hay. The
carrying capacity is still on the light side, but better

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in the western part of the district (Map 227), and the ratio of labour to farm land is as low as the Mallee. Of course these figures are all influenced by the inclusion in the Wimmera figures of the southern parts of these counties, which are sheep country without cropping.

Central Wimmera

The Central Wimmera usually produces the lowest quality wheat in Victoria, as judged by protein content. This wheat gives flour most suited to biscuit production and below the standard for breadmaking. The modern varieties are superior to their forerunners in protein quality, but when these superior varieties are grown in short rotations like those of the Central Wimmera, the grain protein content is lower, than it would be if a pasture spell were included in the rotation. There is no doubt that a general lengthening of rotations in this locality would raise wheat quality but under the present marketing system in which payment is made on bulk alone, farmers have no incentive (in their returns from wheat, at least) to improve their farming practices.

Quality is also influenced by climate, and the wetter climate of the Wimmera is unfavourable to the

maintenance of high levels of soil nitrogen during the growing period of the crop. But farm practices are the major variables, and the most intensively worked grey soils are now the lowest in soil nitrogen, and consequently produce poor quality crops.

**Western Wimmera**

Almost all of this locality will grow one or other of the two main legumes with certainty, mainly because of the rainfall which is both higher than that of the Central Wimmera and more reliable. In general the soils are not as favourable to cropping as those to the east, particularly in the greater occurrence of sandy rises of red soils, as well as more of the red clayey phase of the Wimmera soil. However the yields of wheat are high, as high as most of the Central Wimmera (see Map 14).

Here sheep are much more important than in the Central Wimmera and in the Mallee, and possible causes have been suggested above. Holt notes that farms are larger here and that sheep are kept for wool rather than fat lambs, but does not suggest the reasons. These differences would seem likely to be related to the distinctive features of climate and soil in the Western Wimmera, and also perhaps to the tradition of wool farming and large holdings in nearby parts of South Australia.

**Eastern Wimmera**

The Eastern Wimmera is located on a different soil the red-brown earths, which extend from Donald east to Yarrawongan. Like the Western Wimmera this is a district in which grain and sheep are of about equal proportions, in contrast to the dominance of grain in most of the Mallee and the Central Wimmera. There is a small locality in the middle of the Eastern Wimmera, which is an exception to this generalisation; actually a strip of grey soils known as the "Little Wimmera" and with a heavy concentration on grain. Yields of wheat are lower here than to the west, but not much lower; they average from 18 to 24 bushels per acre, with a southern fringe of higher yields. As with the Central Wimmera, the boundary of the wheat/sheep belt to the south, is the rising ground of the edge of the Highlands. The eastern boundary is the Loddon River, beyond which soils become increasingly silty and most of the land has been left under grass for a long time.

A distinctive soil found at Charlton and derived from granite, has proved particularly susceptible to gully erosion and the country is badly cut up. On the narrow southern fringe of the Eastern Wimmera Subterranean clover grows well, but north of it there is only a narrow zone in which Barrel clover is at all successful. Thus although
sheep are relatively more important here than in the Central Wimmera, the potentialities for pasture improvement are less, and the pasture species are more like those of the Mallee, volunteer annuals of low quality being more common. This characteristic is even more pronounced in the neighbouring district of Dunolly-Rochester.

Dunolly-Rochester

This district is really a succession of isolated patches of wheat-growing, between Dunolly, a small town almost in the hills, and Rochester on the western edge of Goulburn Valley irrigation. Yields are moderate: from 15 to 21 bushels per acre, and sheep are of about equal importance with wheat. The country to the north of it formerly grew wheat, but is now described as "cropped-out."

Northeast Plains

This district is actually in the Northern District almost entirely, except for a small locality around Rutherglen which lies in the Northeast District. Its irregular shape is partly due to the way in which irrigation has developed, and further inroads beyond those shown on Map 133, have been made into wheat-growing country since 1951 with the development of the W.S.L.S. scheme along the Murray between Cobram and Picola.
Rainfall ranges from almost 20 ins. on the southern edge of the district to 16 ins. in the large bend of the Murray. Subterranean clover can be grown over about half of the wheat-growing plains: for instance Bacchus Marsh variety grows quite well at Yarrawonga with 18 ins. of rainfall. Here and at Dookie, which lies to the southwest of Yarrawonga, it is possible to produce a satisfactory crop of wheat with the usual long fallow of most of the wheat/sheep zone, but substituting a short fallow of 3 to 4 months. The area in which the short fallow can be used is approximately that shown on the overlay to Map 133 as being capable of supporting Subterranean clover, and the average yield in this part is higher—21 to 24 bushels—than on the northern half, which yields only 18 to 21 bushels per acre.

Grain and sheep are of about equal importance in the Northeast Plains. The sheep enterprise is favoured by the nearness of the Riverina, which has been a good source of supply of first cross ewes to serve as fat lamb mothers.

**Clover-Ley Farming**

The eastern tip of the Northeast Plains wheat-growing district has been the scene of the furthest development of ley-farming in Victoria, or in Australia.

Rutherglen has 22 ins. of rainfall, with 16 ins.
falling in the March - October period. Such a climate favours Subterranean clover, and the rainfall is high enough to allow the fallow to be dispensed with. Clover-ley farming as practised around Rutherglen has the following main features.17 Subterranean clover is sown and the land is allowed to remain under good clover pasture for a number of years (say 4). This raises the fertility of the soil which can then be cropped for from 2 to 4 years with only slowly diminishing yields. No fallowing is necessary, and clover is again sown with the last crop, and the land allowed to revert to clover for a few years. Wimmera rye grass is the most productive of the annual grasses which can be grown at Rutherglen: except for Phalaris tuberosa, the perennial grasses will not persist because of the dry summer and autumn.

The special features of the Rutherglen long-ley type of farming, are due to its climate: it is between the climate of the rest of the wheat belt, which is suitable only for annual pasture plants, and that of the wetter and cooler parts of Victoria, where perennial pastures will grow provided the soils and topography are suitable.

Clover-Ley Farming in Other Localities

The same type of farming is therefore likely to

be practicable, and may even be economically desirable in other parts of the state which have a growing season of from 8 to 9 months and mild winter temperatures. On Map 5 it can be seen that these intermediate conditions might be expected southwest of Horsham. Elsewhere the eight to nine month belt passes through the Western and Central Highlands, where in the west the country is rugged, and in the central portion north of Ballarat winter temperatures are much lower than at Rutherglen.

Nevertheless conditions in the Central Highlands are quite suitable for the growth of good temporary pastures, but they do not suit wheat, being too cool. However, oats does quite well and has long been grown there as part of a more intricate system of mixed farming than that advocated for Rutherglen (see Chapter 9).

In an article in the *Victorian Journal of Agriculture*, dealing with clover-ley farming, B.F. McKeon suggests that that part of southern Victoria which has from 20 ins. to 25 ins. of rainfall can be considered as probably suitable climatically to clover-ley farming, and this is a rather larger area of land surface than that with from 8 to 9 months growing season (cf. Maps 4 and 5). Amongst other localities it covers the central part of the Western District plain, which according to Map 5 has a

growing season from 9 to 10 months. As with the Apsley district (Map 5) there is some cereal cropping scattered through this part of the Western District, but it is probable that much of it is being undertaken as part of a programme of pasture improvement and to the extent that the pastures are proved to be permanent (either composed of persistent self-regenerating species or including some persistent perennials such as Phalaris) the present cropping will be transitory.

**Mechanisation**

Mechanisation has been mentioned in Chapter 4, where it was pointed out that the wheat/sheep belt has hardly more tractors than other type-of-farming areas. Tractors are merely one part of the mechanisation, in that wheat-growing has inspired a great deal of innovation in all types of machinery.

Fallowing, sowing and harvesting are the three main operations, and some of the machines for the latter task are now self-propelled. The latest phase of mechanisation is in the sphere of handling the grain once it has been stripped. Formerly bags were used, but they are now being replaced by bins towed behind the harvester. Tip trucks are filled from the bins, and the grain is taken to the nearest grain elevator or silo. Towed bins cannot be used easily in the Northern Mallee because of the topography—
the sandhills are too steep for them. Undoubtedly some other system will be devised.

The grain elevator system is worth note: it is organised as a public utility, operating 190 silos in the state, not including one or two very large terminal silos (see Map 11, for the location of silos). Some of them are not used to capacity, for example the four in the Millewa, while in the Western District the amount of use fluctuates a great deal.

**Labour**

The wheat/sheep type of farming now demands less labour than formerly for a larger volume of production. The position is that the demand has been pushed towards capital, to enlarge the farms and to substitute machinery for labour. There is now no extra demand for labour at harvesting, whereas it used to be one of the more reliable of the seasonal jobs, for the casual worker. It has been possible to carry this process of substituting capital for labour much further in wheat farming than in dairying, and labour is the scarce and expensive factor in Australia. To some extent the greater practicability of mechanisation in wheat-farming compared with its limited application in dairying, is responsible for the more favourable position of Australian wheat on world markets: as a wheat-growing country she is a low-cost producer, whereas in butter production her
costs are high on a world basis.

Tenure

Holt's survey gives the only reliable information on the difficult subject of tenure. Other figures such as those of the Statistical Register (see Chapter 8 below) apply to the total area in farms, and not just to the wheat/sheep type of farming, and are in any case considered unreliable. Holt found that the percentages of land held under different types of tenure were as follows:

Tenure: Percentages of Total Area Occupied
Survey of a Sample of Wheat Farms

<table>
<thead>
<tr>
<th>Distric t</th>
<th>Mallee %</th>
<th>Wimmera %</th>
<th>Northern %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of Tenure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owner (some purchase from Crown)</td>
<td>63</td>
<td>70</td>
<td>57</td>
</tr>
<tr>
<td>Tenant</td>
<td>14</td>
<td>7</td>
<td>15</td>
</tr>
<tr>
<td>Shares</td>
<td>14</td>
<td>15</td>
<td>8</td>
</tr>
<tr>
<td>Manager</td>
<td>5</td>
<td>8</td>
<td>20</td>
</tr>
<tr>
<td>Crown Licence</td>
<td>4</td>
<td>.</td>
<td>.</td>
</tr>
<tr>
<td>Total Area</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: A.J. Holt, op cit., p. 34, Fig. 6.

The main tenure was freehold ownership, although in the Mallee there was a considerable proportion of the total area being bought from the Crown, and not then fully
owned. It might seem that the area rented to tenants or
let to share-farmers was more than might have been
expected: in the Mallee it was more than a quarter of
the area in farms. Two additional points explain this
feature. The first is that the survey was carried out
during the war years when it was hard to sell land, and
that prior to 1939 the wheat areas were chronically
depressed so that banks came to own many farms by default.
They had to let this land, and hold on until the next
boom.19

The other aspect, is that many of those renting
or share-farming were already land owners elsewhere. Owners
and part-owners amounted to 81% of all farmers in Holt's
sample.

Of the remainder many were farming under family
agreements, and in the oldest-settled district, the Northern
District, practically all of the tenancy and all of the
share-farming was under family agreements, as well as most
of the managing arrangements.

The share-farming agreements are commonly on
"thirds," a system whereby the share-farmer usually provides
his labour, machinery and two-thirds of the seed, fertilizer
and bags, and receives two-thirds of the return from the crop.

It would be reasonable to assume that most of the land held by the banks would have been sold in the post-war boom, and that tenancy and share-farming would be proportionally smaller. With the increasing complexity and cost of machinery it is also more difficult now for a young man with few resources to work his way up the "farming ladder" by share-farming. On the other hand larger outlays on equipment, and the generally increasing scale of operations with more modern machinery may force some established farmers to do more share-farming.

An ubiquitous feature of the contemporary rural scene, is the workshop and plant of the "contractor," usually owning machinery but no land, and offering to hire out his services for set rates. In the wheat belt these operators are often also the tractor and machinery agent of some big company, and have the main repair works of the locality. Sometimes they are also dealers, taking land on agistment, but using it only for holding livestock while they play the market. As with aircraft in farming (see Chapter 4), these organisations need to be taken into account in collecting rural statistics.
CHAPTER VIII DAIRY FARMING
In economic terms dairying is the third of the three main types of farming, averaging about £37 million in value of production in 1949/51. This includes both gross value of production of dairy products and an estimate of the value of beef from dairy animals. Production of cereals was a little higher in value in these years, and of course wool and mutton together, had a much higher value.

Although third in value, dairy farming is probably the biggest single employer of labour amongst the types of farming being considered here, and possibly has as many 30,000 or 31,000 workers (owner/operators and employees or share-farmers). The number of farms on which dairying is the most important activity is estimated to be between 20,000 and 22,000.¹

Geographically dairying is rather concentrated because it uses good land intensively. It is inevitably associated with pastures of high quality and so is found where rainfall is better than the average for the state, and

¹. See above, Chapter 4, Section C.
on soil which can support improved pastures under moderate to good rainfall. Water supply is the key: if rainfall is too low ground water can occasionally supplement it, or irrigation water supplied cheaply by gravitation.

There are large parts of Victoria with sufficient rainfall for dairying, but where soils are too poor due to rugged topography or to lack of mineral wealth in the soils.

The farming methods used and the range of products are more standardised, less varied, in dairying than in other types of farming; nor does the size of the farm business vary as much as in the other types. Nevertheless there are some noticeable differences between one dairying locality and another.

**General Factors Differentiating Localities**

In some districts the land is almost completely cleared, with small farms closely spaced. In others a great deal of uncleared land remains, or dairying may be confined to a valley while sheep and beef cattle are grazing the hills above.

The use to which the milk is put is another differentiating factor; although butter is the main product, some districts produce milk for urban markets while others specialise in using most of their milk for cheese or condensed products. In the butter-making districts,
pigs are more important than elsewhere. Where dairying is in an early stage of development, whole districts may have farms which have a larger acreage than the average for the state, and in other districts a lack of specialisation is reflected in the mixture of dairying with other enterprises on the farm.

Map of Distribution of Dairy Cattle

Map 102 shows the distribution of dairy cattle in detail; compare the pattern of distribution with the rainfall map (Map 4). Apart from the irrigation districts of the northern plains, most of the dairy cattle of the state are found within the 25 in. - 45 in. isohyets. For dairying to be conducted under rainfall lower than this it needs either a supplement from irrigation (with cheap water also), or special conditions need to apply. The near-metropolitan liquid milk districts are good examples, on the one hand of irrigation as at Bacchus Marsh and Werribee, and on the other of low rainfall as in the localities just north and west of Melbourne in the rain-shadow of Port Phillip.

Soil Conditions

Soils within the rainfall limits given are podzolised associations, most of them of low or only moderate inherent fertility, but the poorest of them are not used for dairying. For example, the coastal sands of East
Gippsland and the western part of the Western District, are used for grazing not dairying, or else are not used at all. In the case of the heavy grey pedocals of the Western District basalt plains, poverty of soils is sometimes the main factor preventing their improvement for dairying or other intensive farming. In parts of the Central Highlands the poverty of the soils found on Ordovician sediments is the obstacle to improvement to dairying status; that the rainfall would be sufficient for improvement is shown by the fact that the better soils alongside the Ordovician do support dairying. On the other hand a few localities with sufficient moisture for dairying, have such highly fertile soils that cropping is almost continual and animals are not of much importance; such places are few and cover only a small area.

Density of Settlement

A third limiting factor is associated with density of settlement; there is a certain minimum density of settlement below which it is uneconomic to attempt to carry on this type of farming. For the last half century dairying has been dependent both on a good road system and on having enough farms of the same type nearby to support a factory of economic size. Remote localities in East Gippsland and in the valleys of the Northeast have found themselves badly placed from this point of view. However,
in the main the surprising thing has been not that dairying needs to be concentrated, but rather how low has been the minimum number of farms that could support a dairy factory. The factory whose existence is closest to being inexplicable, is probably that at Rainbow, on the western edge of the southern Mallee (Map 140).

**Topography and Elevation**

The substitution of other types of farming for dairying, or the failure of dairying to take over land which is suitable for it but occupied by other types of farming, occurs only within fairly narrow limits. Dairying is not favoured by rugged relief and there are cases of its failure under these conditions. Elevation per se, is not necessarily a bar, in that the lower temperatures found with height may not be so cold as to prevent sufficient grass growth. Around Ballarat, a considerable density of cattle appears on the map, at heights shown on Map 1 as up to 2,000 feet and certainly above 1,500 feet. On the other hand in and around the Eastern Highlands, so much more rugged than the Central Highlands, there is no dairying in the south over 6-700 feet and in the north, not above 1,000 feet, and that only in one or two exceptional localities.

**Geographical Location**

On Map 102 a few heavy concentrations of dairy cattle can be identified; the corridor from Colac to
Warrnambool, the western edge of Gippsland, the Maffra-Sale Irrigation Area, and a few localities in the northern irrigation districts. Between and around them are moderate concentrations, but the main feature is really the considerable density on a small part of the total land area, carrying with it the implication of specialisation of farming and a considerable density of population in each dairying district.

**Number and Distribution of Dairy Factories**

The number of butter and cheese factories is 124 (1954-55) and they are distributed as shown on Map 10. Their size varies considerably and it is to be regretted that their individual outputs are not disclosed. The size and type of factories is quite varied; and differences in the nature of their output arise from and affect the local farming. At the same time, their location is clearly most sensitive to transport media, not so much by rail as by road routes. Especially in the central part of the Western District but also in the central part of Gippsland, they are to be found located along the main highway. In the Central Highlands and the Wimmera their location is again along the through highway from Melbourne to Adelaide. But in the Northeast this is not the case to such an extent, and in the irrigation districts the pattern of water distribution rather than the main through highway, has affected the
Types of Dairy Factory Production

There are four main uses of milk; either for butter, cheese or condensery products, or consumption as liquid milk. The two latter forms of utilization have increased faster than butter and cheese in the last few years. In 1954-55 butter took 72% of milk produced, cheese 9%, condensery products 9%, and suburban supply 10%. The amounts of milk used in each type of utilization are shown in the following table:

Utilization of Milk (million gals.) : Victoria, 1954-55.

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Amount+</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butter</td>
<td>370.3</td>
<td>72.3</td>
</tr>
<tr>
<td>Cheese</td>
<td>45.4</td>
<td>8.8</td>
</tr>
<tr>
<td>Liquid Milk</td>
<td>50.4</td>
<td>9.8</td>
</tr>
<tr>
<td>Condensed Products</td>
<td>46.4</td>
<td>9.1</td>
</tr>
<tr>
<td>Total</td>
<td>512.5</td>
<td>100.0</td>
</tr>
</tbody>
</table>

+Source: Vic. Milk Bd., and Vic. Dept. of Agriculture, as for Table 5 in Appendix; small amounts of milk used for by-products not included, and some supplied from milk areas near provincial cities, not included.

Butter is still of overwhelming importance, however, with ¾ of the milk produced going into butter, and every important dairying district must be quite a considerable butter producer. The regional specialization in type
of production is shown on Map 142. The only region in which butter is not the main product is Port Phillip, where on one hand total production is not large (it is the sixth region in total milk production) and on the other, liquid milk for the neighbouring metropolitan market overshadows butter. After butter the next most important product varies a good deal from one region to another. Each type of milk utilization has some special features which will be dealt with below.

**Butter Production and Pig-raising**

The butterfat producer usually separates his own milk and sends only the cream to the factory. This is collected once daily. To make the most efficient use of all farm production the skim milk should be used as food, which usually means feeding it to pigs. Because pigs mean extra work, some farmers merely pour the skim out on the ground, which is wasteful of a by-product with high food value. Another factor which discourages the full use of this by-product by pigs is the lack of a really cheap cereal as a supplement to their diet. This deficiency makes a big difference between pig-raising in, say, midwest U.S.A., or the Argentine, and in southern Australia.

It is difficult to measure the pig population because there are two crops a year, and neither is being
produced when the agricultural census is taken in March. The average number of pigs recorded really represents the breeding stock which produces the year's pig crops. Even so this figure can be compared with that for other dairying countries. On the average, pigs number about 250,000 while dairy cattle total about 1 1/2 million, making a ratio of 6 dairy cattle to one pig. There are thus fewer pigs to dairy cattle in Victoria than in European countries engaged in dairying, and New Zealand has more pigs: the ratio there in 1954, for example was 6 dairy cattle to 1.2 pigs.

Map 231 shows the ratio between holdings with cows and those with pigs in counties. High ratios of 30-40% are to be found in the northern irrigation counties, Gunbower and Rodney, as well as in the Northeast and in East Gippsland. On the other hand, in the main dairying county of Buln Buln (Gippsland) the average figure is less than 30% and this is also the case in Polwarth - 27% - and in the southern part of the Western District.

Map of Distribution of Pigs

Map 116 shows the distribution of pigs in detail, and when it is compared with Map 102 of dairy cattle distribution it can be seen that some of the concentrations of dairy cattle have no corresponding concentrations of pigs. The main concentrations of pigs are in Southern Gippsland and in one or two localities in East Gippsland as well as in
the northern districts.

The lack of pigs is noteworthy in the Western District where it is partly due to there being more cheese and condensery production, and again they are not present along the Princes Highway to Gippsland, where city supply takes a considerable proportion of milk. But even so, there must be a good deal of wasted skim milk, because in Gippsland two-thirds of the milk is still used in butter, and in Corangamite it is not much less than two-thirds.

The irrigation districts may have more pigs because they have cheap water which makes it possible for them to grow summer fodder crops as a supplementary food for pigs. Also, small farms tend to encourage labour-intensive production such as pigs.

The Large White Breed is the main pig breed in Victoria and is used not only as a pure breed, but also in crosses with other breeds, like the Berkshire and Tamworth. There is a good portion of pig-raising which is not associated with dairying at all, but is connected instead with the availability of refuse, such as comes from any urban area. The concentrations which can be seen on Map 116 to the north and southeast of Melbourne are due to this factor.

Butterfat Production compared with Wholemilk Supply

The density of settlement and of the road network is an important factor influencing the type of use to which milk is put. For condensery and cheese production it is necessary to collect wholemilk by truck twice a day. A dense road net and level land provide optimum conditions for cheap road transport. Associated conditions would need to be fertile soils and highly-improved farm land. Of the dairying districts, the Western District is the nearest to flat, except for the northern plains. Gippsland is mostly somewhat hilly, although this is not so around Maffra and Sale. Certainly the two districts with the biggest share of their milk output used for cheese and condensed products, are the two with the flattest topography, that is the Northern District and Western District. In addition, the Western District produces more than half of the total output of condensery products.

The irrigation districts have the lowest unit costs of production for dried and condensed products, but condenseries were established in the south before irrigated dairying was initiated. It began in 1914-18, but did not approach its present output until 1930.3

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The wholemilk supplier receives more per gallon for milk sent for processing than the butterfat supplier gets for the milk-equivalent of the cream he sends to the factory. In theory the latter can make up the difference by raising pigs with the skim milk. The wholemilk man has a much more rigid timetable of collections than the butterfat supplier, but of course most farmers do not have a choice: they are not close enough to a processing company to elect one or the other.

Liquid Milk for Urban Supply

The farmer who supplies wholemilk for cheese and condensery products is free to vary his output with the normal seasonal swings, but not so the man supplying city wholemilk. Returns per gallon are higher in selling milk to the urban market, but there is added work and expense.

Until 30 years ago milk was supplied mainly from farms in the near-surroundings of Melbourne, and transported directly to the dairies in the city. Regulation of urban milk supply in the public interest has long been practised, but the present scheme is quite exacting in its standards. The Milk Board now buys all milk and sells it to retailing dairymen; there is a contract between the Milk Board and the farmer which requires a stated amount to be supplied through the whole year. 4,200 Farmers are at present under contract, though of course, country factories handle their
milk as agents for the Board. The population served by this public regulation of supplies amounts to about 1,600,000 people, including Melbourne, Geelong, Bendigo, and the towns of the Latrobe Valley, but not Ballarat which is said to have satisfactory supplies.

Map of Sources of Supply of City Milk

On Map 149, which shows the sources of supply of city milk in 1954-55, each dot represents approximately 1% of the total supply of just over 50 million gallons. The one-sided nature of the pattern stands out. Around the city on the northern and eastern sides is the area which served Melbourne until 30 years ago. Now the supply zone extends up to 150 miles away in Gippsland as far as Maffra, and even includes small amounts from suppliers in the northern part of Victoria.

However, the Port Phillip and Gippsland Regions supply 88% of the total, and of this, East Gippsland contributes only 3%, so that 85% comes from West Gippsland and the metropolitan area. The greater part of the 85% is from depots located along the Princes Highway to the east of Melbourne. The supply zone has hardly penetrated the southern part of Gippsland which is not as far from Melbourne as Traralgon and towns further east. The extreme distance of any one supplying farm from its depot would be 30 miles, but this is not of great importance because Gippsland is a
compact area.

By contrast with Gippsland, the Western District supplies only a small amount. Why has it not shared in the expansion of the urban market? If one considers the earlier stages of extension of supply from Melbourne outwards, it would have been easier at any one point in time and place, to extend further into Gippsland rather than make a definite break and cross the non-dairying country from Werribee to Colac. It is also certain that the dairy factories themselves, had some part in the decision as to whether milk was sent to the city. It is probable that differences in the type of management as between the two regions, were also important. Gippsland has a higher proportion of cooperatives than the Western District; in the latter a few large firms have been important. The large firms, particularly those making condensery products might be unwilling to see inroads made into their milk supplies, and in the earlier period of supply to Melbourne the factories themselves paid their farmers, rather than acting as they do now, as agents for the Milk Board. 4

The above is merely speculative, but some such sequence of influences and decisions helped to shape the lop-sided pattern shown on the map. But there are some further

points. Why, for example, now that the Western District has been entered, should suppliers much further away, such as those in the northern parts of the state, be kept on as suppliers? The Milk Board seems to feel that it has some obligation to share the benefits of the higher returns from liquid milk amongst all dairying districts that can reach Melbourne. The northern irrigation districts began by supplying milk to Bendigo, and still do so, but were allowed to expand to Melbourne as well. The producers at Kiewa, the most distant supply point, were able to come to the rescue of Melbourne in 1952, when there was a shortage of milk, and they have been kept on as a reward for this rescue operation.

All wholmilk is sent to the city by road transport, whereas in N.S.W., practically all delivery is by train. The Victorian pattern seems to derive from the fact that for so long the near districts were able to supply the city, and the suppliers thus entered the motor age before milk came from really long distances. Sydney, on the other hand, outstripped the supplying potentialities of the near surroundings much earlier, while it also has had a near-monopoly supplying the city. Also the coastal railways of N.S.W. pass through practically all the actual and potential supplying districts.
It must be noted that the urban supply is still only a minor part of the whole output of any region, except Port Phillip. It is even a minor part of the output of most of the supplying farms. The reason for this is the high peak of production in the spring, whereas Melbourne requires a steady supply of milk. The contract for city supply is based on the amount they are prepared to send in June, the most difficult month to maintain city supplies.

For example, a small factory close to Melbourne sent to Melbourne in June 1954, 81% of the milk received at the factory from contract suppliers, but in November it was sending on only 38% of the intake from suppliers on contract. They were still keeping up their contracts, but had large surpluses as well. Another example is a factory at Maffra which sent 36% of its June intake to Melbourne, but in November was sending only 7\% of its intake.

Breeds of Dairy Cattle

The Jersey has so thoroughly taken over the prime position amongst dairy cows that there is much less difference in breeds from place to place than in earlier decades. Between 1910 and 1935 Shorthorn and Ayrshire lost their predominance to the Jersey. The Ayrshire is probably still second with the Friesian third. Payment is made by the factories on butterfat content, and the Jersey has a demonstrably higher butterfat test than other breeds. But
it is also more productive per unit of farm area, because in spite of its being a smaller animal than other breeds, it produces as much or more than others, and so carrying capacity is higher with Jerseys.

The Friesian is the opposite of the Jersey in these characteristics: it is the largest of the diary cows, with the lowest test for butterfat, but is a heavy-milking animal particularly suitable for farmers supplying the city. The Dairy Shorthorn has a test a little above the Friesian and is probably the fourth most important breed.

**Regional Distribution of Breeds.**

Because the Jersey makes up 75-80% of the dairy cow population there is little difference from one part of the state to the other in breeds. It is noticeable that there are more half-bred cows near the city, and a tendency to the heavy-milking types exists where liquid milk is the main product.

**Methods of Farming**

An outstanding feature of dairying methods in Victoria is the almost complete reliance on grass. In the early stages, forty or fifty years ago summer fodder crops were more important than they are now, partly because of the inferior quality of the sown pastures of those times. Nowadays there is a greater conservation of the spring flush
of growth for feeding out later in the season and an intensification of the use of pastures by the grazing animal, through the subdivision of paddocks and the use of electric fences. The pastures so grazed are permanent, and apart from their initial laying-down which may have occurred long since, it would seem that these methods leave little room for the plough and other cultivators. Pastures are not now heavily cultivated at the surface as they were once, but some treatments are still recommended. More control is being achieved by grazing at the right time and to the right degree of severity, in order to preserve or reach the optimum balance of grass and clover growth.

Topping grasses about to seed, and cutting hay at the right time are all techniques which are tending to reduce cultivation but also to increase pasture quality and fodder conservation.

Although research on fodder conservation and pasture management is proceeding very actively, it is possible that reliance on pasture has been carried too far, and that in their anxiety to make the most of the main "crop" (that is grass), dairy farmers have neglected an easy supplement for cows which are otherwise underfed in autumn and winter. Cropping is recommended by some experts, and it is notable that of the dairy farms mentioned as outstanding in the Victorian Journal of Agriculture,
most engage in some summer cropping. These are the exceptions which seem to suggest that more cropping might be a very good technique.

**Mechanisation**

Milking by machine has shown an amazing growth; at the present time the 63,000 units (1952) in use must cover most of the commercial-sized herds (19,000 over 15 cows) in the state. Hay-balers and presses or mowers are becoming standard equipment, though it is the pick-up baler that has taken the hazard and hard work out of hay-making. Fertilizer distributors are almost essential equipment, while there is great scope for organic manure spreaders to take manures back to the paddocks. The role of these items in the pasture economy is obvious.

It is not possible to say what proportion of dairy farms have tractors. In 1951 there were 29,000 in the whole state, and their distribution was proportionately a little greater in the wheat belt in comparison with the number of holdings. An estimate would place less than a third of this total in dairying districts, and mean a distribution of about one to each two farms in 1951. The position is changing rapidly, and at that date the backlog of orders from the war period had not been cleared.
Labour

In Chapter 4 (Section A) it was pointed out that dairying had its beginnings in laborious methods of land clearing which probably seldom paid wages when the capital asset was properly valued. It is remarkable then that the whole development of dairy farming techniques should be witness to a relative shortage of labour and a high return to labour, where it has been employed. Undoubtedly the routine and monotony of dairying operations have engendered a dislike of the type of farming as such, which clearly has not applied to the larger pastoral holdings with permanent employees. One of the effects of this relative shortage of labourers for dairying has been to encourage in this type of farming more than in most, a family-sized farm, appropriate in the main, to the labour of an owner-operator and his family.

Regular and sustained labour is needed and there is a very considerable minimum of work in milking and caring for animals. This contrasts sharply with pastoral work where many tasks can be postponed indefinitely without any absolute loss, and where seasonal peaks in labour demands are met by specialisation. It follows that in dairying the size of farm and size of herd is not likely to vary too greatly in any one district.
In Chapter 4 it was noted that it was possible to estimate employment in dairying from the periodical censuses of the Commonwealth, at a total of approximately 30,000. The number of herds of over 9 cows was seen to be 22,100 and over 14 cows, 19,000 herds. If the labour force of 30,000 were distributed over 19,000 herds there would be 3 men for every two herds on the average. This does not make sufficient allowance for the mixed types of farming which have small herds with regular milking, but where other enterprises take up a good deal of labour. Potatoes, onions and some mixed dairy/sheep farms would be the main forms of mixture. The use of labour is probably not much more than one man's full time per herd. Large herds of nearly 100 animals clearly require more than this and more labour than can be supplied by unpaid family help. But on most dairy farms the wives and children undoubtedly contribute to the input of labour, to an extent that does not occur in other types of farming.

Share-Milking

Various types of share-farming exist in dairying. It is said to be one way in which a worthy worker acquires enough to put a deposit on a farm of his own. The owner usually supplies the animals and equipment and receives

5. Chapter 4 above, p.174
anything from 50-60% of the cream cheque. Sometimes the share-farmer supplies the herd and receives more than 50% of the cream returns. Tenure information has not been published for a long time; a collection was taken in 1949-50, but the Statist judged the figures too inaccurate for publication. Two localities in which share-farming is high are in the Maffra-Sale irrigation locality, and at Yarram in Southeast Gippsland, but it seems to be low in the northern irrigation districts and only moderate in some of the most intensively farmed parts of the Western District.

**Productivity of Dairying in Australia**

Victoria is first among the states in dairy cattle numbers, but, even more significant, the output per cow is much superior to the other states. The following table, giving figures which are representative of recent years, shows quite clearly the very much higher production of milk per dairy animal, in Victoria than in N.S.W., and even more than in Queensland.

<table>
<thead>
<tr>
<th>State</th>
<th>Dairy Cattle ('000)</th>
<th>Milk Production M. gals.</th>
<th>Avg. per dairy animal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Queensland</td>
<td>1,377</td>
<td>276</td>
<td>200</td>
</tr>
<tr>
<td>N.S.W.</td>
<td>1,222</td>
<td>316</td>
<td>250</td>
</tr>
<tr>
<td>Victoria</td>
<td>1,599</td>
<td>537</td>
<td>330</td>
</tr>
</tbody>
</table>

The main cause of this difference is probably the superior climatic conditions of Victoria, giving rise to more productive pastures and more reliable and sustained output of milk. Capitalising on this, gives rise to better farming methods, and it is recognized that cows in Victoria are maintained on a higher plane of nutrition than in the other dairying states.

The records of herd testing in Victoria show further differences in productivity within the state. The records cover up to 22% of the milking cows and consequently give a fair picture of average production. Map 143 shows average production per cow in Herd Tests, 1955-57, by Herd Test Zones. Figures are given for four major regions, of which the Goulburn Valley is usually the highest producer, followed by Gippsland, Western District and last, the Northeast. Figures for the more numerous zones, show a different order. South Gippsland is usually first, and the two zones in the Goulburn Valley come second equal. Thus South Gippsland with its cool summer and mild winter has a slight edge on the irrigation dairying districts. After Goulburn Valley come further southern ones, one next to South Gippsland and including the Mornington Peninsula - almost drought free and mild in climate - followed by one in

the Western District, that portion nearest Melbourne. Then East Gippsland and the remainder of West Gippsland follow in order. The main part of the Western District is really included in the middle zone of that district and comes well down the list in eighth place. The Northeast by itself is second last followed by the far part of the Western District.

Overall the Western District comes rather poorly out of these comparisons and Gippsland and the Goulburn Valley both have much superior productivity to the other two. The map tends to exaggerate the importance of some of the zones, because they cover so much country which is not used for dairying at all. The biggest exaggeration is probably that of the Goulburn Valley Zones, which cover the Mallee where dairying is not at all important. The map should be compared with Map 136 to counter this impression.

Seasonal Variations in Production and Farming

The milking season begins following calving, and the best time for both is when there is new growth, that is spring—August. Milking can continue into the late summer only where supplementary feed is supplied: this is mainly hay or ensilage, made in spring at the peak of pasture growth. The alternative to hand-feeding at the end of the

7. Most of this material is common knowledge, but some information is from: Dairy Farming in Australia, (Revised), ed., L.G. Ashton (Dept. of Commerce, 1954).
summer is to dry off the milking cows, and run them on dried-up pasture. In some of the warmer localities cows are calved in autumn and milking begins then and continues through the winter, but this is nowhere general, except with wholemilk suppliers who have to keep up their contract for city milk.

In the irrigation districts the season can be as long as wished, but normally the factories do not take milk from June to August, closing down instead to overhaul machinery and prepare for the next year.

Dairy-Farming Areas

There are two maps showing the detailed distribution of dairy farming. Map 102 of dairy cattle in parishes has already been analysed (above). The other is Map 136 which shows Dairy Farming Areas; on this map every parish in which dairy cattle are important has been coloured with some sort of symbol. Where they are mixed with other animals and amount to between 1/3 and 2/3 of the total livestock units of the parish the locality is shown with a symbol denoting mixture, but in the rest of the parishes coloured on the map they make up more than 2/3 of the animal units.

Gippsland is dominated by dairy cattle, entirely so in West Gippsland and partly so in East Gippsland.
Bourke County around Melbourne is much the same as West Gippsland. A strip along the southern part of the Western District is also entirely dairying with a small extension to the west.

In northern Victoria along the Murray there are fewer parishes in which dairy cattle dominate, but in the irrigation localities they are clearly ubiquitous. Map 102 brings out the great concentrations that there are in a relatively few of the irrigation parishes.

In the Northeast there is no concentration of dairy cattle such as the three preceding parts of the state have shown. From Map 136 it can be seen that few parishes have dairy cattle in dominating numbers.

The fifth concentration is in the Central Highlands, but the total numbers are small, and although many parishes have a dairy/sheep combination, only a few are dominated by dairy cattle. There are a few dairying parishes in the far west of the Western District.

The following table is an estimate of the numbers of dairy cattle in different parts of Victoria, arranged on the basis of the Planning Regions, with some adjacent regions merged where convenient.
Dairy Cattle in Dairy Farming Areas: 1950-51

<table>
<thead>
<tr>
<th>Regions</th>
<th>Dairy Cattle Nos.</th>
<th>% of Victorian Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Port Phillip &amp; Gippsland</td>
<td>622,300</td>
<td>41</td>
</tr>
<tr>
<td>Corangamite</td>
<td>284,000</td>
<td>19</td>
</tr>
<tr>
<td>Irrigation Regions</td>
<td>218,700</td>
<td>15</td>
</tr>
<tr>
<td>Upper Murray</td>
<td>148,000</td>
<td>10</td>
</tr>
<tr>
<td>Glenelg</td>
<td>62,000</td>
<td>4</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>31,000</td>
<td>2</td>
</tr>
<tr>
<td>Total in listed regions</td>
<td>1,366,000</td>
<td>91</td>
</tr>
<tr>
<td>Victorian Total</td>
<td>1,489,000</td>
<td>100</td>
</tr>
</tbody>
</table>

The estimates are the total number of cattle within the boundaries shown on the overlay to Map 136: these regions will be used below as a general framework within which the dairy farming areas are described.

Port Phillip and Gippsland Dairying Region

Dairying is almost continuous from northwest of Melbourne to Orbost in East Gippsland, and the total number of dairy cattle in this stretch of country is over 600,000 or more than 40% of the Victorian total. It is thus the most important of the dairying regions. In the main it is a region with high rainfall but at both the eastern and western extremes of the regions there are portions which have lower rainfall totals.

The City Milk Zone

If it were not for the nearness of Melbourne, it is probable that dairying would not be carried on at Werribee,
or to the north and northwest of the city. This side of the city is under a rain-shadow, with totals below 25 ins. and a long dry summer: the growing period is probably less than 10 months. Soils are poor and they are also dotted with stony rises which prevent pasture improvement and cultivation. The amount of bought fodder is therefore high, both because fodder conservation is difficult and because the summer is so dry. The common cows here are crossbreds, heavy-milking types with black and white markings (probably Friesian at base).

The Southeastern Suburbs and the Direct Supply Zone

The Mornington Peninsula, Dandenong and the southeastern suburbs, are also part of a zone of direct supply to retailers in the city. By this system the farmer gets more of the consumer's pound, because the cost of cartage is so much lower than further from Melbourne. They have larger contracts than more distant farmers: the average amount contracted for is 77 gallons a day under direct supply, while those supplying through a country depot average only 44 gallons a day. Depot suppliers could well have a peak output of 150 gallons per day in November, so that they send only about a quarter of their output to Melbourne at the flush time of the year. On the other hand the direct supplier spends on the average 10d. per gallon of milk produced for bought feed, whereas the depot supplier averages only 4.7d. per gallon expenditure on
bought feed, and the overall average is 7.5d. per gallon.

The boundary between direct supply and depot supply is not far east of Dandenong, and from here east, milk manufacture becomes important. North of Melbourne and on the northern edge of the dairying area in Gippsland it is the rising ground of the foothills to the Eastern Highlands that is the boundary between the farmer and unused country (see Chapter 3).

West Gippsland

The Koo-wee-rup swamp at the head of Westernport Bay, is a heavy supplier of city milk. Dairying is carried on to complement a programme of rotation of temporary pastures with field crops of vegetables. About one-quarter of the land in farms is cropped at one time (in the two parishes of Koo-wee-rup and Koo-wee-rup East, there is a total of 54,000 acres in farms), and the carrying capacity of livestock is higher than the average for the county. In the two parishes it is 2.1 acres per livestock unit whereas for the county of Mornington the figure is 2.7 acres per livestock unit. In a survey of Koo-wee-rup in 1942, Goudie found that cash crops were a small part of the total


farm system, and that dairy cows were the main interest, but the position has changed today, until cash crops are probably more important (see Chapter 9).

In a similar survey of Berwick\textsuperscript{10} in 1939, it was found that dairy farmers had a smaller size of farm than other farmers and carried more stock per unit of area. Dairying was found to be correlated, not with soil type but rather with the degree of pasture improvement that farmers had managed to achieve. As long ago as 1938 when this survey was being carried out, the acreage of fodder crops grown as supplementary feeding for dairy cattle was falling, and grass hay was becoming more important. Bought fodders were used to maintain the output of milk for Melbourne in the summer and autumn. The success of pasture improvement was itself one of the reasons for decline of sown fodder crops, because farmers would not break up a good permanent pasture.

\textbf{Warragul and the Strzeleckis}

On Map 102, an unusually thick concentration of dairy cattle can be detected about 30 miles east of Dandenong around Warragul. The soils are rich krasnozems developed on Older Basalt of Tertiary age, with high-quality pastures of Subterranean clover, ryegrass, cocksfoot and

\begin{flushright}
\end{flushright}
White clover, on the best farms. The carrying capacity of the Krasnozems is clearly high.

South of Warragul are the Strzeleckis, a range of quite steep hills, but nevertheless carrying a considerable density of cattle. Rainfall in the hills and at Warragul is above 40 ins. per annum, and practically no part of the countryside here has less than 35 ins. The soil associations of the Strzeleckis are podzolic loams developed on Jurassic sandstone, and they seem reasonably fertile and resistant to erosion, with a good improved pastures.

The Strzeleckis and the S.E. Gippsland Hills

The adjacent range of hills in S.E. Gippsland, although similar to the Strzeleckis in many ways, has not been successfully settled. Two difficulties were outstanding; one was the lack of communications, partly due to the greater elevation of the S.E. hills and the steeper slopes, and the other was the progressive deterioration of the first pastures. These were sown in the ashes of burnt forest, and at first did well, but later they deteriorated and were invaded by second-growth or blackberries. One reason would be the exhaustion of the mineral wealth added by the first fires, and the other the difficulty of grazing

the pastures intensively and cutting back second growth, on the very steep slopes.\textsuperscript{12} What was needed was topdressing with superphosphate, but even when this treatment was popularised, much of the pasture could not be topdressed because of the steepness of the slopes.

\textbf{Southern Gippsland}

The low country surrounding the hills on east, south and west is of two contrasted types: one is thinly settled consisting of patches of sandy podzols which do not hold moisture well, are low in mineral wealth and in places deficient in trace elements. Settlement on these lands is advancing only slowly, some of it dairying, some grazing. On the other hand at the mouth of the Tarwin River and at Yarram, there are drained swamps and river flats which are very closely settled and highly productive. Along the northern edges of the hills also, there are narrow valleys of highly productive land, as at Moe, and in the Morwell Valley.

A change begins at Traralgon: there is a rain-shadow in the eastern lee of the hills, and dairying largely ceases except where it is supported by irrigation, or is carried on on moist river flats.

Maffra-Sale Irrigation Area

The main dairying area in the rain-shadow of East Gippsland, is the Maffra-Sale Irrigation Area, where the rainfall is less than 25 ins. It has been calculated by Skene, using Prescott's formula, that rainfall is effective for all summer months except January. In January the monthly average is just equal to the effective rainfall. Possibly January is the only month in which irrigation is likely to be needed, but reliability must be considered also. Skene shows that droughts of two months can be expected in the summer, in about 3 out of 10 years. Normally, then the requirements for irrigation are not large, but dry seasons needing extra water are fairly frequent.

There is an old-established irrigation scheme at Maffra-Sale, but there is a recently-developed scheme at Heyfield, contiguous with Maffra-Sale on the west and expanding at the present time. The scheme is a War Service Land Settlement one, expected to reach 10,000 acres eventually. But there is scope for further expansion in the potential resources of the Thomson River and after the W.S.L.S. scheme is finished there will be further irrigation development. The soils of the flat country in this vicinity are mainly clay loams with heavy clay subsoils, while along

the rivers they are fine silty soils. In the lowest parts of the plains there are also some others of light texture and lower fertility, which are not suitable for permanent pastures and irrigation but have been recommended for annual pastures of the Subterranean clover type. 14

Maffra-Sale is one locality where share-farming is very frequent. One effect of this seems to be that a considerable proportion of herd cows is bought rather than reared, the rationale supposedly being that the share-farmer gets no short-term returns from raising calves, and the owner is quite content to buy indifferent cows, thinking that good cows are not likely to be cared for.

When irrigation settlement first began, the S.R.W.S.C. subdivided the land into 40 acre blocks, but these had to be consolidated into blocks twice this size because they were uneconomic. Now with improved pastures and practices, it seems probable that 40 acres is quite a practicable size, and in actual fact if an 80 acre block provides an income for a share-farmer and an owner such an area is effectively supporting two families. The W.S.L.S. farms are larger still at 110 acres each, but on the dry land without irrigation W.S.L.S. dairy farms are much bigger again — 220 to 340 acres.

As might be expected the milking season is long, beginning in August with spring calving and continuing until May or June. Irrigation is available from August to March, but the main need for it is in January and February.

**Bairnsdale-Orbost River Flats**

East of Maffra, there is little dairying until the river flats near Bairnsdale and Orbost are reached. Here the soils are true alluvials, spread by the rivers on flats and terraces in their lower reaches. Orbost has the best climate for dairying but conditions at Bairnsdale are also better than those at Maffra. As one goes east, the winters become milder and the summers more wet and humid and although variability of rainfall tends to increase also, the larger total amount received compensates for this to an extent.

Although on Map 136 some parishes on the East Gippsland plains are shown with mixtures of sheep and dairy cattle and even one or two with beef cattle and sheep mixed, for the most part these represent statistics for adjacent types of farms which are merged in the figures for single parishes. This is not the case near Bairnsdale and Orbost, where beef cattle and dairy cattle overlap, for here there is a great deal of fattening of beef in dairying localities.
Near Bairnsdale in the valley of the Mitchell River, private irrigation schemes cover an area of approximately 2,500 acres and spray irrigation is becoming increasingly popular. Maize becomes important here because there is a warmer climate and very fine and rich soils, with a water table near the surface even in summer. Floods (mainly in the spring) are a hazard in both the Mitchell and Snowy Rivers.

Farming at Orbost differs from that at Bairnsdale in that there is more cropping, especially of maize, and it is grown not just for feeding to cows, but in addition for sale as grain. There are other crops which are especially favoured by the almost unique climate of Orbost. Beans, peas and pumpkins are notable, but the most remarkable feature is that most of the potential cropping land is mainly given over to dairying and in parts to fattening beef cattle; raising animals pays better than growing crops even on the very best alluvial soils. These islands of fertility on alluvial soils are surrounded by uncleared terrain, carrying heavy bush on inferior podzolised soils.

The Northeast Dairy-Farming Region

The Northeast, delimited in this case by the Upper Murray planning region, has only 10% of the dairy cattle of the state. There are few parishes in which they are a
majority of the livestock units, and many more in which they are combined with either sheep or beef cattle, especially the latter. The problem of classifying this part of the state is made difficult by the topography. Different types of farming are sharply delimited by hills and valleys, dairying being confined very largely to the valleys. Parishes cover both types of surface and the statistics present a degree of mixture not so commonly met in Victoria.

There are four main types of land used for farming:
valley bottom flats;
sloping land on the lower parts of the hillsides;
higher and steeper parts of the hills;
alpine tussock grassland at the head of some of the valleys.

The first two land types are used for dairy farming. Apart from fine alluvial silts on some valley bottoms, the soils are of low or indifferent fertility, for this reason not suited to cropping, but also the slopes are often too steep, and cold.

The most commonly-occurring type of farming is one in which dairy farming is combined with beef grazing; on most farms the beef enterprise is a minor one, beef-type calves being reared and then sold for fattening elsewhere, but on some, the animals are fattened before sale. The
dairy cattle are generally grazed on the flats and on some of the lower slopes of the valleys while the beef animals are run on the lower and upper slopes and fattened on the flats. Sometimes sheep are run on the poor grazing of the higher parts of the hills.

Dairying became established later than beef raising, its development having to wait for the provision of better roads than the district had in early times. Road development and pasture improvement with superphosphate, both had big effects after 1930. Perennial ryegrass was introduced by animals involuntarily, and white clover was sown in the valleys so that carrying capacity has been raised to the point where the best farms on the flats can carry about one cow to 2 acres.

In some valleys pastures are not as productive as this, especially where paspalum dominates the sward, as for example, in the Mitta Mitta. The second land type - the lower slopes - are often improved to the point where they carry subterranean clover with perennial ryegrass or Wimmera ryegrass. They are not good enough for milking cows but can carry dry stock, except in the driest months.

Upper Murray Valleys

As a rule, each valley has some special feature in its farming technique or environment which marks it out
from its neighbours. For instance, furthest east in the Corryong and Cudgewa Valleys beef raising is as important as dairying, and in the Upper Murray to which these two are tributary, beef raising is the main activity. The environmental limitations here, are a fairly severe climate with a moderately hard winter and quite a dry summer. There is little pig production in these valleys compared with their neighbours to the west and no cultivation except of meadow hay.

**Tallangatta Creek and Mitta Mitta Valleys**

The Tallangatta Creek Valley and the Mitta Mitta Valley are both narrow with fairly steep sides, characteristics which distinguish them from their neighbours on the east and west. This may partly account for their having a greater concentration on dairying and more pigs per farm than in the other valleys. A local speciality is the cultivation of small amounts of pumpkins for stock fodder.

**Kiewa Valley**

In the Kiewa Valley beef are even less important than in the other valleys, one of the reasons probably being the larger amount of good-quality flats and lower slopes, in proportion to total farm area. Some millet is grown here as a green fodder and pigs are not as
important as in the Mitta Mitta. Part of the reason for
the latter is possibly that some of the Valley’s output
is now marketed as wholemilk, not only for Melbourne, but
also for Canberra and sometimes for Sydney. Wholemilk
sales are not as attractive here as in the southern part
of the state, because there is a transport charge of 7d.
a gallon which local producers must absorb. The average
charge in the southern part of the state is only 4d. per
gallon, and close to Melbourne it is much lower still.

Ovens and King Valleys

The Ovens and King Valleys, like the Kiewa and
Mitta Mitta, have stretches of high-quality alluvium along
the valley bottoms. Especially in the Ovens Valley the
soil quality and mild summer climate, has proved suitable
for tobacco and other specialty crops as well as dairying.
In the foothills which front the plains between Kiewa and
Wangaratta, dairying, beef grazing and sheep can be found
each on a different class or type of country. On some the
balance between dairying and fat lamb raising is very
narrow and a small change in prices may induce change from
one type of farming to another. For example on W.S.L.S.
farms south of Wangaratta, although cow bails were built by
the Soldier Settlement Commission, they have never been
used by the settlers who have taken up fat lamb production
instead.
Although the Northeast appears to be a mixed area with all the main livestock present, on close examination it is seen that in detail the geographical separation of types of farming is greater than would be thought from the broad figures. On the better quality, country at lower levels dairy cattle predominate and beef cattle have only a minor position, but both beef cattle and sheep are found on the rougher and higher country. Productivity, measured in pounds of butterfat per cow, is the second lowest in Victoria.

Irrigation Region

The combination of irrigation water and dairying found in the plains of the middle course of the Murray is responsible for some of the special characteristics of these districts. For one thing, production can be relied upon when that from other districts fails. As well the long season experienced here and a tendency to better practices gives dairying a higher productivity than any other locality except South Gippsland.

The districts are located on the Murray flood plain or that of its tributaries, below 300 feet. Dairying is remarkably concentrated in 7 or 8 parishes the pattern being largely due to the details of water engineering. Given the large water resources of the Goulburn and Murray Rivers it was likely that the plains along the mid-portion
of the Murray would be plentifully supplied with irrigation water. If water supplies are abundant, the choice in farming is between growing fruit or vegetables or raising perennial pastures for dairying. Fruit was the main irrigation crop when irrigation first started, but in the long run pastures have become more important, partly because the markets for fruit were so much more restricted than those for butter.

Sometimes the risk of salting, or its actual occurrence encouraged dairying rather than fruit. An example is to be found at Cohuna where permanent pastures have been a means of recovering former orchard areas from damage by salt. Also, established pastures tend to keep down salinity. But on the other hand dairying has sometimes given way to market-gardening where new market possibilities have arisen or new crops have been introduced; examples are to be found at Werribee and Bacchus Marsh and on some of the irrigated acreage near Shepparton and Swan Hill.

The soils of the eastern parts of the irrigation districts are of the general red-brown earth association with loams and sandy loams overlying alkaline heavy clay subsoils. The soils tend to be low in some salts and minerals but in general their fertility is good and they have proved quite suitable for irrigation or cropping.
North and west of Gunbower, irrigation is carried out on grey and brown soils of heavy texture; they are clay loam or clay soils over heavy clay subsoils. They have developed under lower rainfall than the red-brown earths and contain more soluble salts, consequently salinity problems are more common following irrigation, if it is not carried out carefully.

The dairying season starts in early spring and extends through to April or May. The main utilization of milk is in butter, cheese is second and processed products are of some importance (Map 142) while a small amount of wholemilk is sent to Bendigo and some to Melbourne.

Compared with other parts of the dairying districts development here was rather late, because it followed closer settlement policies which did not really get under way until after 1914-18. It has already been exemplified by the summary (above Chapter 4) of the expansion of Tongala-Stanhope.

There are seven important localities: Cobram-Nathalia; Shepparton; Tongala-Stanhope; Rochester-Lockington; Dingee-Calivil; Cohuna-Kerang; Swan Hill flats.

Cobram-Nathalia

This locality does not seem an important
dairying locality on the map of dairy cattle numbers (Map 102) but it has been increasing rapidly in output since 1950, due to the setting up of 450 W.S.L.S. farms. The central strip from Cobram to Nathalia, has thus become a 1 in 1 area with a high sales quota, and with farms of about 110 acres. It has been the policy to start each farm with a considerable area of lucerne in addition to perennial pastures, and this has led to the setting up nearby of seed-crushing mills. Around the 1 in 1 Soldier Settlement portion there is a 1 in 4 portion with some dairying in the case of the larger farms. Farmers in a district of this sort tend to concentrate their supplies of irrigation water on one particular part of the farm and some run a share-farm for dairying, while operating the remainder as a wheat/sheep enterprise.

Shepparton has much less dairying than other localities, though north of the town there is some. Dairying is likely to expand only if fruit and vegetables become less attractive for any reason; possible causes of a change are the ageing of orchards and the fact that it is inadvisable to replant some types of trees on the same soils.

Tongala-Stanhope and Rochester-Lockington

These localities have some of the heaviest concentrations of dairy cattle per unit of area in Victoria. Some of the surrounding parishes are shown on Map 124 as
having sheep and dairying mixed, but it is unlikely that this truly represents a mixed type of farming. It is most probably due to the overlapping of parish figures from one type of farming to another. From Lockington, the Waranga Western Channel continues to the west across a large gap of unirrigated country, until at Dingee some water is taken out and there is more dairying.

It was at Dingee that a special strain of white clover, the Irrigation strain, was isolated and recognized and today the seed is a cash-crop of the district. It is commonly claimed for the northern irrigation districts, including Dingee and its neighbours to the east, that they rear all their replacements of dairy stock and thus follow better methods of building up their herds than many other parts of the state. It is difficult to say whether this is because they conserve more fodder than elsewhere, or whether the small size of farm leads to pressure to use the land to the full. An additional factor may be that they are a long way from Melbourne which is the main market for bobby calves.

There are odd small concentrations of dairying along the Loddon River, but none really substantial until the Macorna Channel from the Torumbarry Weir is met with. Much of the country between these two places (from Dingee
to the Macorna Channel) has been ruined by salting, and forty years ago dairy factories were set up here then abandoned or pulled down, only to be re-established in recent years following reclamation of the land. The grey soils of heavy texture which are found from here to the Murray, are much more liable to become saline at the surface than those further east, because with the lower rainfall they have retained more salts.

Cohuna-Kerang is another intensive dairying district, with 1 in 1 water rights and butter is the main factory product. Pigs are more common in this locality than others, perhaps because cereals are more readily grown. Swan Hill is the last outlier of dairy farming. The soils here are fine silts covering low flats in the bend of the Murray, and the land is not suitable for fruit, both because of the soil type and poor drainage. Paspalum is common and there is a good deal of only poorly-improved pasture, but the main problem is that the water table under the flats has begun to rise. Shorthorns are favoured here, but it has not been ascertained whether they have any advantage over Jerseys.

Corangamite or Western District Dairying Region

On Map 126 the parishes marked as having dairy cattle in the Western District, are nearly all those in which dairy cattle are dominant, and few parishes show a
mixture of dairy cattle and other animals. In this characteristic the Western District is not unlike Gippsland. The few which are mixed, are almost entirely sheep/dairy, and are found on the northern fringe of the dairy belt. Within the boundaries of the Corangamite region there were 284,000 dairy cattle in 1950-51, or 19% of the state total. This number makes it the second largest of the state's dairying regions, and even so some cattle in outlying districts bordering Corangamite, are not included; these would raise the total for this part to above 20%.

There are some noticeable differences in climate between Corangamite and Gippsland (Chapter 2). The summer is dryer in the western region and the growing season is shorter over most of it according to Map 5. At Portland, on the western boundary of Corangamite, the growing season is shown as only 10 months. On the other hand winter temperatures on the coast are milder in the west than in Gippsland. However, these differences are small, and their effect on farming is probably not marked.

Colac and the Stony Rises

On the east, the boundary of the Corangamite dairying region is almost certainly a soil boundary in the main, although the rain-shadow between the Otways and the Central Highlands has had some influence. North and
east of Colac the total rainfall is rather low for dairying, in that considerable areas have less than 25 in. and some, not much more than 20 in. It is noticeable that north from Colac the eastern boundary of dairying is a fixed dune blown from Lake Colac and other lakes nearby and now covered with improved pasture. To the east of the dune the farm type changes rapidly to large pastoral holdings. South of Colac rainfall increases in the foothills of the Otway Ranges, and there is some dairying here. On the west of the town there are unpromising stony rises but these too have been utilized for dairying. In the stony rises one of the problems is to get a reasonable water supply, because there is a great deal of underground drainage and water seldom lies on the surface for long; wells and small lakes constitute the water supply. What soil there is between the boulders is quite remarkably fertile, but pasture improvement and other cultivation is practically impossible because of the ubiquitous stone barriers. The rises have the reputation of being "warm" in the winter, and their milk output at this season is large, but they dry off early in summer before the surrounding country does. Cows are mainly sent away to other farms outside the stony rises for agistment in summer and autumn.

Between Lakes Colac and Corangamite there is a very dense concentration of dairying in the Warrions and
around it. The Warrions is one of the old volcanic cones from which tuff has been thrown, and the surrounding soil developed on this material is highly fertile. Dairying and onions are a common combination on the tuff soils.

The Colac district and the district just west of the metropolitan are two dairying localities that are substantial milk producers although they have rainfall totals of less than 25 ins. They are both in the shadow of ranges somewhat to the west of them and both have considerable areas of stony rises, which inhibit pasture improvement or fodder conservation. Another problem common to both is the rabbit problem, which is particularly severe in the stony rises because they find excellent shelter in the rises.

From Camperdown to Port Fairy there is a long stretch of first-class dairying country which merges on the north into sheep runs. It is a fairly narrow corridor with bush-covered country (some of it half-cleared) to the south, and unimproved pastures to the north. Along the northern edge, 26 ins. to 27 ins. of annual rainfall marks the approximate limit of the dairy belt, but this is not to be taken as meaning that rainfall is the factor which limits the spread of dairying to the north.

The greatest concentrations of dairy cattle with-
in this dairying corridor are to be found on and around volcanic cones which have yielded a highly-fertile soil from past showers of tuff and ash. Examples are Mt. Leura at Camperdown, Mt. Noorat at Terang, and Mt. Warrnambool near the junction of the Hopkins River and Mt. Emu Creek. At the mouth of the Hopkins River there is also a heavy concentration of dairy cattle on the Wangoom flats, which were formerly swampy. West of Warrnambool, there is another patch of dairying and cropping on the rich soils around Tower Hill caldera. Dairying practically ends at Port Fairy, because here a barren stretch of stony rises reaches the coast.

The collection of milk is highly-organised around Warrnambool. The farmers and processing factories have combined to organise a system of roadside stands to which farmers bring their cans twice a day, and where the factories collect milk and return empty cans. This is because of the emphasis on processing milk into condensery products which is to be found at the western end of the corridor. But the main product for the dairying region as a whole is butter (see Map 140) and the processed products use less than half as much milk as is used for butter. Cheese is less important than either.

An interesting question is, what is the environmental factor limiting the northward spread of dairying
in this belt. It may not be rainfall, at least not rainfall totals alone, because the isohyets cross the northern edge at an angle and rainfall increases along the dairy/sheep boundary from west to east. It is possible that it is due to the locking up of the land to the north in large sheep holdings, which could be used for dairying if subdivided. This theory might gain a little support from the fact that there are some sheep and cattle grazing runs within the dairy belt that are clearly historical survivals from the early period of large runs.

But it is not likely that this historical factor would have operated uniformly along the whole east-west line, as it were. It seems probable that both soils and rainfall become unfavourable to dairying. This latter theory is supported by the fact that beyond the zone of small dairy farms, the larger grazing properties often have a dairy farm which is established only on the better part of the farm. Where this occurs, and it is mainly in the west near Terang and Warrnambool, there is thus a zone of mixture in farm type. How far it would be desirable or possible to extend dairying into this zone cannot be judged. The dairy belt curves sharply south along the Hopkins River towards Warrnambool, and this curve to the south seems to correspond to the occurrence of a zone of poorer soils on the older basalt to the west of the Hopkins.
Heytesbury Forest and Otway Ranges

These two neighbouring localities are very strongly contrasted. Heytesbury Forest is adjacent to the Ranges on the west, but is itself low-lying without major relief features. Although the soils are poor - sandy and gravelly podzolised soils - the rainfall is good and there was a cover of dry schelerphyll forest. The poor soils and the bush cover, discouraged early settlement, but it has been discovered that the soils are deficient in copper and with this and superphosphate, they will carry improved pastures quite readily.

The average size of farm here is large, because development is still under way and being thought almost worthless much of it was held in large blocks.

The Otways, on the other hand are elevated and like the S.E. Gippsland Hills attempts were early made to settle them. Some of these clearings have become permanent settlements mainly along the two roads that penetrate the ranges. The roads were paralleled by narrow-gauge railways for some distance. But much of the country has simply been wrecked and abandoned. The tall rain forest, mainly Blue Gum (Eucalyptus globulus) has been toppled to make potato patches which are abandoned when erosion makes them unworkable. In one or two small localities, beef cattle are as important as dairy cows.
Glenelg Dairy Farming Region

The Glenelg Region with about 4% of the state's dairy cattle, produces about 3% of its butter. Dairying occurs on a patch of krasnozems around Portland, then in odd pockets of better land north from Portland to Hamilton, and is more concentrated to the west of Hamilton, around Coleraine and Casterton. The latter is one locality in which dairying and sheep are probably combined on a considerable proportion of holdings. It was the site of very early pastoral settlement by the Hentys, and was later subdivided from large sheep runs after 1918 when soldier settlers were given small holdings of from 150 to 250 acres for dairying. The tableland which tops the hills between Coleraine and Casterton has poorer soils than the slopes and river flats; the tableland soils are podzolised associations with ironstone, but even so are capable of being raised to the status of supporting good pastures of annual self-regenerating species. Dairying is now being displaced because wool pays better, even on the improved country. Soil erosion has been severe and is still a problem so that it is fortunate that pasture improvement is possible, and that cropping for supplementary fodder has declined following pasture improvement.

Central Highlands

Although dairying is an important element in the farming of the Central Highlands, it is part of a type of farming which is integrated with crop production. As such it belongs in a later Chapter (Chapter 9) where it will be distinguished as a whole. But some features of this situation are also related to dairying in its topical aspect and so should be treated here.

One point is that the number of dairy cattle is small, only 30,000 or 2% of the state total. The milk is used either for liquid consumption in Ballarat and Bendigo, or in local butter factories. Environmental conditions do not favour dairying, especially the low winter temperatures which inhibit grass growth in the three winter months. But at least one locality is an exception to the mixed farming type in that it engages in dairying without associated cropping. This is a locality west and northwest of Ballarat. Here the soils are not the krasnozems of the mixed farming belt, but grey loamy soils of heavy texture, acid at the surface with clay alkaline subsoils.\footnote{Central Highlands Region, Resources Survey, Central Planning Authority, (Melbourne, 1956), p. 110.} The farms in part developed to supply oaten and meadow hay to Ballarat when horses were important, but with the decline of that market they have given up cropping in the main and have been forced
to turn to dairying. They are too small to be successful sheep farms and the soils are not suitable for potatoes.

**Other Small Dairying Localities**

There are a few other localities in which dairying is of minor importance. The Bellarine Peninsula close to Geelong, has about 15,000 dairy cattle. These cows supply the city, but it has also to draw some of its milk from Colac and Alvie. Rainfall is rather low for dairying on the Bellarine Peninsula (22-23 in.) but the local climate is moderated by nearness to the sea.

Even in the Mallee there are some dairy cattle on a few farms, a practice which was much more widespread during the 'thirties', than today. The expansion of dairying near Horsham in the Wimmera is being deliberately encouraged by using water from the Grampians to irrigate the W.S.L.S. dairy farms. Some country towns run short of milk in summer; Mildura for example, is poorly supplied in both summer and winter, and what milk it does receive often comes hundreds of miles from Gippsland. The most rational source would appear to be Swan Hill, and it is not known why milk from Swan Hill is not used in Mildura. The lack of cross-country rail connections may be one of the reasons.

The Mallee and Wimmera are the only Districts of Victoria which do not have a reasonable amount of local dairy production.
CHAPTER IX

A. BEEF CATTLE GRAZING
B. LIVESTOCK / FIELD CROP FARMING
C. POULTRY FARMING
A. BEEF CATTLE GRAZING

The value of beef produced in Victoria, from the beef-cattle type of farming was estimated in Chapter IV, above at approximately £12 million. This assumes that one-third of the value of all beef produced arose from within the dairy industry, and in the table on p. 180 (above), that amount was included with the value of dairy products. But looked at from another point of view the figure of £12 million is still too high; many of the animals slaughtered in Victoria have come in from other states as stores and only the last stage of their preparation for market has occurred in Victoria.

In the course of a study of the beef cattle industry of the whole continent, W.A. Beattie, estimated the numbers of cattle coming from the beef-cattle industry and from dairying; the figures for Victoria are given in the table below:

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1 A Survey of the Beef-Cattle Industry of Australia, Bul. 276, C.S.I.R.O. (Melb. 1956) Table 5, p. 117

-369-
Slaughterings apportioned between Beef and Dairy Industries: Victoria

<table>
<thead>
<tr>
<th>Year</th>
<th>Dairying Cows</th>
<th>Dairying Calves</th>
<th>Beef Cows</th>
<th>Beef Bullocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1946-7</td>
<td>144.4</td>
<td>411.4</td>
<td>104.0</td>
<td>160.0</td>
</tr>
<tr>
<td>1947-8</td>
<td>151.8</td>
<td>285.8</td>
<td>131.2</td>
<td>179.6</td>
</tr>
<tr>
<td>1948-9</td>
<td>158.1</td>
<td>322.8</td>
<td>174.1</td>
<td>194.9</td>
</tr>
</tbody>
</table>

Source: Beef-Cattle Industry of Australia, op. cit. p.117

Unfortunately there are no figures beyond 1948-9, but the general drift of the information is clear: the dairy industry made a very substantial contribution to meat supplies. The calves make only a small contribution as they are killed when very young and the meat is veal, not much eaten in Australia, but the culled cows of the dairy herds supply almost a third of the animals killed, and the remainder of between 250,000 and 300,000, are from the beef herds proper. The total beef cattle population was less than 750,000, so that it is clear that a large proportion of the beef animals slaughtered have originated in other states, mainly N.S.W., and Queensland. Victoria also imports meat from the inland killing works of N.S.W., and from coastal Queensland works. The following table gives particulars of the numbers of holdings carrying beef cattle in 1950 and 1956:
Holdings with Beef Cattle: Number of holdings and Number of beef cattle carried: 1950 & 1956

<table>
<thead>
<tr>
<th>Size of Herd</th>
<th>Number of Holdings 1950</th>
<th>Number of Holdings 1956</th>
<th>No. of Cattle 1950 '000</th>
<th>No. of Cattle 1956</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 - 19</td>
<td>10,714</td>
<td>11,945</td>
<td>66.4</td>
<td>79.5</td>
</tr>
<tr>
<td>20-149</td>
<td>5,537</td>
<td>8,171</td>
<td>299.5</td>
<td>448.6</td>
</tr>
<tr>
<td>150- &amp; above</td>
<td>1,016</td>
<td>1,300</td>
<td>365.9</td>
<td>417.5</td>
</tr>
</tbody>
</table>


The herds were divided into those greater than and less than, 150 animals. It is probable that this is not a large enough herd to give a livelihood, but assuming that it is a reasonable lower limit for a herd of some importance, then the number greater than 150 animals is seen to be only 5 to 6% of the total number of herds, and to include only one-half or less of the total beef cattle in the state.

Even so, many of these herds of more than 150 animals, will be being run with other enterprises, and will not be the main interest of the farmer. It would be surprising if there were 500 farms on which beef cattle were the sole, or even the main, enterprise, and correspondingly the labour force would be less than 1,000, for this type of farming.

To summarise: beef cattle farming is rare as a separate type of farming in Victoria, and more than half the cattle
are to be found on farms of other types. The work force in beef farming would therefore be small, and the value of beef output is not great, amounting to about £12 million from farms other than dairy farms. The raising of beef in Victoria is linked with that in other states in some ways.

**Beef Cattle Distribution**

Another illustration of the lack of a separate existence for a beef-grazing type of farming, can be had from a comparison of Maps 103 and 137. Map 103 shows that beef cattle are spread widely, being found in most parts of the state, except the northwest. But on the other hand Map 137 shows that in only a handful of parishes are beef cattle the dominant livestock type.

In a few other parishes they are mixed with sheep or dairy cattle, and these parishes are located mainly around the fringe of the Eastern Highlands. The large number of animals to be found beyond the fringes of the Highlands and especially in the central north and in the west, must be associated with other types of farming in which they are not a major element.

Five types of farming can be distinguished, in which beef cattle have a place:
a. Beef cattle grazing predominant - summer grazing on hills, bush country or High Plains;
b. Beef grazing predominant on improved pasture;
c. Beef grazing mixed with dairying - summer grazing on hills, winter on improved pasture;
d. Beef grazing mixed with dairying on improved pasture;
e. Beef grazing, mixed with sheep on partly-improved pasture:

This is rather too elaborate a systematization of the various possibilities, because beef cattle are for the most part a stopgap. At one end of the scale they may be associated with the use of the poorest types of pasture or rough grazing in the wetter and cooler parts of the country, and at the other end they may be found on highly-improved pasture.

Two points are important about beef cattle: firstly that they can graze pastures too coarse for sheep, and secondly that other livestock pay better than beef cattle, where sheep, dairy cattle and beef may all be considered for the same farm. In an article in the Victorian Journal of Agriculture, A.C.T. Hewitt suggests that 100 breeding cows would bring in only a third of the income of 100 milking cows, or 1,000 ewes but the land would cost about the same.

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2 Beef Cattle Farming in Victoria, Sept. 1957, pp. 565-67
Beef cattle are much used as "lawn mowers" to graze pastures which are too rank or coarse for sheep and dairy animals. They can be carried on sheep farms without lowering their capacity to carry sheep, up to a certain fairly low ratio. Indeed, if they are skillfully managed they will make additional fodder available to the sheep over what the latter would normally have received.

Beattie, in writing of the beef cattle of southern Australia, is critical of the general tendency to regard them as "lawn mowers" and shows that there are many special circumstances where they are much more than this, or where they could become so if their full potential were realized. Some of these aspects can be dealt with if the geographical location of the different types of beef grazing listed above, is discussed.

In Victoria as a whole, there is much more fattening than breeding, so it is important to distinguish the major practice of different localities, and particularly to pick out any localities which are both breeding and fattening.

The alpine and forest country of the Eastern Highlands is one of the main breeding areas, and almost the only place where some breeding and fattening is carried on by the same owners or in localities close to one another. It is also

3 op. cit., A Survey ..., pp. 98-99
4 Ibid, Part 3, pp. 84-135, drawn upon for some of this section.
the only part farmed exclusively for beef cattle. Those who graze beef animals as their main interest are largely rearing the animals to the point where they can be sold for fattening elsewhere. Some of the improved flats of the rivers of the Northeast are owned by beef cattle farmers, and the narrow upper parts of the valleys are entirely given over to beef rearing. Those with some of this valley floor type of country usually winter the cattle on the valley floor and either lease alpine pastures for the summer, or turn their breeding stock out into partly-cleared bush, on the slopes of the ranges.

The river valleys in which this practice is common are marked on the Overlay to Map 137. The main valleys are the Upper Murray, Mitta Mitta, Kiewa, Ovens: on the Gippsland side they are the Cann, Buchan-Snowy, Tambo (round Omeo), Dargo, Mitchell and Macallister valleys. The cows calve in spring if they are staying below, or in winter if they are going to alpine pastures. The number that uses alpine pastures has declined steadily as the control of State Departments of Soil Conservation and Electricity has increased. On the Overlay to Map 137, are marked the alpine districts within which there are High Plains tussock grasslands. There are three main localities. One is the Snowy-Murray plains, which are part of a much larger extent of grazing ground in neighbouring N.S.W. The number of
cattle depastured there is small, and some of them come from the N.S.W. side of the river where there is more winter lowland suitable for cattle.

The second locality is the Bogong High Plains which is reached from the valleys of the Mitta, Kiewa and Ovens rivers and from the Omeo valley. This is the largest alpine grazing ground: about 8,000 cattle are permitted to graze here each summer. The surface is deficient in salt, and stockmen use this to control the animals. They place salt at known points weekly or fortnightly, and call the cattle with a cry of "salt". At the last call they round them up, and thus save themselves a great deal of difficult mustering.

The Bogong High Plains have an average elevation of 4,500 feet, but extending up to 6,500 ft. on Mt. Bogong and some of its neighbours. October is the earliest that they can get onto the High Plains, and that depends on snow conditions, but the dates of entry and exit are controlled by the Soil Conservation Authority, to preserve the tussock growth. They must leave in April and even then there is a risk of being caught by early snows during mustering.

The Dargo High Plains are similar in many ways, but smaller in area and with more difficult routes of entry. The valleys leading to them are long and narrow, except from the Goulburn Valley side, where the Delatite and Howqua
Rivers are short. But their valleys are very narrow and
there is not as much cleared and improved valley land for
winter grazing as in the valleys further east. The Dargo,
Mitchell and MacAllister River valleys lead up to the High
Plains from the Gippsland side.

The High Plains cattle are mainly Herefords, although
there are a few Aberdeen Angus and Shorthorn.

In some of the lower valleys the breeding was formerly
carried out by grazing in bush runs, which were largely
areas of leasehold with scattered clearings and some open graz­
ing along streams. Sometimes these runs were created or kept
open by burning, but repeated burning and grazing has led to
the growth of seedlings which have gained an increasing
hold and so have slowly lowered the grazing capacity of the
bush runs. The tendency now is to get cattle out of these
runs and to improve the open country outside, fencing and
topdressing, and turning off younger cattle from the
improved country. The Omeo valleys, Buchan-Wul­gulmerang,
and parts of the Ovens valley and Upper Murray are turning to
this form of operation.

In such valleys as the Upper Murray and Corryong-
Cudgewa and Kiewa, there are many dairy farms on which
half-bred, beef cattle are bred and reared on the least
highly-improved part of the farm, or put out on the rougher
hillsides in summer and autumn. In contrast to these rearing activities there are many dairy farms on the better country which devote some attention to fattening. Orbost for example, buys stores from the Monaro and according to one source,\(^5\) turns off 4,000 head of fat cattle annually from the Orbost flats. As can be seen from Map 137, beef are important enough on the flats for the type of farming to be a mixed one. There are other similar fattening localities, at the mouth of the Tambo river, and along the edge of the plains country of East Gippsland (see Map 137).

Around Melbourne there are two or three localities shown on Map 137 as a beef or beef/dairy type of farming. They are on the shores of Port Phillip, at the head of Westernport Bay and in the Yarra Valley. The Yarra Valley is a case of a damp valley bottom with rank pastures, not really suitable for dairying but too moist for sheep. Being near to Melbourne the locality has become of interest to "Collins St." farmers who raise stud breeds of beef cattle, for the most part. The small localities at the head of Westernport Bay are fattening types on poor land. On Port Phillip, near Werribee, is the most dense concentration of cattle in the whole state. They are raised on rank

pastures irrigated by the sewerage outflow of the Metropolitan Farm. It is difficult to manage this operation in a normal manner because the pastures must be rested after irrigation, which means that they will inevitably be rank and cannot be kept down by the usual grazing management and fodder conservation. Nevertheless the carrying capacity of the Farm is very high, and the product is probably the best beef in Victoria.

There are only another two localities marked on Map 137; one is due north of Melbourne in the valley of the Goulburn River – there are beef cattle all along the Goulburn, but at Trawool, the river flats are wide and damp, and there is a concentration of beef animals and dairying.

The Otways support beef cattle in most of the cleared localities, but generally dairy cattle and potatoes are more important enterprises than beef, except in the higher parts of the ranges, and overall the livestock population is itself very small – of any type.

In Gippsland the high-quality dairying districts carry many beef animals, mainly in the process of fattening, but some of them reared from half-bred calves using a beef bull on a dairy cow. The similar dairy localities in the Western District have a smaller beef population in proportion, and the numbers actually increase outside the dairy belt, as towards the west and northwest from Terang, or between Colac
and Geelong. In the irrigation districts with dairying, the beef animals are much more evenly spread than are the dairy cattle, and nowhere are important enough in numbers for a mixed livestock type to be shown.

There is a large number of beef run with sheep on farms mainly devoted to raising sheep for wool. This is the "lawn-mower" function (mentioned above), but it is noticeable that it is only found in the southern half of the main areas of sheep farming for wool. For example, there are practically no beef cattle in the country surrounding the Grampians or north of it. Nor in a considerable part of the Western District north of Lake Corangamite. What appear to be the environmental limits to the distribution? First thoughts are of the distribution of sown or topdressed pasture, but these both extend beyond the general distribution of beef cattle (Maps 121 & 122). In fact the northern edge of the "beef zone" is most closely followed by the 25 ins. rainfall isohyet.

This is about the limit at which perennial grasses will flourish, although the most widespread clover, that is Subterranean clover, will grow in dryer conditions. The zone from 20 ins. to 25 ins. is the locale of a great deal of present pasture improvement as the maps show, but apparently it will take some time for extra beef cattle to be brought into this zone as a consequence. Or perhaps the deterrent
is the absence of the taller perennial grasses, with their
more rank growth. Beattie, in his discussion of beef cattle
in southern Australia concentrates most attention on land
with 20 ins. of rainfall and more, and within this category
he is clearly mainly concerned with that part on which
pasture improvement is possible, on the assumption that
beef cattle are a more economical method of using much of the
lush extra growth, than sheep alone.

Breeding versus buying stores

The sheep farmer who decides to add some cattle to
his livestock has to decide whether it is better to breed
them or to buy store cattle. Many express the opinion that
stores are so expensive and deteriorate so much in transit
that they are not worth buying. Nevertheless the need for
cattle is often one that cannot be foreseen such as when a
good season produces fodder that is best consumed by cattle,
when there may be none available from breeding on the farm.
Basically the decision is likely to rest on prices of stores,
and as they change, buying stores rather than breeding may
become more or less attractive. What are the sources of stores?

Supply of Store Cattle

The sources of supply are mainly outside Victoria.
They must be, when one considers the large numbers of cattle
killed (see above) compared with the total cattle population.

6 op. cit., p. 103, et. seq.
Beattie estimates that only about 10,000 stores are turned off the Eastern Highlands and surrounding bush runs annually. Sales are held at Bairnsdale and Wodonga, but it seems that they act more as a channel for interstate cattle than as outlets for local stores. The "snow country" stores are much sought after and fetch high prices, and similar stores come from the Monaro plateau to Gippsland, where they make up the largest source of supply in southeast Victoria. The main source for the rest of Victoria is the other breeding country of the remainder of N.S.W., especially the New England plateau and its eastern fall to the Pacific and even southern Queensland. But stores also come from many parts of the western slopes, especially in the south from Holbrook to Gundagai. The total number entering the state annually is probably about 200,000.

Gippsland and the Northeast thus act as funnels for store cattle from further north, as well as meeting themselves, some of the Victorian demand for stores. Beattie emphasises that the future of the beef cattle business in Victoria is tied up with that of northern Australia. Many southern farmers who used to buy stores but have taken to breeding because of the cost and difficulty of obtaining them, like to contest this view and point out that they do not intend to have anything more to do with interstate buying. But overall Victoria cannot escape an increasing interest
in interstate (including northern) developments, because they will so much influence prices for fat cattle in Melbourne. Melbourne prices are the other end of the chain of buying and selling so that even those who breed and fatten within Victoria are directly affected by the amount of fat cattle and carcass meat bought from outside Victoria for the local killing centres. The fact is that Victoria is consuming much more beef than she is producing, and the likelihood is that in spite of growth in local production there will be more and more meat and fat cattle bought from outside the state.

The Northern Territory is closed as a source of stores because of the occurrence of pleuropneumonia, and in spite of quarantine restrictions between Queensland and N.S.W. which it would be thought would protect Victoria, nevertheless the disease breaks out occasionally in Victoria.

The steps in raising beef numbers on sheep farms are the following: pasture improvement, strengthening fences, improving water supplies, breeding more cattle or buying stores, more fodder conservation, subdivision of paddocks. Where natural conditions defeat any one of these steps, cattle will be excluded: for example on the stony rises of the Western District and the Central District pasture improvement is really not possible and even if it
were, water supplies can often not be improved, nor is it possible to conserve fodder on such uncultivable country.

Beef cattle have so long been given the worst feed and whatever happens to be surplus fortuitously, that the economics of steady or rapid fattening has been neglected. Animals have not been bred or selected on a performance basis, but rather on show points, and this is holding back an advance to rapid and steady fattening. The main period of difficulty is the autumn, when many cattle lose weight; this is when there should be plenty of fodder ready to be fed out, until the autumn break brings more green feed.

Another important factor is the relationship between meat, milk and wool prices. When meat prices compare more favourably with the others than they have generally done to date, the rapid fattening techniques of the United States and some other countries, will probably be adopted in southern Australia, and there will be more specialisation in beef cattle grazing as a separate form of farming.

B. FIELD CROP/LIVESTOCK FARMING

It is in the identification of this type of farming that the difference between studies of products and studies of a particular type of farming, becomes most apparent. Like wheat/sheep farming, this type is a combination of the growing of an important crop or crops for cash, with
the raising of a diversity of livestock. Its ancestor
is the mixed farming of Western Europe, but in Victoria
the type has a limited importance: the main crops of the
combination are two vegetable-type crops, onions and potatoes.
They are grown only for the national market not for export,
and grown within fairly limited districts. This type of
farming is found only within the environments which suit
the two crops, but should new cash crops become important,
it could easily spread into other localities which are now
largely given over to livestock.

This suggestion emphasises the active role of the
particular crop in the field crop/livestock type of farming,
and the fact that livestock are there to "fill in" as it
were, between crops. This is stressed when it is observed that
these are localities with soils of much higher than average
fertility, and with physical qualities useful in growing
intensive crops. The main crops are the potato and onion,
but in one locality other vegetable crops are grown by
field-cropping methods.

In Chapter IV above, the number of holdings with
potatoes in 1950-1, was given as 5,174 and the number growing
onions as 652. There is a more elaborate segregation of
potato holdings by size, for the year earlier:
## of Holding

### Holdings Growing Potatoes: Area Series, 1949-50

<table>
<thead>
<tr>
<th>Area - Acres</th>
<th>No. of Holdings</th>
<th>Tot. Area all Crops</th>
<th>Area of Potatoes</th>
<th>Ratio: Potatoes to All Crops</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-49</td>
<td>1,110</td>
<td>15,141</td>
<td>5,861</td>
<td>1 : 2.7</td>
</tr>
<tr>
<td>50-99</td>
<td>877</td>
<td>21,914</td>
<td>9,178</td>
<td>1 : 2.3</td>
</tr>
<tr>
<td>100-149</td>
<td>795</td>
<td>24,413</td>
<td>9,785</td>
<td>1 : 2.5</td>
</tr>
<tr>
<td>150-249</td>
<td>909</td>
<td>31,712</td>
<td>11,428</td>
<td>1 : 2.7</td>
</tr>
<tr>
<td>250-499</td>
<td>718</td>
<td>30,924</td>
<td>10,194</td>
<td>1 : 3.0</td>
</tr>
<tr>
<td>500-50,000</td>
<td>343</td>
<td>17,845</td>
<td>4,205</td>
<td>1 : 4.2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>4,752</strong></td>
<td><strong>143,949</strong></td>
<td><strong>50,651</strong></td>
<td><strong>1 : 2.8</strong></td>
</tr>
</tbody>
</table>


Four-fifths of the potatoes were grown on holdings between 50 and 500 acres, and in this group the average area of potatoes per holding was 12 acres. The area of all crops on potato-growing holdings was from 2.3 to 3 times as great as the area of potatoes alone, so that crops other than potatoes were always more important in acreage than potatoes themselves. This lends support to the concept of a variety of crops on these holdings, in addition to potatoes. Of course they could quite possibly all be crops of lower value per acre, such as hay, or other fodder crops. But the important point is that on the average, potato holdings do not appear to be small patches devoted mainly to the cash crop. If, as was suggested above, the livestock (and other crops) are there to "fill in" as it were, between crops, nevertheless a great deal of the area of the farm is devoted to these other enterprises.
The nearest group to the "potato patch" concept, is perhaps the size group between 50 and 100 acres: the preceding group has small holdings indeed, but with only 5 acres of potatoes per holding, not enough to bring a sizeable share of farm income (in Chap. V, p. 203, the value of potatoes per acre was given as £66 in the Scale of Numbers and Acreages). There may be some "patches" with a larger average area of potatoes amongst these, and if they also had high yields, potatoes could bring in a reasonable income.

To summarise: the number of holdings growing potatoes varies between about 4,000 and 5,000; of these more than 3,000 are between 50 and 500 acres and supply about 4/5ths of total production. On the average these 3,000 holdings have a larger area under other crops than they have under potatoes, and the average area of potatoes for each holding would approximate 12 acres, which at £66 per acre, would have given a gross return of almost £800 in the years 1948-51, sufficient to make up a considerable share of farm income.

Potato growing is subject to quite considerable variations in production, with an irregular swing in prices, perhaps approximating to a cycle, superimposed on changes in output due to weather differences from one season
to another. Following a low point in prices as many as a third of the farmers who recently planted some acreage of the crop, are liable to abandon production.

This leads to attempts to distinguish between what are described as speculators and regular growers, but the basis for this distinction has not been documented.

Environmental Conditions for Potatoes

Potatoes need moisture, cool conditions, but no frost. They need a steady supply of soil moisture during the growing period, with night temperatures below 60 degrees during the early growing period, but not so low that the young plants will be frosted. Hilly districts with cool temperatures but without frost, are best. In the Highlands or along the coasts are the cool but moist parts of the state. Even so these belts are large and within them it is the districts with highly fertile soils that grow potatoes.

Potatoes can be grown in a variety of soils, but high yields are necessary to make the heavy labour worthwhile, and so they are largely confined to soils of high fertility.

2 G.H. Mattingley, Potato Growing in Victoria, Dept. of Ag. Vic., (3rd Edition, 1954), has been drawn upon in the following section.
unless other special conditions apply. The soils need too to be easily worked - heavy loams are not really suitable - and retentive of moisture. The krasnozems and the soils derived from volcanic tuffs are the best, and only a minority of potato districts is located on other types of soils.

**Potato-Growing Districts**

The distribution of potatoes is shown on Map 108: the Overlay shows the main district names, with some localities within them marked in smaller letters.

The Potato Marketing Board uses these districts for estimates of the acreage of the crop, and their estimate for 1952/3 is given in the following table:

| Acreage of Potatoes in Districts: 1952/3 |
|-----------------|-----------------|
| **District**    | **Acre.**       | **District**    | **Acre.**       |
| Central Highlands | 14,850          | Metropolitan    | 2,271          |
| S. Gippsland     | 10,167          | Otway           | 1,937          |
| Koo-Wee-Rup      | 5,089           | Neerim          | 1,738          |
| Emerald/Gembrook | 3,403           | Northeast       | 1,667          |
| Koroit           | 3,223           | Geelong         | 1,471          |
| Colac            | 3,088           | Kinglake        | 1,409          |
|                 |                 | Portland        | 907            |
|                 |                 | Other           | 1,470          |
|                 |                 | **Total**       | **52,690**     |

*Source: G.H. Mattingley, Potato Growing in Victoria, p. 29*

Almost half the acreage is in the two districts of the Central Highlands and South Gippsland. These are hilly or elevated, which means that they are cool but have air
drainage for frost protection, and they both have patches of krasnozem soils. Actually the greatest part of the Central Highlands output comes from one or two scoria cones, which have highly fertile soils developed on the tuff.

Other cool, hilly, districts with krasnozem soils are Emerald-Gembrook in the Dandenongs, Neerim in the hills of Gippsland, Kinglake on the Divide north of Melbourne, and Archerton, one of the two localities in the Northeast. Koroit and Colac, are near-coastal localities with tuff centres, and Portland has poor sandy soils, but a mild climate.

The remaining districts are Metropolitan, Koo-wee-Rup, Geelong and Otway. Koo-Wee-Rup, Metropolitan and Geelong are prominent on Map 109, which shows the distribution of Early Potatoes. This crop must be grown in ground which warms up early in spring, so that the potatoes have grown sufficiently to be lifted in November, even though they are still not mature. This crop being the first of the new season is sold at a premium price, and consequently can be treated more like a market-garden crop with a heavy application of artificial fertilisers and intensive working and care.

The early acreage is found along the coast, where winters are fairly mild. At Koo-Wee-Rup the soil is peat,
which is fairly fertile, easily worked and heavily fertilised. In the market gardens near Melbourne, the soils are not good but are brought up to higher standards by care and extra attention. The Bellarine Peninsula is really a market garden for Geelong, and Koroit has an advantage in being on the coast. Note that Colac which is 30 miles inland does not grow any of the early crop, while Koroit, with much the same soils but on the coast, does grow some of the early crop. The northern part of the state seems to have no advantage in producing the early crop.

The remaining district is Otway, and here early potatoes are grown on the podzolic loams of the Jurassic country, but rather because of the coolness and isolation of the district, than because of any positive virtue of the soil. Otway is ideal for the production of high-quality seed, especially in that its isolation protects it from the wind-borne virus diseases which are one of the scourges of potatoes.

**Rotations and Other Crops**

Other crops which are grown in rotation with potatoes are there to serve either the potatoes or the livestock; few of them are cash crops in their own right. Some are grown to be turned in when green, to raise the level of organic matter in the soil, others are forage or
fodder crops to carry animals through the autumn or winter. There are differences according to whether the livestock are sheep or dairy cattle. In South Gippsland and in some of the other localities of intensive production, such as Bungaree, Colac and Koroi, the livestock are dairy cattle. In South Gippsland, dairying is often the main interest and potato paddocks are returned to pasture to be rested for a number of years. The acreage of potatoes is likely to be smaller here than elsewhere because the paddocks are good quality permanent pasture, which will not be broken up readily if prices or prospects seem less than favourable.

In the Central Highlands crop rotation is general with potatoes, the rotation crops being such as will be grazed by livestock or provide hay for feeding out to livestock in autumn and winter. Potatoes may be grown every third year, with the two years between filled by:
1. barley, rape, or peas, fed off and turned under;
2. hay; oaten or wheaten hay is usual. Every ten years or so the paddock is returned to permanent pasture and grazed for a number of years.

Whether the livestock will be dairy cattle or sheep, depends a good deal on the size and fertility of the farm and the climate. The most elevated parts of the Central Highlands are too cold for dairying to be very attractive. There is
no grass growth in winter and "few farmers carry stock over that period, when feed is sparse and losses from adverse weather conditions can be serious." Instead these farmers fatten lambs over the summer on rape or a similar forage crop. They buy spring lambs in November, hold them on grass until the New Year, then as pastures dry off they "top them" on rape for 6 weeks or so and sell them in early March. The residue of the rape is ploughed under, thus helping to prepare the ground for further potato production and the lambs bring a profit of about £1 a head for the brief fattening. Rape usually follows barley, which is grown in small paddocks, and harvested still by the reaper and binder.

There is some evidence that the coming of the hay baler is altering the cropping rotations of the Central Highlands, and the area of crops other than meadow hay is falling, while the latter is increasing sharply. Provided the hay is fed out on the farm this should have no harmful effect on soil fertility. Potato yields per acre have risen a little in recent years, to offset a drop in acreage. The Central Highlands is normally the latest district in growing and selling its potato crop, but recently has tended to move forward.

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The crop is planted in spring and early summer, from October to the end of December and harvesting continues right through the winter and into the spring. The Central Highlands grower is thus selling at the end of the season when he feels that early crops may cut his prices or that wet weather is very likely to prevent his harvesting.

At Colac, dairying and onions are both more important than potatoes, and at Koroit onions and potatoes are about equally important, with dairying as the livestock combination. Here both early and late crops are grown, the early being planted in July, with no real risk of frost, and harvested in December and January. In spring later crops are sown, and they are harvested from January until July.

Kinglake and Emerald-Gembrook are localities emerging from the pioneer stage, in which potatoes were the first crop on cleared land. Kinglake is another like Otway in which seed potatoes are a specialty due to elevation and isolation, but here the soil has been mined by too much continuous cropping of potatoes, and changes are needed. The district may turn more to dairying, or adopt the more drawn-out rotations of the Central Highlands. Neerim and the Northeast locality of Archerton are somewhat similar clearings in the hills north and south of the Eastern Highlands, on good soils, and producing potatoes in the winter in July and August. Dairying is the accompanying activity.
At Myrtleford in the Northeast potatoes are grown on small farms which are mainly engaged in tobacco production, with dairying as an associated activity. Potatoes are merely a crop requiring intensive work, and producing a fairly high income per acre, and are not especially suited to the somewhat fine soils of Myrtleford. Spray irrigation keeps up yields.

The potato-growing districts can be divided into four or five types according to the associated farming, and it is necessary at this stage to pick out those that fit the field/crop livestock type.

Those around Port Phillip Bay, from Geelong to Werribee to Bentleigh in the southeast of Melbourne, are market garden districts and early potatoes are merely one of the vegetables of their range.

At Colac and Warrnambool the farming is the field crop/livestock type, with the crop side made up of onions and potatoes and the livestock consisting of dairying. In the Central Highlands the type is potatoes and a variety of fodder and forage crops, with dairying more important in the lower parts as around Ballarat, and sheep more important in the higher parts as at Trentham and Romsey.

In other hill locations, such as Kinglake, Neerim, Otway, S. Gippsland, and Archerton in the Northeast, the combination
is simpler, with potatoes and dairying and few variations. A wider rotation would help some of these localities, but their farming system lacks mature development in some cases.

Two others close to the city are more diverse. Emerald-Gembrook is in a small locality of special crops, ranging from small fruits, to flowers and nursery output, with potatoes as just another cash crop. To some extent this is a market-gardening locality, and again it is something of a pioneering enterprise, as much of the farmland is newly-cleared (this applies also, to some of the other mountain sites). Koo-Wee-Rup is a locality where the farming system is half-way between field crop/livestock and market gardening in type. Vegetables are very important, potatoes of some importance and livestock have an important place.

The distribution of onion-growing will be examined before the mixed farming districts are investigated further.

Environmental Conditions for Onions

Onions can be grown in a wide variety of environments, but the crop demands so much labour that it is produced

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commercially only on the most productive soils. Its requirements are not unlike those of potatoes, in that it grows through the summer and so needs adequate soil moisture in that season. It will tolerate a dryer autumn than potatoes, but one of the advantages of the richer soils on which it is generally grown, is that these deep soils stay moist for longer than the lighter types, but with irrigation, the latter grow the crop quite successfully.

Land is fallowed for a short period prior to sowing which takes place mainly in June or July. The plant grows through the spring but needs constant moisture until it starts to form its bulb during December and January: for this reason it needs a locality with moderately high rainfall, so that there is a reasonable certainty of summer rainfall sufficient to keep the soil moist into January. The dry autumn helps the marketing of the crop, because bulbs harvested in February and March can be cured if conditions are dry, and sold much later in the year when fresh onions are no longer available. In the other eastern states onions do not keep well in store, because harvesting weather is not dry, and accordingly Victoria has become the main onion-growing state.

There is also a market-garden crop of white onions, grown in spring and harvested in November and December,
but this variety is highly perishable, must be consumed quickly for that reason, and is not suitable for Board marketing. But white onions make up only 5% of the crop, and are not unlike "new" potatoes, in being grown and sold by different methods. White onions are produced in the market garden localities around Melbourne and Geelong, but the crop has been declining because it occupies the ground too long, and in the eight or nine months that it takes, the market gardener could take off two or more crops of cabbages.

The total area of onions grown is about 4,000 acres, worth approximately £500,000. They are grown altogether on about 650 holdings of which some 450 to 500 are probably considerably dependent on them as a source of farm income. Onions are sold by a Marketing Board which has operated for 20 years, apparently to the grower's satisfaction.

The distribution of onions is shown on Map 110: Colac is the main centre and as much as 3/5ths of the crop may be grown here. That labour is the main input in onion-growing is illustrated by the fact that about 75% of the onions at Colac are grown on rented land. The tuff deposits of the Warrions, between the two lakes Corangamite and Colac, are the locale of production. Koroit is the next most important centre, the crop being located on the tuff of Tower Hill, and the other two main localities are
the Bellarine Peninsula, where they are grown on market
gardens mainly, and on the market gardens southeast and
southwest of Melbourne. Here is a good example of the way
in which disease has influenced the distribution of a crop
and has been influenced itself in its spread, by the methods
of farming used.

During the last 15 to 20 years the onion-growing districts
have been increasingly infested with White Rot Fungus, and
many hundreds of acres of land have had to be abandoned for
onion-growing. To quote D.E. Harrison,

This state of affairs is very largely due to the
genral system of agriculture carried on in these
districts (especially the Colac area) where many of
the farms are small and the land is so highly
capitalized that onions are the only crop that can
be grown to provide commensurate returns for the
capital outlay. When ground becomes badly infested,
fresh clean land is leased... and since the lessee
has to pay a high rental... and has not the same
keen interest in its general welfare, he grows as
many crops of onions as possible until he is
forced to look for further uncontaminated land.
Such practices provide every opportunity for the
multiplication and spread, not only of white rot,
but also Fusarium root rot, neck rot, and downy
mildew, all of which have caused serious losses
to the onion industry in recent years.

At Warrnambool it has become so bad that many hundreds of
acres have been permanently retired from onions, but the
limestone soils of a high pH, are not affected and some that

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5 D.E. Harrison, "White Rot of Onions in Victoria",
have grown onions for 37 consecutive years are still growing them.

In the Colac district many more hundreds of acres have been retired, but on much of the remaining onion acreage, White rot has only a thinning effect, but it may be enough to cut the yield per acre from 6 tons to only 2 tons. When land is retired and sown down to permanent pasture (it is often not possible to sow potatoes because of similar disease problems, or adverse prices) there is a large reduction in capital value, say from £150 per acre to approximately £70 to £80 per acre for dairying.

In the Melbourne market garden districts, the disease is present but is kept in check in most cases by a system of crop rotation, combined with heavy liming and destruction of onion refuse. At Colac and Warrnambool many of the farming practices helped to spread the disease. Feeding the onion refuse to animals spread the fungus through droppings, thorough preparation of the seed bed spread it across paddocks, renting out land brought in implements and workers with infection from other farms: hand-weeding by crawling through the growing crop spread it along the rows; wind and water probably helped to spread it also. White rot has appeared in other onion districts, even in the irrigation districts of the north, where onions are a recent crop: but they may be grown
more in the irrigation districts where the disease will not survive so long if the ground dries out. In southern Victoria it will last at least fifteen years even in land where no crop is grown. The only district where White rot has not been reported is the Southern Gippsland hill district around Leongatha and it is possible that onions may become more important here because of the apparent immunity.

An Assessment of the Mixed Farming Districts

To measure the mixed farming of the above districts, statistics have been taken for parishes which seem representative of six localities: only those localities in which crops are of considerable importance have been taken, for, as pointed out above many of the potato-growing localities are dominated by the associated dairying, or have only a few hundred acres of potatoes, which is not enough for them to be picked out. The Scale of Numbers and Acreages, p. 203, above, has been used to measure the cereal, potato, onion and vegetable crops, and the equivalent of the cash crops is compared with the total of livestock units from dairying, sheep and beef cattle. The following table summarises the estimates for representative parishes:
Relative Importance of Livestock & Field Crops

<table>
<thead>
<tr>
<th>County or nearest Town: selected parish</th>
<th>Livestock (as livestock units)</th>
<th>Crops (as livestock units)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mornington County</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Koo-Wee-Rup parish</td>
<td>8,000</td>
<td>16,600</td>
</tr>
<tr>
<td>Koo-Wee-Rup East parish</td>
<td>14,100</td>
<td>6,870</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>22,100</td>
<td>23,470</td>
</tr>
<tr>
<td><strong>Talbot County</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bungaree parish</td>
<td>4,600</td>
<td>6,950</td>
</tr>
<tr>
<td>Dean</td>
<td>2,900</td>
<td>4,100</td>
</tr>
<tr>
<td>Spring Hill</td>
<td>4,100</td>
<td>1,400</td>
</tr>
<tr>
<td>Trentham</td>
<td>2,000</td>
<td>4,195</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>6,950</td>
<td>1,400</td>
</tr>
<tr>
<td><strong>Dalhousie County</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Newham parish</td>
<td>2,900</td>
<td>1,350</td>
</tr>
<tr>
<td><strong>Colac Town</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Warrion parish</td>
<td>9,100</td>
<td>7,880</td>
</tr>
<tr>
<td><strong>Warrnambool City</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Koroit parish</td>
<td>6,270</td>
<td>2,030</td>
</tr>
<tr>
<td>Remainder of Koroit Borough</td>
<td>1,900</td>
<td>2,440</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>8,170</td>
<td>4,470</td>
</tr>
</tbody>
</table>

All of these localities are marked as type-of-farming areas on Map 136; only brief comments on each follow. The two Koo-Wee-Rup parishes are within the same range in their relative emphases on crops and livestock, but the ratio is reversed from one to the other. When Goudie made a survey

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in 1939-40, livestock were the main source of livelihood and crops had been given up since the great flood of 1934. But farmers have returned to crops and they now equal livestock in importance. Some of the increase in cropping is due to an enlargement of vegetable-growing but Koo-Wee-Rup is not a proper market-garden locality. Its vegetables are grown on contract largely for a few canning companies and some of the increase in cropping has followed the changes in taste of the general public - greater consumption of canned foods. Potatoes are no more important than they were in 1938-39, but vegetables have increased from 1,100 to 1,900 acres. At the same time the growing of maize for grain has declined - Orbost is better suited, as Goudie pointed out and the manufacturing market is stationary.

The vegetable crops are canning specialities, with mechanisation wherever possible: sweetcorn, asparagus, melons, pumpkins, carrots, parsnips, peas, mostly grown under contract, and with a certain amount of company control. Koo-Wee-Rup is half-way to market-gardening but its type of farming is still best described as an example of mixed farming, with animals and crops, the animals being mainly dairy cattle.

The parishes of the livestock/field cropping type in the Central Highlands extend from near Ballarat to the east
across the higher parts of the Highlands, and comprises two
groups, one around Ballarat, and represented by the parishes
of Bungaree and Dean, and another to the east around Trentham
and Newham. Spring Hill is between them and is really a
fringe type, outside the mixed type of farming.

Bungaree parish is the heart of the "potato country"
containing two tuff cones in Mts. Buninyong and Warrenheip,
with very heavy crop production from the rich soils. Bungaree
grows as much as 2,200 acres of the state total of 52,000
acres, and in addition has 1,000 acres of cereals grown for
grain and 30 acres of grass seed. Half of the livestock units
are dairy cattle, and a third are sheep.

Dean to the north of Bungaree has a more balanced
crop pattern, with 1,240 acres of potatoes and 1,450 acres of
cereals for grain, in addition to further hay crops and other
fodder crops. As mentioned above, the fodder crops are
ploughed in, as also are pea crops, to raise the level of
organic matter in preparation for later potato crops. This
is the true mixed farming pattern, in which livestock and
crops are rotated and interdependent. Sheep are more important
in Dean than dairying.

In Spring Hill which is a transitional type, sheep
and livestock are more important than crops altogether. In
Trentham and Newham sheep displace dairy cattle as the most important in numbers of livestock units, although potatoes still dominate the farming system in Trentham, but are much less important in Newham, at the eastern end of the type-of-farming area. In Newham, there are no cereal crops grown for grain at all, which is not the case for the rest of the parishes treated above.

Warrion parish near Colac is the heart of the main onion-growing district: it has 1,200 acres of onions which is a third of the state total. With the onions is a large total of dairy cattle, about as important, in fact as the crops, and a few sheep and beef animals. In Koroit parish, the western part of the parish concentrates on dairying today, but this is due to the infestation with White Rot, and is a post-war change. Including the borough along with the parish redresses the balance somewhat, but the stage may soon be reached where dairying overshadows crops at Koroit.

Taking this type of farming as a whole, the usual combination is one of crops with dairying, except in the higher colder parts of the Central Highlands. The distribution of the more intensive crops is changing however, partly because of disease and fertility problems and partly because of the rapid advance of pasture improvement. In the future these livestock/field crop type-of-farming areas, may swing
more to livestock, and the cash crops may be diffused more widely through the dairying areas.

C. POULTRY FARMING

Of all types of farming in Victoria, poultry farming is perhaps the most difficult to characterise and locate. This fact is related to the small size of the farms, but more especially to the controversy which has surrounded the marketing of eggs for many years. Because of this, the Statist has not included poultry flocks in the annual farming census, although poultry farmers return information about their size of farm and other crops. Another difficulty is in taking account of the large number of hens maintained by householders. In 1950-51 40% of egg output was estimated to have come from "uncontrolled" production, that is from eggs not marketed through statutory bodies of the Egg Board type. Much of this share of output would have come from small flocks owned by householders - the "backyard" type.

Number of Farms

In value of production poultry farming comes after beef cattle farming, and is somewhat similar to it in that poultry are often not the main interest of those owning many

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of the flocks. In 1949-51 the average value of production was £11.6 million, which places it fifth after sheep farming, wheat/sheep, dairying and beef. It is difficult to estimate the number of poultry farms. At the end of 1950 there were 8,344 registered flocks of more than 40 hens in Victoria, and there were approximately 650 owners of flocks of 150 fowls or more.

There is a very wide range in the size of flock: of the 8,300 registered flocks, only 5% were over 1,000 birds in size and only 13% had more than 500 birds. What would seem to be a reasonable lower limit to flock size, below which the flock would not provide a major interest or a reasonable addition to income? If 500 birds were taken as a lower limit to commercial production, then only 13% or 1,079 of the 8,300 registered flocks would be commercial in size. Snape considers that there are three levels of production, one from very small fowls run as a sideline on farms which are predominantly of other types but where the flock may amount to a hundred or two, and thirdly flocks of some hundreds or a thousand or more, which are a full-time occupation.

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3 Ibid, p. 148
At the upper limit there is one almost fantastic poultry farm, owned by the Carter Bros. of Werribee. It has 120,000 birds and is said to be the world's biggest poultry farm. Nor is it a new development; for they had reached a peak of 125,000 birds some 20 years ago (1940), and for a time since have run the farm at less than capacity. This corresponded to some of the disturbing periods in the organisation of marketing. All of the eggs from the Carter farm are now sent to N.S.W., thus bypassing the Egg Board in Victoria, which is unable to compel marketing through itself because Section 92 of the Constitution prevents interference with inter-state trade. In N.S.W. the eggs are sold from a floor owned by the Carter Bros., not through the N.S.W. Egg Board, although the latter sets the price for all egg sales in the state, by its own marketing operations. This is only one aspect of a chaotic marketing pattern, for the Victorian Egg Board also engages in cut-price dumping of eggs in Adelaide and Sydney, selling them as much as 2/- a dozen less than in Melbourne, while it is protected from the other Egg Boards by the appropriate clause of the Federal Constitution.

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Location of Poultry Farming

The table below is an estimate of the receivals of eggs at the main centres of Victoria: 6

Victoria: % Receivals of Eggs, 1950-51

<table>
<thead>
<tr>
<th>Location</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melbourne</td>
<td>54%</td>
</tr>
<tr>
<td>Bendigo</td>
<td>12.5%</td>
</tr>
<tr>
<td>Geelong</td>
<td>10.5%</td>
</tr>
<tr>
<td>Ballarat</td>
<td>5.0%</td>
</tr>
<tr>
<td>Others</td>
<td>18.0%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>

According to this estimate most production was located near Melbourne. Hewitt 7 also considered that 50% of the fowls of Victoria, were within 50 miles of Melbourne (but this could still include Geelong). Sherwin and Bollen considered that the reasons for the location near the metropolitan area and smaller cities, was proximity to markets and sources of foodstuffs (other than grain) and the amenities of a city.

Nearness to markets is not such an advantage as might be thought, because with the Egg Board system of equalising returns to all producers, transport differences are eliminated to a great extent. The apparent dominance of Melbourne has

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6 Sherwin & Bollen, op. cit., p. 148
decreased since 1951; as Melbourne expands many poultry farms come within urban boundaries, and with heavier rates and taxes and health regulations, production often becomes uneconomic or is prohibited. The lure of capital gains from subdivision for building is also strong.

Bendigo has been the main locality to expand as Melbourne contracts, and it seems probable that feed costs are lower there than in some other places. What is wanted for feed is mill offals, ground cereals and meat-meal, as well as grain and green feed. A flour-milling town is the best site from this aspect and Bendigo and Geelong both have big mills. If feed is cheaper in these centres, it is a big attraction because feed costs are the biggest single item in egg production.

Map 257 shows the buying and selling floors and the agencies in outlying towns. It gives an impression of dispersal of egg production, which seems unlikely to be correct. The concentration around Melbourne is clear, and otherwise there is a line of agencies along the break of slope between the Highlands and the wheat/sheep belt. The gaps are clear too: there is little poultry production in the dairying districts, practically none in those which are grazing sheep for wool, and the Northwest - the wheat/sheep belt proper, lacks poultry. In fact poultry farming clusters on urban sites, and is little influenced by the usual environmental
factors of farming.

Seasonality of Production

A marked feature of poultry farming is the seasonality of production. In Victoria the trough of output occurs in May, when it is about 60% of the monthly average, while the peak is reached in September, when it is about 50% above average. In order to achieve an output which satisfies winter needs, there has to be a large surplus in spring. Some of the spring surplus is stored for winter consumption, but most of it is exported for much lower prices than are received at home. The spring surplus is exacerbated by the fact that "backyard" producers come into production strongly in the spring, and also this time of the year is the low-point of egg consumption by the general public. It will be possible to change the seasonal pattern of production by adopting different methods of farming, and there are signs that this process is beginning.

Methods of Farming

At present poultry farming has come to a stage of intensiveness which was not common 20 years ago. Then most birds were raised on an open range system or a modification

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of it, with sheds scattered over 10 acres or so, but now they are mainly raised in sheds on deep litter, and on small farms which are laid out to reduce labour expenditure. There is still a long way to go in improving the methods used, but if the changes increase the number of birds which can be attended by one man, then labour costs will be lowered. The Bureau of Agricultural Economics found that the larger farms had a lower labour cost per layer.  

One of the factors which has worked against efficiency in poultry farming is the common impression that its methods are easy to master. Sherwin and Bollen limited their survey to farms with over 1,000 birds, but even so they found that most farmers had entered poultry farming recently: half the farmers had been poultry farmers for less than 10 years, and two-thirds were over 40 years of age. Part of the reason for this mobility is the ease of entry - and of exit. Capital requirements are fairly small, and equally both stock and land are usually easy to dispose of.

There are signs that the commercial farms are increasing in size of flock, and that there is more specialisation elsewhere: producers and hatcheries are becoming more specialised as fewer egg producers hatch their own stock.

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9 An Economic Survey of A Sample of Egg Producers, B.A.E., Canberra, 1955, p. 11
10 Op cit., p. 149
An increased demand for poultry meat has encouraged the culling of young stock and broadened the sources of income. It is now realised that the pure breeds do not give as high egg output as crossbreds and so the latter are becoming more common as whole flocks. The main breeds are White Leghorn, Australorp and Rhode Island Red, and the common crossbreds are between males of the first breed and females of the second. 11

Modern methods of poultry raising as practised in California, may come to Victoria, in which case one can expect an increase in size of flock, a decrease in the area of farm, the abandonment of growing green feed, the use of lights and early hatching of chickens in June to even out the flow of eggs through the seasons. This will be less and less like farming and more like some form of livestock hydroponics, but it may bring cheaper eggs and white meat.

CHAPTER X

A. VINEYARDS AND VITICULTURE
B. FRUIT FARMING
C. MARKET GARDENING
D. OTHER CROPS AND LIVESTOCK
CHAPTER X

A. Vineyards and Viticulture
B. Fruit Farming
C. Market Gardening
D. Other Crops and Livestock

Viticulture, other fruit farming, and market gardening are considered together because their methods are similar. This similarity is related to the nature of the products to a considerable extent. They are products of relatively high value for their weight, involving a large amount of attention and care in production and using relatively little land but a good deal of labour and skill. Vineyards, orchards, and market gardens are widely scattered, especially the first two.

The following table sets out the number of holdings growing these crops, the average acreage under each, and the average value of production:
### Crops

<table>
<thead>
<tr>
<th>Crops</th>
<th>Growers No. 1951</th>
<th>Acreage Bearing</th>
<th>Average Value</th>
<th>Production £.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Orchards</td>
<td>5,541</td>
<td>5,292 (Citrus)</td>
<td>650,000</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>51,435 (other)</td>
<td>3,757,000</td>
<td></td>
</tr>
<tr>
<td>Vineyards</td>
<td>2,467</td>
<td>42,064</td>
<td>4,222,000</td>
<td></td>
</tr>
<tr>
<td>Vegetables (other)</td>
<td>3,430</td>
<td>36,376</td>
<td>4,872,000</td>
<td></td>
</tr>
<tr>
<td>Nurseries &amp; Flowers</td>
<td>n.a.</td>
<td>3,097</td>
<td>371,000</td>
<td></td>
</tr>
</tbody>
</table>

Orchardists are the most numerous and their orchards occupy the largest area, about 1/10th of which is under citrus. Vineyards occupy an area about 1/5th smaller than orchards but their product is more valuable in toto. Vegetables are also very valuable, for although the area is only half that of the orchards, the production is valued a little above it. Nurseries and cut flowers occupy a very small space, but like citrus their product has a high value per acre. Nursery crops and cut flowers can be counted in with market gardens because they use the same sorts of methods and are often grown on market gardens, or in the same localities.

### A. Vineyards and Viticulture

Map 113 shows the location of vineyards: there are four important localities: Mildura, Robinvale, Swan Hill, Rutherglen.

Of these Mildura stands out - it has almost ⅓ of the acreage of vines, and Swan Hill the next most important
place has 1/6th of the Victorian total. The following are figures of vines irrigated, and acreage of vines in bearing in the four main localities:

<table>
<thead>
<tr>
<th>District</th>
<th>Vines bearing</th>
<th>Vines irrigated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mildura, Merbein, Redcliffs</td>
<td>29,646</td>
<td>29,666</td>
</tr>
<tr>
<td>Swan Hill, Tresco, Nyah</td>
<td>7,539</td>
<td>7,060</td>
</tr>
<tr>
<td>Robinvale</td>
<td>726</td>
<td>1,275</td>
</tr>
<tr>
<td>Rutherglen</td>
<td>3,417</td>
<td>600 - est.</td>
</tr>
<tr>
<td><strong>Four District Total</strong></td>
<td><strong>41,328</strong></td>
<td><strong>38,601</strong></td>
</tr>
<tr>
<td><strong>State Total</strong></td>
<td><strong>42,204</strong></td>
<td><strong>42,582</strong></td>
</tr>
</tbody>
</table>


Vines not in bearing amount to 3,100 acres and of these some are young vines, such as would account for the discrepancy in the two sets of figures for Robinvale. In total about 42,000 acres of vines is in bearing and the same area is irrigated, while about 3,000 acres is unirrigated, and another 3,000 acres is not in bearing. Most of the unirrigated acreage is at Rutherglen, but there is another 1,000 acres scattered through the state.

Grapes can be used for drying - which is the main use in Victoria - or for wine or table consumption. Different varieties are suited to these specialised uses but there is some diversion of grapes from one use to another depending on how much spoilage takes place with
drying grapes, and taking account of prices on the fresh fruit market. The difference is not well shown by the acreages planted for different uses, but is better expressed in terms of the acreage used for one or the other in any one year:

<table>
<thead>
<tr>
<th></th>
<th>Acres</th>
<th>Value per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drying</td>
<td>32,364</td>
<td>£113</td>
</tr>
<tr>
<td>Wine</td>
<td>6,303</td>
<td>30</td>
</tr>
<tr>
<td>Table</td>
<td>1,606</td>
<td>79</td>
</tr>
</tbody>
</table>

The returns per acre were much higher for dried grapes and 4/5th of the area was used for drying, but costs of production in the later processing of the grapes are much higher than for wine grapes which are merely sold to a winery. Table sales involve some special care in picking and transporting, so that this accounts for some of the extra value of the product.

During last century most fruit-growing was carried on in southern Victoria, because here was the main market. Changes since that time in transport, irrigation and processing have allowed fruit-growing to spread into other parts of the state, and this is particularly the case with viticulture. Vines were planted in a number of places around Melbourne, Geelong and Bendigo and on some of the gold-fields of the northeast. In 1887 the Chaffey Brothers,
who had begun irrigation settlements in California, started similar ones in Australia, beginning at Mildura with a grant of 50,000 acres from the Government. The settlement ran into trouble almost immediately when the depression of the nineties bankrupted some of its supporters, but early in this century Closer Settlement Schemes were set up to extend the irrigated land around Mildura and so Merbein and later, Redcliffs and Irymple, were planted to vines and citrus.

In the 1890s phylloxera wiped out the established centres in the south and only Rutherglen was replanted with resistant rootstocks. Mildura was not affected then and has continued to plant non-resistant stocks, but precautions are taken to prevent the entry of possibly diseased material. Actually the insect would probably not survive in the dry climate of the irrigation settlements.

Swan Hill vineyards began with a small private settlement at Nyah pumping from the river, but this was taken over and enlarged by the State Rivers Commission. Robinvale, the third of the four vineyard localities, was begun in 1947 to resettle ex-servicemen. There has been tight control over the planting of grapes for drying purposes in Australia, because of the tendency to world over-supply, and because control was easily exercised
through public irrigation authorities. The climates suitable for drying are restricted to a few localities and large amounts of irrigation water are needed, so that almost the whole acreage is supplied with irrigation water by public bodies. The compactness of the producing areas has been an important factor in allowing tight control of production and marketing.

**Environmental Conditions**

The three vine localities in the west are located on Mallee soils, sandy loams which are quite suitable for vines. The main problems in using the Mallee soils arise from the salt content which is fairly high, giving rise to soil salinity unless drainage is adequate. Public authorities have now put through some large drainage schemes but the block-owners have also had to pay for subsoil drainage in many cases. Only the lighter soils are suitable for citrus, though this was not at first appreciated in planting trees along the Murray.

Vines require freedom from frost in the spring, and if they are to be dried the summer climate needs to be hot and dry, and even for other purposes than drying the ripening period climate needs to be fairly dry because humidity encourages mildews and moulds. Mildura is well suited on almost all of these grounds.\(^1\) The average date

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of the last frost of 32 degrees, is between July and September, and vines are susceptible from September to early November when they carry young growth: September then is the critical month. At Mildura and Swan Hill the frequencies are only 1 to 2 frosts a year, while over the remainder of the localities they are higher. The Murray River itself provides protection and much of the land of the three settlements drains to the river also, giving added protection. Robinvale was chosen as a site for a new horticultural settlement partly because it is enclosed by a loop of the Murray and was rightly expected to be frost free.²

When all this favourable material has been surveyed there nevertheless remains a risk of a severe spring frost in Mildura and Swan Hill, and for some parts of each district there are continuing risks - the "frost pockets" into which air drains, are always likely to suffer sometime after bud-burst. The usual methods of prevention are effective: clean cultivation to remove weeds before the spring, irrigation during the risky period is a general practice and finally the growers have organized frost clubs, which give a warning at 34 degrees, and leave the growers to take preventive measures.³ The usual method

is to light heaters burning diesel oil: 60 heaters per acre is the usual number. Many Mildura vineyards also contain citrus trees, in which case the above measures are taken right through the winter but with a lower warning temperature: citrus can stand lower temperatures than 32 degrees provided there is no new growth, but 28 degrees will damage the fruit, and 31 degrees will damage shoots and buds on lemons. Rutherglen has a longer period of frost risk, from May to September inclusive.

The summer climate is quite favourable to drying at Mildura and Robinvale, but much less so at Swan Hill. Mildura has an average monthly temperature of 74 degrees in December but Swan Hill does not reach this until January. In general it can be said that Swan Hill is three weeks behind Mildura in ripening, and is never as hot as Mildura. It has to dry its grapes therefore in a shorter period. This places it just on the margin of suitability of drying, and in future it can be expected that there will be a trend away from drying grapes.

The following figures of yield per acre, derived from a sample of vineyards are indicative of the greater suitability of Mildura compared with Swan Hill:
Dried Vine Fruit: Production and Yield

<table>
<thead>
<tr>
<th></th>
<th>Mildura District</th>
<th>Swan Hill District</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tons per Acre</td>
<td>Tons per Acre</td>
</tr>
<tr>
<td>1946</td>
<td>1.54</td>
<td>-</td>
</tr>
<tr>
<td>1947</td>
<td>1.44</td>
<td>-</td>
</tr>
<tr>
<td>1948</td>
<td>1.78</td>
<td>-</td>
</tr>
<tr>
<td>1949</td>
<td>37,608</td>
<td>3,569</td>
</tr>
<tr>
<td>1950</td>
<td>41,825</td>
<td>4,242</td>
</tr>
</tbody>
</table>


Size of Farm

The number of vineyards which supply a living to the occupier, is very much less than the figure of 2,500 growers given above. Originally holdings were only of 10 or 15 acres, due to over-optimistic estimates of the area which would support a farmer, but these have been amalgamated progressively until the average around Mildura is probably between 20 and 30 acres, and is not much different at Swan Hill. At Robinvale the W.S.L.S. blocks are over 20 acres.

In the vineyards harvesting begins in mid-February with currants, and continues with sultanas about the end of the month; lexias and wine grapes are later still in March and April. The sun-drying process is interrupted if humid weather occurs in February or March, and some of the crop may be lost. Losses are greater if the humid spells come in January and February, because high temperatures and high humidity favour diseases which can destroy fruit on
the vines. To avoid drying losses the dehydration process is being developed, and is now quite widely used as a supplement to sun-drying. Mechanisation has made some progress in the vineyards, but not as rapidly as in wheat-growing, because the needs of horsepower are absolutely less. In 1950, as can be seen from Map 117 there were approximately 1,200 draught horses in and around Mildura.

There is probably a total of between 1,200 and 1,500 vignerons in the Mildura locality, with perhaps 200 at Swan Hill and another 70 or 80 becoming established at Robinvale.

**Rutherglen**

Before the phylloxera outbreak, Rutherglen had 20,000 acres under vines⁴, the largest single area in Victoria, but replanting has amounted to only 3,400 acres. Of this about 600 acres is irrigated from the Murray, and more will be in future. Rutherglen would not be suitable for drying grapes: its total rainfall is 22 ins. which is too high, especially when it is seen that 5 ins falls in the period December-February. Summer temperatures are not high enough for drying either. The average monthly mean temperature reaches 72 degrees only in February:

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during the summer it is from 2 to 3 degrees cooler than Swan Hill and from 5 to 6 degrees cooler than Mildura.

It is commonly said that wines made from irrigated grapes are not as fine in taste as those made from dry land grapes, and it is true that the Lower and Mid-Murray settlements tend to specialise in fortified wines and sweet wines, while Rutherglen has established a reputation for dry wines and other table wines. Whether there is a scientific basis for this or not, it is important to Rutherglen that it has this reputation. Many of the growers here maintain their own cellars, and there are some famous names amongst them.

In selling wines, reputation is of great importance and although there are scattered localities growing grapes in other parts of the state (see Map 113) only one of them, located in the Central Highlands west of Ballarat at Great Western, is at all widely known. Great Western resembles some of the famous French wine districts in that it has poor, acidic, podsolized soils; it is particularly well known for its sparkling wines.
B. Fruit Farming

Orchards covered a total of 56,700 acres on the average over the period 1948/9-50/1, and of this total about one-tenth or 5,290 acres, was under citrus fruits. Citrus are thus of small importance compared with the total of other fruits, and it is true that apples, peaches and pears all have a larger acreage than citrus. But on the other hand their climatic affinity with the vine makes it more realistic to deal with citrus directly following vineyards. Citrus also have a higher value per acre than other fruits and resemble the vine in this respect.

Citrus Fruits

Map 114 shows the location of the citrus acreage and it can be seen that there are six main localities: Mildura, Robinvale, Murrabit, Bamawn, Cobram, Melbourne.

**Acreage of Citrus Fruits : 6 Localities, 1951**

<table>
<thead>
<tr>
<th>Location</th>
<th>Acres Bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mildura</td>
<td>1,508</td>
</tr>
<tr>
<td>Robinvale</td>
<td>352</td>
</tr>
<tr>
<td>Murrabit</td>
<td>673</td>
</tr>
<tr>
<td>Bamawn</td>
<td>233</td>
</tr>
<tr>
<td>Cobram</td>
<td>500</td>
</tr>
<tr>
<td>Melbourne</td>
<td>720</td>
</tr>
</tbody>
</table>

Of these six places, Mildura is clearly the most important with more than a quarter of the state acreage. Melbourne and its vicinity would be next, with 720 acres in the locality of Doncaster and Templestowe and nearby places,
plus two other plantings of 90 to 95 acres each, further east of the city and deeper into the hills. Altogether, the acreage near Melbourne is just over 900 acres. Murrabit, a small place on the Murray between Kerang and Swan Hill would come next and be followed by Cobram, with 500 acres or so, then Robinvale which is however likely to expand further, and finally just over 200 acres at Bamawn on the western edge of the Goulburn Irrigation District.

There are scattered plantings elsewhere however, such as north and south of Swan Hill, at one or two points in the Goulburn Valley, and near Wangaratta. The map of citrus fruits thus resembles that of grapes, except for the locality near Melbourne, and the reason for this resemblance is the similar need for irrigation, and for most citrus a need also for a warm climate.

The temperature requirements for citrus are in fact, quite complex, for while they can endure quite low temperatures when dormant - from 22 degrees for tangerines, to 27 degrees for lemons - nevertheless the fruit will be damaged by temperatures below 29 degrees, and some variety or other of citrus fruit is on the tree for most months of the year. For example the two commonest varieties of oranges grown in Victoria, the Washington Navel and the Valencia, are harvested in directly opposite seasons, the
Navel in winter and the Valencia beginning in spring and extending over the summer. In addition, citrus like many other fruit require some cool weather for development. In general it can be expected that most types of citrus need to be protected from frosts of 32 degrees and accordingly they are usually planted in sites with air drainage, and as it happens that irrigation and sandy soils are required for most types, it is often the case that they are grown on sand ridges near the Murray. Such sites give them air drainage to the river, drainage down the sand bank, both of air and water, and the warm summer of northern Victoria, which they need.

The locality to the east of Melbourne is the exception, being located in a cooler climate and not on sandy soils, and the explanation is that it grows lemons; it is not the only lemon-growing locality, but it grows only lemons. Oranges used to be grown near Melbourne, meeting most of its needs, but that was before irrigation and better transport opened up the northern parts of the state.

Drainage is a problem in all citrus-growing districts, and not less so in the Doncaster-Templestowe locality. Agricultural drains have been installed on many citrus orchards here, because even on sloping land such as
lemons are planted on, natural drainage is usually not good enough. This follows from the nature of the "Australian podzol" as Leeper calls it (see p. 86), with a sandy loam or silty loam on top and an almost impermeable clay at from 1 to 2 feet below the surface.

There are two other localities which are not placed on sandy soils or on sandy phases of the Mallee soils. They are at Murrabit and near Wangaratta. The plantings at Murrabit are the only ones on the grey soils of heavy texture which are the main soils associations in the middle part of the Murray's course. Problems of drainage have arisen from this fact, and in addition the varieties which are successful elsewhere in northern Victoria have often been unthrifty at Murrabit. The problems are being overcome and it seems likely that the locality will remain important.

Near Wangaratta there are orchards including citrus on the slopes of a low range, the Warby Hills, near Glenrowen. The rainfall is just sufficient for some fruits without irrigation, and the hills give air and water drainage.

Citrus orchards are probably not much larger than vineyards in absolute size, many not exceeding 25 to 30 acres, if they yield well and are operated only by the
owner. Citrus is produced very largely for home consumption, although there is a small export to New Zealand. Victoria exports some to this market because N.S.W. has been plagued by the fruit fly which has so far been kept under control in Victoria, but N.S.W. is the largest producer of citrus in the Commonwealth, and a large amount comes in from N.S.W. to Melbourne. The trend will probably be further in this direction, because the type of soil required is not common in Victoria, and even less often is it found near water, and in the right climate.

The availability of land with adequate water in a suitable climatic zone is an absolute limiting factor and is probably responsible more than any other factor for the failure to meet the present requirements of citrus, particularly the Valencia orange. 5

Relative Importance of Citrus and Vines

As citrus fruits require somewhat similar conditions to vines, but occupy only about 1/8th of their area it is likely that there are few localities in which citrus are as important as grapes. For example the Mildura locality has almost 30,000 acres of vines but only 1,500 acres of citrus, and as there is not a great difference in their value of production per acre (see scale on p. 203, above), this means that Mildura is over-

whelmingly an area of viticulture. Around Swan Hill there are some few hundreds of acres of citrus but nothing to approach the 7,500 acres of vines. Murrabit is the only example of a locality where citrus are of main importance. Bamawn might be considered, but it has only 200 acres compared with 700 at Murrabit.

Other Fruits

While citrus orchards cover only 5,000 acres, other orchard fruits cover 50,000 acres, ten times as much. These other fruits do not overlap much with citrus in location. For the most part their optima in climatic conditions and soils do not coincide with those demanded by citrus. The exception to this is the lemon-growing locality east of Melbourne.

Of the 50,000 acres under these non-citrus orchards, apples are the most important, followed by peaches and pears, and apricots are fourth.

Acreage of Fruits: Average 1948-51

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Acreage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Apples</td>
<td>18,162</td>
</tr>
<tr>
<td>Peaches</td>
<td>11,886</td>
</tr>
<tr>
<td>Pears</td>
<td>11,432</td>
</tr>
<tr>
<td>Apricots</td>
<td>4,187</td>
</tr>
</tbody>
</table>

Smaller areas are taken up by plums, cherries, quinces, almonds, walnuts, olives, prunes, nectarines, figs and other minor fruits and nuts. The berry fruits also take
up a small area: mainly strawberries, with some raspberries and currants.

**Distribution of Orchard Fruit**

Map 115 shows the distribution of orchard fruit and there are only five main concentrations, each of them along a north/south axis at the centre of Victoria: Mornington Peninsula, near Melbourne, Bendigo, Shepparton, and Cobram.

**Apple Orchards**

Apple orchards are fairly widely distributed, though very few orchards are found north of the Divide. The total number of trees in March 1950 was almost 2 million and 7 counties contained over 50,000 trees each. Four of these counties were those of the Central District surrounding Melbourne, and two others are south of the Divide, or on it, as are Normanby in the Western District and Talbot in the Central Highlands.

G.W. Gayford has estimated the relative importance of the main apple districts, not in terms of the number of trees, which is the way they are presented in the official statistics, but by estimating the average output over the ten years 1943 to 1953. Of course nothing would alter the

---

great importance of the near-metropolitan districts. Orchards are to be found to the north of Melbourne, but mainly just to the east, with very convenient access to the main produce market in Melbourne. Apples are cool-stored for up to eleven months, in stores located amongst the orchards. It is this part just east of the city that is being cut up for building blocks at present.

Gayford estimated Victoria's total output over 1943-1953 to be 1,800,000 bushels, of which this suburban district produced $\frac{1}{3}$, or 570,000 bushels. Pears and peaches are grown along with apples here, and a good part of the area is irrigated, either from the metropolitan system or by farm dams. Rainfall is quite good - 30 ins. average - but supplementary water is needed in January and February. Frost rarely causes damage, because the orchards are on rolling country much of which drains to the Yarra Valley.

Mornington Peninsula had an estimated output of 400,000 bushels per annum or a little less than $\frac{1}{4}$ of the state total. Here the soils include a patch of krasnozems at Red Hill, but in the main are podsolised, sandy, loams, on which water storage is difficult. Actually the climate is remarkable for its mildness and the growing season is long.

A nearby district is located at the head of
Westernport Bay, on the slopes of the hills rising up to the Eastern Highlands. Its rainfall is 35 to 40 ins. so that it does not need irrigation. This is not a concentrated district but nevertheless its total output is about 250,000 bushels on the average, or about 1/10th of the state output. It is too far from Melbourne to share much in the metropolitan market, and accordingly a good deal of its output goes to N.S.W. and Queensland.

South of Bendigo, in the Central Highlands is the Harcourt district which grows an equal amount of apples and pears. Its elevation is 1,000 ft., otherwise at this latitude it could be expected to be too hot for apples. Frosts are occasionally damaging here, and as the rainfall is only 22 ins. supplementary irrigation is needed. This is supplied by the Coliban Water Trust. Harcourt is between the near-Gippsland district and Mornington Peninsula in output - estimated at 350,000 bushels per annum.

There are a few irrigated apple orchards in the western part of the state, for instance at Bacchus Marsh and at Quantong near Horsham in the Wimmera. Other un-irrigated localities are in mild places by the sea, as at Portland, and on the Bellarine Peninsula.

In the Northeast is a small apple district around the old gold-mining town of Stanley, with a prod-
uction of 80,000 bushels per annum. This is another high-
rainfall district like the West Gippsland one, with
averages of 40 to 45 inches.

Pears

As already indicated above, two of the main pear
districts overlap with apples in the locality to the east
of Melbourne and at Harcourt, but they are not grown to
any great extent to the south on Mornington Peninsula, nor
in the West Gippsland district. Pears are best suited by
mean temperatures a little higher than those for apples,
and accordingly they are found beyond the Highlands, out
into the northern plains. Two northern counties with
irrigation, Rodney and Moira, have from 65-70% of the
pear trees. This is in the Goulburn Irrigation System, from
Cobram and Shepparton to the west. Here the crop is grown
mainly for canning, which in turn depends very much on
exports.

Soft Fruits

The optimum conditions for most of the soft fruits
are warmer than for the pome types. All deciduous tree
fruits need a cool period before they will bud properly,
and this period is longest for apples, less for pears, and
shorter still for peaches and apricots. However, ripening
temperatures need to be higher for the latter, so that
there is a progression in the required length of coolness in winter and the optimum heat of summer. Canning varieties of the soft fruits require higher ripening temperatures also than the varieties sold as fresh fruit. The limit of high summer temperatures for pears is really found in Shepparton, which is 7 or 8 degrees warmer than Melbourne in summer, and still 4 or 5 degrees cooler than Mildura. The northern part of the state is little different from Melbourne in winter cold, being actually a little colder and with more frost risk, but not to such an extent that this is an important difference between the two regions.

Of greatest importance in appreciating the conditions of fruit-growing in the Goulburn Valley is the fact that the great bulk of the fruit goes into relatively few canneries at 4 or 5 localities. This means that it is an advantage to have orchards fairly concentrated to cut transport costs, and it means also that there needs to be a spread of canning over as long a period as possible to bring about fullest utilization of the canning machinery.

It is understandable therefore that as many different types of fruits will be grown as suit the climate, and that even though all environmental factors are not favourable there will have been a tendency to concentrate orchards near the canneries and near water supplies.
The soils are red-brown earths: loams at the surface above heavy clay subsoils, and are suitable for irrigation, with some care. Two soil problems have arisen during the 40 years of orcharding. Under cultivation, the soils lost their structure and became impermeable to irrigation so that only 7 or 8 inches could be wetted. Various methods of overcoming this impermeability are being tried out, from frequent light irrigations, to no cultivation plus kerosene sprays to kill weeds, or treating the surface with a straw mulch, or developing a sward cover with increased application of water. The latter methods attempt to improve permeability, the former to improve the water supply. It seems likely that the production of soft fruits per acre, or per tree, can be raised a great deal.

The other soil problem arises from the irregular occurrence of very heavy autumn or winter rains. Such exceptional rains occurred in 1931, 1939 and 1956 and the water from them lay in the surface layer being unable to drain through the clay subsoil, which is practically impermeable. In 1931, 30,000 apricot and peach trees were

lost and in 1939, 80,000. As a result pears were planted instead as they were able to survive in most places. It was widely thought that the losses were due to water rising from below, but the soil survey referred to above, established that the main losses were due to surface water being unable to drain off or penetrate the subsoil. There were losses in the southern peach and apricot trees in the same years, which tends to confirm the latter point of view, because the southern plantings are on slopes.

Care is now being taken to avoid the shallow soils with clay subsoil, and in the Murray Valley W.S.L.S. orchards near Cobram, peaches and apricots are being planted only on the deep, well-drained loams or sandy loams. Drainage is also being developed in the fruit districts that have been planted, and the expenditure on drains will eventually total almost as much as that on channels.

Apricots are the newcomer in the Goulburn Valley, while peaches are the most important fruit, and pears come between the two. The following figures are taken from a census of trees carried out in 1952, covering 958 orchards in each main locality in the Goulburn Valley:
Acreage and Production of Canning Fruit: 1952

<table>
<thead>
<tr>
<th>Fruit</th>
<th>Acreage</th>
<th>Tons</th>
<th>% Canned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peaches</td>
<td>9,070</td>
<td>30,000</td>
<td>90%</td>
</tr>
<tr>
<td>Pears</td>
<td>5,170</td>
<td>30,100</td>
<td>75%</td>
</tr>
<tr>
<td>Apricots</td>
<td>3,230</td>
<td>7,400</td>
<td>89%</td>
</tr>
</tbody>
</table>


The share that this represents of total Australian production of canned fruits is very high. In 1952 it was 2/3rds of the peaches, 4/5ths of the pears, and over 1/3rd of the apricots.

The problem of evolving a fair marketing system is a difficult one for products like soft fruits, where the grower must be able to get his crop accepted at the ripe stage, and has really hardly any alternative outlet to the local cannery. However, the marketing system has not evolved to such a tightly controlled stage as is found in dried vine fruits. Some overall control has been imposed by the strange medium of the control over the marketing of sugar. Since sugar is an essential item in canning fruits, and as Australian products would be handicapped if they had to pay the Australian home price for sugar, they are allowed bulk supplies of sugar at cheaper rates, as determined by the Fruit Industry Sugar Concession Committee.
The concession is not allowed to canners who get fruit at cheap rates, and accordingly the Committee sets minimum rates for fruit for canning. This gives a floor on the basis of which contract rates can be agreed. The canners and the Department of Agriculture advise growers of techniques which lead to the fruit ripening at the right time, and if possible at the time that will spread the canning season from one type of fruit to the next in an orderly sequence.

Apricots are the first to come into bearing, from late December to mid-January, followed by a small volume of early peaches from early January to early February. Then in late January the main crop of pears comes in and continues over the next month. Mid-season peaches come in early in February for the next month, and finally the late peach crop extends over March into early April. The greatest strain on cannery facilities is thus from early February to the end of the month, when the pear and mid-season peach crops overlap.

In the W.S.L.S. orchards near Cobram, apricot, pear and peach varieties have been planted to spread the work, and relieve the strain on the limited supplies of casual labour available for picking. Of course the canneries are able to spread their work to some extent by
holding a part of the crop in cool stores, and there is evidence to show that properly controlled temperature changes in cool stores will defeat one of the curses of soft fruits, the Brown Rot.

Peaches and apricots are also grown for sale fresh, in the Doncaster locality due east of the metropolitan area, while the Bellarine Peninsula and Werribee Irrigation District have some apricot orchards. Plums and cherries are minor fruits: plums are grown around Cobram and in the Dandenong Hills east of Melbourne, and cherries are mainly confined to the Dandenongs which are cooler than other orchard districts, because of their elevation. Cherries are particularly susceptible to Brown Rot during sultry weather, if they are not grown in cool localities.

Of the remaining fruit, olives and prunes are both commercially important in the irrigation districts of the northern half of the state, and olives are also grown in the Grampians without irrigation.

The berry fruits are grown in the Dandenongs or on the Mornington Peninsula. Diseases have bedevilled berry fruit-growing, and for this reason strawberries have disappeared from the Mornington Peninsula and raspberries have been drastically reduced in the Dandenongs.
They are often pioneer crops, as in the eastern part of the Dandenongs, where newly-cleared land is often sown down to them in preference to potatoes or flowers. The supply of berry fruits is well below the potential of the fresh fruit market and very little is processed in Victoria.

C. Market Gardening

The number of holdings growing vegetables other than potatoes and onions in 1950/51 was 3,450, and a few hundred grew nursery and flower crops. At the most there may have been 4,000 of these holdings, but probably the total is a good deal less, because of the mixing of orchards, poultry and sometimes dairying, with vegetable-growing.

It is easy to exaggerate the possibilities of such mixture. The map of distribution of vegetables in 1951, Map 112, shows an overwhelming concentration of vegetables in two localities, in which so far, no very large amount of other farming has been recorded. These are the southeastern and southwestern fringes of Melbourne. Two other centres which have been dealt with already in connection with other types of farming, are the next most important localities. These are Koo-wee-rup and Shepparton. Then there is a number of less important localities, with about 1,500 acres each or less: Bellarine Peninsula,
East Gippsland, Bendigo, Cobram, Swan Hill, Robinvale.

What factors influence the distribution of market gardens? First and foremost, proximity to markets, and for most market-gardeners that means being within 20 miles of the central produce market in Melbourne. Secondly, an assured water supply, for it is generally recognized that irrigation is practically a necessity in raising vegetables under Victorian conditions. Around Melbourne the water is mainly supplied by the suburban system controlled by the Melbourne and Metropolitan Board of Works.

This is a case in which and soil are of little importance, and in fact some of the most intensive market garden production is carried out on almost the poorest soil in Victoria: the podzolised sands southeast of Melbourne have nothing to recommend them, neither mineral wealth nor good structure. Nor is Melbourne any different in this, from most of the large cities of the world. The fact is that the market gardener's first task is to add to the soil whatever it lacks for his purposes, and that the effort he is prepared to put in to cultivating a small area is so intensive, that it soon makes up for deficiencies in soil.

The area of other vegetables is close to that of vines, and includes a good deal of double-cropping:
Vegetables other than Onions and Potatoes

<table>
<thead>
<tr>
<th>Average Value, 1949/51</th>
<th>Average Acreage</th>
<th>No. of Growers, 1951</th>
</tr>
</thead>
<tbody>
<tr>
<td>£4,972,600</td>
<td>36,376</td>
<td>3,430</td>
</tr>
</tbody>
</table>

Almost two-thirds of the acreage is located in the four counties around the metropolitan area, that is 22,400 acres of the total of 35,740 acres in 1950/51. But of this 36,000 acres, a large part is taken up with one or two outstanding crops, as shown in the following table:

<table>
<thead>
<tr>
<th>Crop</th>
<th>Acreage 1950/51</th>
</tr>
</thead>
<tbody>
<tr>
<td>Green peas</td>
<td>7,719</td>
</tr>
<tr>
<td>Tomatoes</td>
<td>5,992</td>
</tr>
<tr>
<td>Cauliflower</td>
<td>3,257</td>
</tr>
<tr>
<td>French beans (green)</td>
<td>2,788</td>
</tr>
<tr>
<td>Pumpkins</td>
<td>2,568</td>
</tr>
<tr>
<td>Cabbages</td>
<td>2,486</td>
</tr>
<tr>
<td>Lettuce</td>
<td>1,995</td>
</tr>
<tr>
<td>Carrots</td>
<td>1,933</td>
</tr>
<tr>
<td>Asparagus</td>
<td>1,392</td>
</tr>
<tr>
<td>Parsnips</td>
<td>922</td>
</tr>
<tr>
<td>Beetroot</td>
<td>876</td>
</tr>
<tr>
<td>Brussels Sprouts</td>
<td>753</td>
</tr>
<tr>
<td>Other - Melons, turnips, etc.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>12,925</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>35,742</strong></td>
</tr>
</tbody>
</table>

The first four vegetables occupy more than half the acreage of all vegetables. A reference has already been made to green peas in Chapter 9, in connection with the farming of Koo- wee-rup. But Koo- wee-rup shares this crop with a large number of other localities. Although
it is true that Mornington County in which Koo-wee-rup is located has the largest acreage of any county, nevertheless the other Central District counties each has at least 10% of the total acreage, and peas are grown also in quantities near Swan Hill, in the Goulburn Valley, and in Gippsland. A considerable proportion of the crop is irrigated, especially that grown by market-gardeners proper, but there is also a large area grown for canning firms under contract, and much of this is not irrigated, but is grown by potato farmers on land under a potato rotation. The processing firms supply the seed, specify the planting time and methods of cultivation, and do their own harvesting. A pick-up machine takes away the whole crop to a viner at their own depot, the peas are automatically pulled off the vine and shelled, and the residue is sold for cattle fodder.

Peas are a more popular food even, than the figures make it appear, for a great amount of green peas is imported to Victoria from N.S.W. One of the reasons for their large acreage is the practicability of field cropping methods being used for a good part of the crop.

Tomatoes are also grown to a great extent for processing though they are not yet quick-frozen, in the way that a good deal of the pea crop is treated. Victoria grows about 1/3 of the Australian acreage of tomatoes, but it also
imports out-of-season tomatoes from Bowen in Queensland and Geraldton in West Australia. The two leading centres for canning tomatoes are Bendigo and Shepparton, and along with the Murrumbidgee Irrigation Area in N.S.W. they grow 90% of the tomatoes used for processing - into paste, sauce, soup and other canned goods. The counties of Bendigo, Rodney and Moira grow 4,300 acres of the Victorian total of almost 6,000 in 1950/51. Another 300 acres was in the districts from Swan Hill to Mildura, again irrigated localities; 200 acres was in the small irrigated settlement of Pomonal near Horsham, and the remainder was around Melbourne in the four Central counties.

It seems that the irrigated localities have established a definite hold on most of the crop, and this is partly because of the availability of water, followed by the presence of canning factories. There are canning plants in Melbourne too, but most of the crop grown around Melbourne is for table purposes. When prices are favourable the irrigated districts send table supplies to Melbourne, and some Melbourne canneries buy large amounts from Shepparton and Bendigo.

Swan Hill and Robinvale and Mildura tend to specialize in supplying the first Victorian-grown early

tomatoes. At Mildura they are grown in glasshouses, some of them heated, but generally the crop is protected by boards using a method perfected by Chinese growers last century. This is a reminder that last century the market gardening of the whole country was mainly performed by Chinese who had stopped over from the gold rushes. Hot-house tomatoes can be harvested in September or October, but early field crops are not ready until November. There is a great deal of labour involved in early tomato crops, especially in protecting them from frosts. Overall the tomato is a labour-intensive product, yielding heavily from a small area of land. Extra care and hard work is well rewarded. Because of these features of the crop it is recognized as a good opening for anyone without capital. Most of the crop is said to be grown by share-farmers, and production "for processing is generally a sideline to some other major farm enterprise, or even to other employment of quite a different nature." Family labour is of great importance, and the crop for processing is mainly in the hands of Italians. Labour was found to represent 2/3rds of total production costs.

The difficulties outlined above for soft fruits marketing, exist in a more exacerbated form with tomato marketing. Both processors and growers arbitrarily vary

agreements that they may have entered into before the season was under way, and it is suggested that processors might well undertake more advisory work and supervision, in the way that they already do with peas for processing.

Late tomatoes used to come to Melbourne from Portland, a locality with a mild climate and absence of frost, but growers near the city have now taken the late market and Portland has declined as a late season supplier.

The crop with the third largest acreage (3,250), is cauliflowers, a product much more like the ordinary market garden types than green peas and tomatoes. This is clearly shown in the distribution of the crop through the counties: of the 3,250 acres total, all but 200 acres is located in the four Central District counties, and as much as 2,700 acres alone in Bourke. Bourke includes Werribee and the S.E. suburbs. Werribee is undoubtedly the main source of cauliflowers for Melbourne, and in Victoria, and in turn the cauliflower is the largest single form of production in Werribee. Some rotation is practised, the growers endeavouring to rest their land from cauliflowers, every second or third year. The specialisation on this crop has the interesting side effect of discouraging the growing of cabbage and broccoli, because they cannot be allowed to seed in the locality for fear of their affecting
the purity of cauliflower seed. Of course there are certain acreages of other vegetables, mainly the leafy types.

Green french beans occupy 2,780 acres, and are grown in the Central District in the true market garden zone (1,220 acres), and in Gippsland (1,030 acres). The Gippsland acreage is shown on Map 112, around Orbost and Bairnsdale, where it is grown on farms, many of which depend on other types of farming for their main income. But it is interesting to note that in the hills around Bairnsdale there is a number of Italians growing green crops such as peas and beans on very small plots of land. Gippsland is specially suited to growing this crop for any one of three reasons: it is capable of producing early crops because of its mild winter; the green crop keeps growing through the summer when it might well have been checked in dryer climates to the west, and the alluvial soils of the river flats on the Dargo, Mitchell, Tambo and Snowy Rivers are of very high fertility, and so capable of producing high-yielding crops, such as beans. There is another factor also. The French bean crop is grown with an eye to seed production, and normally the whole of Australia is supplied from here. Should seed prices appear unfavourable, farmers can choose to divert the beans to the fresh vegetable market. Beans for seed have at times been unsaleable due to cheaper supplies from South Africa, and the farmers have
organised a marketing board to attempt to regulate the product. The prospects for seed production are not favourable.

Pumpkins are about evenly divided in their distribution between the metropolitan market garden localities, and the neighbourhood of Swan Hill. They are most commonly grown just south of Swan Hill and then north of the grape-citrus localities at a place called Piangil, which is a privately-organized irrigation district, pumping from the Murray. The metropolitan crop is sold from December until some time in the winter, while the Swan Hill crop is stored after harvest, and sold through the winter and spring until early November. They compete with Queensland supplies, in the later part of the year. The pumpkin crop is distinctive in that half of the harvest from the irrigation districts never reaches the market. It is a bulky product and storage is a problem, so that it is not surprising that 50% of the tonnage is lost by bacterial and fungal rots.

Gubbages and lettuce are like cauliflowers in being almost entirely a product of metropolitan market gardens. Of the acreage of 2,500 cabbages, practically all is in the four Central District counties, and 3/5ths is in Bourke alone; this means Werribee and the southeastern
suburbs mainly. They are both leafy crops which need to be grown close to market, and with irrigation.

Carrots, being a root crop can stand longer transport than leafy vegetables, but even so 1,580 acres of the total of 1,930 acres is grown in the metropolitan counties. 140 Acres is grown in the Mallee, mainly around Mildura, and more is grown just across the river from Mildura in N.S.W., but marketed in Melbourne. Practically all asparagus is grown in Mornington county - 1,115 acres out of 1,390 - and Koo-wee-rup grows almost all of the county output. Asparagus is a perennial crop and in this respect differs from the others in economics and farming methods. It requires a deep friable soil, for which the peat is admirably suited, and most of it is grown under contract to canneries. The cannery selects the seed and it is 3 years before the first of the tips is ready to be cut.11 The cutting is carried on daily from October to December and the planting will last about 15 years. It is not surprising that asparagus is usually grown on a large scale; as a perennial it is much more like an orchard crop than a market-garden one.

Of the remaining vegetables, such as parsnips, beetroots and Brussels sprouts, practically all are grown

around Melbourne on the ordinary market gardens. There are one or two specialities such as marrows, cucumbers and melons, which are partly the products of the irrigation districts in the north, but for the most part the remainder are merely part of the diversity and crop rotation of the suburban growers.

Each generation tends to see the problem of the vegetable needs of the growing metropolis as one which has arisen recently and has begun to get acute. Probably every large city displaces its market-gardeners as it grows, but for the most part they do not go far. A great deal of attention has been given to the growth of vegetable-growing in the northern irrigation districts, with the implication that this is a replacement for the lost suburban gardens, but the above analysis suggests that the northern irrigation districts have not really replaced or even imitated the ordinary market gardener of the suburbs.

It is useful to characterise the main localities, shown on Map 112. Firstly there is the suburban fringe of true market gardens. For the most part they are irrigated, either from a S.R.W.S. Commission system as at Werribee, from the M.M.B. Works supply on the southeastern fringe of the city, or elsewhere by private bores and tanks, as in some parts of the Dandenongs, or beyond Dandenong.
These holdings are small, and are often on poor soils; sandy loams or sands over heavy clay subsoils are common, and artificial drainage is usually a necessity, except on the deep sands of Bentleigh just southeast of the city. The soils are all enriched by a variety of methods: at one time horse manure was most common, but this is no longer readily available, and other forms are bought from poultry and pig farms, or industrial waste, such as spent hops, may be purchased. But more and more the market gardener is using chemicals - artificial fertilisers for his soil and sprays, for diseases and pests. Although gardening is laborious, many gardens are now entirely mechanised, at least where they grow only crops that are susceptible to machine treatment. Although most market gardeners own their own farms, much of the production is carried on by various forms of share-farming and renting. The reason for this is the same as with tomato growing: the main item in the cost of production is often labour, and under Australian wage rates and conditions the labourer prefers to share the profits of marketing - and its risks - to working for wages alone.

Immigrants have been particularly attracted by this occupation: since 1920 there has been a steady influx of southern Europeans into the traditional districts, especially where there is irrigation. Thus Werribee has a
population of 850 of British origin and 930 of non-British, the latter mainly southern Italian.\textsuperscript{12} Other Mediterranean groups such as Macedonians, various groups from within Yugoslavia and some Maltese, are also to be found there.

On the southeastern side of Melbourne there are fewer Europeans amongst the growers, probably because the district has been so much longer established, whereas Werribee did not adopt market gardening until 1925.

However the proportion of non-British rises again in the Dandenong Hills, at such places as Silvan, Gembrook, Emerald and Wandin. Here there is a most varied mixture, comprising nurseries - mainly Australian-owned - flower gardens, some of which are run by Dutch immigrants, and market gardens, which may produce anything from bulbs, to strawberries, to potatoes or lettuces, any of which may be grown by Italian owners or share-farmers, or a variety of other types of farmers.

In general the aim of the market gardener close to Melbourne is to maximise his skill, his small area of land, and his proximity to the city, and he does this best by growing a variety of crops rather than specialising too much. The risks of over-production and of poor weather are least with a variety of crops, and earnings can be

\textsuperscript{12} L.F. Bartels, \textit{op cit.}, p. 268.
spread over much of the year. It should be added that Melbourne both imports and exports vegetables interstate, and perhaps as much as a third of the grower's income comes from these shipments, while they also provide competition to locally-grown crops.

Melbourne imports heavy supplies of green beans and peas, from the eastern states, of celery and lettuces from South Australia, but is a considerable supplier of the cruciferous crops to other states.

After the metropolitan fringe - the market garden zone no more than say, 20 miles from the central produce market - there are growers on the Mornington Peninsula and Bellarine Peninsula, and at Koo-ween-rup. The main features of the type of farming and crops at Koo-ween-rup have been dealt with in Chapter 9, and it was seen that the type of farming was half-way between market gardening and field-crop/livestock farming. The Mornington and Bellarine Peninsulas are also different from the metropolitan fringe. With their mild climates they are especially suited to green peas, which have been shown to be partly a contract crop for processing. Figures for Grant County, which is largely the Bellarine Peninsula, amount to a total of 1,900 acres of vegetables of which green peas and asparagus, both mainly contract crops, make
up 1,100 acres, or 60%. The remainder cover the usual market garden crops, and some supplies go to Geelong. But it must be noted that the influence of central marketing in Melbourne is powerful, and that the improved transport of recent decades has operated to draw vegetable production closer to the city, and to disperse the produce through the state, stifling local production away from Melbourne. The East Gippsland district is one of special production of green beans and peas, which are especially suited by the mild and moist spring and summer climate and by the alluvial soils of the river flats.

In the north it is mainly a case of special crops, grown by share-farming very often and frequently grown for processing or for sale, out-of-season. Shepparton, Cobram and Bendigo, concentrate on tomatoes, green peas and some pumpkins, which fit the pattern outlined, while Swan Hill, Robinvale and Mildura produce early peas, early tomatoes - some from glass houses - and late season melons and pumpkins, with some early carrots and lettuce from Mildura. In these irrigation districts some of the vegetable crops are grown on new vineyards not yet established, and others are grown by share-farmers, or on rented land. Clearly there is a number of variations on the theme of market-gardening.
D. Other Crops and Livestock

Although the main types of farming have been dealt with above, some crops and livestock have not received specific mention. The lists on pp. 180 and 202, include "other crops" to the value of £2 million, and mention bee products, tobacco and linseed.

Some of the other apparent omissions have been given passing attention in the livestock chapters. It is particularly the hay crops, silage and green forage and other fodder crops, which may seem to have been passed over. Hay is so important that it might have been justifiable to talk of dairying with hay, or fat lamb production with hay, except that the stress has been laid here on methods of farming, rather than on products. Hay has also become less and less an item of trade, and has been consumed increasingly on the farm where grown, this development following on the decline of the horse.

Green forage crops do not occupy much above 1% of the cropped area, and other fodder crops even less and they are concentrated in localities with good rainfall, as Maps 218, 219 and 223 indicate. Pasture improvement and hay and silage-making eclipse them. This is an outstanding feature of the types of farming described, that they are based heavily on livestock but grow few crops to support the livestock, apart from hay.
Industrial Crops

Tobacco and linseed are the only industrial crops of any great economic importance. The latter fits into the clover ley-farming pattern in that it grows quite well around Rutherglen and in the northern part of the Western District plains, where ley-farming is recommended. But the question is one of returns, and so far the price paid for linseed has not been markedly above the returns for meat and wool from improved pastures.

Tobacco will grow in a wide variety of environments, but only on certain soils is it sure to meet the idiosyncratic tastes of the public and the manufacturer. Good quality depends on the choice of a sandy, well-drained soil, and a regular supply of moisture is necessary through the summer. Though summer temperatures need to be warm to hot, the plant needs to be shielded from drying winds, either by shelter-belts or by seclusion in a sheltered valley. In Victoria it is mainly grown in the Ovens Valley on sandy soils along the river, and irrigated from the river.

Of the 1,021 acres under tobacco in 1951, 988 acres was grown in the Ovens and King Valleys, 10 acres north of Shepparton and 23 at Gunbower on the River Murray (see map 224). The crop is practically entirely grown by Italians, and the Ovens Valley itself, recalls the alpine valleys
of the Veneto, which also grow tobacco. A great deal of
the crop is grown by share-farmers, similarly to tomatoes,
or else is grown on land rented from Australian farmers.
In 1950/51 there were 74 growers, but the figure is not
very useful, because it excludes share-farmers. Tobacco-
growing resembles market-gardening, though with a higher
return per acre: in the period 1948/51, the average return
was £213 per acre, compared with £136 for vegetables.

Apiculture

In 1949/51 the value of production of honey and
beeswax was about £250,000. This was produced by a total
of 1,600 beekeepers, but of them only 270 are really
commercial apiarists. A large proportion of the commercial
apiarists are migratory, travelling from one locality to
another as different blossoms in various districts. East Gippsland is one locality with numerous blossoms,
mainly on eucalypt trees, and at other times of the year
the beekeepers move into the Murray Valley and into the
fringes of the Mallee.

Bees perform another very important task in
addition to collecting honey, and that is the pollination
of a number of crops. They are necessary for some
orchard crops, such as apples, pears, plums, cherries;

13. D.F. Langridge, "Honey-bees in Agriculture and Horti-
for vine-type vegetables, such as pumpkins; seed crops such as clovers and many vegetables and grasses. It is suggested that orchardists should rent bees from an apiarist, and that there should be strict control over the use of insecticidal sprays.

Beekeeping requires much skill, judgement of the conditions in different regions for the migratory producers, and vigilance against disease. Its climatic hazards are as marked as in other farming. Prolonged wet weather and heat waves, both cause casualties amongst the bees and reduce the supply of honey.

**Horses**

There is little further to say about horses, in adding to the points made in Chapter 7, above. The main concentrations of both light horses and draught horses, are still the main cities, and there is some truth in the observation that the country is more mechanised than the city. Of course many of the light horses concentrated in and around the cities are used for recreation and racing, and there are many racing studs to the southeast of Melbourne and in the Yarra and Goulburn Valleys, but they do not show up particularly on Maps 118 and 119.
PART 4

SUMMARY AND CONCLUSION

CHAPTER XI  A SUMMARY OF THE TYPE-OF-FARMING AREAS OF VICTORIA
CHAPTER XI

A SUMMARY OF THE TYPE-OF-FARMING AREAS OF VICTORIA

In making a final summary, there are two dimensions within which Victorian farming needs to be assessed. On the one hand are the broad-scale grain and livestock types of farming, and on the other, the more intensive types such as orchard, poultry and market gardens. Because the latter occupy so little area, relative to the former, they could be submerged in a general summary, especially in a summary which focuses on the area occupied by each type of farming.

Accordingly an attempt is made below to summarise the intensive types first, fixing their location by reference to overlay maps on Maps 112, 113, 114 and 115, and the relative importance of each locality by acreage figures. For economic comparability, the acreage figures need to be further multiplied by the values given to each type on p. 203 above. Generally the dominance of one or other is obvious within any one locality. The first table covers the irrigation districts which lie along the Murray and Goulburn Rivers. The names given to the localities are to be interpreted broadly, as including nearby places which lie along the rivers: for example Swan Hill includes settlements from fifteen or more miles either side of the
town. Places which have less than 200 acres of any one crop have generally not been included.

<table>
<thead>
<tr>
<th>Locality</th>
<th>Vines (Acres)</th>
<th>Citrus Fruits</th>
<th>Vegetables</th>
<th>Stone &amp; Pome Fruits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mildura</td>
<td>29,600</td>
<td>1,500</td>
<td>600</td>
<td></td>
</tr>
<tr>
<td>Robinvale</td>
<td>1,200</td>
<td>350</td>
<td>400</td>
<td></td>
</tr>
<tr>
<td>Swan Hill</td>
<td>7,500</td>
<td>400</td>
<td>1,450</td>
<td>400</td>
</tr>
<tr>
<td>Murrabit</td>
<td></td>
<td>700</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shepparton</td>
<td></td>
<td>2,200</td>
<td>7,450</td>
<td></td>
</tr>
<tr>
<td>Ardmona</td>
<td></td>
<td>1,050</td>
<td>5,300</td>
<td></td>
</tr>
<tr>
<td>Kyabram</td>
<td></td>
<td>3,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cobram</td>
<td></td>
<td>500</td>
<td>290</td>
<td>1,200</td>
</tr>
<tr>
<td>Rutherglen</td>
<td>3,400</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For economic equivalence, multiply vine acreage by 5, citrus by 6, vegetables by 7, and "other fruits" by 4. Most of these places fall into one or other of two patterns. Either they are important in vines (dried fruit) and have small areas of citrus and vegetables, as around Mildura, or they are important in soft fruits, with vegetables (mainly tomatoes) of next importance.

The final group of places is mainly around Melbourne, but includes also some places in the Highlands. In the following table vines have been dropped out, and citrus is generally unimportant as a type, but poultry farming, and intensive pig farming using urban refuse are two additional types to be considered. The Ovens Valley has been included in the table by placing its special crops
in brackets.

**Intensive Farming in the Highlands & in Southern Victoria (acted)**

<table>
<thead>
<tr>
<th>Locality</th>
<th>Stone &amp; Pome Fruits</th>
<th>Citrus &amp; Pome (mainly lemons)</th>
<th>Vegetables (flowers &amp; figures)</th>
<th>Poultry (no farming)</th>
<th>Pig Farming (intensive)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Warby Ranges</td>
<td>200</td>
<td>200 (300)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ovens Valley</td>
<td>200</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Beechworth</td>
<td>700</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harcourt</td>
<td>1,400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bendigo</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Werribee</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Geelong</td>
<td>300</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bellarine Pen.</td>
<td>400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>North of Melb.</td>
<td>1,400</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>East of Melb.</td>
<td>10,000</td>
<td>725 (500)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>S.E. of Melb.</td>
<td>550</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dandenongs</td>
<td>2,400</td>
<td>150 (2,325)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W. Gippsland</td>
<td>1,850</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mornington Pen.</td>
<td>4,700</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

When these types of farming have been condensed in this fashion, two main aspects of place and cause become clear: the influence of irrigation and climate along the Murray, and the effect of a great city on its immediate hinterland. The provincial cities also have their effects, but it has been pointed out in Chapter X, that this latter effect is not identical with that of Melbourne and merely repeated on a small scale. Ballarat bears this out very well: it has no special local conditions, and lacks these intensive forms of farming in its vicinity, except for a certain amount of poultry farming.
Type-of-farming Areas of Victoria

The next and final stage of condensation is as shown on Map 25f. Ten type-of-farming areas have been outlined on the map, with one complex area left for an inset, that is the irrigation area which is shown on Map 25o. Irrigation is not a type of farming, but it is the common element in the diverse farming of the lands along the Murray and Goulburn. A very brief description of each type-of-farming area follows.

1. Northeast Dairying and Grazing—Sheep and Beef Cattle

In the valleys of the Northeast, there is a diversity of farming, but except for small areas of apples and special crops, the main types are dairying and grazing. Dairying is found on the valley bottom land, and grazing on hills and high plains where the pasture available is poor. The Northeast contains about 150,000 dairy cattle, or about 10% of the Victorian total but productivity per cow is the lowest of the main dairying areas, and practically all milk is manufactured into butter. The Northeast turns off about half of the store cattle raised in Victoria for fattening elsewhere, but no great expansion of this type of farming can be expected. Although it has adequate rainfall, it is hampered by its topography and by the difficulties of transport in a mountain and valley environment.
2. **Northeast Wheat/Sheep Farming**

This is the oldest of the wheat/sheep farming areas and sheep are relatively more important here than in the Wimmera/Mallee portion. It is largely dependent on neighbouring parts of N.S.W. for the supply of fat lamb mothers, mainly Merino X Border Leicester in breed. The southern parts of this area have almost 8 months of growing season, and over much of it only a short fallow is used before the wheat crop is sown. The soils are red-brown earths in the main, and quite suitable for wheat. Yields range from 24 bushels per acre in the south and east, to 18 to 21 bushels in the north, but these are all above the state average. In the eastern tip of this area, at Rutherglen a clover-ley type of farming has been pioneered, consisting of a long period under clover, followed by three or four successive crops.

A much higher proportion of cropland is held or worked under share-farming or tenancy agreements, than in the other districts of wheat/sheep farming, but the basis for almost all tenancy is a family agreement of some sort. There is a total of about 1,000 wheat/sheep farms and perhaps 1,500,000 sheep within the area.

3. **Northern Plains Wheat/Sheep Farming**

This area is similar to the Northeast, but is
less continuous. Sheep are relatively more important than in the main wheat/sheep belt and yields are only moderate—from 15 to 21 bushels per acre. The sheep population numbers about 250,000 and there may be 150 wheat/sheep farms.

4. **Wimmera-Mallee Wheat/Sheep Farming**

This is the wheat belt proper with a great range in physical conditions from an eight months growing season in the south to 5 months only in the north, and soils varying from black earth types to Mallee soils in the north. Yields are as high as 40 bushels to the acre on the black earths in the Wimmera, but drop to unpayable levels in the Millewa, where wheat is slowly declining. Except on the northern fringe, sheep are kept for fat lamb production, and the flocks are kept at a low level in the summer because of a deficiency of feed. In the south, wherever farms are not so small as to preclude it, the longer rotation is replacing wheat/fallow methods of farming, and improved pastures with a legume are sown between the wheat crops.

In the north legumes are not as yet generally available or generally used, but the long rotation is being used with volunteer pasture between the crops. Oats is a common second crop in most of the wheat/sheep
belt, and barley is common on the western side of the Mallee and Wimmera, in the more sandy soils and cooler climates. The number of wheat/sheep farms is probably about 6-7,000, and the sheep numbers, over 3 million.

5. Southwest and Central Highlands Sheep Grazing.

This great sheep belt extends from the fringe of the plains of the Northeast to the Highlands, and southwest across them to the Western District Plains and on to the South Australian border. In 1951 its total population of sheep was between about 12 million and 13 million, a majority of them of the wool breeds. On better soils where pastures have been improved, the meat breeds are kept and fat lambs are a main product, but most of the area is not so well suited to fat lamb production as is the wheat/sheep belt, coarser fodder and cooler winters militating against meat production to some extent.

Beef cattle are kept with the sheep in the wetter portions of the belt, but not so much in localities with less than about 25 ins. of rainfall. The belt contains great tracts of rocky, stony or otherwise poor soil, and this major feature goes a long way to explain why sheep grazing for wool should be the main concern of a tract of country with a good rainfall and growing season by Australian standards. There is still great scope for improvement of pastures by sowing Subterranean Clover and
perennial grasses with topdressing of superphosphate. But on large areas, such as the stony rises of basalt, (except with aircraft, but hay-making is still impossible) no real improvement is likely. Even where cropping is possible, as in the mid-portion of the Western District plains, meat and wool seem to pay better than crops. This type-of-farming area is the basic underpinning of the agriculture of Victoria.

6. Gippsland Dairying

This dairying area has almost half the dairy cattle of Victoria (41%, 1951), and extends from the suburbs of Melbourne on the west to the rain-shadow of East Gippsland, at Maffra and Sale in the east. The greater part is of rolling, if not hilly, country, well watered with from 30 ins. to 45 ins. of rainfall, and with only a very short autumn break in the growing season. The soils are only moderate in fertility, but sowing of perennial pasture plants and topdressing with superphosphate has raised most of the area to an even standard of good quality.

The southern part of the area has the highest productivity per cow of any part of the state, due mainly to its cool summer and mild winter. Although most of Melbourne's liquid milk comes from here, the main product of Gippsland dairying is still butter, with cheese in
third place. For Gippsland to change from milk production to meat, there would need to be a big change in the ratio between the prices of the two products.

7. S.E. Gippsland Sheep Grazing

This farming area extends along the southeast coast in the lee of the S.E. Gippsland Hills, and onto the plains between Sale and Bairnsdale. The climate is mild, the rainfall only moderate but the handicap of the area is poverty of soil and lack of determined improvement rather than a climatic handicap. Sheep are run for wool, but the breeds are mixed with a good deal of British blood, and Crossbreds are more common than might be expected in a wool area. Beef cattle are grazed along with sheep.

8. Western District Dairying

This is a narrow area extending from Colac to Port Fairy, and containing about 1/5th of the dairy cattle of Victoria. Crops are found at places with particularly high fertility, mainly tuff deposits around extinct volcanoes, but dairying is the chief economic support of the area as a whole. Only 8% or so of Melbourne's liquid milk supplies are drawn from here, but on the other hand more than half of the condensed milk products of Victoria are made here. Level land and geographical compactness are advantages for this type of production. But the area
is not high on the list of per cow productivity: in general it has lower rainfall than Gippsland, and although the winter is mild the autumn is more trying.

The northern boundary of the area is the point where poorer soils and lower rainfall both discourage small farms, and cattle give way to sheep.

9. Metropolitan Market, Gardening, Fruit and Poultry Farming.

This area extends around Melbourne from Werribee in the southwest to the Mornington Peninsula on the southeast. It is moderately favoured by a mild climate, fairly free from frosts, a reasonable rainfall which increases in the hills to the east of the city, and the availability of supplementary water, of good transport, and a large market.

The area produces more than half the vegetables grown in Victoria, from over 15,000 acres of market gardens, it supports the largest single concentration of orchards (15,000 acres) in a narrow zone to the east and south of the city, and the biggest single concentration of poultry farms in the state is to be found in the suburban fringe. Nurseries and cut flowers are largely concentrated here, depending mainly on the Melbourne market and to some extent on the transport facilities it offers for interstate shipment. Specialist pig farming is also concentrated here,
using the refuse of the city as food. All this production takes place on a background of dairying, which is everywhere important amongst the more specialised lines. The hills to the east of the city offer a cooler climate for out-of-season and cool temperate crops. But the advantages of the metropolitan farming area are largely those that follow the growth of a great city.

10. **Central Highlands Field-Crop/Livestock Farming.**

This is the largest single grouping of a mixed type of farming, not unlike that of much of the plains of northern Europe. The livestock, dairy cattle or sheep, are partly sustained from crops grown for them, and partly by conservation of fodder, mainly as hay. Potatoes, and one or two less important cash crops, are associated with the livestock and fodder crops, in a sometimes complex rotation. The cool climate of the Central Highlands is an advantage for potato cropping, but the main reason for the location and nature of this farming type is the fertile soils - krasnozems and tuff soils - which surround the approaches to the Dividing Range here. The area extends from Ballarat to Woodend, and the main type of livestock farming in the mixture is dairying. At the eastern end, dairy cattle give way to sheep because of the lower winter temperatures and the great difficulty of feeding animals at this time of the year.
II. Diverse Farming with Irrigation

The great variety of types of farming to be found in this area, has been indicated already above. It is outlined on the inset map, Map 260, which must be viewed along with the early tables in this Chapter-XI.

Map 260 further condenses the information of these tables. Four farming types have been selected as being the main types in eight different parts of the Irrigation Region. Viticulture is of predominant importance along the Murray, on the edge of the Mallee: fruit farming (pome and stone fruits) at the other end of the Irrigation Region, in the east; dairying occurs where water is plentiful close to the Goulburn and Murray Rivers, and sheep farming where irrigated land is furthest from the main channels.

Conclusion

The thesis has surveyed the farming of Victoria, with the primary aim of delimiting areas with similar types of farming. At the same time the methods used by each type have been considered, and the relative importance of each has been assessed in terms of human activity and the rural economy of Victoria.

In most cases also, either general or specific explanation have been advanced for the nature and location of each type of farming, and accordingly a brief assessment has been given of the environment, both physical and economic.
Nevertheless it is not a complete account: there are many different positions from which human activities can be viewed, and this is an account of one aspect only.
INDEX TO APPENDIXES

Appendix I. Table of Values
Appendix II. Climatic Statistics
Appendix III. Irrigation Statistics
Appendix IV. County Agricultural Statistics
Appendix V. Utilization of Milk
APPENDIX I

(From an unpublished manuscript. Deputy Commonwealth Statistician, Sydney, N.S.W.)

TABLE OF VALUES FOR PURPOSE OF CLASSIFICATION OF FARMS BY TYPE

### Wheat

<table>
<thead>
<tr>
<th>Region</th>
<th>Value per acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>L (14 or more bus. per acre of grain)</td>
<td>£11.75</td>
</tr>
<tr>
<td>M (10 or less than 14 bus. p.a.g.)</td>
<td>£ 9.5</td>
</tr>
<tr>
<td>N (less than 10 bus. p.a.g.)</td>
<td>£ 6.75</td>
</tr>
</tbody>
</table>

Region L: Ashford, Barraba, Berrigan . . . Yarrowlumla
Region M: Abercrombie, Apsley . . . . Yanco
Region N: Lachlan . . . Waradgery and any other areas not in L or M.

### Dairy

**Not supplying Milk Board:**

<table>
<thead>
<tr>
<th>Region</th>
<th>Value per cow in milk and dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>X</td>
<td>£23.47</td>
</tr>
<tr>
<td>Y</td>
<td>£26.40</td>
</tr>
<tr>
<td>Z</td>
<td>£32.27</td>
</tr>
</tbody>
</table>

**Supplying Milk Board:**

<table>
<thead>
<tr>
<th>Region</th>
<th>Value per cow in milk and dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>£33.40</td>
</tr>
<tr>
<td>B</td>
<td>£36.50</td>
</tr>
<tr>
<td>C</td>
<td>£47.30</td>
</tr>
<tr>
<td>D</td>
<td>£53.70</td>
</tr>
</tbody>
</table>

Region X: All Nth. Coast Shires, plus . . Stroud (non-Mk.Bd.
Region Y: All parts of N.S.W. other than X & Y suppliers only
Region Z: Berrigan . . . . Yanko
Region A: Gloucester . . . . Upper Hunter
Region B: Gosford . . . . Newcastle
Region C: Blue Mountains . . Bowral
Region D: Baulkham Hills . . in County of Cumberland.

### Beef

(Count as one beef unit each head of stock on farm at 31st March)

Per beef unit £12.5
Pigs
(Count as pig units breeding sows x 12, or if no breeding sows, the number of pigs (ex boars) x 2, on farm at 31st March).

Per pig unit £10

Poultry
(Count as poultry units each pullet, hen turkey, duck or goose on farm at 31st March)

Per poultry unit £2.077

Grain Sorghum Per acre £6.66
Rice Per acre £40
Broom Millet Per acre £40
Tobacco Per acre £300
Sugar Cane (for cutting) Per acre £80
Linseed Per acre £11.4
Lucerne Hay (where obviously a major cash crop) Per acre £20

Maize Hybrid Per acre £30
Non-Hybrid " " £20

Peanuts Per acre £80

Sheep
Criteria for kind of sheep farming:

Wool-breeding Merino flock: 75% or more rams used merino; more breeding ewes than other ewes and wethers
Wool - Non-Breeding Merino flock: fewer breeding ewes than other ewes and wethers

Wool and lamb Crossbred flock; long wool rams (Border Leicester, Romney Marsh, Corriedale, Polwarth, Crossbred)

Fat Lamb Short wool flock: 75% rams short wool (Southdown, Dorset Horn, Suffolk, Shropshire, Ryeland).

Sheep units

Wool-breeding
Wool - Non-breeding
Wool and lambs

Total sheep ex lambs
Total sheep ex lambs
Two-thirds breeding ewes plus all other ewes and wethers plus two-thirds lambs (including lambs marked not on holding at 31st March)

Fat Lamb

Two-thirds breeding ewes plus all other sheep and lambs (including lambs marked not on holding at 31st March).

Per sheep unit £2.87

Vegetables

Potatoes (English) Per acre £80
Turnips (Swede and other) £40
Carrots (irrigation Areas) £240 (non-irrigation areas) £160
Onions £120
Beetroot £160
Parsnips £160
Tomatoes (not glass house) £320 (glasshouse) £960
Beans, French £80
Peas, Green £40
Cabbages £160
Cauliflowers £200
Lettuce £200
Silver Beet, Spinach £200
Pumpkin £40
Sweet corn £20
All other vegetables £80
Non Orchard Fruit

| Grapes - Irrigation Areas | Wine | Per Acre | £70
|--------------------------|------|----------|----
|                          | Table|          | £200
|                          | Drying|         | £120

Non Irrigation Areas

| Wine | £20
| Table| £70

Bananas

£1140

Pineapples

£1130

Passion Fruit

£1100

Nurseries

£400

Orchard Fruits

(£ per 100 trees in bearing per acre)

| Oranges - Selville Poorman | 55 | 45
| Navel                     | 145| 70
| Valencia                  | 165| 90
| Other                     | 70 | 40
| Lemons, Limes             | 90 | 60
| Mandarins                 | 120| 75
| Grapefruit                | 120| 70
| Apples                    | 230| 115
| Pears                     | 130| 90
| Peaches                   | 160| 70
| Nectarines                | 170| 90
| Apricots                  | 330| 90
| Prunes                    | 200| 160
| Plums                     | 95 | 85
| Quinces                   | 80 | 35
| Figs                      | 240| 80
| Nuts                      | 50 | 60
| Cherries                  | 15 | 215
| Other Fruit               | 100| 100
**APPENDIX II**

**CLIMATIC STATISTICS - MONTHLY MEAN TEMPERATURES AND PRECIPITATION**

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<th>Jan</th>
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Source: Results of Rainfall Observations made in Victoria, Commonwealth Bureau of Meteorology, 1937.
### APPENDIX III

**IRRIGATION STATISTICS**

**Table 1.**

*Average Annual Flow to the Sea of Victorian Rivers*

<table>
<thead>
<tr>
<th>River System &amp; Basin</th>
<th>Area Sq. Miles</th>
<th>Average Annual Discharge in Acre Feet</th>
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<td>Murray Drainage Basin:</td>
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<tr>
<td>Murray (Mildura)</td>
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<td>Loddon (Laanecoorie)</td>
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<td>Campaspe (Elmore)</td>
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<td>S.E. Slopes Drainage System:</td>
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<td>Snowy</td>
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### Table 2

**Capacity of Storages: Total and Victorian Share**

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<td>Hume Reservoir</td>
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<td>Murray Weirs</td>
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<td><strong>Total</strong></td>
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<td><strong>Kow Swamp &amp; others</strong></td>
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<td><strong>Goulburn system</strong></td>
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<td>Goulburn Weir</td>
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<td><strong>Loddon system</strong></td>
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<td>Laanecorrie</td>
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<td>&amp; others</td>
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<td><strong>Total</strong></td>
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<td><strong>Wimmera-Mallee System</strong></td>
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<td>Lake Lonsdale</td>
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<td>Others</td>
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<td><strong>Total</strong></td>
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<td>Wurdie Boluc &amp; basins</td>
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<td><strong>Otway System: Total</strong></td>
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Additional Storage from present work: 1951

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<th>Region</th>
<th>Storage Capacity</th>
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Additional Total: 423,000

Grand Total with additional under construction in 1951: 2,790,000

Table 3.
Water Delivered and Area Irrigated: 1950-51
(In Districts and from district channels).

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<th>Acre Feet Water Delivered</th>
<th>Acres Water Irrigated</th>
<th>Ratio of Water to Area</th>
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<td>Dingee, Calivil,</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Boort, Loddon.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Murray System</strong></td>
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<td>Yarrawonga - MVIA</td>
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<td>Torrumbarry Weir</td>
<td>148,786</td>
<td>173,416</td>
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<td>Nyah, Robinvale, Red Cliffs, Merbein,</td>
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<td><strong>Other Northern</strong></td>
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<td></td>
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<td>Campaspe &amp; Wimmera</td>
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<td>Werribee, Sale, etc.</td>
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<td><strong>Users outside Districts</strong></td>
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<td><strong>Private Diversions</strong></td>
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<td><strong>TOTAL</strong></td>
<td>786,885</td>
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Table 4
Areas Irrigated for Different Products, and Approximate Water Requirement, 1950-51.

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<thead>
<tr>
<th>Type of Production</th>
<th>Acres</th>
<th>Percentage</th>
<th>Acre Feet per Acre</th>
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<td>Pasture &amp; Fodder</td>
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<tr>
<td>Pasture - Perennial</td>
<td>193,817</td>
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<td>54,472</td>
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<tr>
<td>Sorghum &amp; others</td>
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<td>0.7</td>
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<tr>
<td>Fruits</td>
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<td></td>
</tr>
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<td>Vines</td>
<td>42,582</td>
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<tr>
<td>Orchards</td>
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<td>Vegetables</td>
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<tr>
<td>Market gardens</td>
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<td>Cereals</td>
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<td>Fallow &amp; Miscellaneous</td>
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<td>Total</td>
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Table 5
Value of Primary Production in Irrigation Areas 1949-50: £ million

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<th></th>
<th>Livestock Products</th>
<th>Horticultural Products</th>
<th>Other Products</th>
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<tr>
<td>Milk and Milk Products</td>
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<tr>
<td>Wool, Lamb and Mutton</td>
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<tr>
<td>Vine Fruits</td>
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<tr>
<td>Fresh &amp; Canning Fruits</td>
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<tr>
<td>Vegetables</td>
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<td></td>
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<tr>
<td>Poultry &amp; Eggs</td>
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<tr>
<td>Pigmeats</td>
<td>1.15</td>
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<td></td>
</tr>
<tr>
<td>Beef &amp; veal meats</td>
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<td></td>
</tr>
<tr>
<td>Other Primary Products</td>
<td></td>
<td></td>
<td>2.05</td>
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<tr>
<td>Total</td>
<td>12.49</td>
<td>6.06</td>
<td>3.95</td>
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</tbody>
</table>

Grand Total £22.5 million
APPENDIX IV
COUNTY AGRICULTURAL STATISTICS

Index

Cols. 1 - 20. Land Area & Crops

1  Area of Counties, square miles
2  Area of Counties, acres
3  Area in Farms, acres
4  Area in Farms, percent of total area
5  Percent of Farm Area Cultivated
6  Area under Cultivation, acres
7  Area under Fallow, acres
8  Area in Crops, acres
9  Area in Hay
10 Area in Hay as a Percent of Area in Crops
11 Area under Grass Hay, acres
12 Area of Grass Hay as a Percent of all Hay
13 Area under Oaten Hay, acres
14 Area of Oaten Hay as a percent of all Hay
15 Area of all other Hay, as a Percent of all Hay
16 Unproductive Land included in Area Occupied by Farms, acres
17 Productive Land in Farms - Occupied land minus unproductive, acres
18 Maize for Grain, acres
19 Maize for Green Fodder, acres
20 Area under Rye for Grain, acres

Cols. 21 - 26. Machinery and Labour

21 Number of Tractors
22 Rural Holdings in Counties, 1950-51
23 Rural Holdings in Counties, 1953-54
24 Holdings with Permanent Male Labour, 1953-54
25 Holdings with No Permanent Labour, 1953-54
26 Percent of Holdings without Permanent Labour, 1953-54

Cols. 27 - 39. Relation between Livestock, Crops and Area

27 Sheep and Lambs in Counties, 1950-51
28 Sheep as Livestock Units, 8 sheep equal 1 cow
29 Dairy Cattle in Counties, 1950-51
30 Beef Cattle in Counties, 1950-51
31 Total Livestock Units in Counties, 1950-51
<table>
<thead>
<tr>
<th>Column</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>32</td>
<td>Holdings with Pigs, 1950-51</td>
</tr>
<tr>
<td>33</td>
<td>Holdings with Pigs as a Percent of all Holdings</td>
</tr>
<tr>
<td>34</td>
<td>Acreage of Grass and Clover Seed Harvested</td>
</tr>
<tr>
<td>35</td>
<td>Acreage of Lucerne, Millet &amp; other Green Fodder</td>
</tr>
<tr>
<td>36</td>
<td>Acres of Productive Farm Land per Livestock Unit</td>
</tr>
<tr>
<td>37</td>
<td>Average Size of Holdings, acres</td>
</tr>
<tr>
<td>38</td>
<td>Average No. of Permanent Male Rural Workers per 10,000 acres in rural holdings</td>
</tr>
<tr>
<td>39</td>
<td>Percent of total land area, productive farm land</td>
</tr>
</tbody>
</table>

Note: The source for the following figures is Statistical Register, 1950-51, and Victorian Year Book, 1950-1; except for Cols. 23 to 26, inclusive and Col. 38. These latter are from Rural Labour in Australia, 1953-4, B.A.E. Canberra, 1957.
<table>
<thead>
<tr>
<th>Counties</th>
<th>Area of Counties Sq. Mls</th>
<th>Area of Counties Acres</th>
<th>Area in Farms Acres</th>
<th>% of Total</th>
<th>Areas % of Total</th>
</tr>
</thead>
<tbody>
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<td>749,828</td>
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<tr>
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<td>15,548</td>
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<td>Bendigo</td>
<td>244</td>
<td>9.1</td>
<td>430</td>
<td>24</td>
<td>80</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rodney</td>
<td>1,186</td>
<td>4.8</td>
<td>346</td>
<td>44</td>
<td>80</td>
<td>(79.6)</td>
<td></td>
</tr>
<tr>
<td>Moira</td>
<td>894</td>
<td>7.9</td>
<td>475</td>
<td>30</td>
<td>88</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delatite</td>
<td>1,319</td>
<td>5.4</td>
<td>638</td>
<td>21</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bogumbra</td>
<td>1,094</td>
<td>6.3</td>
<td>549</td>
<td>26</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benambra</td>
<td>418</td>
<td>6.4</td>
<td>1,260</td>
<td>13</td>
<td>44</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wonnangatta</td>
<td>31</td>
<td>11.3</td>
<td>2,049</td>
<td>5</td>
<td>11</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Croajigolong</td>
<td>362</td>
<td>3.5</td>
<td>1,148</td>
<td>10</td>
<td>4.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tambo</td>
<td>530</td>
<td>4.4</td>
<td>907</td>
<td>13</td>
<td>17</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dargo</td>
<td>382</td>
<td>4.0</td>
<td>453</td>
<td>30</td>
<td>14</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tanjil</td>
<td>1,887</td>
<td>4.1</td>
<td>580</td>
<td>24</td>
<td>37</td>
<td>(36.6)</td>
<td></td>
</tr>
<tr>
<td>Buln Buln</td>
<td>4,423</td>
<td>3.3</td>
<td>280</td>
<td>49</td>
<td>55</td>
<td>(54.8)</td>
<td></td>
</tr>
<tr>
<td>Total Vic.</td>
<td>34,526</td>
<td>7.2</td>
<td>546</td>
<td>24</td>
<td>61</td>
<td>(60.8)</td>
<td></td>
</tr>
</tbody>
</table>
### APPENDIX V

**UTILIZATION OF MILK, VICTORIA, BY REGIONS, MILLION GALLONS, 1954-55.**

<table>
<thead>
<tr>
<th>Region</th>
<th>Butter</th>
<th>Cheese</th>
<th>Urban Wholemilk Products</th>
<th>Condensery Products</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Barwon</td>
<td>5.3</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>5.3</td>
</tr>
<tr>
<td>Central Highlands</td>
<td>14.2</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>14.2</td>
</tr>
<tr>
<td>Corangamite</td>
<td>61.7</td>
<td>10.9</td>
<td>3.6</td>
<td>25.2</td>
<td>101.4</td>
</tr>
<tr>
<td>Gippsland East</td>
<td>32.2</td>
<td>1.4</td>
<td>1.3</td>
<td>11.6</td>
<td>45.5</td>
</tr>
<tr>
<td>Gippsland West</td>
<td>105.3</td>
<td>14.6</td>
<td>27.7</td>
<td>1.4</td>
<td>149.0</td>
</tr>
<tr>
<td>Glenelg</td>
<td>15.2</td>
<td>2.2</td>
<td>-</td>
<td>-</td>
<td>17.5</td>
</tr>
<tr>
<td>Goulburn</td>
<td>43.5</td>
<td>11.8</td>
<td>2.5</td>
<td>4.9</td>
<td>62.7</td>
</tr>
<tr>
<td>Loddon</td>
<td>18.8</td>
<td>4.1</td>
<td>.6</td>
<td>-</td>
<td>23.5</td>
</tr>
<tr>
<td>Mallee</td>
<td>4.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.4</td>
</tr>
<tr>
<td>Port Phillip</td>
<td>10.9</td>
<td>.7</td>
<td>14.2</td>
<td>3.1</td>
<td>28.9</td>
</tr>
<tr>
<td>Upper Goulburn</td>
<td>9.7</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>9.7</td>
</tr>
<tr>
<td>Upper Murray</td>
<td>44.7</td>
<td>.7</td>
<td>.5</td>
<td>.1</td>
<td>46.0</td>
</tr>
<tr>
<td>Wimmera</td>
<td>4.4</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>4.4</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>370.3</td>
<td>45.4</td>
<td>50.4</td>
<td>46.4</td>
<td>512.5</td>
</tr>
</tbody>
</table>

**Source:** Based on figures collected by the Dept. of Agriculture, relating to manufacture of dairy products. Converted by the following ratios: Gallons of milk to pounds of product: Butter, 2.08 gals. to 1 lb; Cheese, 1 to 1; Sweetened condensed milk, .26 gals. to 1 lb. By-products such as Buttermilk powder, etc. have not been included. Some small items, e.g., liquid milk for Geelong from Bellarine Peninsula, are not included.
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